

Approval Standard

Steel Pipe for Automatic Fire Sprinkler Systems

Class Number 1630
November 2013

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Approval Standard for Steel Pipe for Automatic Fire Sprinkler Systems

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Foreword

The FM Approvals certification mark is intended to verify that the products and services described will meet FM Approvals' stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for certification by FM Approvals shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing shall ensure a consistently uniform and reliable product. Approval Standards strive to be performance-oriented. They are intended to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

- must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- must be readily identifiable.

Continuance of Approval and listing depends on compliance with the Approval Agreement, satisfactory performance in the field, successful re-examinations of equipment, materials, and services as appropriate, and surveillance audits of the manufacturing facility.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

Table of Contents

1. INTRODUCTION.....	1
1.1 Purpose.....	1
1.2 Scope.....	1
Table 1.2.7 Pipe OD Comparison Chart.....	2
1.3 Basis for Requirements.....	2
1.4 Basis for FM Approval.....	3
1.5 Basis for Continued Approval.....	3
1.6 Effective Date.....	3
1.7 System of Units	3
1.8 Applicable Documents	4
1.9 Definitions	4
2. GENERAL INFORMATION	7
2.1 Product Information	7
2.2 Approval Application Requirements.....	8
2.3 Requirements for Samples for Examination.....	8
3. GENERAL REQUIREMENTS	8
3.1 Review of Documentation	8
3.2 Physical or Structural Features	9
3.3 Materials	9
3.4 Markings	10
3.5 Minimum Wall Thickness.....	10
Table 3.5 Minimum Wall Thicknesses	10
3.6 Manufacturer's Installation and Operation Instructions	11
3.7 Calibration	11
3.8 Tolerances	11
4. PERFORMANCE REQUIREMENTS	11
4.1 Examination.....	11
4.2 Hydrostatic Strength.....	12
4.3 Bending Moment Resistance	12
4.4 Rotational Bending Moment Resistance.....	13
4.5 Vibration Resistance	14
Table 4.5.2 Vibration Test Conditions	14
4.6 Marking Durability	14
4.7 Corrosion-Resistant Coatings.....	14
4.8 Long-Term Corrosion Testing	15
4.9 Chemical Compatibility Test for Environmental Stress Cracking between Plastic Piping Products and Steel Pipe with Antimicrobial (AMC) and/or Antibacterial Coatings/Films	16
4.10 Additional Tests.....	16
5. OPERATIONS REQUIREMENTS.....	17
5.1 Demonstrated Quality Control Program	17
5.2 Surveillance Audit Program.....	18
5.3 Installation Inspections	19
5.4 Manufacturer's Responsibilities.....	19
5.5 Manufacturing and Production Tests.....	19
5.5.1 Test Requirement No. 1 - Hydrostatic Test	19
5.5.2 Test Requirement No. 2 - Flattening Test	19
5.5.3 Other	19

APPENDIX A: Units of Measurement	20
APPENDIX B: FM Approvals Certification Marks	21
APPENDIX C: Figures	23
Figure C-1. Hydrostatic Test Sample	23
Figure C-2. Bending Moment Test.....	24
Figure C-3. Rotational Torque Tests	25
Figure C-4. Vibration Test.....	26
APPENDIX D: Bending Moment Calculations	27
Figure D-1. Bending Moment Calculation	27
Figure D-2. Bending Moment Resistance Test.....	29
Figure D-3. Rotational Bending Moment Calculations	29
APPENDIX E: Bending Moments	30
Table E-1. ASME B36.10M-2004, Schedule 40 Steel Pipe.....	30
Table E-2. ASME B36.10M-2004, Schedule 30 Steel Pipe.....	31
Table E-3. ASME B36.10M-2004, Schedule 10 Steel Pipe.....	32
Table E-4. ASME B36.10M-2004, Schedule 5 Steel Pipe.....	33
Table E-5. EN 10255:2004, Heavy Steel Pipe.....	34
Table E-6. EN 10255:2004, Medium Steel Pipe.....	35
Table E-7. JIS G3454-2007 Schedule 40 Steel Pipe.....	36
APPENDIX F: Rotational Bending Moments	37
Table F-1. ASME B36.10M-2004 Schedule 30 and Schedule 40.....	37
Table F-2. ASME B36.10M-2004 Schedule 5 and Schedule 10.....	37
Table F-3 BS EN 10255:2004 Medium and Heavy and JIS G3454-2007 Schedule 40	38
APPENDIX G: Remaining Pipe Wall Calculations	39
APPENDIX H: Sample Listing	42
APPENDIX I: Chemical Compatibility Test Protocol	43
Chemical Compatibility Test for Environmental Stress Cracking between Plastic Piping Products and Steel Pipe with Antimicrobial (AMC) and/or Antibacterial coatings/films	43
Figure I-2-1 - Schematic drawing for dimensions of Type V tensile specimens in accordance with ASTM D638-10 of NPS 1 (DN 25) CPVC in accordance with ASTM F442-13 (units in inches).	44
Figure I-2-2 - Schematic drawing for the machining direction of the Type V tensile specimen in accordance with ASTM D638-10 of NPS 1 (DN 25) CPVC pipe in accordance with ASTM F442-13 (units in inches).	44
APPENDIX J: Tolerances	46

