FM Approvals®

Member of the FM Global Group

Approval Standard for Pipe Hanger Components for Automatic Sprinkler Systems

Class Number 1951-1952-1953

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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:

a) 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

b) must be readily identifiable.

Continuance of Approval and listing depends on compliance with the Approval Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up 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.

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1 INTRODUCTION

1.1 Purpose

1.1.1 This standard states FM Approval criteria for pipe hanger components used in automatic sprinkler systems. FM Approvals Class 1951 encompasses most pipe hanger components including attachments to steel and wood building members; Class 1952 encompasses concrete expansion shields, anchors and screws (i.e. post-installed concrete anchors installed in hardened concrete); and Class 1953 encompasses concrete inserts (devices installed before the concrete pour and embedded in concrete).

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 follow-up audit program.

1.2 Scope

1.2.1 This standard encompasses the design and performance requirements for pipe hanger components used in automatic sprinkler systems. Appendix C illustrates various sprinkler pipe hanger components, and is intended to serve as a guide to consistent use of nomenclature for the examination and listings. In cases where metric sized pipe hanger components are to be examined for Approval, test loads comparable to the English equivalent shall be used.

1.2.2 Pipe hangers encompassed by this standard are designed to support NPS ¾, 1, 1¼, 1½, 2, 2½, 3, 3½, 4, 5, 6, 8, 10, and 12 in. (20, 25, 32, 40, 50, 65, 80, 90, 100, 125, 150, 200, 250, and 300 mm) nominal pipe sizes.

1.2.3 FM Approval standards are intended to verify that the product described will meet stated conditions of performance, safety, and quality useful to the ends of property conservation.

1.2.4 Pipe Hanger Types — Some common types of sprinkler pipe hanger components covered by this standard are:

Pipe Support Components	*Building Attached Components*
Eye Rods	C-Type Clamps
U-Type Hangers	Cantilever Brackets
Swivel Hangers	Channel Clamps
Clevis Hangers	I-Beam Clamps
Hinge Hangers	Ceiling Flanges
Ring Hangers	Angle Brackets
Steel Band Hangers	Expansion Shields
	Concrete Inserts
	Trapeze Hangers
	Tipping Dowels

1.2.5 Other types of hanger components may be FM Approved if they meet the requirements and intent of this standard. Components of unusual design may be subjected to special tests to determine their suitability.

1.2.6 This standard does not evaluate pipe hanger components with respect to their adequacy to resist earthquake forces and pipe displacements in earthquake-exposed areas (FM Global 50-year through 500-year earthquake zones as shown in Data Sheet 1-2, Earthquakes).

1.2.6.1 Where post-installed concrete anchors are to be used in earthquake-exposed areas they should be separately determined, based on a recognized national or international standard (e.g., American Concrete Institute [ACI] standard 355.2 "Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary"), to be allowed and adequate for the test loads specified in this Approval Standard when installed in cracked concrete.

1.2.6.2 Adequacy of pipe hanger components to resist the upward or downward reaction from earthquake sway bracing is not evaluated by this standard.

1.2.6.3 Adequacy of pipe hanger components subject to swinging of unbraced piping in an earthquake is not evaluated by this standard.

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 pipe hanger components for the purpose of obtaining FM Approval. Pipe hanger components having characteristics not anticipated by this standard may be FM Approved if performance equal, or superior, to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, pipe hanger components which meet 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:

- the suitability of the product
- the performance of the product as specified by the manufacturer and required by FM Approvals; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures shall be made to evaluate the manufacturer's ability to consistently produce the product which was examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of FM Approvals' Surveillance Audit program.

1.5 Basis for Continued FM Approval

Continued Approval is based upon:

- production or availability of the product as currently FM Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval Report and Master Agreement;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Surveillance Audits conducted as part of FM Approvals' product surveillance audit program.

Also, as a condition of retaining FM Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

1.6 Effective Date

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

The effective date of this Standard is **One Year from Issue Date** 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 measures 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) SI 10-2010, ''*American National Standard for Metric Practice*.''

1.8 Applicable Documents

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

IEEE/ASTM SI 10-2010, *American National Standard for Metric Practice*
American Concrete Institute (ACI) 355.2-07, *Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary*
American Concrete Institute (ACI) 318-08, *Building Code Requirements for Structural Concrete (ACI 318-08) and Commentary*
ASTM A6/A6M-02b, *Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling*
ASTM A653/A653M-02, A635/A635M-02, *Standard Specification for General Requirements for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled*
ASTM A924/A924M-99, *Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*
ASTM B117-16, *Standard Practice for Operating Salt Spray (Fog) Apparatus*
ASTM B633-15, *Specification for Electrodeposited Coatings of Zinc on Iron and Steel*
ASTM C33/C33M, *Standard Specification for Concrete Aggregates*
ASTM D1654-08, *Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments*
FM Global Property Loss Prevention Data Sheets
International Organization for Standardization (ISO) 3575:1996, *Continuous Hot-Dip Zinc-Coated Carbon Steel Sheet of Commercial, Lock-Forming and Drawing Qualities*
ISO 4998:1996, *Continuous Hot-Dip Zinc-Coated Carbon Steel Sheet of Structural Quality*
Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), SP-69-02, *Pipe Hangers and Supports — Selection and Application*

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. When the 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, or not to accept. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere. (Contrast with FM Approved.)

Adjustable Swivel Band Hanger

A type of band hanger that is adjustable and swivels.

Band Hanger

A type of hanger that is adjustable and utilizes a band looped around the pipe.

Bracket

A cantilever-type hanger that is attached directly to a vertical surface of the building structure.

Building Attached Component

A product that is used to make load carrying connection to a building structural element.

''C'' Clamp

A product that is used to provide a load carrying connection to a building structural element, usually by use of a jaw and setscrew combination.

Ceiling Flange

A product that is used to provide a load carrying connection to the ceiling for installation of pipe hangers.

Beam Clamp

A clamp that is rigidly attached to both edges of the bottom flange of a structural member.

Top or Bottom Beam Clamp

A clamp that is rigidly attached to one edge of the top or bottom flange of a structural member.

Clevis Hanger

A type of split ring hanger.

Concrete Anchor

A bolt, screw or explosive-driven fastener installed in concrete used to transfer forces to a structural member. Can be installed before the concrete is poured (i.e., a cast-in-place anchor), but is more often installed after the concrete is hardened (i.e., a post-installed anchor)

Concrete Insert

Concrete inserts provide anchorage to concrete building structures for supporting pipe hangers. Concrete inserts must be installed before the concrete is poured.

Concrete, Normal Weight

Structural concrete conforming to ACI 318-08, containing coarse and fine aggregates that conform to ASTM C33. Typically has a density of approximately 145 to 150 lb/ft^3

Coupling

A hanger part used to connect expansion shields or fasteners to a rod. Couplings may have male or female threads and may have a straight or reducing pattern.

Expansion Shield (Case, Shell, or Base)

An anchor that is inserted into a self-drilled or predrilled hole in hardened concrete (i.e. post-installed) and then ''set'', usually by tightening of a bolt, setting of a cam or semisoft member, or forced expansion over a hardened steel plug.

FM Approvals Certification Mark

The FM Approvals Certification Mark. Its use is mandatory on all units of FM Approved products. These registered marks cannot be used except as authorized by FM Approvals via the granting of FM Approval to a specific product.

