MSS SP-58-2009

Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation

Standard Practice
Developed and Approved by the
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This MSS Standard Practice was developed under the consensus of the MSS Technical Committee 403 and the MSS Coordinating Committee. The content of this Standard Practice is the result of the efforts of competent and concerned volunteers to provide an effective, clear, and non-exclusive specification that will benefit the industry as a whole. This MSS Standard Practice is intended as a basis for common practice by the manufacturer, the user, and the general public. The existence of an MSS Standard Practice does not in itself preclude the manufacture, sale, or use of products not conforming to the Standard Practice. Mandatory conformance is established only by reference in a code, specification, sales contract, or public law, as applicable.

Unless otherwise specifically noted in this MSS SP, any standard referred to herein is identified by the date of issue that was applicable to the referenced standard(s) at the date of issue of this MSS SP. (See Annex C.)

U.S. customary units in this SP are the standard, the metric (SI) units are only for reference.

In this Standard Practice all notes, annexes, tables, and figures are construed to be essential to the understanding of the message of the standard, and are considered part of the text unless noted as "supplemental". All appendices appearing in this document are construed as "supplemental". Supplemental" information does not include mandatory requirements.

This document has been substantially revised from the previous 2002 edition, INCLUDING THE ADDITION OF INFORMATION FROM ANSI/MSS SP-69, MSS SP-77, MSS SP-89, AND MSS SP-90. It is suggested that if the user is interested in knowing what changes have been made, that direct page by page comparison should be made of this document.

Non-toleranced dimensions in this Standard Practice are nominal, and, unless otherwise specified, shall be considered “for reference only”.

Originally Approved September, 1959

FOREWORD

This Standard Practice was developed by a cooperative effort of representatives of the pipe hanger manufacturers. It is based on the best practice current at this time and on the collective experience of the industry. There is a companion Standard Practice, MSS SP-127, which relates to the design, selection, and application of bracing for piping systems subject to seismic – wind – dynamic loading.

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Manufacturers Standardization Society of the Valve and Fittings Industry

PIPE HANGERS AND SUPPORTS – MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION, AND INSTALLATION

1. SCOPE

1.1 This Standard Practice establishes the material, design, fabrication, and inspection criteria to be used in the manufacture of standard types of pipe hanger components.

1.2 This Standard Practice establishes the allowable stress values for materials used in standard types of pipe support components and unique hanger design assemblies.

1.3 This Standard Practice establishes minimum design load ratings for rigid pipe hanger assemblies (see Table 1).

1.4 This Standard Practice presents the recommended practice for the selection and application of pipe hangers and supports for all service temperatures.

1.5 This Standard Practice establishes recommended procedures for detailing, fabrication, and installation of pipe hangers and supports.

2. OBJECTIVE

2.1 To serve as a "guide" for pipe hanger and support design, manufacture, selection, and installation.

2.2 To enable the user to specify a minimum level of acceptance for pipe hanger design and performance.

2.3 To define types of hangers and supports that are illustrated in the Type Chart, Figure A1. Hangers and Supports shown on the Type Chart indicate general types only and manufacturers' other standard products shall be acceptable under this Standard Practice if they meet dimensional and load rating limitations set forth in this Standard Practice.

2.4 To serve as a pipe hanger and support specification for selection and application, by being referenced in whole or in part.

2.5 To serve as a guide to proven industry practice during engineering design and writing of job specifications covering the hanging, supporting and controlling the movement of piping systems.

2.6 To provide the erector with information on types of hanger and support components to be used for specific application and installations, where such information is not otherwise provided.

2.7 To serve as a companion document to MSS SP-127 which provides recommendations for the design, selection, and application of bracing for piping systems subject to seismic– wind – dynamic loading.

3. MATERIALS

3.1 Materials commonly used in manufacturing pipe hangers and supports are listed in Tables A2 and A2M.

3.2 Other materials may be used provided they comply with the allowable stress requirements of Sections 4.5 or 4.7.

3.3 Non-metallic materials can be used to transfer the compressive loading from the piping and equipment to the metallic components of a piping support. Material shall comply with requirements of Section 4.13.

3.4 The material in contact with the pipe shall be compatible with the piping material so that neither shall have a deteriorating action on the other.

3.5 Materials subject to corrosion or galvanic action shall be protected as specified by the engineering design and such protection shall be applied in accordance with the coating requirements of Section 10.

TABLE 1
Minimum Design Load Ratings for Pipe Hanger Assemblies

Applicable to all components of complete assembly; including pipe attachment, rod, fixtures, and building attachment.			
Nominal Pipe or Tube Size		Minimum Design Load Ratings at Normal Temperature Range[b]	
NPS - Inch	DN - mm	Pounds	kN
3/8	10	150	0.67
1/2	15	150	0.67
3/4	20	150	0.67
1	25	150	0.67
1 1/4	32	150	0.67
1 1/2	40	150	0.67
2	50	150	0.67
2 1/2	65	150	0.67
3	80	200	0.89
3 1/2	90	210	0.93
4	100	250	1.11
5	125	360	1.60
6	150	480	2.14
8	200	760	3.38
10	250	1120	4.98
12	300	1480	6.58
14	350	1710	7.61
16	400	2130	9.47
18	450	2580	11.48
20	500	3060	13.61
24	600	3060	13.61
30	750	3500	15.57

Notes:

a. See Section 4 for allowable stresses and temperatures.

b. Normal temperature range is -20ºF to 650ºF (-29ºC to 343ºC) for carbon steel, -20ºF to 450ºF (-29ºC to 231ºC) for malleable iron and -20ºF to 400ºF (-29ºC to 204ºC) for gray iron.

c. See Section 7.2.1 for minimum rod diameter restrictions.

d. For loads greater than those tabulated, hanger component load ratings shall be established by the manufacturer. Design shall be in accordance with all criteria as outlined in this document.

e. Pipe attachment ratings for temperature ranges between 650ºF to 750ºF (343ºC to 398ºC) shall be reduced by the ratio of allowable stress at service temperature to the allowable stress at 650ºF (343ºC).

f. For services over 750ºF (398ºC), attachments in direct contact with the pipe shall be designed to allowable stresses listed in Tables A2 and A2M.

4. ALLOWABLE STRESSES, LOAD RATINGS, AND TEMPERATURES

4.1 The maximum allowable tensile stress for materials commonly used in the design of pipe hangers and supports are listed in Tables A2 and A2M. Allowable values for the types of stress stated in Sections 4.1.1 through 4.1.5 shall be computed by multiplying the maximum allowable tensile stress by the applicable factor. Materials should not be used above the highest temperature for which a stress value appears.

		Factor
4.1.1	***Tension:***	
a)	On the gross area	1.0
b)	On the net section at pin holes	0.9
4.1.2	***Bending***	1.0
4.1.3	***Shear***	0.8
4.1.4	***Bearing***	1.5
4.1.5	***Compression***	1.0 (max)

Allowable compressive stress must be reduced on the basis of structural stability and buckling (column action).

4.1.6 ***Combined Stress Check***

$$\frac{\text{Stress in Tension or Compression}}{\text{Allowable Tension or Compression}} + \frac{\text{Stress in Bending}}{\text{Allowable Bending}} \leq 1.0$$

4.2 Maximum allowable shear stress in welds shall be limited to 80% of the maximum allowable stress of the weaker of the base metals being joined. Maximum allowable tension and bending stresses in welds shall be limited to the maximum allowable stress of the weaker of the base metals being joined.

4.3 Higher allowable stresses under well defined short-term loading conditions shall be as designated by the applicable codes.

4.4 Steel metal framing channel conforming to *Metal Framing Standards Publication* (MFMA-4) by Metal Framing Manufacturers Association shall have a maximum design stress of 25ksi (172 MPa) and a temperature range of -20°F to 650°F (-29°C to 232°C).

4.5 Allowable stresses for materials not listed in Tables A2 and A2M, produced in accordance with a recognized specification and with known physical properties shall be determined as the lower of the following values:

a) 29% of minimum tensile strength at service temperature.

b) 67% of minimum yield strength at service temperature.

c) Such materials shall not be used where temperatures exceed 650°F (345°C) and shall not be welded to the piping or piping component.

d) Refer to Section 6 for application specific considerations.

4.6 Allowable stresses for cast materials calculated in accordance with Section 4.5 shall be reduced by a casting quality factor of 20%. Allowable stress for gray iron castings shall be limited to 10% of minimum specified tensile strength.

4.7 For steel materials of unknown specification, a stress value of 30% of yield strength (0.2% offset) at room temperature may be used. The yield strength shall be established by tensile testing a sample of material in accordance with ASTM A 370. The value corresponding to a 0.2% permanent strain (offset) is the material yield strength. The stress value so established shall not exceed 9500 psi (65.5 MPa).

4.8 Load ratings for the threaded hanger rods made from carbon steel are shown in Tables 2 and 2M. Load ratings for hanger rods made from all other materials shall be based on the thread root area with a 25% reduction of the allowable stress. (The 25% reduction is to allow for normal installation and service conditions.)

4.9 Forged eye rods, and formed and welded eye rods shall have load capacities at least equal to those determined in accordance with Section 4.8 for the same nominal diameter. Formed but not welded eye rods shall have load capacities not greater than 40% of those determined in accordance with Section 4.8 for the same nominal diameter.

4.10 Capacities for U-bolts, loaded in tension, shall be limited to twice the capacity of hanger rods of the same material and diameter.

4.11 All threaded items, both external and internal, not covered by Sections 4.8, 4.9 or 4.10 need not be subjected to the 25% stress reduction.

4.12 Design temperature of hanger components in direct contact with the pipe shall be the temperature of the contained fluid. For conventional high temperature piping installations, a reduction in temperature of 100°F/in (2.2°C/mm) as measured from the outer pipe surfaces may be applied for strength calculations and material requirements. Alloy bolting within insulation may be furnished with ASTM A 194 Grade 2H nuts for line temperatures not exceeding 1050°F (566°C).

4.13 The compressive loading of non-metallic material shall be limited to the compression capacity of the material as rated in accordance with the governing ASTM specification for the specific material utilized with an appropriate safety factor for the specific material used.

TABLE 2
Load Ratings of Carbon Steel Threaded Hanger Rods
(For metric rod sizes see Table 2M.)