1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states FM Approval criteria for steel pipe for use in aboveground fire sprinkler systems.
- 1.1.2 FM Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance audit program.

1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for steel pipe for use in aboveground fire sprinkler systems designed and installed in accordance with FM Global Property Loss Prevention Data Sheets.
- 1.2.2 This Approval standard is limited to NPS (Nominal Pipe Size) 1/2, 3/4, 1, 1-1/4, 1-1/2, 2, 2-1/2, 3, 3-1/2, 4, 5, 6, 8, 10, and 12 steel pipe. Note that NPS 1/2 pipe, for example, may be referred to as 1/2 in NPS, or 1/2 in pipe. Larger sizes of steel pipe may be evaluated on a case-by-case basis. Approval of NPS 1/2 and 3/4 pipe is permitted for use as valve trim, gauge connections, and for other peripheral service. Approval for use in aboveground fire sprinkler systems is limited to steel pipe NPS 1 through 12. The waterflow path of the sprinkler system cannot be designed using pipe smaller than NPS 1. In cases where metric sized steel pipe is to be examined for Approval, test criteria comparable to the equivalent or nearest nominal diameter (DN) size shall be used (Refer to Table 1.2.7).
- 1.2.3 Steel pipe may be Approved under this Standard for use in either wet or dry pipe sprinkler systems, or both, but in all cases for aboveground service only.
- 1.2.4 This standard is intended to verify that the product described will:
- Meet stated conditions of performance, safety, and quality useful to the ends of property conservation.
 - If the steel pipe includes a manufacturer-applied internal coating and is intended for use in a hybrid sprinkler system (*i.e.*, plastic pipe connected to internally-coated steel pipe), evaluation of the internally-coated steel pipe under this standard shall include chemical compatibility testing with all FM Approved plastic pipe and fittings (Refer to Appendix I).
- 1.2.5 This Standard encompasses steel pipe manufactured by the furnace welded, continuous butt-weld, or electric resistance welded process. Other methods of manufacturing, such as spiral welded, or seamless pipe may be evaluated under this Standard as long as the intent of this Standard is met.
- 1.2.6 This Approval Standard encompasses “Specialty Tubulars” for use with mechanical press connections. Like Schedule 5 steel pipe, “Specialty Tubulars” are limited for use in branch line service, but only after a transition fitting from steel pipe. These “Specialty Tubulars” are limited to sizes NPS 1 through 2 when manufactured in carbon steel, and NPS 1 through 4 when manufactured in stainless steel.
- 1.2.7 For comparison between the outside diameters (OD) of pipes manufactured to ASME B36.10M-2004 dimensions, and those of other standards, the following table, Table 1.2.7 has been made for reference.