FM Approved

This term refers to products Approved by FM Approvals. Such products are listed in the *Approval Guide*, an on-line 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. This form obligates the manufacturer to allow re-examination of the product and surveillance audits of at FM Approvals' discretion. It further requires the manufacturer not to deviate from the as-Approved configuration of the product without review by and agreement of FM Approvals. Approval is product and site specific.

Non-Heat Sensitive Material

A material whose measured tensile strength at 1005 °F ± 50 °F (540 °C ± 10 °C) is at least 90 percent of the value measured at 68 °F ± 41°F (20 °C ± 5 °C).

Post-Installed Concrete Anchor

An anchor that is installed in hardened concrete. Examples include expansion shields, adhesive anchors, driven fasteners and screws.

Retaining Strap

A component used to hold a top or bottom beam clamp in its intended position.

Ring

A pipe hanger that completely encircles a pipe without a positive gripping action.

Riser Clamp

A style of pipe clamp used to prevent downward movement of risers at each floor within a building.

Solid Ring

A ring that has to be slipped onto the end of the pipe and cannot be opened in any way for attachment to the pipe after the pipe line is made up.

Split Ring

A ring that can be opened in some way to allow it to be put on the pipe after the pipe line is made up.

Swivel Ring

A solid or split ring that has a top swivel allowing the hanger to be connected to a rod after it has been installed on the pipe.

Screw

Threaded head screws used to provide anchorage to concrete, steel or wood building structural members for supporting pipe hangers.

Trapeze Hanger

A building attached component that attaches to the rib width underside of a structural steel deck.

Tipping Dowel

A building attached component that inserts into the rib width opening of a structural steel deck.

2 GENERAL INFORMATION

2.1 Product Information

2.1.1 A pipe hanger usually consists of two or more components combined to make a functional assembly. One part of a hanger attaches to a structural element of the building and another part supports the pipe. Pipe hangers encompassed by this standard are used to support overhead piping in an automatic sprinkler system. Complete hanger assemblies or individual components may be tested for Approval. Installation shall be in accordance with FM Global Property Loss Prevention Data Sheet 2-0 and the manufacturer's installation instructions.

2.1.2 Pipe hanger components shall be examined on a type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical products, produced with identical materials by different manufacturers, or even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample pipe hanger components, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

2.2 Approval Application Requirements

To apply for an Approval examination the manufacturer, or its authorized representative, should submit a written request to information@fmapprovals.com.

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 or services being submitted for FM Approval consideration,
- General assembly drawings, complete set of manufacturing drawings, materials list(s) and material specifications (such as ASTM A48 CL 40 — Cast Iron), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures, etc;
- The number and location of manufacturing facilities.
- All documents 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.

2.3 Requirements for Samples for Examination

2.3.1 Sample requirements are to be determined by FM Approvals following a review of the preliminary information used in the preparation of the examination proposal. Sample requirements may vary depending on size range of product under consideration, design features, or results of prior testing. Following the authorization of the examination

proposal, the manufacturer shall submit samples for examination and testing using the shipping guidance included with the proposal letter.

2.3.2 It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of FM Approvals. The manufacturer shall provide any special test fixtures which may be required to evaluate the product.

2.3.3 If there are failures encountered during the examination testing, FM Approvals will provide the manufacturer with information regarding what testing will need to be repeated and any additional sample requirements.

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

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.

3.2 Physical or Structural Features

3.2.1 Pipe Support Components

Pipe support components shall have adequate strength to support the test loads shown in Table 3.2.1. These loads are based on five times the weight of water filled Schedule 40 steel pipe plus 250 lbs. (113 kg) at each point of piping support using distances between hangers of 12 ft (3.6 m) for 3⁄4 through 1 1⁄4 in. nominal pipe sizes and 15 ft (4.6 m) for larger pipe sizes. These test loads are intended to provide adequate reserve capacity to account for the effects of shock, vibration, or unanticipated loading.

Table 3.2.1
Pipe Attached Component Test and Pre-Loads

Nominal Pipe Size		*Pre-Load*		*Test Load*	
NPS (in.)	*(DN [mm])*	*Lbf*	*(N)*	*Lbf*	*(N)*
¾	*(20)*	*20*	*(89)*	*340*	*(1512)*
1	*(25)*	*30*	*(133)*	*410*	*(1824)*
1 ¼	*(32)*	*45*	*(200)*	*430*	*(1913)*
1 ½	*(40)*	*55*	*(245)*	*520*	*(2313)*
2	*(50)*	*80*	*(356)*	*635*	*(2825)*
2 ½	*(65)*	*120*	*(534)*	*940*	*(4181)*
3	*(80)*	*175*	*(778)*	*1060*	*(4715)*
3 ½	*(90)*	*200*	*(890)*	*1255*	*(5583)*
4	*(100)*	*250*	*(1112)*	*1475*	*(6561)*
5	*(125)*	*350*	*(1557)*	*2000*	*(8896)*
6	*(150)*	*475*	*(2113)*	*2615*	*(11632)*
8	*(200)*	*750*	*(3336)*	*3800*	*(16903)*
10	*(250)*	*1120*	*(4982)*	*5855*	*(26044)*
12	*(300)*	*1530*	*(6808)*	*7900*	*(35141)*

3.2.2 Building Attached Components (including concrete anchors, screws and expansion shields)

Building attached components shall provide a secure connection to a building structural element and shall have sufficient strength to support sprinkler system piping in accordance with the rod size and pipe size combinations shown in Table 3.2.2. The test loads, also shown in Table 3.2.2, will be applied to verify adequate strength.

Table 3.2.2
Building Attached Component Test and Pre-Loads

Nominal Pipe Size		*Minimum Rod Size*		*Pre-Load*		*Test Load*	
NPS (in.)	*(DN [mm])*	*In.*	*(Metric)*	*Lbf*	*(N)*	*Lbf*	*(N)*
¾ - 4	*(20 -100)*	*3/8*	*(M10)*	*250*	*(1112)*	*1475*	*(6561)*
5, 6, 8	*(125, 150, 200)*	*1/2*	*(M12)*	*750*	*(3336)*	*3800*	*(16903)*
10, 12	*(250, 300)*	*5/8*	*(M16)*	*1530*	*(6808)*	*7900*	*(35141)*

3.3 Design Requirements

3.3.1 General

A. To provide adequate durability, ferrous metal parts ⅛ in. (3.18 mm) thick or less shall be protected as specified in Section 4.3.1

B. Sprinkler pipe hangers shall be substantially supported from the building structure and designed to support the loads specified in Sections 3.2.1 and 3.2.2.

C. Hanger components are usually interconnected by threaded steel rods. Approved components shall be threaded to accept the appropriate rod size. Minimum rod sizes for each pipe size shall be as shown in Table 3.2.2. However, components designed for larger rod sizes can be Approved. Hanger rods alone shall not be considered for Approval.

D. To avoid possible loosening due to vibration or other long term conditions, jam nuts shall be used to secure set screws used with building attached components. These set screws shall have cone or cup points.