Nominal Rod Diameter	Root Area of Thread	Maximum Safe Load at Rod Temperature of 650°F (343°C)	
Inch	in^2	Pounds	kN
3/8	.0678	730	3.23
1/2	.126	1350	5.98
5/8	.202	2160	9.61
3/4	.302	3230	14.4
7/8	.419	4480	19.9
1	.551	5900	26.2
1 1/4	.890	9500	42.4
1 1/2	1.29	13800	61.6
1 3/4	1.74	18600	82.8
2	2.30	24600	109
2 1/4	3.02	32300	144
2 1/2	3.72	39800	177
2 3/4	4.62	49400	220
3	5.62	60100	267
3 1/4	6.72	71900	320
3 1/2	7.92	84700	377
3 3/4	9.21	98500	438
4	10.6	114000	505
4 1/4	12.1	129000	576
4 1/2	13.7	146000	652
4 3/4	15.4	165000	733
5	17.2	184000	819

Notes:

a. For materials other than carbon steel, see requirements of Section 4.8 and Table A2.

b. Tabulated loads are based on a minimum actual tensile stress of 50ksi (345MPa) divided by a safety factor of 3.5, reduced by 25% resulting in an allowable stress of 10.7ksi. (The 25% reduction is to allow for normal installation and service conditions.)

c. Root area threads are based upon the following thread series:

diameter 4” and below—coarse thread (UNC)

diameter above 4”—4 thread (4-UN)

TABLE 2M
Load Ratings of Carbon Steel Threaded Hanger Rods
(For inch rod sizes see Table 2.)

Nominal Rod Diameter	Root Area of Thread	Maximum Safe Load at Rod Temperature of 650ºF (343ºC)	
mm	mm^2 *	kN	Pounds
M10	49.49	3.66	820
M12	72.40	5.35	1200
M16	138.3	10.2	2300
M20	217.1	16.0	3610
M24	312.8	23.1	5200
M30	503.0	37.2	8300
M36	738.0	54.5	12300
M42	1018	75.2	16900
M48	1343	99.2	22300
M56x4	2014	149	33500
M64x4	2701	200	44900
M68x4	3082	228	51200
M72x4	3488	258	58000
M80x4	4376	323	72700

Notes:

a. For materials other than carbon steel, see requirements of Section 4.8 and Table A2M.

b. Tabulated loads are based on a minimum actual tensile stress of 345MPa divided by a safety factor of 3.5, reduced by 25% resulting in an allowable stress of 73.9MPa. (The 25% reduction is to allow for normal installation and service conditions.)

* M10-M48 are based on minimum root diameters for standard coarse thread class 6g. Taken from ASME B1.13M for metric thread forms.

5. PIPING SYSTEMS

5.1 *Temperature*

5.1.1 This section establishes an identification of piping systems according to the operating (service) temperatures of the piping contents for the purpose of pipe hanger and support selection.

a) Hot Systems

A-1. 120º F (49ºC) to 450ºF (232ºC)

A-2. 451ºF (233ºC) to 750ºF (399ºC)

A-3. Over 750ºF (399ºC)

b) Ambient Systems

B. 60ºF (16ºC) to 119ºF (48ºC)

c) Cold Systems

C-1. 33ºF (1ºC) to 59ºF (15ºC)

C-2. -19°F (-28ºC) to 32ºF (0ºC)

C-3. -39ºF (-39ºC) to -20ºF (-29ºC)

C-4. -40ºF (-40ºC) and below (Cryogenic Range)

5.1.2 Typical product types for use at these temperature ranges can be found in Table A1.

5.2 *Hanger and Support Spacing*

5.2.1 The recommended maximum spacing of hangers shall be as shown in Table 4.

5.2.2 Spacings less than shown in Table 4 may be required to conform with building structure loading limitations and standard product load ratings.

5.2.3 The recommended minimum rod diameters for rigid rod hangers are listed in Table 3.

5.2.4 When periodic dismantling of a piping system for cleaning, etc. is anticipated, the Piping Design Engineer shall specify any required additional supports.

5.2.5 Other conditions specific to a particular piping material can be found in Section 5.3. Additional conditions pertaining to insulated lines can be found in Section 5.5.

5.3 *Piping Materials*

5.3.1 This section offers special notes and considerations for various piping materials.

5.3.2 *Steel (Carbon, Stainless, and Alloy)*

a) The size of the hanger components shall be suitable for the O.D. of the pipe to be supported.

b) Hanger material and finish shall be compatible with the expected operating temperature and base piping material to be supported.

5.3.3 *Copper Tubing*

a) The size of the hanger components shall be suitable for the O.D. of the tubing to be supported.

b) Hanger material and finish shall be compatible with copper tubing. See Section 10.6 for further information.

5.3.4 *Ductile Iron and Cast Iron Soil Piping*

a) The size of the hanger components shall be suitable for the O.D. of the pipe to be supported.

b) For buried lines, supporting means that may be required due to soil conditions or settlement of terminal points shall be specified by the Piping Design Engineer.

TABLE 3
Recommended Min. Rod Diameter for Single Rigid Rod Hangers[(a)(b)]

		COLUMNS [(c)]		COLUMNS [(c)]	
		1,2,6,7		3,4,8,9,10	
Nominal Pipe or Tubing Size		Nominal Rod Dia.		Nominal Rod Dia.	
NPS-in	DN-mm	in	mm	in	mm
1/4	6			3/8	M10
3/8	10	3/8	M10	3/8	M10
1/2	15	3/8	M10	3/8	M10
3/4	20	3/8	M10	3/8	M10
1	25	3/8	M10	3/8	M10
1 1/4	32	3/8	M10	3/8	M10
1 1/2	40	3/8	M10	3/8	M10
2	50	3/8	M10	3/8	M10
2 1/2	65	1/2	M12	1/2	M12
3	80	1/2	M12	1/2	M12
3 1/2	90	1/2	M12	1/2	M12
4	100	5/8	M16	1/2	M12
5	125	5/8	M16	1/2	M12
6	150	3/4	M20	5/8	M16
8	200	3/4	M20	3/4	M20
10	250	7/8	M20	3/4	M20
12	300	7/8	M20	3/4	M20
14	350	1	M24		
16	400	1	M24		
18	450	1	M24		
20	500	1 1/4	M30		
24	600	1 1/4	M30		
30	750	1 1/4	M30		

Notes:

(a) For calculated loads, rod diameters may be sized in accordance with Tables 2 and 2M provided Table 1 and Section 7.2.1 are satisfied.

(b) Rods may be reduced one size for double rod hangers. Minimum rod diameter shall be 3/8 in (M10).

(c) Columns noted refer to Table 4.

5.3.5 ***Glass Piping***

a) Hangers shall be provided with pads or cushions on the bearing surfaces to prevent scratching the pipe. The hangers shall fit loosely around the pipe yet contact it through the pads or cushions in a manner to distribute the load over the largest possible area. Point loading shall be avoided. The system of hangers shall be designed with the least practical number of rigid anchor points. Supports for vertical piping and all anchors shall be as recommended by the pipe manufacturer.

b) Hangers shall be placed approximately one foot (305 mm) from each side of fittings or couplings. At least two hangers shall be used for each 10-foot (3.0 m) section.

5.3.6 ***Plastic Piping***

a) Rigid plastic piping shall normally be supported by the same type of hangers used with steel pipe.

b) In pressure applications, hangers shall be provided with pads or cushions on the bearing surfaces to prevent scratching the pipe. The hangers shall fit loosely around the pipe yet contact it through the pads or cushions in a manner to distribute the load over the largest possible area. Point loading shall be avoided. The system of hangers shall be designed with the least practical number of rigid anchor points. Supports for vertical piping and all anchors shall be as recommended by the pipe manufacturer.

c) Support spacing shall be based on the pipe manufacturer's recommendations for the service conditions.

d) Flexible plastic tubing or rigid plastic pipe operating at temperatures high enough to materially reduce its strength, shall be supported continuously.

5.3.7 ***Fiberglass Reinforced Pipe (FRP)***

a) The size of hanger shall be suitable for the O.D. of the pipe to be supported.

b) Support spacing shall be based on the pipe manufacturer's recommendations for the service condition.

c) FRP should not be point loaded and all shields and hangers in contact with the pipe shall be free of burrs.

5.4 ***Fire Protection Systems***

a) Hangers and supports for fire protection systems shall conform to the following standards published by the National Fire Protection Association in the National Fire Codes for fixed extinguishing equipment:

NFPA 11 *Foam Extinguishing Systems*

NFPA 12 *Carbon Dioxide Systems*

NFPA 13 *Installation of Sprinkler Systems*

NFPA 14 *Standpipe and Hose Systems*

NFPA 15 *Water Spray Systems*

NFPA 16 *Foam Water Systems*

NFPA 17 *Dry Chemical Extinguishing Systems*

b) Hangers, in general, are covered in NFPA 13. If the system is other than a standard water sprinkler system, the applicable NFPA Standard shall also be consulted.

5.5 ***Insulated Lines***

5.5.1 For piping systems using Type 40 protection shield for insulated piping, see Table A3 for spacing. Insulation protection shields shall be provided to protect the vapor barrier of insulation on cold lines. Under no circumstances shall hangers, supports or guides be applied directly to horizontal pipe or tubing on vapor barriered lines. (See Table A3.)

5.5.2 The connections to pipe attachments shall be outside the insulation so that movement of the line shall not cause damage to the insulation.

5.5.3 For cryogenic piping systems, shields incorporating rigid, high density polyurethane foam inserts or other load bearing insulation should be used. The support should include means for maintaining vapor barrier integrity. Because of the temperature/compressive strength relationship of polyurethane foam, the recommended shield designs described in Table A3 do not apply. Shields must be designed to accommodate loading conditions at both the installation and operating temperature.

5.5.4 For hot piping systems, pipe covering protection saddles (Type 39) may be utilized. Hanger spacing would be the same as for non-insulated line spacing.