Table 1.2.7 Pipe OD Comparison Chart

Nominal Pipe Size		Nominal Outside Diameter	
NPS	DN	in	mm
1/2	15	0.840	21.3
3/4	20	1.050	26.7
1	25	1.315	33.4
1 1/4	32	1.660	42.2
1 1/2	40	1.900	48.3
2	50	2.375	60.3
2 1/2	65	2.875	73.0
3 OD	-	3.000	76.1
3	80	3.500	88.9
3 1/2	90	4.000	101.6
4 1/4 OD	-	4.250	108.0
4	100	4.500	114.3
5 1/4 OD	-	5.250	133.4
5 1/2 OD	-	5.500	139.7
5	125	5.563	141.3
6 1/4 OD	-	6.250	158.8
6 1/2 OD	-	6.500	165.1
6	150	6.625	168.3
8 (JIS)	200A	-	216.3
8	200	8.625	219.1
10 (JIS)	250A	-	267.4
10	250	10.750	273.0
12 (JIS)	300A	-	318.5
12	300	12.750	323.8

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of steel pipe for the purpose of obtaining FM Approval. Steel pipe having characteristics not anticipated by this standard may be Approved if performance equal, or superior, to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, steel pipe that meets all of the requirements identified in this standard may not be FM Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for FM Approval

FM Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate:

- Suitability of the product;
- Performance of the product as specified by the manufacturer and required by FM Approvals; and, as far as practical,
- Durability and reliability of the product.

1.4.2 An initial audit shall be conducted to evaluate the manufacturer's ability to consistently produce the product that was examined and tested as part of the Approval project. The audit shall review the facility and in-place quality control procedures used in the manufacturing of the product. Typically, areas of review are incoming inspection, work in progress, production testing, final quality control, marking, calibration of equipment, shipping procedures, and document and drawing control. These examinations are repeated periodically as part of the FM Approvals Surveillance Audit Program. (Refer to Section 5.2, Surveillance Audit Program)

1.5 Basis for Continued Approval

1.5.1 Continued Approval is based upon:

- Production or availability of the product as currently Approved;
- Continued use of acceptable quality assurance procedures;
- Satisfactory field experience;
- Compliance with the terms stipulated in the Master Agreement;
- Satisfactory re-examination of production samples for continued conformity to requirements; and
- Satisfactory Surveillance Audits conducted as part of FM Approvals' Surveillance Audit Program.

1.5.2 Also, as a condition of retaining Approval, manufacturers shall not change an Approved product or service without prior written authorization by FM Approvals. (Refer to Section 5.1.3 for further details regarding changes.)

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after that date shall satisfy the requirements of the standard. Products Approved under a previous edition shall comply with the new version by the effective date or forfeit Approval.

The effective date of this Standard is **January 1, 2014** for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measurements appearing in this standard. Conversion of U.S. customary units is in accordance with the Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI10 - 2010 *Standard for Use of the International System of Units (SI): The Modern Metric System*.

1.8 Applicable Documents

The following standards, test methods, and practices are referenced in this standard or are beneficial in understanding this standard:

American National Standards Institute (ANSI)/American Water Works Association (AWWA) C606 - 2011, *Standard for Grooved and Shouldered Joints*

ANSI/American Society of Mechanical Engineers (ASME) B1.20.1 - 1983 (2006), *Pipe Threads, General Purpose*

(Inch).

IEEE/ASTM SI 10 - 2010, *Standard for Use of the International System of Units (SI): The Modern Metric System*

ASME B36.10M - 2004, *Welded and Seamless Wrought Steel Pipe*

ASTM A53/A53M - 12, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*

ASTM A123/A123M - 12, *Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products*

ASTM A135/A135M - 09, *Standard Specification for Electric-Resistance -Welded Steel Pipe*

ASTM A795/A795M - 13, *Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use*

ASTM D543-06, *Standard Specification for Evaluating the Resistance of Plastics to Chemical Reagents*

ASTM D638-10, *Standard Test Method for Tensile Properties of Plastics*

ASTM D883-12, *Terminology Relating to Plastics*

ASTM F442-13, *Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)*

British Standard BS 21 - 1985, *Specification for Pipe Threads for Tubes and Fittings Where Pressure-Tight Joints are made on the Threads (Metric Dimensions)*

BS EN 228-1, 3rd Edition (2003), *Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances, and designation*