E. To ensure adequate strength and long term durability, load bearing threaded fastening components used in sprinkler system pipe hangers shall have a minimum thread engagement. The minimum thread engagement shall be at least that provided by an equivalent nominally sized standard hex nut as defined in Table 3.3.1e. Threaded components that do not support a load due to the weight of the sprinkler piping do not need to comply with this requirement. Some examples include set screws installed at the top of beam clamps, clevis hanger cross members, center load clamp cross members and trapeze hanger cross members.

Table 3.3.1e
Minimum Thread Engagement

Nominal Rod Size NPS (in.)	*Minimum Thread Engagement in.*
3/8	*0.320*
1/2	*0.427*
5/8	*0.535*

Nominal Rod Size DN (mm.)	*Minimum Thread Engagement mm*
10	*8.0*
12	*10.4*
16	*14.1*

3.3.2 Pipe Support Components

A. Pipe support components shall have sufficient strength to support the test loads assigned without failure. Before application of the test loads shown in Table 3.2.1, the components shall be first pre-loaded in accordance with Table 3.2.1 to take up any slack between parts.

B. Hanger components are usually interconnected by threaded steel rods. Approved components shall be threaded to accept the appropriate rod size. Pipe size vs. rod size combinations shall be as shown in Table 3.2.2. Rod sizes shall not be less than those shown; however, components designed for larger rod sizes are acceptable.

3.3.3 Building Attached Components (including concrete anchors, screws and expansion shields)

A. Building attached components shall have sufficient strength to support the test loads assigned without failure. Before application of the test loads shown in Table 3.2.2, the components will first be pre-loaded in accordance with Table 3.2.2 to take up any slack between parts.

B. To prevent slippage, any elongation observed during testing of a beam or C-type clamp, or other similar product, shall require the manufacturer to provide retainer straps, or other equivalent means of securing the component to the structural member.

C. Threaded components shall have a minimum applied torque as specified in Table 3.3.3c.

Table 3.3.3c
Minimum Recommended Torque

Thread Size		*Minimum Torque*	
in.	*(Metric)*	*Lbf·in.*	*(N·m)*
¼	*(M6)*	*40*	*(5)*
5/16	*(M8)*	*50*	*(6)*
3/8	*(M10)*	*60*	*(7)*
7/16	*(M11)*	*90*	*(10)*
1/2	*(M12)*	*125*	*(14)*
9/16	*(M14)*	*180*	*(20)*
5/8	*(M16)*	*250*	*(28)*
¾	*(M19)*	*400*	*(45)*
7/8	*(M22)*	*665*	*(75)*
1	*(M25)*	*990*	*(112)*

D. Expansion shields, screws and concrete anchors may be threaded either externally or internally.

E. Threads shall be in accordance with the national or international recognized standard of the intended market for the component.

3.3.4 Connections to Steel Deck

Connection of the pipe hangers shall be to the building structural framing.

EXCEPTION

Connection to the floor or roof steel deck shall be permitted when the following conditions apply:

3.3.4.1 Where the construction practices in some countries have spacing between building structural framing that immediately supports the steel deck, and exceeds the maximum allowable branch line hanger spacing.

3.3.4.2 Building attached components such as Trapeze, Tipping Dowel, etc., for branch lines up to nominal 3 in. (80 mm) in pipe size shall be permitted and attached to steel decking under the following conditions*:

A. The building attached components intended for use with steel decking shall be installed per the manufacturer's installation instructions. These instructions shall include steel deck types and minimum thicknesses. In addition, any limitations specified by the FM Global Property Loss Prevention Data Sheets and FM Approval Report should also be considered.

B. The structural design of the decking shall consider the weight of the water-filled pipe (for both wet-and dry-systems) plus dead, live and collateral loads (e.g., suspended ceilings or other items hung from the steel deck). This comment, as well as a statement that it is the responsibility of the sprinkler system designer to certify and include structural design details with submitted plans, shall be included in the ‘‘Manufacturer’s Installation Instructions’’.

C. A positive means of connection and engagement to the steel deck shall be provided, and will not loosen under normal cycles of steel deck deflection.

*Note: * This does not apply to deck material other than steel, nor to the crossmain or feedmain sprinkler piping.*

3.3.4.3 The test samples shall be installed on a section of the steel deck of minimum thickness acceptable, in accordance with the ‘‘Manufacturer’s Installation Instructions.’’ Test loads shall be applied in tension along the axis of the threaded rod.

3.3.5 Couplings

A. Couplings are sometimes required to connect expansion shields, driven fasteners and screws to other hanger components. Couplings may be of the straight or reducing type. Standard thread sizes are listed in Table 3.3.5.

Table 3.3.5
Coupling Standard Thread Sizes

Straight		*Reducing*	
In.	*(Metric)*	*In.*	*(Metric)*
3/8 x 3/8	(M10 x M10)	3/8 x 1/2	(M10 x M12)
1/2 x 1/2	(M12 x M12)	1/2 x 5/8	(M12 x M16)
5/8 x 5/8	(M16 x M16)	5/8 x 3/4	(M16 x M20)
3/4 x 3/4	(M20 x M20)	3/4 x 7/8	(M20 x M22)

B. When couplings are used with a hanger component or as part of a hanger assembly, they shall be tested in accordance with the test loads shown in Table 3.2.2, based on the largest threaded connection.

Couplings shall not be used to adapt another pipe hanger component in such a manner as to violate the minimum rod sizes of Table 3.2.2. Except when used as part of an expansion shield or powder-driven fastener rated for the load of the pipe being supported, couplings shall be used only to adapt larger threaded building-attached components to smaller threaded pipe support components, and never the converse.

3.4 Materials

Common materials used in hanger components are malleable iron, ductile iron, rolled steel, and heat treated steel. These and any other materials used in hanger components shall have physical properties necessary to render them suitable for their intended use. When unusual materials are used, special tests may be necessary to verify their suitability.

3.5 Markings

3.5.1 Marking on the product shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- identifying model or part number;
- the maximum pipe size or the hanger rod size used with the component; and,
- FM Approvals Certification Mark
- If a Top or Bottom Beam Clamp or C clamp is only FM Approved when installed in one orientation (see paragraph 4.2.1.1), it shall be marked with an installation (up) arrow, or equivalent means to indicate proper installation orientation.

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

3.5.3 Products which cannot be completely marked due to their size shall have complete identification on the smallest size shipping container, including the complete name and address of the manufacturer.

3.5.4 The FM Approvals Certification Mark shall be displayed visibly and permanently on the product and/or packaging as appropriate. The manufacturer shall not use this mark on any other product unless such product is covered by separate Approval Report with FM Approvals.

3.5.5 Pipe hanger components that are produced at more than one location shall be identified as the product of a particular location.

3.5.6 All markings shall be legible and durable.

3.6 Manufacturer's Installation and Operation Instructions

Installation instructions, including any special dimensional, orientation or torque requirements, shall be furnished by the manufacturer. Instructions shall be provided in each shipping container or attached to each major component. A reference on each container or component to installation instructions available on a web site is an acceptable alternative.

3.7 Calibration

All equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage of the equipment. A copy of the calibration certificate for each piece of test equipment is required for FM Approvals records, indicating that the calibration was performed against working standards whose calibration is certified as traceable to the National Institute of Standards and Technology (NIST) or to other

acceptable reference standards and certified by a ISO 17025 calibration laboratory. The test equipment must 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, "General Requirements for the Competence of Testing and Calibration Laboratories", calibration laboratory is required for FM Approvals records.