5.5.5 See Section 7.6 for further information on insulated lines.

TABLE 4 Maximum Horizontal Pipe Hanger and Support Spacing

	1	2	3	4	5	6	7	8	9	10
NOMINAL PIPE OR TUBE SIZE	STD WT STEEL PIPE		COPPER TUBE		FIRE PRO-TECTION	DUCTILE IRON PIPE	CAST IRON SOIL	GLASS	PLASTIC	FIBERGLASS REIN-FORCED
	WATER SERVICE	VAPOR SERVICE	WATER SERVICE	VAPOR SERVICE						
NPS-in / DN-mm	ft / m	ft / m	ft / m	ft / m						
1/4 / 8			5 / 1.5	5 / 1.5						
3/8 / 10	7 / 2.1	8 / 2.4	5 / 1.5	6 / 1.8						
1/2 / 15	7 / 2.1	8 / 2.4	5 / 1.5	6 / 1.8						
3/4 / 20	7 / 2.1	9 / 2.7	5 / 1.5	7 / 2.1						
1 / 25	7 / 2.1	9 / 2.7	6 / 1.8	8 / 2.4						
1 1/4 / 32	7 / 2.1	9 / 2.7	7 / 2.1	9 / 2.7						
1 1/2 / 40	9 / 2.7	12 / 3.7	8 / 2.4	10 / 3.0						
2 / 50	10 / 3.0	13 / 4.0	8 / 2.4	11 / 3.4						
2 1/2 / 65	11 / 3.4	14 / 4.3	9 / 2.7	13 / 4.0						
3 / 80	12 / 3.7	15 / 4.6	10 / 3.0	14 / 4.3						
3 1/2 / 90	13 / 4.0	16 / 4.9	11 / 3.4	15 / 4.6						
4 / 100	14 / 4.3	17 / 5.2	12 / 3.7	16 / 4.9						
5 / 125	16 / 4.9	19 / 5.8	13 / 4.0	18 / 5.5						
6 / 150	17 / 5.2	21 / 6.4	14 / 4.3	20 / 6.1						
8 / 200	19 / 5.8	24 / 7.3	16 / 4.9	23 / 7.0						
10 / 250	22 / 6.7	26 / 7.9	18 / 5.5	25 / 7.6						
12 / 300	23 / 7.0	30 / 9.1	19 / 5.8	28 / 8.5						
14 / 350	25 / 7.6	32 / 9.8								
16 / 400	27 / 8.2	35 / 10.7								
18 / 450	28 / 8.5	37 / 11.3								
20 / 500	30 / 9.1	39 / 11.9								
24 / 600	32 / 9.8	42 / 12.8								
30 / 750	33 / 10.1	44 / 13.4								
					FOLLOW REQUIREMENTS OF THE NATIONAL FIRE PROTECTION ASSOCIATION. SEE SECTION 5.4.	20 ft (6.1 m) MAX SPACING; MIN OF ONE (1) HANGER PER PIPE SECTION CLOSE TO THE JOINT BEHIND THE BELL AND AT CHANGE OF DIRECTION AND BRANCH CONNECTIONS. FOR PIPE SIZES SIX (6) INCHES (150 mm) AND UNDER, INSTALLED ON ASME B31 PROJECTS, THAT ARE SUBJECTED TO LOADINGS OTHER THAN WEIGHT OF PIPE AND CONTENTS, THE SPAN SHOULD BE LIMITED TO THE MAXIMUM SPACING FOR WATER SERVICE STEEL PIPE. SEE SECTION 5.3.4.	10 ft (3.0 m) MAX SPACING; MIN OF ONE (1) HANGER PER PIPE SECTION CLOSE TO JOINT ON THE BARREL. ALSO AT CHANGE OF DIRECTION AND BRANCH CONNECTIONS. SEE SECTION 5.3.4.	8 ft (2.4 m) MAX SPACING, FOLLOW PIPE MANUFACTURER'S RECOMMENDATIONS SEE SECTION 5.3.5.	FOLLOW PIPE MANUFACTURER'S RECOMMENDATIONS FOR MATERIAL AND SERVICE CONDITION. SEE SECTION 5.3.6.	FOLLOW PIPE MANUFACTURER'S RECOMMENDATIONS FOR MATERIAL AND SERVICE CONDITION. SEE SECTION 5.3.7.

NOTE: (a) FOR SPACING SUPPORTS INCORPORATING TYPE 40 SHIELDS, SEE TABLE A3.

(b) THIS TABLE DOES NOT APPLY WHERE SPAN CALCULATIONS ARE MADE OR WHERE THERE ARE CONCENTRATED LOADS BETWEEN SUPPORTS SUCH AS FLANGES, VALVES, SPECIALTIES, ETC., OR CHANGES IN DIRECTION REQUIRING ADDITIONAL SUPPORTS.

(c) UNBALANCED FORCES OF HYDROSTATIC OR HYDRODYNAMIC ORIGIN (THRUST FORCES) UNLESS RESTRAINED EXTERNALLY CAN RESULT IN PIPE MOVEMENT AND SEPARATION OF JOINTS IF THE JOINTS OF THE SYSTEM ARE NOT OF A RESTRAINED JOINT DESIGN. SEE SECTION 7.5.3.

6. GENERAL REQUIREMENTS

6.1 Where applicable, selection and application of pipe hangers and supports may be required to conform to codes and standards, such as:

a) ASME B31 Codes for Pressure Piping

b) ASME Boiler and Pressure Vessel Codes

c) UL 203 *Standard for Pipe Hanger Equipment for Fire Protection Service*

d) Factory Mutual FM 1951/1952/1953 *Approval Standard for Pipe Hanger Components for Automatic Sprinkler Systems*

e) NFPA 13 *Installation of Sprinkler Systems*

f) National and local building codes

g) All other applicable codes

6.2 The selection of pipe hangers and supports shall be based upon the overall design concept of the piping systems and any special requirements which may be called for in the specifications. The supporting systems shall provide for, and control, the free or intended movement of the piping including its movement in relation to that of connected equipment, and provide the piping system with the degree of control that its operating characteristics require.

6.3 A careful study shall be made of the piping lay-out in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

6.4 Hangers, supports, anchors and restraints shall be selected to withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected.

6.5 When pipe hanger load and movement calculations are required by the design specification, the following must be considered:

a) Deadweight loads
b) Hydrostatic loads
c) Thermal loads
d) Loading due to expansion joint reaction forces

6.6 When occasional pipe hanger load calculations are required, they must be clearly defined in the design specification. Types of occasional loads are:

a) Safety valve thrust loads

b) Seismic loads

c) Wind, snow or ice loads

d) Turbine trip out loads

e) Water hammer loads

6.7 Allowable stress levels listed in Section 4 shall be used in the design of hanger assemblies with the following exceptions:

a) The load capacities for threaded hanger rods shall conform to Table 2 and Table 2M.

b) A 20% increase in allowable stress may be permitted for short time overloading conditions during operation.

c) For steels of known physical properties, an increase to 80% of minimum yield strength, at room temperature, during hydrostatic testing, is permissible.

For steels of unknown physical properties, an increase to 80% of yield strength is permissible, as established by tensile testing a sample of material in accordance with ASTM A 370. The stress so established shall not exceed 19,000 psi (131 Mpa).

d) Loading combination considerations and allowable stress levels to be applied shall be established by the Piping Design Engineer.

6.8 Hanger and support components shall be selected from Table A1 within the system classification.

6.9 Where additional structural framing members are required, they shall be designed for the specific loads they are to support in accordance with the AISC *Steel Construction Manual*, 13th Edition, Allowable Stress Design Section. No increase in allowable stress is permitted for hydrostatic test periods.

6.10 Hanger assemblies for the suspension of NPS 2 ½ (DN65) and larger pipe and tubing shall be capable of vertical adjustment under load.

6.11 Building structure shall be adequate for supporting pipe hanger loads as generated in Sections 6.5 and 6.6, including hydrostatic test loads. In general, the Civil Design Engineer has this responsibility.

6.12 Installed hangers or hanger components shall be used only for their intended purpose. They shall not be used for rigging and erection purposes.

6.13 Pipes shall not be suspended directly from each other unless formal calculations are performed and accepted by the responsible Piping Design Engineer. If no calculations have been made, the individual hanger for each horizontal pipe in a vertical bank shall have the load transmitted directly to the rods, not the pipe above. Care shall be taken to size the rod appropriately for the total load at the support point.

6.14 Where negligible movement of pipe occurs at hanger locations, and no harmful loading on connecting equipment, piping, or structure would result, rod hangers may be used for suspended lines. For piping supported from below, bases, brackets or structural cross members may be used.

6.15 ***Significant Horizontal Movement***

6.15.1 Where there is significant horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. Where horizontal piping displacement exceeds 1 inch (25mm), it is common practice to offset the pipe attachment or structural attachment by the amount of anticipated displacement or a percentage thereof. If horizontal pipe movement results in a vertical angle of the hanger rod greater than 4 degrees a traveling device should be provided for horizontal movement. In special cases, vertical angles greater than 4 degrees may be used provided the resulting horizontal force and vertical deflection are considered in the piping and support design.

6.15.2 For piping supported from below, the use of slides, rollers, or roller carriages should be considered.

6.16 ***Significant Vertical Movement***

6.16.1 Where significant vertical movement of the pipe occurs at the hanger location, a resilient support must be used. Selection of resilient supports shall be based on permissible load variation and effects on adjacent equipment. Support selection for typical load variations are shown in Table 5. Load and movement calculations shall be made for the proper selection of spring hangers. Vertical movement and load transfer from riser expansion to horizontal runs shall be given consideration when applying spring hangers.

TABLE 5
Spring Support Selection

VERTICAL EXPANSION	ALLOWABLE VARIABILITY OR DEVIATION	SINGLE ROD HANGER	DOUBLE ROD HANGER	BASE SUPPORT
	NOTE (a)	**NOTE (b) AND (c)**		
MAX. 1/4 in (6mm)	25%	48, 51SS	48, 49, 51SS, 53SS	52SS
	6%	51SS	51S, 53S	52S
MAX. 1 in (25mm)	25%	51S	51S, 53S	52S
	6%	54, 55	54, 55, 56	54, 55
MAX. 3 in (76mm)	25%	51LS	51LS, 53LS	52LS
	6%	54, 55	54, 55, 56	54,55
OVER 3 in (76mm)	25%	51LS	51LS, 53LS	52LS
	6%	54, 55	54, 55, 56	54, 55

Note (a)

Variable Spring Hangers

$$\text{Variability Factor} = \frac{\text{Pipe Travel in (mm) x Spring rate lbs/in (N/mm)}}{\text{Operating Load lbs (N)}}$$

Constant Support Hangers

$$\text{Deviation from Specified Load} = \frac{\text{Max. Reading Moving Down} - \text{Min. Reading Moving Up}}{\text{Max. Reading Moving Down} + \text{Min. Reading Moving Up}}$$

Maximum Reading Moving Down and Minimum Reading Moving Up shall be within 6 % of specified load.