BS EN 10255:2004, *Non-Alloy Steel Tubes Suitable for Welding and Threading – Technical Delivery Conditions*

BS EN 10226-1:2004, *Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation*

BS EN 10226-2:2005, *Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation*

BS EN 10226-3:2005, *Pipe threads where pressure-tight joints are made on the threads. Verification by means of limit gauges*

Chinese Standard, GB/T 3091 - 2008, *Welded Steel Pipe for Low Pressure Liquid Delivery*

Deutsches Institut für Normung E.V. (DIN) EN 10220 - 2003, *Seamless and Welded Steel Tube Dimensions and Masses per Unit Length*

FM Global Property Loss Prevention Data Sheets

International Standard (ISO) 65 - 1981, *Carbon Steel Tubes Suitable For Screwing in Accordance with ISO 7/1*

ISO 7-1 – 3rd Edition (2007), *Pipe threads where pressure-tight joints are made on the threads -- Part 1: Dimensions, tolerances and designation*

ISO 7-2 - 2000, *Pipe threads where pressure-tight joints are made on the threads. Verification by means of limit gauges*

ISO 4200 - 1991, *Plain End Steel Tubes, Welded and Seamless - General Tables of Dimensions and Masses per unit Length*

ISO 17025/International Electrotechnical Commission (IEC) (2005), *General Requirements for the Competence of Testing and Calibration Laboratories*

ISO 22088-3 (2006), *Plastics – Determination of Resistance to Environmental Stress Cracking (ESC)*

Japanese Industrial Standard (JIS) G3454 - 2012, *Carbon Steel Pipes For Pressure Service*

1.9 Definitions

For purposes of this standard, the following terms apply:

Accepted

This term refers to installations acceptable to the authority enforcing the applicable installation rules (Authority Having Jurisdiction). When this authority is FM Global, such locations are termed “FM Global Accepted.”

Acceptance is based upon an overall evaluation of the installation. Factors other than the use of FM Approved equipment impact upon the decision to accept the product. Acceptance is not a characteristic of a product, it is installation specific. A product accepted for one installation may thus not be acceptable elsewhere. (Contrast with FM Approved.)

Bundle

This term refers to the commonly accepted method of packaging and shipping pipe. Predetermined quantities of pipe lengths are grouped together and banded for shipment. The manufacturer shall indicate on the dimensional drawings or specifications the actual number of pipes per bundle, per nominal pipe size. It is important to note that although the phrase is common in industry, the actual count of pipe lengths may vary from one manufacturer to another.

Corrosion Resistant

Steel pipe shall be termed corrosion resistant if its interior surface exhibits equivalent resistance to aqueous corrosion as steel pipe which is internally coated with zinc by the hot-dip process to a weight of no less than 1.8 oz/ft² (0.55 kg/m²).

Cut Groove

A groove that is cut into the outside diameter of a pipe or fitting near the end to allow its joining by means of a gasketed, split, grooved pipe coupling.

End Connections

The method of connecting components of a pipe system. Typical end connections in fire protection service are cut groove, rolled groove, threaded, plain end, and welded end.

FM Approvals Certification Mark

The FM Approvals Certification Marks are detailed in Appendix B. Their use is mandatory on all manufactured lengths of FM Approved steel pipe for automatic fire sprinkler systems. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to a specific product.

FM Approved

This term refers to products FM Approved by FM Approvals. Such products are listed in the *Approval Guide*, an online resource of FM Approvals. All products so listed have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. These forms obligate the manufacturer to allow re-examination of the product and surveillance audit at the discretion of FM Approvals. It further requires the manufacturer not to deviate from the as - FM Approved configuration of the product without review by and agreement of FM Approvals. Approval is product specific.

Lightwall Pipe

Lightwall pipe is characterized by having a combination of outside diameter and wall thickness not suitable for cut grooving or threading. Lightwall pipe shares the same outside diameter dimensions as Schedule 40 pipe; however the wall thickness of Lightwall pipe ranges between that of Schedule 5 and 10 and can vary from manufacturer to manufacturer. The normal end connections for Lightwall pipe are: welded, roll grooved, and plain end. This pipe is also commonly referred to in industry as "Flow" pipe or "Schedule 7" pipe. There is no national or international standard for this product at this time.