4 PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

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

4.1.2 Test/Verification

The samples shall be examined and compared to drawings and specifications. It shall be verified that the sample conforms to the physical and structural requirements described in Section 3, General Requirements.

4.2 Tensile Tests

4.2.1 Requirements

4.2.1.1 Building attached components shall have sufficient strength to support the required load and no component shall fail, slip and/or elongate more than $^{3}\!/_{16}$ in. (4.76 mm) between application of the pre-load and the minimum required test load, as shown in Table 3.2.2. An exception is a beam or C-clamp, or similar device, without a retainer strap (see Appendix C). Elongations less than 3/16 may cause these devices to become disassembled or fall off the beam. This would be considered a failure.

If the component elongates more than 3⁄16 in. (4.76 mm) the load shall be increased to 150% of the test load shown in Table 3.2.2 and the elongation measured. The test shall be recorded as successfully completed if elongation is less than ½ in. (12.7 mm) and there is no cracking or tearing of the hanger material or excessive deformation in the area of through holes.

All size Beam and C-clamp types shall be tested on an ASTM Standard A6/A6M-90a, W8X24 ''W'' shape beam, under load, in positions with load on and opposite the set screw side, unless specified by the manufacturer for one position. Other beams will be tested on a case-by-case basis if deemed necessary by the manufacturer's installation instructions.

A. Testing of building attached components to C-or Z-shaped steel secondary roof members shall be on the minimum allowable thickness of roof members per the manufacturer's installation instructions. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer's instructions. Attachment of hanger components to the flanges of C-shaped purlins is not permitted. There shall be no visual physical damage to the roof members at the minimum required load.

Installation of these building attached components to Z-shaped purlins at the vertical web midpoint is highly advisable. (Alternatively for Z-shaped purlins, attachment may be to the bottom flange, at a point as close to the web as possible, but at a distance from the web no further than 1⁄2 of the flange width.) In no case should purlin stiffeners be used as the point of attachment. Any clamp-type hangers used on Z-shaped purlins with flange stiffeners shall be the type which will not contact the flange stiffener, such as the large flange C-clamp shown at the top center of Appendix C, *Typical Hanger Types*. For C-shaped purlins attachment shall only be to the vertical web at midpoint.

B. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer's instructions. Concrete inserts, screws, expansion shields and similar products shall be tested using minimum 10 × 10 × 6 in. (254 × 254 × 152 mm) reinforced concrete blocks. Blocks shall be normal weight concrete and have a compressive strength of 2,500 to 3,000 psi (17.24 to 20.68 MPa), see Appendix E. If anchors are tested in concrete with a higher strength, increase the test loads for the purposes of determining if concrete failure occurs in accordance with the following formula.

$$L_T = L_S * SQRT(CS_A/CS_S)$$

where:

L_T = Test Load to be used to identify concrete failure modes
L_S = Load specified in the standard (see Table 3.2.2)
CS_S = Concrete strength specified in the standard [3,000 psi (20.68 MPa)]
CS_A = Actual concrete strength used in test

If failure occurs that is not associated with the concrete (e.g. the anchor steel fails) before the increased test load is reached, additional tests will be required with lower strength concrete in order to verify that the failure does not occur in the concrete specified by the standard [2,500 to 3,000 psi (17.24 to 20.68 MPa) compressive strength].

C. Installation instructions for side beam brackets and other components designed to attach to wood or steel beams must specify the fasteners to be used. Testing shall be performed with the minimum length fasteners allowed by the manufacturer in #2 Southern Yellow Pine Pressure treated lumber with a thickness no less than the length of the fastener being tested.

4.2.1.2 Steel Deck Attachment Components may be FM Approved for branch lines up to nominal 3 in. (80 mm) in size. They shall have sufficient strength to support the required load and no component shall fail, slip and/or elongate more than $^{3}/_{16}$ in. (4.76 mm) between application of the pre-load and the minimum required test load, as defined in Table 3.2.2. If the component elongates more than $^{3}/_{16}$ in. (4.76 mm) the load shall be increased to 150% of the test load shown in Table 3.2.2 and the elongation measured. The test shall be recorded as successfully completed if elongation is less than ½ in. (12.7 mm) and there is no cracking or tearing of the hanger material or excessive deformation in the area of through holes. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer's instructions. Hangers for use on steel decking shall be tensile tested on the minimum allowable thickness of steel decking per the manufacturer's installation instructions. There shall be no visual physical damage to the steel decking, such as cracking or tearing of the decking, at the minimum required load. Deflection of the decking is allowed.

4.2.1.3 Other pipe hanger and pipe support components shall have sufficient strength to support the required load and no component shall fail or elongate more than $^{3}/_{16}$ in. (4.76 mm) between application of the pre-load and the minimum required test load, as defined in Table 3.2.1. If the component elongates more than $^{3}/_{16}$ in. (4.76 mm) the load shall be increased to 150% of the test load shown in Table 3.2.1 and the elongation measured. Elongation must be less than ½ in. (12.7 mm) and there shall be no cracking or tearing of the hanger material or excessive deformation in the area of through holes. Tested components shall be assembled, installed, and adjusted as specified in the manufacturer's instructions. Riser clamps shall be tested when installed on ungalvanized, unpainted, steel pipe.

4.2.2 Tests/Verification

Building Attached, Pipe Hanger, Pipe Support, and Steel Deck Attachment Components shall be installed in a tensile test machine (See Appendix B) having sufficient strength to support the required load. Fixed reference points shall be set to zero after the pre-load is reached. The test load shall be maintained for one minute before the final observation and elongation measurement is made. If required by paragraphs 4.2.1.1, 4.2.1.2, or 4.2.1.3 the load shall be increased to 150% of test load and held for one minute. Threaded components shall have a minimum applied torque before application of the tensile load as specified in Table 3.3.3c.

For building or steel deck attached pipe hanger components, the manufacturer shall provide three minimum thickness steel secondary roof members or steel deck samples for each size of pipe hanger rod along with all hanger installation components to be tested. A steel mounting jig/plate measuring no more than 21 × 21 inches (533 × 533

mm), with four ⅜ inch (11 mm) mounting holes, centered and spaced exactly 3½ × 11 inch (89.9 × 279.4 mm) on the jig/plate, shall be provided by the manufacturer. The minimum thickness steel secondary roof members or steel deck samples shall be prepared and provided, by the manufacturer, with the mounting hardware for attachment to the jig/plate. For testing performed at the manufacturer's location or a third party laboratory other jig dimensions may be used at the discretion of the FM Approvals engineer.

4.3 Coating Evaluation

4.3.1 Requirement

To provide adequate durability, ferrous metal parts 1⁄8 in. (3.18 mm) thick or less shall be plated with a nonferrous material to a minimum of 5 microns (µm) [0.0002 in. (0.005 mm)] thickness as defined in ASTM B633, Service Condition SC1 (Mild) or equivalent or be otherwise coated in accordance with a recognized national or international standard to retard oxidation of the base material. Coatings shall withstand the effect of shipping, weathering, assembly, and installation. All corrosion-resistant coatings shall be visually inspected for continuity, adhesion, and durability. Corrosion resistant specifications shall be submitted for review. This requirement does not apply to parts that are completely encased in concrete. Hardware such as bolts, screws, nuts, washers and springs shall not be subject to this requirement but shall be coated with corrosion resistant material or made of corrosion resistant material.