Note (b)	Numbers in column are Type Numbers from Figure A1**.**
Note (c)	Variable Spring Types 51, 52, and 53, i.e., standard spring, short spring, and long spring models are identified as S, SS, and LS, respectively.

6.16.2 Spring Cushion Hangers may be used where vertical movement does not exceed 1/4 inch (6 mm), and where formal load and movement calculations are not required.

6.16.3 Variable Spring Hangers shall be used for all other resilient support requirements except as noted in Section 6.16.4.

6.16.4 Constant Support Hangers shall be used on piping systems where the deviation in supporting force must be limited to 6 percent and which cannot be accommodated by a Variable Spring Hanger.

7. PRODUCT DESIGN

7.1 *General Hangers*

7.1.1 Unprotected flat steel shall have a minimum thickness of 0.120 inch (3.2mm) and a minimum width of 1 inch (25.4mm). The minimum cross section for unprotected hangers (Types 1,5,7,9 and 10) shall be 0.105 inch (2.7mm) x 0.88 inch (22.4mm). As an exception, for pipe NPS 1 (DN25) and smaller the minimum cross section shall be 0.060 inch (1.6mm) x 0.75 inch (19.1mm). Equivalent cross section may be substituted provided the minimum thickness is not decreased.

7.1.2 Hangers that meet the tabulated load requirements of Table 1 and that have protective coatings in accordance with Section 10 need not conform to the minimum dimensional requirements of Section 7.1.1.

7.1.3 Hangers and supports shall be sized to fit the outside diameter of the pipe, tubing, or, if specified, the outside diameter of insulation. Manufacturer's catalog hangers provide a nominal clearance over standard tolerance piping and tubing. Consideration for fit should be given by the user for large diameter and/or out of tolerance piping and tubing.

7.2 *Hanger Rods and Eye Rods*

7.2.1 Hanger rods shall be a minimum of 3/8 inch (M10) nominal diameter. The use of 3/8 inch rod is limited to pipe or tubing NPS 4 (DN100) and less. For pipe and tubing greater than NPS 4 (DN100), the nominal rod diameter shall not be less than 1/2 inch (M12) and sized for the design load per Tables 2 and 2M. In addition, the minimum rod diameter for rigid hangers must be sized for the loads shown in Table 1, subject to the above restrictions.

7.2.1.1 Hanger rods utilizing rolled threads must be threaded full length.

7.2.2 Eye rods shall have a minimum inside diameter of eye 0.12 inch (3.2mm) larger than the rod size.

7.2.2.1 Forged eye rods shall have a metal area across the eye equal to or greater than 1.25 times the area of the rod.

7.2.2.2 Formed and welded eye rods shall have circumferential length of weld not less than twice the rod diameter.

7.3 *Multiple Supports*

7.3.1 Horizontal banks of piping may be supported on a common base member without regard to the pipe centerline elevation. The particular method of support to be used shall be as required by the engineering design.

7.3.2 In the supporting of multiple pipe runs, provisions shall be made to keep the lines in their relative lateral positions, using clamps or clips as required. Lines subject to thermal expansion shall be free to roll axially or slide.

7.4 *Riser Supports*

7.4.1 The selection and location of riser supports shall take into consideration the entire weight of the riser, and adjacent piping, hydrostatic test load conditions, line temperature, other live load conditions, and available supporting structure. On a riser subject to expansion, only one support of the rigid type shall be used.

7.4.2 Riser clamps (Type 42) shall have a positive means of engagement (i.e. shear lugs) between the pipe and the clamp.

7.4.3 Rigid riser clamps (Type 42), when used for deadweight purposes, shall be specified for two times the calculated load.

7.5 *Anchors, Guides, And Restraints*

7.5.1 Anchors, guides and restraints shall be located by the Piping Design Engineer. Should the need or the desirability of relocating, eliminating or adding anchors, guides or restraints arise, such changes shall be brought to the attention of the Piping Design Engineer for consideration and approval.

7.5.2 Anchors, guides and restraints shall be designed for imposed loadings as determined by the Piping Design Engineer. For guided systems, in the absence of specified lateral loads, the guide shall be designed for 20% of the dead weight load based on the spans listed in Table 4, with a design load of 50 lbs. (0.22 kN) as a minimum.

7.5.3 For pressure piping with joints not having a restraining design, other positive restraining means such as clamps, rods and/or thrust blocking shall be used to maintain the integrity of the joints.

7.5.4 The necessity for, and the location of, shock suppressors and other seismic control devices shall be as determined by the Piping Design Engineer.

7.5.5 The location, type and number of corrective devices which may be necessary to control any unforeseen vibrations, as determined after the piping is in service, are not a part of this standard.

7.5.6 Refer to MSS SP-127 for the design, selection, and application of bracing piping systems subject to seismic – wind – dynamic loading.

7.6 ***Protection Saddles And Shields***

7.6.1 Pipe covering protection saddles (Type 39) shall be made of material as follows: For pipe NPS 5 (DN125) and smaller, the minimum metal thickness shall be 0.12 inch (3.2mm); for pipe NPS 6 (DN150) and larger, the minimum metal thickness shall be 0.19 inch (4.8mm). Saddles shall have sufficient depth for the insulation thickness required and the ribs shall be notched so that the rib contact with pipe is between 25% and 50% of each rib length. All standard saddles shall be 12 inch (305mm) in axial length and shall span an arc of approximately 60°. Saddles for pipe NPS 12 (DN300) and larger shall have a center rib. Standard saddles shall accommodate nominal insulation thicknesses 1”, 1-1/2”, 2”, 2-1/2”, 3”, 4”, and 5-1/2” (25mm, 38mm, 51mm, 64mm, 76mm, 102mm and 140mm).

7.6.2 Pipe covering protection shields (Type 40) are used to prevent crushing of insulation at the hanger point. They can be used with or without high-strength compressive inserts.

7.6.3 When used without high-strength compressive inserts, pipe covering protection shields shall be in accordance with Table A3 and shall span an arc of 180°.

7.6.4 When pipe covering protection shields are used with high-strength compressive inserts, the shield length and thickness shall be appropriate for the compressive strength of the insert material. The insert shall be at least as long as the shield and where a vapor barrier is required, the vapor barrier shall extend 2 inches (51mm) beyond the shield and overlap the outside circumference by 2 inches (51mm).

7.6.5 It is recommended that provision be made to hold shields and saddles in place.

7.6.6 Protection shield gauges listed in Table A3 are for use with band type hangers only. For point loading, increase shield thickness and length. When shields are used with rollers, shield thickness may be adjusted accordingly and shield lengths shall be increased to keep rolling point of contact within the middle one-third of the shield length.

7.7 ***Spring Supports and Sway Braces***

7.7.1 ***Spring Supports*** Spring supports are divided into three classes; Spring Cushion, Variable Support, and Constant Support.

7.7.1.1 ***Spring Cushion Supports (Types 48 and 49)*** This class is limited to those using springs having a 2 inch (51mm) or less total deflection and which are not provided with load or travel indicators. Springs shall be confined so that accidental release of load is impossible. Travel limit stops need not be provided.

7.7.1.2 ***Variable Supports (Types 51, 52, and 53)*** This class applies to all variable-effort spring supports. Supports in this class shall have travel scales with provisions for marking "hot" and "cold" settings. Unit load rating shall be in the form of load scales or indicated operating load and spring rate. Limit stops shall be provided to prevent excessive travel from overstressing the spring or release of load. A properly designed confined compression spring will serve as such a stop. When stops for hydrostatic test purposes are provided, the unit shall be capable of supporting up to 2 times the normal operating load. Spring supports for this class shall have characteristics so that use at the maximum recommended pipe travel results in a variability factor of not more than 25%. (See Equation 1.)

Equation 1:

$$\text{Variability Factor} = \frac{\text{Pipe Travel in (mm) x Spring rate lbs/in (N/mm)}}{\text{Operating Load lbs (N)}}$$

7.7.1.3 ***Constant Supports (Types 54, 55, and 56)*** This class applies to all constant-effort spring supports where the variable spring force is compensated either mechanically or by auxiliary springs to result in a mean variability (deviation from specified load)[(a)], including friction, of not more than 6% throughout total travel range. These supports shall be provided with a travel scale, a load adjustment scale, provisions for field load adjustment of at least ± 10%, provisions for "hot" and "cold" settings, limit stops to prevent over travel or release of load. When auxiliary stops are required for installation and hydrostatic test purposes, the unit shall be capable of supporting up to 2 times the normal operating load. All constant supports shall be calibrated by the manufacturer. Special consideration shall be given to the possible effects of calibrating the unit in other than the intended installed position. The user is advised to specify a unit with sufficient total travel to provide adequate travel reserve.

7.7.2 ***Spring Sway Brace (Type 50)*** This class includes spring devices designed to control undesirable pipe movement and also provide forces to restore pipe to normal operating position. They shall consist of one or more springs, suitably confined, and may be either single or double acting.

7.7.3 Structural components of all classes of spring supports and sway braces shall be designed as specified elsewhere in this standard practice except that the spring shall be designed as stated in Section 8.

7.7.4 ***Demolishing practice*** Hanger devices utilizing spring components are normally loaded to some extent even when removed from service. Proper procedures must be employed to remove spring stored energy prior to removal and scrapping of the unit.

7.8 ***Restraint Control Devices***

7.8.1 Hydraulic devices for the control of vibration or dynamic loads shall be designed in accordance with proven commercial practice and the requirements of Section 4. It is recommended that a non-flammable fluid be used. These devices shall accommodate thermal movement.

7.8.2 Mechanical devices for the control of vibration and dynamic forces shall be designed in accordance with the requirements of Section 4. Materials shall be suitable for the intended service and ambient conditions. These devices shall accommodate thermal movement.