Master Coil

For the cases where steel is supplied to the pipe mill in coiled form, the original wide coil is referred to as the master coil. If the steel is supplied pre-slit, then each slit coil shall be identified to retain material traceability to the master coil.

Mechanical Press Connection

A mechanical connection that joins Specialty Tubulars to a metallic fitting with an elastomeric seal with the use of a pressing tool. The joint is created when the Specialty Tubular is inserted into the metallic fitting past the seal, and then mechanically joined using the pressing tool.

Pipe Schedule

The commonly accepted reference indicating a specified wall thickness for a given nominal pipe size. Traditional pipe Schedules were derived on a largely empirical basis and do not represent truly proportional design. Generally, smaller sizes are much thicker in proportion to diameter than larger sizes. This is because mechanical considerations predominate in smaller sizes, and pressure carrying capacity predominates in larger sizes.

Plain Ended Pipe

Pipe with ends cut perpendicular to its axis and incorporating no grooves or threads on either end.

Pressure Rating

The pressure rating assigned to a product as a part of the Approval process. The minimum pressure rating considered for FM Approval is 175 psi (1205 kPa). The pressure rating of an assembly is that of its lowest pressure rated component.

Rolled Groove

A groove pressed into the surface of a pipe or fitting near the end to allow joining by means of a gasketed, split, grooved pipe coupling. For clarity, the definition used in this Standard is for grooves that start from the outside diameter of the pipe, and project radially inward towards the pipe axis. Not to be confused with shouldered pipe that may be formed on similar equipment.

Schedule 40 Pipe

Schedule 40 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M-2004. Other national and international standards also make reference to Schedule 40 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Therefore, Approval of pipes manufactured under the specifications of other national or international standards must be specified using the title of the standard and the dimensions for outside diameter and wall thickness. For the purposes of this Approval standard, dimensional values of Schedule 40 pipe and pipes of similar outside diameter and wall thickness have been listed in Appendix E. Approved end connections are threaded, welded, rolled or cut groove, or plain end.

Schedule 30 Pipe

Schedule 30 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M-2004. Other national and international standards also make reference to Schedule 30 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Therefore, Approval of pipes manufactured under the specifications of other national or international standards must be specified using the title of the standard and the dimensions for outside diameter and wall thickness. For the purposes of this Approval standard, dimensional values of Schedule 30 pipe have been listed in Appendix E. Approved end connections are welded, rolled groove, or plain end.

Schedule 10 Pipe

Schedule 10 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M-2004. Other national and international standards also make reference to Schedule 10 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Therefore, Approval of pipes manufactured under the specifications of other national or international standards must be specified using the title of the standard and the dimensions for outside diameter and wall thickness. For the purposes of this Approval standard, dimensional values of Schedule 10 pipe have been listed in Appendix E. Approved end connections are welded, rolled groove, or plain end.

Schedule 5 Pipe

Schedule 5 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M-2004. Other national and international standards also make reference to Schedule 5 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Therefore, Approval of pipes manufactured under the specifications of other national or international standards must be specified using the title of the standard and the dimensions for outside diameter and wall thickness. For the purposes of this Approval standard, dimensional values of Schedule 5 pipe have been listed in Appendix E. Approved end connections are welded, roll grooved*, mechanically swaged fittings. Schedule 5 pipe is not suitable for FM Approved bolted-style plain end fittings. (* - Limited Approval of rolled grooved connections. Refer to the

listings of the pipe couplings or fittings, in the *Approval Guide*, an online resource of FM Approvals for specific mention of their suitability for use with Schedule 5 pipe.)

Shouldered Pipe

Pipe with mechanical shoulders that are cast, welded, or mechanically formed on the outside diameter of the pipe. For clarity, the definition as used in this Standard refers only to shoulders that start at the pipe outside diameter, and extend radially outward from the pipe axis.