4.3.2 Test/Verification

4.3.2.1 Zinc based coatings shall be examined to determine average coating thickness. A minimum of four measurements are required for 2 inch (50 mm) and smaller nominally sized devices, and six measurements for nominally sized devices greater than 2 inches (50 mm). The minimum accepted average coating thickness shall be 5 µm.

4.3.2.2 Any coatings other than zinc based shall be evaluated by subjecting three samples of the component to a 20 percent salt spray (fog) environment as specified by ASTM B117-2016, Standard Practice for Operating Salt Spray (Fog) Apparatus, for a duration of 10 days. The samples shall be scribed as discussed in paragraph 6.4 of ASTM B117 in accordance with ASTM D1654. At the conclusion of the test, the samples shall be evaluated in accordance with ASTM D1654 Procedure A, Method 2 and shall achieve Rating No. 6 or better.

4.4 Mechanical Locking

4.4.1 Requirement

All components which depend on spring-loaded engagements, loose interlocking engagement fits, untorqued fasteners and other non-positive locked assembly features shall be evaluated by appropriate impact, vibration, and displacement tests. This test may be waived at the engineer's discretion if thread locking compounds, peening, or other methods are used to secure the fasteners.

4.4.2 Test/Verification

Compliance shall be verified by tests of a minimum of one sample of each type appropriate to the hanger component under examination. The hanger component shall be subjected to the vibration sequence of Table 4.4.2. The plane of vibration shall be vertical.

The hanger shall be installed in accordance with the manufacturer's instructions and connected to a threaded rod. The threaded rod shall be fixed to a non-moving surface above the vibration table via a spring with a spring constant of approximately 50 pounds per inch that provides approximately 50 pounds upward force. Pipe attached hangers shall have a test pipe attached to the vibration table and building attached products shall be attached to the vibration table with appropriate structures (beam, angle iron, wood beam, etc).

No parts should become disassembled due to the vibration. The pull test of Section 4.2, as applicable, shall be repeated after the vibration test of each sample assembly. No failure shall be observed.

Table 4.4.2
Vibration Conditions

Total Stroke		*Frequency*	*Time*
in.	*(mm)*	*Hz*	*Hours*
0.020	*(0.51)*	*28*	*5*
0.040	*(1.04)*	*28*	*5*
0.150	*(3.81)*	*28*	*5*
0.040	*(1.04)*	**18 to 37 (variable)*	*5*
0.070	*(1.78)*	**18 to 37 (variable)*	*5*

**Frequency shall be varied from 18 to 37 Hz at Two Cycles Per Minute*

4.5 Additional Tests

Additional tests may be required, including fire tests, impact test, etc., depending on design features, results of any tests, material application, or to verify the integrity and reliability of the pipe hangers, at the discretion of FM Approvals.

Unexplained failures shall not be permitted. A re-test shall only be acceptable at the discretion of FM Approvals and with adequate technical justification of the conditions and reasons for failure.

5 OPERATIONS REQUIREMENTS

A quality control program is required to assure that subsequent pipe hanger components produced by the manufacturer at an authorized location shall present the same quality and reliability as the specific pipe hanger components examined. Design quality, conformance to design, and performance are the areas of primary concern. Design quality is determined during the Approval examination and tests, and is covered in the FM Approval Report. Conformance to design is verified by control of quality and is covered in the Surveillance Audit. Quality of performance is determined by field performances and by periodic re-examination and testing.

5.1 Demonstrated Quality Control Program

5.1.1 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and,
- handling and disposition of non-conformance materials.

5.1.2 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.3 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.4 Drawing and Change Control

The manufacturer shall establish a system of product configuration control that does not allow unauthorized changes to the product. Revisions to critical documents, identified in the Approval Report, must be reported to, and authorized by, FM Approvals prior to implementation for production. The manufacturer shall assign an appropriate person or group to be responsible for reporting proposed revisions to FM Approved products to FM Approvals before implementation. In situations involving significant modifications to an Approved product, the notification shall be in the form of a formal request for an Approval examination. For modifications of a more common nature, the manufacturer shall provide notification to FM Approvals by means of FM Approvals Form 619, *FM Approved Product/Specification-Tested Revision Request Form*. Records of all revisions to all FM Approved products shall be maintained.

5.1.4.1 The table below has been included as a guide to manufacturers of product revisions that FM Approvals considers to be a significant change. The table is not all-inclusive. As mentioned above, modifications that fit this category should be documented by means of a letter stating the change, and requesting a quotation for an Approval examination.

Modification	***Description/Example***
Addition of Product Sizes	The hanger component was originally FM Approved for use on pipe sizes 3 through 8 inch, and now Approval of sizes 10 and 12 is desired.
Additional or Relocation of the Manufacturing Location	The product was originally FM Approved as manufactured in location A, and now is desired to be made in locations A and B, or only in location B.
Major Changes to Critical Dimensions or Components	Modifications that would depart from the national or international standards that are used in the manufacturing of the product as originally FM Approved.
	Modifications that may affect the results of earlier satisfactory testing of the pipe hanger components such as a change in the thickness or width of the loop of a loop or clevis hanger.

5.1.4.2 The listing below has been included as a guide to manufacturers of modifications that are commonly submitted on FM Approvals Form 619, *FM Approved Product/Specification-Tested Revision Request Form*.

Modification	***Description / Example***
Change in Company Contact Information:	Company Name, Company Office Address, Company Contact and Title, Phone Number, Fax Number, Email Address.
Updating of Drawings:	Form 619 is used to notify FM Approvals in the event of: minor dimensional changes to non-critical features, minor changes in notes, relocation of title block, re-creation of the same drawing on CAD, etc.
Changes in Markings:	Proposed changes should include a drawing of the proposed marking.
Changes in Materials:	Where new material is either superior, or comparable, to material used in original Approval
Updating of Documentation:	Creation of new, or revisions to existing, sales literature, Installation Instructions, Quality Manual, etc.

5.1.4.3 In instances where the modification is difficult to categorize, manufacturers are encouraged to contact FM Approvals to discuss the nature of the change, and to inquire about how to send the information to FM Approvals for further review. The examples shown in Sections 5.1.4.1 and 5.1.4.2 are based on common examples of modifications as they relate to the manufacture of pipe hanger components.

5.2 Surveillance Audit Program

5.2.1 An audit of the manufacturing facility is part of the Approval investigation to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and FM Approved.

5.2.2 These audits shall be conducted periodically but at least annually by FM Approvals or its representatives or more frequently dependent on jurisdictional requirements. At issue of this standard the Occupational and Safety Health Administration (OSHA) of the United States Department of Labor requires audits of manufacturing sites producing products for use in hazardous locations during each quarter the product is manufactured.

5.2.3 FM Approved products or services shall be produced or provided at or from the location(s) audited by FM Approvals and as specified in the Approval Report. Manufacture of products bearing the FM Approval Mark is not permitted at any other location without prior written authorization by FM Approvals.

5.3 Manufacturer's Responsibilities

5.3.1 The manufacturer shall notify FM Approvals of changes in product construction, design, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation of such changes.