7.8.3 Rigid struts or sway braces used for the control of vibration and dynamic forces shall be designed in accordance with the requirements of Section 4 and MSS SP-127. Materials shall be suitable for the intended service and ambient conditions. Rigid struts cannot accommodate thermal movement in the primary direction (tension or compression).

[(a)] Deviation from specified load is the sum of kinetic friction and manufacturing tolerance factor. Determination of deviation is by load test machine and is calculated in Equation 2.

Equation 2:

$$\text{Deviation from Specified Load} = \frac{\text{Max. reading moving down} - \text{Min. reading moving up}}{\text{Max. reading moving down} + \text{Min. reading moving up}}$$

Maximum reading moving down and minimum reading moving up shall be within 6% of specified load.

7.9 ***Threads***

7.9.1 Threads on all hardware and spring product connections shall comply with 7.9.2.

7.9.2 Inch screw threads shall be in conformance with ASME B1.1. Metric screw threads shall be in conformance with ASME B1.13M 6H/6g.

7.9.3 Threads on products such as hydraulic and mechanical snubbers shall be in accordance with the manufacturer's specification for type, material, heat treatment and finish. Mated threaded connection components or adaptors shall be furnished with the product.

7.9.4 Pipe that is threaded for adjustment means shall be in accordance with ASME B1.20.1 NPSM and NPSL for Standard Straight Pipe Threads.

7.9.5 Tapered pipe threads shall be in conformance with ASME B1.20.1 NPT.

7.9.6 Special thread forms and fits other than those specified by Sections 7.9.2, 7.9.4 and 7.9.5 shall be used only when both male and female members are furnished as part of a permanent assembly or in cases listed in Section 10.3.4.

8. SPRING DESIGN

8.1 Springs for pipe supports are generally of the helical type. Compression springs, unless suitably guided, shall have a free length to coil diameter (O.D.) ratio not greater than 4:1. For spring coils with a ratio greater than 4:1 and stacked coils provided with spacer plates, the spring casing serves as a guide. Special forms of springs such as leaf, disc, volute, involute, torsion, extension springs, and the like may be used. Such forms, when used, are to be designed and manufactured in accordance with acceptable commercial practices.

8.2 ***Helical Hot Wound Quenched and Tempered or Helical Cold Wound Springs Tempered After Forming***

8.2.1 Springs shall be designed so that maximum uncorrected solid stress[(1)] for compression springs shall not exceed those shown on the chart, Figure 1, by more than 20%. Working stresses (uncorrected) for compression springs shall be limited to 90% of the chart values.

8.2.2 Springs shall be manufactured and tested in accordance with ASTM A 125.

8.2.3 Alloy springs of 1.5 inch (38.1mm) and larger bar diameter shall be inspected after heat treatment by magnetic particle or equivalent method. Springs with seams, slits, or quench cracks deeper than 3% of bar diameter shall be rejected. The depth of discontinuity may be determined by grinding and blending, and measuring the minimum diameter of the remaining bar.

8.3 ***Helical Cold Wound Springs***

8.3.1 Compression springs shall be designed so that the maximum uncorrected solid stress shall not exceed those shown on the chart, Figure 2. Working stresses (uncorrected) for compression springs shall be limited to 80% of chart values. For other materials, refer to publication referenced in Section 8.4.

8.4 Springs shall be manufactured in accordance with Spring Manufacturers Institute, Inc. *Standard for Compression, Extension, Torsion and Garter Springs*.

8.5 Non-metallic coatings are recommended for corrosion protection whenever possible to avoid inherent electroplating difficulties. Springs may be electroplated for corrosion protection provided proper procedures to avoid embrittlement are observed in accordance with ASTM B 242. Maximum allowable working stress shall be reduced 15% for electroplated springs.

(1) Maximum uncorrected solid stress is a calculated stress without correction for curvature.

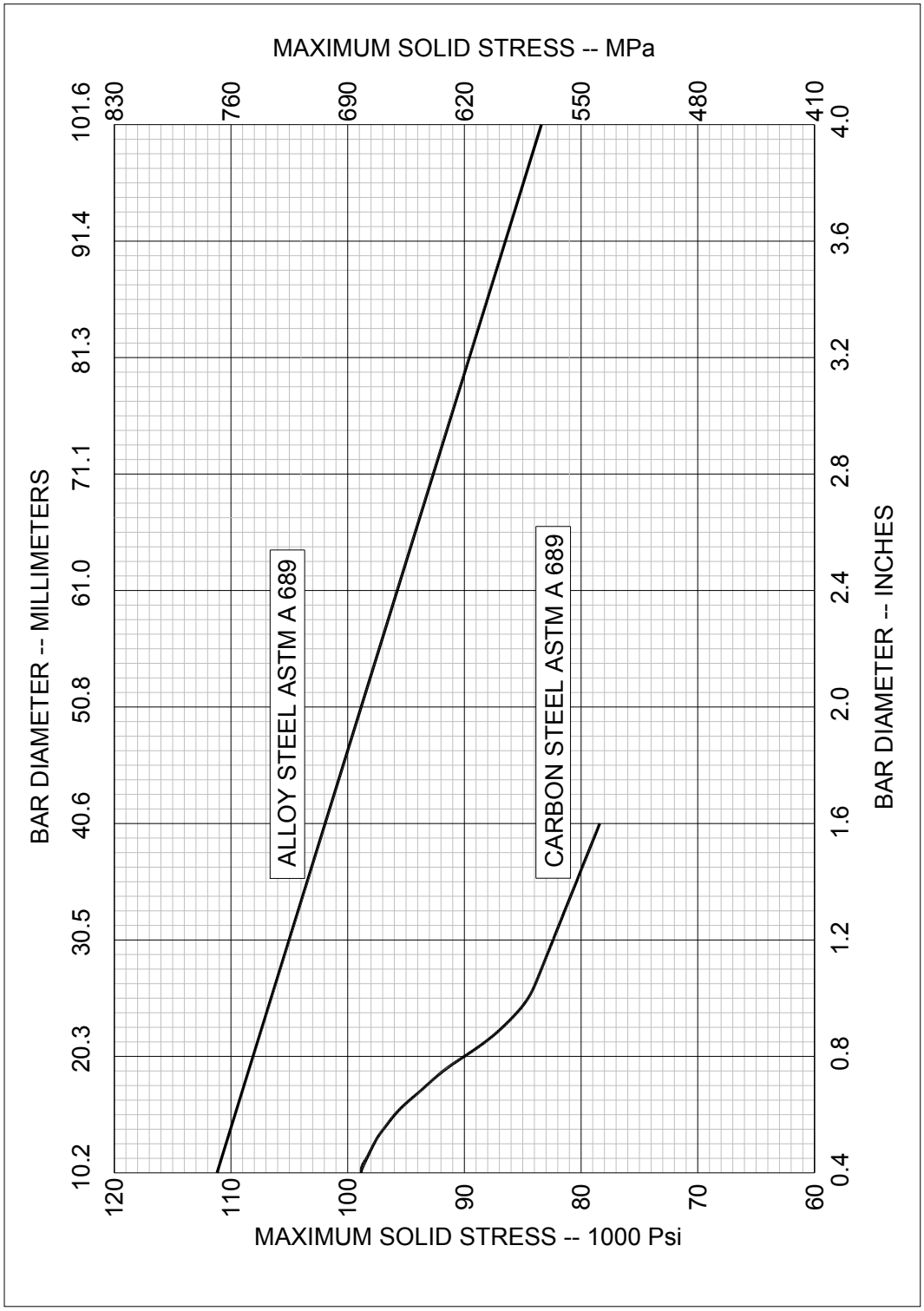


FIGURE 1
Solid Design Stress (Uncorrected) for Helical Hot Wound Quenched and Tempered or Helical Cold Wound Springs Tempered After Forming