Specialty Tubulars

Specialty Tubulars refer to the collection of pipe and tube products that are used to make mechanical press connections that are not defined by the other defined classifications of pipe/tube product included within this standard such as: Schedules 40, 30, 10, or 5; Thinwall Pipe; or Lightwall Pipe. The outside diameter of the tubular product may coincide with that of either pipe or tubes made to other national or international standards. For the purposes of this standard, the tubular product shall have a minimum wall thickness nearly equal to that of Schedule 5 pipe. Submittal information must include reference to the industry standard used in production of the Specialty Tubular product, and the dimensions for outside diameter and wall thickness. Specialty Tube may be Approved with mechanical press style couplings and fittings only. (Refer to listings within the *Approval Guide*, an online resource of FM Approvals for mechanical press style couplings and fittings that make specific mention of their suitability for use with Specialty Tubulars.)

Threaded Pipe

Pipe which has been furnished with its end(s) threaded with external pipe threads conforming to national or international standards for pipe threads such as ANSI/ASME B1.20.1-1983, ISO 7-1 (2007), etc.

Thinwall Pipe

Thinwall pipe is characterized by having a combination of outside diameter and wall thickness suitable for threading but not suitable for cut grooving. Thinwall pipe dimensions are not addressed in any current national or international standard. Thinwall pipe typically is manufactured using outside diameter dimensions equivalent to those used on Schedule 40 pipe. However, the actual outside diameter dimensions may vary from that of Schedule 40 pipe and may vary from manufacturer to manufacturer. Pipe wall thickness range between those of Schedules 10 and 40 and may vary from manufacturer to manufacturer. The normal end connections for Thinwall pipe are: threaded, roll grooved, welded, or plain end. There is no national or international standard for this product.

Welding End

Steel pipe furnished with welding ends is characterized by having the ends cut perpendicular to its axis and finished with a pronounced bevel on each end to allow for butt-welding.

2. GENERAL INFORMATION

2.1 Product Information

- 2.1.1 Steel pipe has been effectively used in fire sprinkler systems since its introduction in the nineteenth century. However, evolution in pipe specifications, materials, and production technology impairs the direct correlation of this successful service history to that to be expected from newer products. Further, some evidence exists that some products currently available in the field do not meet all the criteria of the commonly-accepted standards for steel pipe. This may result from the fact that some standards contain no enforcement mechanisms except those agreed upon between manufacturer and purchaser. In addition, pipe designs exist which do not match the Schedules traditionally used in fire protection. For these reasons, FM Approvals has established this Approval Standard for steel pipe.
- 2.1.2 In order to meet the intent of this Standard, steel pipe must be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated using identical materials by different manufacturers, or even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample steel pipe, selected in conformance to this criterion, shall satisfy all of the requirements of this Standard.

2.2 Approval Application Requirements

- 2.2.1 To apply for an Approval examination, the manufacturer, or an authorized representative, shall submit a request to:

Fire Protection Group Manager
FM Approvals - Hydraulics Laboratory
743A Reynolds Road
West Glocester, RI 02814 U.S.A.

- 2.2.2 The manufacturer shall provide the following preliminary information with any request for Approval consideration:

- A complete list of all models, types, sizes, and options for the products being submitted for Approval consideration,
- General assembly drawings, one complete set of manufacturing drawings, materials list(s), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures, and
- Number and location of manufacturing facilities making the products submitted for Approval.

- 2.2.3 All the above referenced documents shall be controlled by the manufacturer's Quality Assurance procedures, and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation at the time of submittal.

2.3 Requirements for Samples for Examination

- 2.3.1 Following set-up and authorization of an Approval examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by FM Approvals following review of the preliminary information. Sample requirements may vary depending on design features, results of prior testing, and results of the foregoing tests. It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated utilizing prototypes is at the discretion of FM Approvals. The manufacturer shall provide any special test fixtures which may be required to evaluate the steel pipe.