5.3.2 FM Approved pipe hanger components shall be produced under production controls adequate to maintain quality within the parameter of the design.

5.3.3 Where all or part of the quality control has been subcontracted, the manufacturer shall, at a minimum, conduct sufficient oversight audits to verify the continued application of the required controls.

5.4 Manufacturing and Production Tests

5.4.1 Test Requirement No. 1 — Material Composition

Composition of materials shall be verified by vendor certifications. The chemical or physical properties that are critical to the functioning of the item shall be sample tested. Testing shall be performed by the manufacturer or, on their behalf, by an agency independent of the vendor. Testing shall be conducted at a minimum of once a year.

5.4.2 Test Requirement No. 2 — Dimensional Checks

The manufacturer shall measure and record critical component dimensions, material thickness, markings, and threaded connections (as applicable) at the beginning of each production run. Thereafter, these measurements shall be recorded every 4 hours. The number of samples to be measured shall be based on the manufacturer's Quality Control Manual, but in no case shall be less than five samples. Measurements shall be compared to the latest revision of the component drawings.

APPENDIX A

UNITS OF MEASUREMENT

AREA: in^2 —‘‘square inches’’; (mm^2 —‘‘square millimeters’’)
$mm^2 = in^2 \times 6.4516 \times 10^2$
ft^2 —‘‘square feet’’; (m^2 —‘‘square meters’’)
$m^2 = ft^2 \times 0.0929$

FORCE: lb —‘‘pounds’’; (N —‘‘Newtons’’)
N = lb × 4.4482

LENGTH: in. -‘‘inches’’; (mm —‘‘millimeters’’)
mm = in. × 25.4
ft —‘‘feet’’;
(m —‘‘meters’’) m = ft × 0.3048

MASS: lb —‘‘pounds’’; (kg —‘‘kilograms’’)
Kg = lb × 0.454

STRESS: ***** psi —‘‘pounds per square inch’’; (kPa —‘‘kilopascals’’)
(MPa —‘‘megapascals’’)
kPa = psi × 6.895

TEMPERATURE: °F —‘‘degrees Fahrenheit’’; (°C —‘‘degrees Celsius’’)
°C = (°F -32) × 0.556