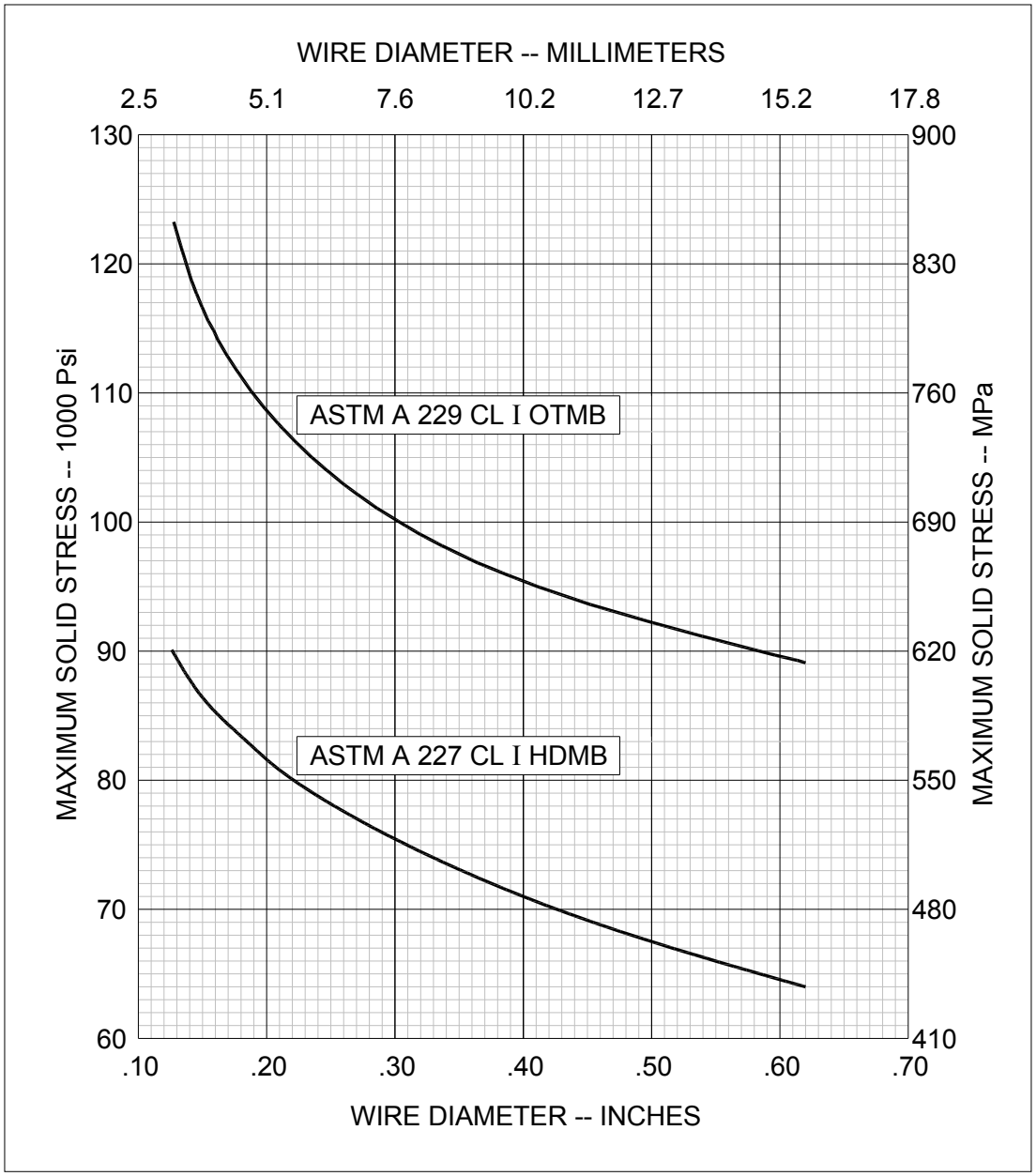


FIGURE 2
Solid Design Stress (Uncorrected) for Cold Wound Compression Springs

9. TOLERANCES

9.1 *Raw Material and Purchased Components*

9.1.1 Tolerances for raw materials such as strip, sheet, bar, plate, pipe, tubing, structural and bar size shapes, bolting, hot wound springs and cold wound springs shall be in accordance with recognized standards or specifications.

9.1.2 Tolerances for castings, forgings and extrusions shall be to the individual manufacturer's standard.

9.2 *Fabricating Tolerances*

9.2.1 Cut to length -- linear

a) Hanger rods: ±1/2 in. (13mm).

b) Structural shapes, pipe and tubing for critical assembly make-up dimensions: ±1/8 in. (3mm). Squareness of cut 1 degree, not to exceed 1/8 in. (3mm) offset.

c) Plates and bars for critical dimensions: ±1/8 in. (3mm). Squareness of cut: 1 degree, not to exceed 1/8 in. (3mm) offset.

d) Tolerances for non-critical dimensions shall be to the individual manufacturer's standards.

9.2.2 Weld Size - All welds: plus only, no minus.

9.2.3 Angularity - All forming operations: plus or minus 4 degrees.

9.2.4 Punched Holes

a) Location - center to edge, or center to center: plus or minus 1/8 in. (3mm).

b) Diameter - plus 0.2 times metal thickness or minus 1/32 in. (1mm).

9.2.5 Drilled Holes - As specified on manufacturer's drawings.

9.2.6 Machined Parts - As specified on manufacturer's drawings.

TABLE 6
Clamp Tolerances

Clamp, I.D.	Diameter	Pipe Centerline to Load Bolt Hole
up to 2 in. (51mm)	± 1/16 in. (2mm)	± 1/8 in. (3mm)
over 2 in. to 4 in. (51 to 102mm)	± 1/8 in. (3mm)	± 1/8 in. (3mm)
over 4 in. to 8 in. (102 to 203mm)	± 3/16 in. (5mm)	± 1/4 in. (6mm)
over 8 in. to 18 in. (203 to 457mm)	± 1/4 in. (6mm)	± 3/8 in. (10mm)
over 18 in. to 30 in. (457 to 762mm)	± 3/8 in. (10mm)	± 1/2 in. (13mm)
over 30 in. (762mm)	± 1/2 in. (13mm)	± 1/2 in. (13mm)

Notes:
a) Clamp I.D. equals pipe or tubing O.D. plus suitable clearance as established by the clamp manufacturer.
b) Clamp I.D. measured at one half of the clamp width.

10. PROTECTIVE COATINGS

10.1 Protective coatings are either factory-applied or field-applied and fall into two general types: Metallic Coatings and Non-metallic Coatings. The type of protective coating used for hanger material shall be the fabricator's standard coating, either factory-applied or field-applied unless otherwise specified.

10.2 Whether factory-applied or field-applied, material surfaces shall be prepared for coating by removal of loose scale, loose weld spatter, and other foreign material. Removal may be done by scraping, wire brushing, or other suitable means. Blasting or pickling need be done only when specified.

10.3 ***Metallic Coatings***

10.3.1 Metallic coatings for corrosion resistance may be applied by electroplating, pre-galvanizing (also called hot-dip mill galvanizing), hot-dip galvanizing (also called hot-dip galvanizing after fabrication), or mechanical plating. Other metallic coatings may be selected for specific purposes.

10.3.2 Electroplating shall be in accordance with ASTM B 633 or ASTM F 1941 for threaded fasteners. To avoid difficulty in assembling threaded parts that are plated, female machine threads may be tapped oversized. It is not permissible to rethread male parts after plating. It is acceptable for female threads to be uncoated.

10.3.3 Pre-galvanized steel shall meet the requirements of ASTM A 653.

10.3.4 Hot-dip galvanizing shall be in accordance with ASTM A 153 or ASTM A 123. To avoid difficulty in assembling threaded parts, it is recommended that male parts be shaken, spun, or hand brushed to remove spelter lumps from the threads. It is recommended that female machine threads be tapped oversize to accommodate the male thread. It is acceptable for female threads to be uncoated.

10.3.5 Mechanical plating shall be done in accordance with ASTM B 695.

10.3.6 Repair of metallic protective coatings may be performed in accordance with the coating manufacturer's recommendations.

10.4 ***Non-Metallic Coatings***

10.4.1 Non-metallic coatings shall be the types selected for specific purposes. Application of coatings shall be in accordance with the coating manufacturer's recommendations.

10.4.2 When paint is required, either factory applied or field applied, fabricated hanger material shall receive one coat of rust inhibitive primer, unless otherwise specified.

10.4.3 Special paints and surface preparation, either factory-applied or field-applied, shall be applied in accordance with approved procedures.

10.4.4 Stainless steel or other corrosion resistant material should not be painted unless specified by the customer.

10.4.5 Alloy steel or other material intended for high temperature service need not be painted unless specified by the customer.

10.4.6 Small items such as beam attachments which are to be welded to existing steel need not be painted prior to installation.

10.4.7 Non-metallic coatings that are suitable for threaded products may be applied before assembly.

10.4.7.1 Rod threads for field adjustment shall not be painted.

10.4.7.2 Bolt threads in assembled components may be painted.

10.4.7.3 When specified, external adjustment threads shall receive a coating of rust preventative compound.

10.4.8 Non-metallic coatings, jackets, and liners to prevent abrasion of glass or plastic pipe, etc., shall be applied in accordance with manufacturer's recommendations.

10.4.9 Non-metallic coatings, jackets, and liners for electrolytic resistance shall have dielectric strength suitable for the intended use.

10.5 Any coating process that is performed by parties other than the hanger manufacturer may affect the performance of the product; therefore the hanger manufacturer shall be consulted.

10.6 Superficial copper plating or other superficial coatings applied for identification purposes are generally not intended to provide corrosion protection. It is recommended that a non-metallic coating, jacket, or liner be used on the hanger material to prevent galvanic corrosion.

11. TESTING OF HANGER COMPONENTS

11.1 *Description*

11.1.1 This section defines the testing of hanger components and gives the purpose for tests in each category.

11.1.2 This section also recommends the type of records for each category of test.

11.2 *Classification*

11.2.1 Testing of hanger components falls into three categories:

a) Design Proof Test

b) Qualification Test

c) Calibration Test

11.3 *Design Proof Test*

11.3.1 Design Proof Tests should consist of tests for both strength and function.

11.3.2 Strength tests are performed to prove the adequacy of the final design as to allowable stress or safety factor criteria. Tests may be physical, analytical, or a combination of both.

11.3.2.1 Physical Strength Test Method “a” shall consist of loading to destruction a sufficient number of hanger components of one size and design to establish a minimum failure load to which a factor can be applied for safe load rating purposes. A single test sample is permitted, but in this case, the load rating shall be decreased by 10%.

11.3.2.2 Physical Strength Test Method “b” shall consist of loading to destruction a sufficient number of hanger components of one size and design to establish a failure mode that can be related to the results from standard test bars made from the same material as the hanger components. This test is used to establish a safe load rating at the allowable stress level of the hanger component material.

11.3.2.3 Analytical strength test shall consist of applying appropriate analytical methods and formulae to the structure of a hanger component to determine stress levels and conditions within that structure. This test is used to establish a safe load rating at the allowable stress level of the hanger component material.

11.3.2.4 Combination physical and analytical strength test shall consist of physical strength test method "b" described in Section 11.3.2.2 and applying these results analytically to a family of hanger components of the same design form. This test is used to establish a safe load rating for each component size at the allowable stress level of the hanger component material.

11.3.3 Functional tests are performed to prove the ability of a component to meet the design criteria at rated load.

11.3.3.1 The configuration of some components in a product may result in visible overall elongation or deflection of a product during functional test at established rated load. The allowable rated load, as established by strength testing, shall be reduced to a value at which acceptable elongation or deflection of a product is reached.

11.3.3.2 When applicable, the acceptable elongation or deflection value used as a limiting factor during functional test shall be incorporated in rated load capacities and/or performance characteristics of a product.

11.3.4 After Design Proof Tests are complete, they need not be repeated unless significant dimensional or material changes are made in the hanger component.

11.3.5 Results of Design Proof Tests should be presented in report form. Since this report may contain proprietary information, a summary report is acceptable.

11.4 ***Qualification Test***

11.4.1 Qualification Tests are performed to assure that hanger components meet or exceed the minimum requirements of particular codes or approval agencies. Test equipment should be of the same type and condition as for Design Proof Test. Design Proof Tests may serve as Qualification Tests. Qualification Tests may be performed by the hanger component manufacturer or by an approval agency.

11.4.2 Results of Qualification Tests should be presented in a report form suitable for distribution.

11.4.3 Except as required by the approval agency, Qualification Tests need not be repeated unless significant dimensional or material changes are made in the hanger component.