- 2.3.2 In addition to the sample requirements, manufacturers submitting samples of Lightwall, Thinwall, or Schedule 5 steel pipes; or Specialty Tubulars, are also required to advise FM Approvals in writing of the manufacturer and model numbers of the couplings and/or fittings to be used in the evaluation. The pipe manufacturer shall also obtain and submit a letter from the coupling/fitting manufacturer to allow the addition of the pipe usage reference in the coupling/fitting manufacturer's listing in the *Approval Guide*, an online resource of FM Approvals, pending successful completion of the examination testing.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

- 3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The product shall be capable of being used within the limits of the Approval investigation.
- 3.1.2 The manufacturer's dimensional specifications and/or dimensional drawings shall fully describe the product. All critical dimensions shall be indicated with the allowed upper and lower tolerance limits clearly shown.
- 3.1.3 All documents pertaining to the product materials, dimensions, processing, and marking shall be controlled by the manufacturer's Quality Assurance procedures, and shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation.

3.2 Physical or Structural Features

- 3.2.1 Pipe shall be designed for a minimum rated working pressure of 175 psi (1205 kPa) for use in fire protection systems. Pipe may be evaluated based on a higher-pressure rating at the manufacturer's option.
- 3.2.2 Installation of black steel pipe is limited to wet pipe sprinkler systems only. Coatings shall be evaluated on a case-by-case basis, as they may require special test methods and test equipment.
- 3.2.3 Installation of galvanized pipe is permitted in wet and dry pipe (including preaction) sprinkler systems. The galvanized pipe shall have an average minimum coating thickness of 1.8 oz/ft² (0.55 kg/m²). Steel pipe with a galvanized coating shall be evaluated in accordance with ASTM A123/A123M-12.
- 3.2.4 Approval examinations of galvanized pipe shall include performance testing using a representative sampling of grooved end couplings and/or pipe fittings. Threaded end connections shall be in accordance with ANSI/ASME B1.20.1-1983, BS 21 (1985), ISO 7-1 (2007) or other recognized national or international standards for their country of use.
- 3.2.5 Grooved and shouldered end connections shall conform to the dimensional requirements of ANSI/AWWA C606 (2011). Alternatively, grooved or shouldered end connections specified in the manufacturer's literature, or to another recognized national or international standard shall be evaluated by FM Approvals on a case-by-case basis.
- 3.2.6 Pipes manufactured with either plain or welding ends shall conform to a recognized national or international standard.
- 3.2.7 Other types of end connections may be evaluated on a case-by-case basis. Refer to definitions, Section 1.9, for normal end connections for Schedule(s) 40, 30, 10, and 5, Thinwall, and Lightwall steel sprinkler pipe, and Specialty Tubulars.
- 3.2.8 Pipe samples submitted for testing shall be true production samples and shall be free of sharp edges, burrs, or other imperfections that might injure the test technician or interfere with proper assembly of the test assembly.
- 3.2.9 Manufacturers shall exhibit their ability to trace material back to the individual master coils and obtain mechanical and physical properties from the steel mill for each master coil used in the production of FM Approved pipe. Production pipe shall be marked with a manufacturing date reference in the form of: production code, heat number, date and shift code, or run number at the manufacturer's option. Other methods may be acceptable and will be reviewed on a case-by-case basis.
- 3.2.10 Installations for Schedule 5 pipe and Specialty Tubulars are limited to branch line service and are subject to maximum hanger spacing of 12 ft (3.6 m) for the allowed sizes. Specialty Tubulars have an additional requirement to be installed downstream of a transition fitting that makes the connection from traditional steel pipe to the Specialty Tubular system in order to maintain system integrity.

3.3 Materials

- 3.3.1 All materials used in the fabrication of these pipes shall be suitable for the intended application. Raw material shall be evaluated in accordance with the appropriate sections of the manufacturer's Quality Assurance Manual plus any applicable national and/or international standards.
- 3.3.2 Examples of suitable materials are included in the standards ASTM A53/A53M-12, ASTM A135/A135M-12, and ASTM A795/A795M-13.

3.4 Markings

3.4.1 Each length of pipe shall be permanently and continuously marked with the following minimum information:

- Manufacturer's name or trademark;
- Pipe size and nominal length;
- Schedule or model reference;
- Rated working pressure;
- National or international standard (including grade reference) to which the pipe was manufactured;
- Manufacturing source code where necessary;
- Heat number or master coil reference number, or a date and shift code;
- Production test reference (NH, Test Pressure, NDE, etc.); and,
- FM Approvals Certification Mark (See Appendix B).