* Also strength and pressure

APPENDIX B

SAMPLE TESTS CONFIGURATION

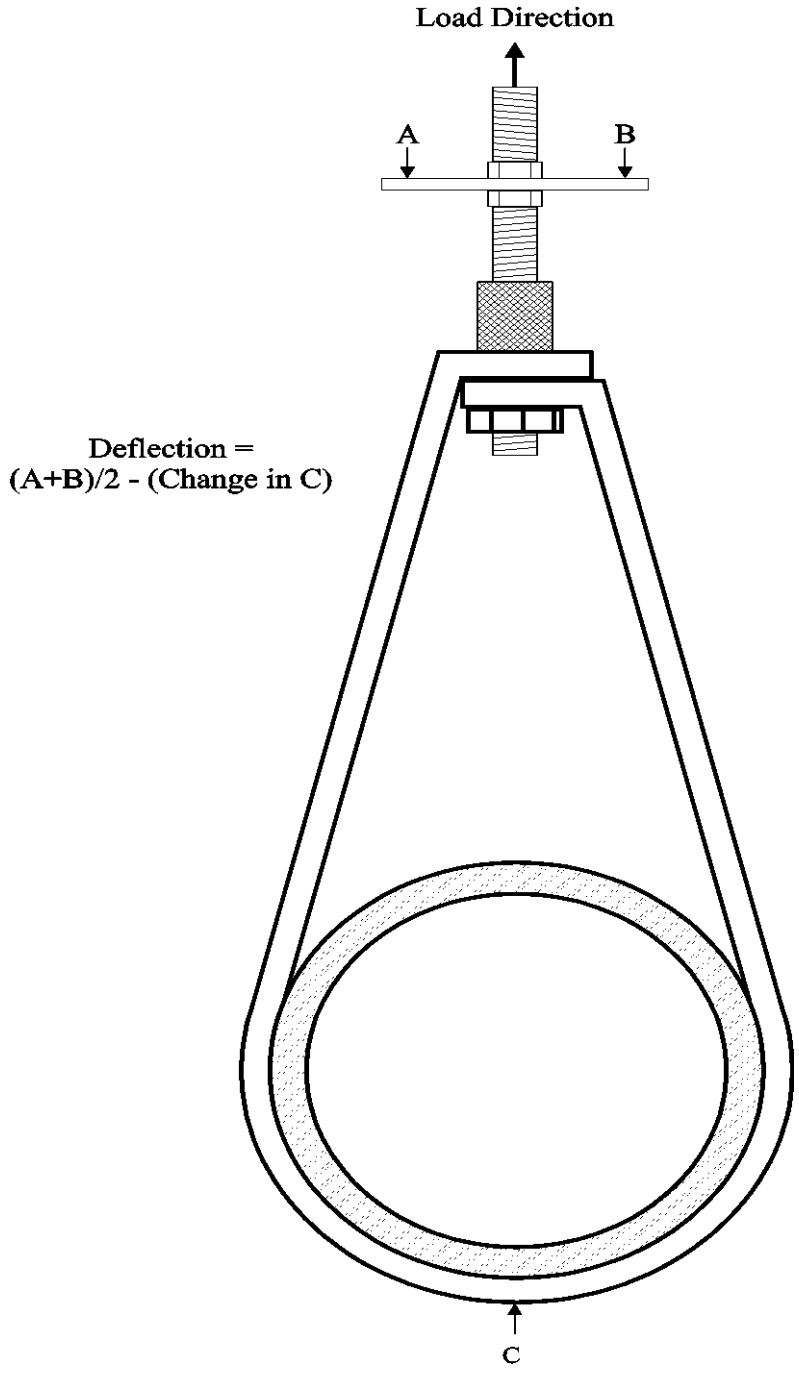


Figure 1. Loop Hanger

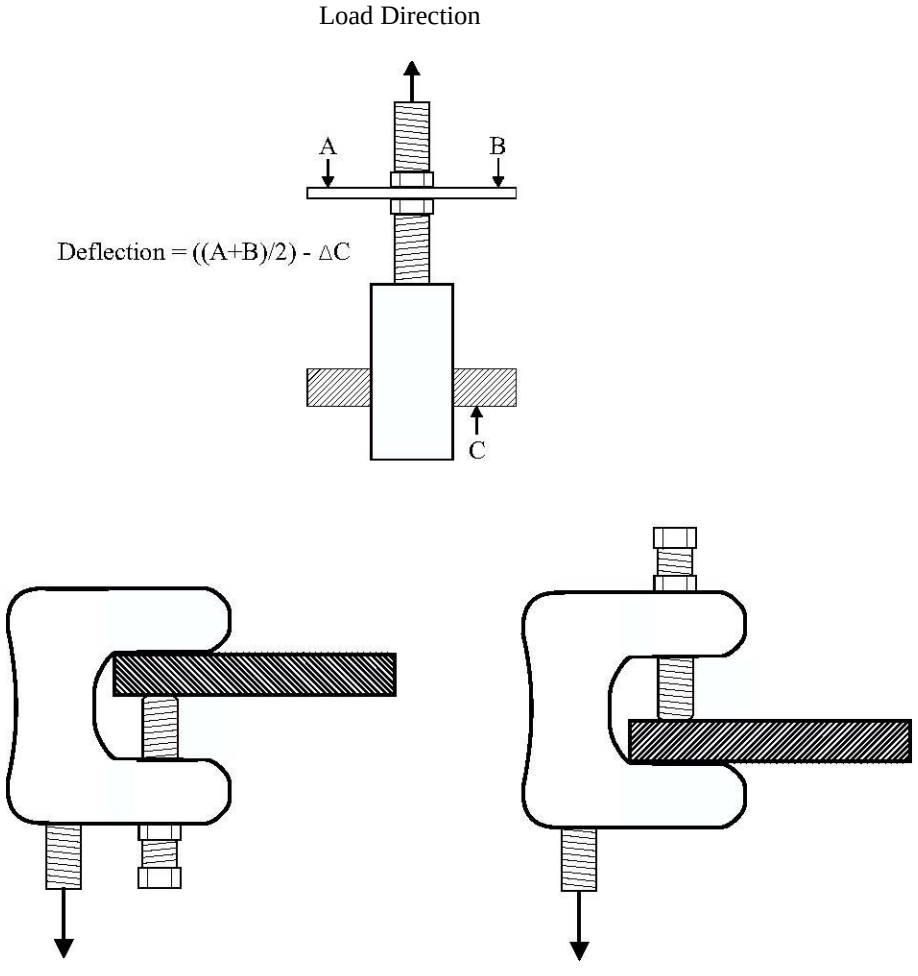
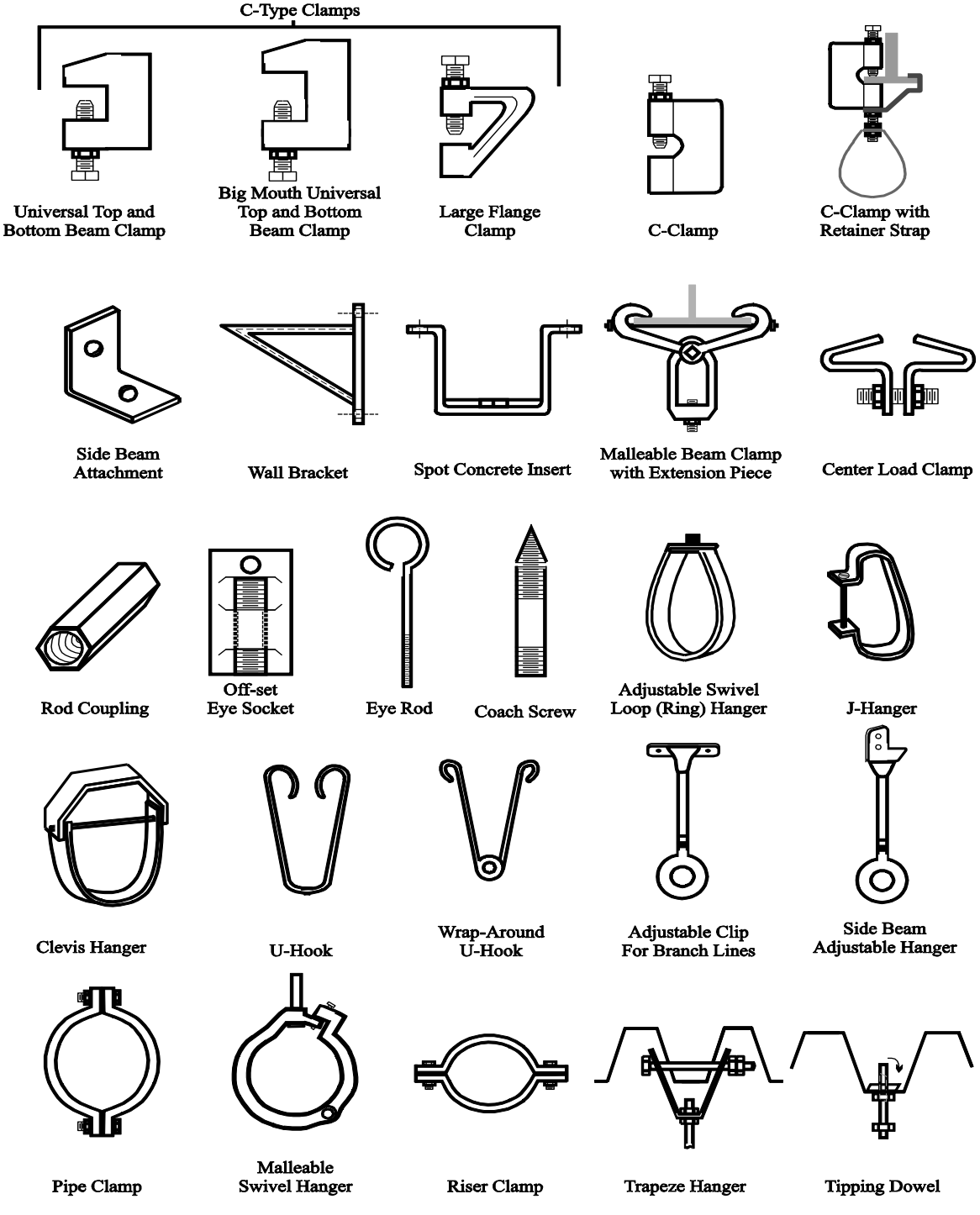


Figure 2. Beam Clamp

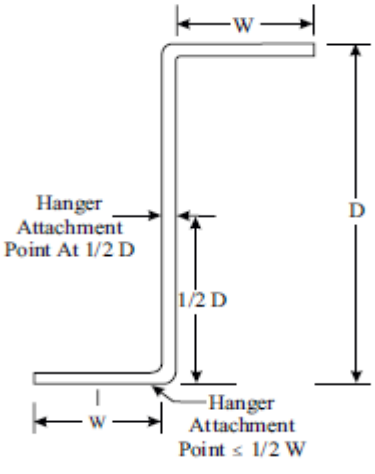
APPENDIX C

TYPICAL HANGER TYPES

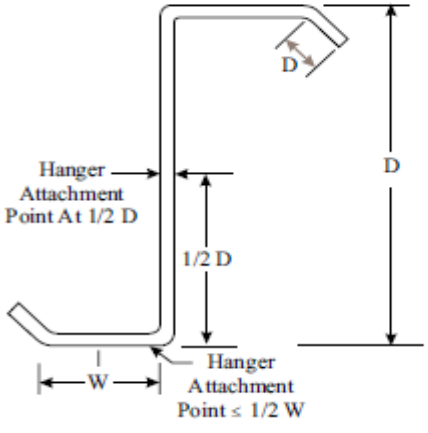


APPENDIX D

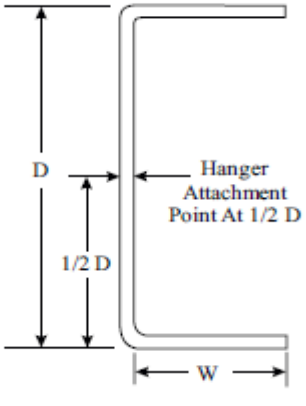
ATTACHMENT LOCATIONS FOR HANGERS WITH C-SHAPED OR Z-SHAPED PURLINS