11.5 ***Calibration Test***

11.5.1 Calibration Tests are performed on some types of individual hanger components, such as constant supports, to ensure that they are properly calibrated to meet specific installation requirements. Calibration Test equipment may be the same used for Design Proof and Qualification Tests; or it may be specific equipment for the Calibration Tests performed. The test equipment shall be calibrated to ensure reliable results.

11.5.2 Records of Calibration Tests should be retained by the manufacturer.

11.6 ***Quality Control***

11.6.1 Prior to testing, verification of material composition should be performed to ensure that material components being tested are representative of standard manufactured product design specifications.

11.6.2 Quality Control should be exercised over the procurement of raw materials, fabrication procedures, and dimensions to ensure the continued validity of Design Proof and Qualification Tests.

11.6.3 Physical strength tests should be performed using calibrated test equipment that appropriately simulates an installed service condition, with the acknowledgement of any and all assumptions and/or limitations inherent with this method of testing. Tests should only be performed by qualified personnel.

11.6.4 Analytical strength tests should be performed using appropriate formulae and methods, with the acknowledgement of any and all assumptions and/or limitations inherent with this method of testing. Tests should only be performed by qualified personnel.

11.7 ***Additional Testing***

11.7.1 Any physical or non-destructive testing of units or parts thereof, beyond that required for normal production control, shall be the responsibility of the purchaser.

12. MANUFACTURE AND FABRICATION

12.1 ***General***

12.1.1 All manufacturing and fabrication should be performed to approved drawings and/or instructions based upon guidelines and principles outlined in the design sections of this standard practice. Other guidelines as appropriate should also be followed.

12.1.2 Annex B, Pipe Hanger Assembly Drawings, gives additional detail for fabrication drawings.

12.1.3 Fabrication tolerances shall be in accordance with Section 9.

12.2 ***Material Cutting***

12.2.1 Plates, rods, bars, etc. which are used for the fabrication of hanger assemblies may be cut to shape or size by shearing, sawing, machining, or thermal cutting.

12.2.2 When required, material identification for each piece of material cut shall be maintained by color coding, tagging, stamping, or other suitable means.

12.2.3 When thermal cutting is performed, the process shall be suitable for the material to which it is applied.

12.2.4 After thermal cutting, slag should be removed prior to further fabrication or use. Discoloration remaining on the cut surface is not considered to be detrimental.

12.3 ***Forming***

12.3.1 ***Cold Forming***

12.3.1.1 Cold forming of plate and flat bars may be performed on materials 0.5 inch (12.7mm) thick or less to a minimum inside radius of one times the stock thickness. Cold forming may be performed on material over 0.5 inch (12.7mm) thick to a minimum inside radius of 2.5 times the stock thickness. Material over 0.5 inch (12.7mm) thick may be cold formed to an inside radius less than 2.5 times, but not less than one times, the stock thickness provided heat treatment is performed as prescribed in Section 12.3.3 and a case history is established showing that forming or a subsequent process does not have a damaging effect detrimental to the strength or function of the product.

12.3.1.2 Round bars 0.75 inch (19mm) diameter and smaller may be cold formed to a minimum inside radius of 0.5 times the bar diameter. Round bars greater than 0.75 inch (19mm) diameter may be cold formed to a minimum inside radius of 2.5 times bar diameter. Forming is not permitted on threaded areas.

12.3.1.3 Heating material to less than minimum temperature shown in Section 12.3.2, to facilitate the forming operation, shall be considered cold forming.

12.3.2 ***Hot Forming***

12.3.2.1 Hot forming of plate and flat bars may be performed on materials of any thickness to an inside radius not less than one times the stock thickness within the following surface temperature ranges (no holding time required):

Carbon Steel	1400°F Min. (760°C)	2000°F Max (1093°C)
Chrome-Moly Alloy Steel	1550°F Min (843°C)	2000°F Max (1093°C)
Austenitic Stainless Steel	1400°F Min (760°C)	2100°F Max (1148°C)

Material shall not be heated in bundles or closed stacks in other than induction type furnaces but shall be separated to allow good circulation within the furnaces.

Materials should not be heated above the maximum temperature shown. No hot forming operation shall be performed below the minimum temperature shown. Carbon steel and chrome-moly alloy steel shall be cooled in still air. Water quenching is not permitted. Cooling of stainless steel other than still-air cooling, may be accomplished as per ASTM A 403, Section 6.

12.3.2.2 Round bars of any diameter may be hot formed to a minimum inside radius of 0.5 times the bar diameter within the temperature ranges given in Section 12.3.2.1. Forming is not permitted on threaded areas.

12.3.3 ***Heat Treatment After Forming***

12.3.3.1 Stress relieving, when required of carbon steel and chrome-moly steel, shall be done within the temperature ranges shown below. The material is to be held at temperature for one hour per inch (25.4 mm) of thickness, but not less than fifteen minutes, followed by slow cooling in furnace. Carbon steel may be cooled in still air.

Carbon Steel	1100°F Min. (593°C)	1200°F Max (676°C)
Chrome-Moly Alloy Steel	1300°F Min (704°C)	1400°F Max (760°C)

12.3.3.2 A carbide solution heat treatment of austenitic stainless steel, when required by design specification, shall be performed as prescribed by ASTM A 403, Section 6.

12.3.4 Incremental bending by braking is an acceptable method of forming.

12.3.5 Formed components may be furnished in "as formed" condition without any further mechanical work.

12.4 ***Welding***

12.4.1 Unless otherwise specified by the design specification, welders and welding procedures shall be qualified in accordance with the ASME Boiler and Pressure Vessel Code, Section IX. AWS D1.1 may also be used.

12.4.2 When qualifying a welding procedure for materials listed in Tables A2 and A2M, which do not have a Section IX P-Number or S-Number and Group Number from ASME Section III, Code Case N-71-16 qualifies that material to corresponding P-Number/S-Number and Group Number in Section IX. Welder's performance test results and Welding Procedure Qualification Records shall be available upon request, to authorized inspection personnel.

12.4.3 When tack welds are to become a part of the finished weld, they shall be visually examined and ground or feathered, if necessary. Defective tack welds and tack welds made by unqualified welders shall be removed.

12.4.4 Attachments welded directly to the pipe shall be of appropriate chemical composition, compatible for welding, and able to withstand the anticipated loads at the piping temperature. The method of attachment to the pipe shall meet all the preheating, welding, and post-weld heat treating requirements of the applicable piping code.

12.4.5 All attachments welded to the pipe shall be in accordance with Section 12.4.4 and Pipe Fabrication Institute, Standard ES-26. The pipe support manufacturer is not responsible for local pipe wall stresses.

12.4.6 Welded cold-finished steels of a specific classification, grade, and/or type should be evaluated with the mechanical properties for its hot rolled counterpart in the heat affected zone.

12.4.7 Preheating and post-weld heat treating (PWHT) requirements for pipe hangers shall be as outlined in Tables 7 and 7M.

12.4.8 Unacceptable welds shall be removed by flame or arc gouging, grinding, chipping, or machining. Welds requiring repair shall be welded in accordance with the requirements of the original weld procedure. Base metal irregularities requiring repair by welding shall be repaired in accordance with the material specification or ASTM A 6, as applicable. Welders and welding procedures used in making repair welds shall be qualified in accordance with Section 12.4.1.

12.4.9 ***Surface Discontinuities***

12.4.9.1 Surface discontinuities of welds shall be evaluated in accordance with the applicable code or job specification requirements.

12.4.9.2 Only those surface discontinuities that are detrimental to the strength or function of a product shall be cause for rejection.

12.4.10 ***Machining, Drilling and Punching***

12.4.10.1 These operations shall be performed as required by drawings and specifications.

12.4.11 ***Threading, Coating and Assembly***

12.4.11.1 These operations shall be performed as required by drawings and specifications.

TABLE 7
Preheat and Post-Weld Heat Treatment Requirements
See Notes on Page 27

Material Designation	Base Material Size	Thickness of Weld (Equal Leg Fillet Weld)*	Other Requirements	Minimum Preheat Temperature	Post-Weld Heat Treatment (See Note d)
P-1 Carbon Steel	¾" and less	All Welds	None	50ºF	Not Required
	Over ¾" to 1"	1/16" to ¾" (1/8" to 1" Fillet)			
		Over ¾" (Over 1" Fillet)			1100ºF – 1200ºF (See Note f)
	Over 1"	¾" and Less (1" & Less Fillet)	0.3% Carbon or Less	50ºF	1100ºF – 1200ºF (See Note f)
			Greater than 0.3% Carbon	175ºF	
			Or as an Option, None	200ºF	Not Required
		Over ¾" (Over 1" Fillet)	0.3% Carbon or Less	50ºF	1100ºF – 1200ºF (See Note f)
			Greater than 0.3% Carbon	175ºF	
P-4 Chrome/Moly Alloy Steel	½" and Less	All Weld Sizes	Not Mandatory (See Note i)	250ºF	1200ºF – 1300ºF (See Note f)
	Over ½"		None		
P-5A Chrome/Moly Alloy Steel	½" and Less	All Weld Sizes	Not Mandatory (See Note i)	300ºF	1300ºF – 1400ºF (See Note f)
	Over ½"		None		
P-5B Chrome/Moly Alloy Steel	All Sizes	All Weld Sizes	None		
P-8 Stainless Steel	All Sizes	All Weld Sizes	None	50ºF	(See Note g)

*Size of equivalent equal leg fillet weld shown in parentheses for convenience. The weld thickness of all types of welds needs to be determined by an acceptable conventional method.