3.4.2 Markings shall be painted, inked, or laser printed on the outside surface of each length of pipe at regular

repeating intervals. The spacing between the end of one complete marking and the start of the next shall not exceed 12 inches (300 mm).

3.4.3 Any additional pertinent marking information required by the national or international standard to which the pipe is manufactured shall be permanently marked on the outside surface of each length of pipe.

3.4.4 Each required marking listed in Section 3.4.1 shall be legible and durable and shall be applied in any of, or any combination of, the above methods.

3.4.5 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the product as Approved. The manufacturer shall not place this model or type identification on any other product unless covered by a separate agreement.

3.4.6 The FM Approval Mark shall be displayed visibly and permanently on the product. The manufacturer shall not use this Mark on any other product unless such product is covered by separate agreement with FM Approvals.

3.5 Minimum Wall Thickness

FM Approvals has established minimum pipe wall thickness values, shown in Table 3.5 that shall be maintained after threading or cut grooving of steel sprinkler pipe. For reference, the datum points at which the minimum wall thickness is defined for each end connection are: under the first exposed thread, and at the minimum cut groove diameter (including tolerance) as applicable. Pipe that exhibits a wall thickness less than these values at their respective localized areas shall be subjected to long term corrosion tests. Pipe that has a continuous wall thickness less than these values, due to the manufacturing process, or due to the pipe Schedule requirements, shall not be acceptable. Pipe designed in accordance with SI unit standards shall be of the minimum thickness values in the nearest corresponding U. S. customary pipe sizes unless otherwise noted in this standard. A sample calculation that illustrates the pipe thickness under the first exposed thread is shown in Appendix G.

Table 3.5 Minimum Wall Thicknesses

<i>Nominal Pipe Size</i> <i>NPS</i>	<i>Nominal Diameter</i> <i>DN</i>	<i>Minimum Wall Thickness</i>	
		<i>in</i>	<i>(mm)</i>
1/2	15	0.035	(0.89)
3/4	20	0.039	(0.99)
1	25	0.044	(1.12)
1-1/4	32	0.050	(1.27)
1-1/2	40	0.054	(1.37)
2	50	0.057	(1.45)
2-1/2	65	0.065	(1.65)

<i>Nominal Pipe Size</i> <i>NPS</i>	<i>Nominal Diameter</i> <i>DN</i>	<i>Minimum Wall Thickness</i>	
		<i>in</i>	<i>(mm)</i>
3	80	0.073	(1.85)
3-1/2	90	0.080	(2.03)
4	100	0.086	(2.18)
5	125	0.099	(2.51)
6	150	0.110	(2.79)
8	200	0.134	(3.40)
10	250	0.159	(4.04)
12	300	0.183	(4.65)

3.6 Manufacturer's Installation and Operation Instructions

Identification tags, final Quality Control acceptance tags, and Installation Instructions, including any special dimension requirements, shall be furnished by the manufacturer, and provided in each bundle of pipe.

3.7 Calibration

Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of its stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment shall be submitted to FM Approvals for its records. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified as traceable to the National Institute of Standards and Technology (NIST) or traceable to other acceptable reference standards and certified by an ISO 17025, "General Requirements for the Competence of Testing and Calibration Laboratories", calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service accreditation certificate as an ISO 17025 calibration laboratory is required for FM Approvals' records.

The calibration of new equipment is also required. Documentation indicating either the date of purchase or date of shipment, equipment description, and model and serial number is required for identification. The new test equipment shall be clearly identified by label or sticker showing the date of the initial calibration and the next due date. When the inspection equipment and/or environment is not suitable for labels or stickers other methods such as etching of control numbers on the measuring device is allowed provided documentation is maintained on the calibration status of this equipment.

3.8 Tolerances

Tolerances on units of measure shall be as described in Appendix J, unless otherwise specified in this standard.

4. PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

The steel pipe shall conform to the manufacturer's drawings and specifications and to FM Approvals requirements.