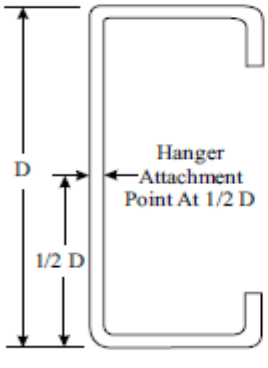
Z Purlin Without Flange (Edge) Stiffeners



Z Purlin With Flange (Edge) Stiffeners



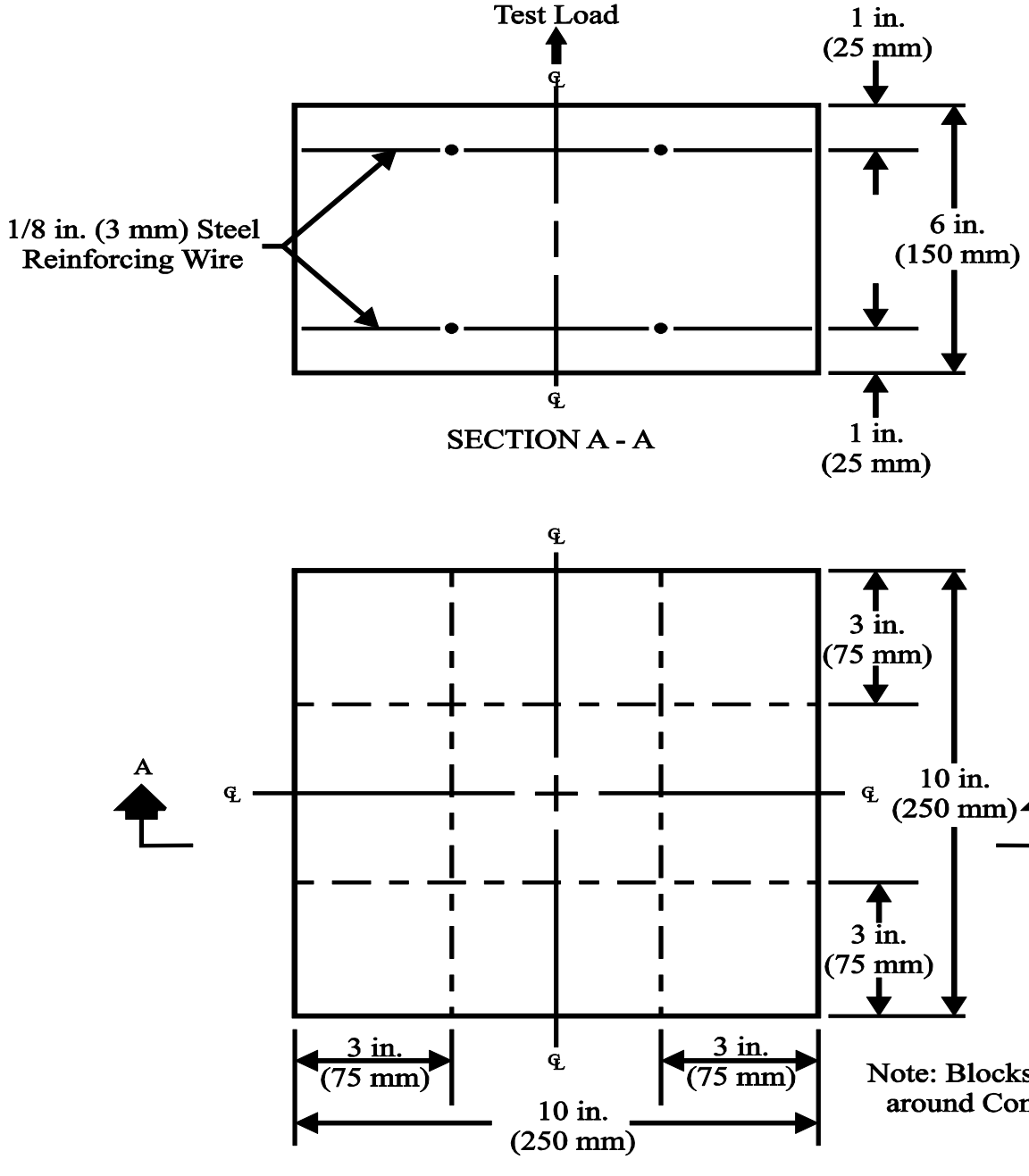
C Purlin Without Flange (Edge) Stiffeners



C Purlin With Flange (Edge) Stiffeners

APPENDIX E

CONCRETE BLOCK FOR TENSILE TESTS



APPENDIX F

SAMPLE LISTINGS

Automatic Sprinkler Systems Pipe Hangers

Pipe Hangers

Pipe hangers are used to support a sprinkler piping system from the building structure. Two or more listed components may be required to form a complete hanger. The specific components required depend upon the type of building construction and the pipe size.

Product Designation	*Hanger Rod Size, in. NC*	*Component Description*	*For Nominal Pipe Sizes, in.*
A	3⁄8	Adjustable Swivel Ring Hanger	3⁄4 through 4

Automatic Sprinkler Systems Fasteners Concrete Inserts

Concrete Inserts

Concrete inserts provide anchorage to concrete building structures for supporting pipe hangers. Concrete inserts must be installed when the building is constructed. Fasteners have not been evaluated by FM Approvals for support of pipe hangers to structural members in Earthquake Zones as defined by FM Global Property Loss Prevention Data Sheet 1-2. The restrictions discussed in Data Sheet 1-2 should be followed. Fasteners have been evaluated in normal weight concrete. The restrictions discussed in Data Sheet 2-0 should be followed.

Product Designation	*Nominal Rod Size, in.*	*Nominal Pipe Size, in.*	*Remarks*
Fig. 1 Concrete Insert	3⁄8	3⁄4 through 4	-

Automatic Sprinkler Systems Fasteners Expansion Shields

Expansion Shields

Expansion shields provide anchorage to a concrete building member for supporting pipe hangers. Fasteners have not been evaluated by FM Approvals for support of pipe hangers to structural members in Earthquake Zones as defined by FM Global Property Loss Prevention Data Sheet 1-2. The restrictions discussed in Data Sheet 1-2 should be followed. Fasteners have been evaluated in normal weight concrete. The restrictions discussed in Data Sheet 2-0 should be followed.

Product Designation	*Hanger Rod Size, in., NC*	*Max Nominal Pipe Size, in.*	*Remarks*
Model 1	5⁄8 x 2 1⁄4	12 Inch	Wedge Concrete Anchor

Screws

Threaded head screws provide anchorage to concrete, steel or wood building structural members for supporting pipe hangers. Fasteners have not been evaluated by FM Approvals for support of pipe hangers to structural members in Earthquake Zones as defined by FM Global Property Loss Prevention Data Sheet 1-2. The restrictions discussed in Data Sheet 1-2 should be followed. Fasteners have been evaluated in normal weight concrete. The restrictions discussed in Data Sheet 2-0 should be followed.

Product Designation	*Hanger Rod Size, in. (mm)*	*Component Description*	*For Nominal Pipe Sizes, in.*
37EG	3⁄8	Threaded Head Screw for use in concrete	3⁄4 through 4