TABLE 7M
Preheat and Post-Weld Heat Treatment Requirements, Metric Units
See Notes on Page 27

Material Designation	Base Material Size	Thickness of Weld (Equal Leg Fillet Weld)*	Other Requirements	Minimum Preheat Temperature	Post-Weld Heat Treatment (See Note d)
P-1 Carbon Steel	20mm and less	All Welds	None	10ºC	Not Required
	Over 20mm to 25mm	2mm to 20mm (3mm to 25mm Fillet)			
		Over 20mm (Over 25mm Fillet)			593ºC – 649ºC (See Note f)
	Over 25mm	20mm and Less (25mm & Less Fillet)	0.3% Carbon or Less	10ºC	593ºC – 649ºC (See Note f)
			Greater than 0.3% Carbon	79ºC	
			Or as an Option, None	93ºC	Not Required
		Over 20mm (Over 25mm Fillet)	0.3% Carbon or Less	10ºC	593ºC – 649ºC (See Note f)
			Greater than 0.3% Carbon	79ºC	
P-4 Chrome/Moly Alloy Steel	13mm and Less	All Weld Sizes	Not Mandatory (See Note i)	121ºC	649ºC – 704ºC (See Note f)
	Over 13mm		None		
P-5A Chrome/Moly Alloy Steel	13mm and Less	All Weld Sizes	Not Mandatory (See Note i)	149ºC	704ºC – 760ºC (See Note f)
	Over 13mm		None		
P-5B Chrome/Moly Alloy Steel	All Sizes	All Weld Sizes	None		
P-8 Stainless Steel	All Sizes	All Weld Sizes	None	10ºC	(See Note g)

*Size of equivalent equal leg fillet weld shown in parentheses for convenience. The weld thickness of all types of welds needs to be determined by an acceptable conventional method.

TABLES 7 and 7M

Preheat and Post-Weld Heat Treatment (PWHT) Requirements (continued)

NOTES:

a. When joining carbon steel and alloy steel by welding, the higher preheat and PWHT temperatures of the two materials shall apply.

b. When joining stainless steel to either carbon steel or alloy steel, caution shall be exercised as the stainless steel material may not be suited for the preheat or PWHT temperatures required by the other materials.

c. When carbide solution heat treatment of stainless steel is required by the design specification, heat treatment shall be in accordance with ASTM A 403, Section 6.

d. PWHT Requirements:

1. PWHT may be by full furnace heat treatment or by local heating. When local heating is used, the width of the heated band shall be at least three (3) times the thickness of the thickest section at the joint.
2. For Table 7- Above 600°F the rate of heating and cooling shall not exceed 600°F per hour divided by one-half (1/2) the maximum thickness of material in inches at the weld, but in no case shall the rate exceed 600°F per hour.
3. For Table 7M- Above 315°C the approximate rate of heating and cooling shall not exceed 315°C per hour divided by 0.02 times the maximum thickness of material in mm at the weld, but in no case shall the rate exceed 315°C per hour.

e. Base material size refers to the thickness at the weld of thicker part being joined.

f. Hold Time Requirements:

1. For Table 7- Hold time shall be one (1) hour/ in. up to 2” thick with fifteen (15) minutes minimum. For 2” and over; two (2) hours plus fifteen (15) minutes for each inch over 2”.
2. For Table 7M- Hold time shall be one (1) hour/ 25mm up to 50mm thick with fifteen (15) minutes minimum. For 50mm and over; two (2) hours plus fifteen (15) minutes for each 25mm over 50mm.

g. Post weld heat treatment of stainless steel is neither required nor prohibited (Notes 2 and 3).

h. These tables, which cover materials commonly used in the manufacture of pipe hangers and supports, have been consolidated from ASME B31.1.

i. PWHT is not mandatory for P-4 & P-5A material when welds comply with all the following conditions:

1. Nominal material thickness is ½” (13mm) or less.
2. Specified carbon content of material to be welded is 0.15% or less.
3. A minimum preheat of 250°F (120°C) is maintained for P-4 material during welding.
4. A minimum preheat of 300°F (150°C) is maintained for P-5A material during welding.

13. PACKAGING, MARKING, SHIPPING, RECEIVING & STORAGE

13.1 ***Description***

13.1.1 This section covers the recommendations for packaging, marking, shipping, receiving and storage of hanger components and assemblies.

13.1.2 Special requirements not covered in this section should be a matter for discussion and agreement between the purchaser and supplier.

13.2 ***Packaging***

13.2.1 ***General***

13.2.1.1 Hangers should be assembled to the degree practical, taking into account shipping and handling limitations. Constant supports, variable springs, and similar items may be packaged, skidded, or shipped loose, separate from the remaining assembly components.

13.2.1.2 Where possible, each hanger assembly should be shipped complete.

13.2.1.3 Hanger assemblies or subassemblies shall be properly marked with identifying numbers. Random material may be identified in bulk.

13.2.1.4 Each hanger shipment shall contain a packing list identifying the material included in the shipment, also noting the total number of boxes, bundles, bags, etc. making up the shipment.

13.2.2 ***Containers***

13.2.2.1 Where size permits, hanger assemblies and subassemblies may be packed in the manufacturer's standard containers.

13.2.3 ***Bundles***

13.2.3.1 Hanger assemblies, steel members, welded brackets, etc. which are too large for the standard containers should be bundled and banded for shipment.

13.2.4 ***Loose Components***

13.2.4.1 Large rigid components, which do not require special protection during shipment, need not be packaged.

13.2.5 ***Bags***

13.2.5.1 Small loose items may be placed in bags. The bags may be shipped separately or placed in containers for shipment.

13.2.6 ***Pallets and Skids***

13.2.6.1 Hanger components may be palletized for shipment to facilitate handling as a compact unit.

13.3 ***Marking for shipment***

13.3.1 ***General***

13.3.1.1 Marking shall be accomplished by use of labels, stamping, printing, or tagging.

13.3.1.2 Marking shall be applied with waterproof ink or paint.

13.3.1.3 Labels shall be of water resistant type.

13.3.1.4 Tags may be cloth, paper, plastic, or metal and affixed by waterproof adhesive, tacks, or wire.

13.3.2 Container marking by stenciling, printing, or labeling should appear in a minimum of two locations, preferably on one side and one end.

13.3.3 Bundles and bags shall be tagged.

13.3.4 Loose components, pallets, and skids may be stenciled, labeled, or tagged.

13.3.5 Marking should include the following information when applicable:

a) Consignee name, street address, city, state, zip code, and country.

b) Consignor name, street address, city, state, zip code, and country.

c) Purchase order or contract number. Package number followed by the total number of packages in the shipment.

d) Material identification number, e.g., hanger mark numbers or manufacturer's figure numbers and quantity. A packing list may be used in lieu of material identification. The container in which the packing list is enclosed shall be clearly identified.

e) Special handling instructions, e.g., use no hooks, lift points, keep dry, stacking limitations, etc.

f) Weight of package.

g) Special instructions.

13.3.6 On cast hangers or supports, the name, initial or other identifying mark may be legibly cast on each piece. On fabricated hangers and supports, the name or mark may be die stamped on a main member. This marking may be omitted if it cannot be incorporated into the regular production process without additional operational steps, and should be omitted where it may impair the strength.

13.3.7 Hanger components specifically sized for use on copper tubing or copper pipe are normally identified by the manufacturer by a color coating; this may not be intended to provide corrosion protection. The user should consult with the manufacturer when corrosion protection is required. (See Section 10.6).

13.4 ***Shipping***

13.4.1 Shipping shall be in accordance with the method, routing, and sequence as required by the purchase document.

13.4.2 The location of the packing list should be indicated on the bill of lading.

13.5 ***Consignee receiving***

13.5.1 The receiving clerk should be responsible for verifying agreement between the bill of lading and the shipment as received. Any damage or shortage should be noted on the bill of lading and the shipper and carrier immediately notified.

13.5.2 Unloading should be done with reasonable care, taking note of any precautionary notices on the containers. Items of shipment should not be dropped.

13.6 ***Consignee storage***

13.6.1 Storage should be in a dry area, enclosed for security purposes, and protected from the direct effects of weather and contaminants.

13.6.2 It is recommended that containers be opened and contents verified before they are placed in the storage area.

13.6.3 It is recommended that a system be established to facilitate retrieval of material from storage.

14. HANGER INSTALLATION PRACTICES

14.1 ***Description***

14.1.1 This section outlines the recommended field practices for field personnel during hanger installation, adjustment, testing, and inspection.

14.2 ***General***

14.2.1 Installation control shall be as defined in the owner's job specifications for each classification of piping.

14.2.2 Installation information may be in any of the following forms:

a) Completely engineered: individual hanger assembly drawings. Refer to Annex B, Pipe Hanger Assembly Drawings.

b) Semi-engineered: typical hanger type drawings and approximate locations for field fabricated supports using preselected bulk hanger material.

c) Random: guidelines for location, hanger type selection, and installation of supports using preselected bulk hanger material where all operations are performed by the field forces.

14.2.3 Relocation and reorientation of any hanger or restraint from the specified location shall not be permitted beyond that which is established by the responsible hanger designer, without his expressed permission.

14.2.4 Installed hangers or hanger components shall be used for their intended purpose. They shall not be used for rigging or erection purposes.

14.2.5 Recommended maximum applied torque for set screws in C-clamps (Types 19 & 23) is listed below:

Nominal Thread Size			**Torque**	
UNC - Inch	(mm)		Inch-Pound	(Nm)
1/4	M6		40	4.5
3/8	M10		60	6.8
1/2	M12		125	14.1
5/8	M16		250	28.2
3/4	M20		400	45.2
7/8	M22		665	75.1
Note: Caution should be taken not to overtighten the set screw.				

14.2.6 Hangers that are installed with clearance for future insulation shall be properly supported with blocks at three points approximately 60 degrees apart around the lower circumference. These blocks shall be the thickness of the intended insulation to prevent distortion of the hanger assembly.

14.2.7 For attachment to concrete structure, poured in place anchor bolts or inserts are preferred whenever possible. When necessary, approved concrete fasteners may be used. Construction access should be considered in attachment to floor.

14.2.8 For installation of pipe attachments made by welding, see Section 12.4.5.

14.3 ***Planned Installation Sequence***

14.3.1 The hanger designer assumes responsibility for avoiding hanger interference with all piping, electrical trays, ducts and equipment specifically dimensioned on drawings made available to him. Studies are made to avoid such interferences during the design phase of pre-engineered hangers; however, the hanger designer cannot assume responsibility for any resulting interference used by field run piping, electrical conduits, instrumentation, added steel framing, etc.

14.3.2 The hanger installer should be cognizant of the total amount of piping and equipment to be installed in any given area. He should develop an installation sequence giving priority to major components and strata of piping closest to the supporting structure. The installer also should review routing of field run piping in order to reserve space for known components to be installed at some later date in order to minimize revamp work. He should coordinate erection of all piping with other trades to maintain erection clearances and availability of building structure for supporting functions.

14.4 ***Hanger Locations***

14.4.1 Completely engineered hangers shall be located in strict accordance with the hanger design detail drawings. It is normal design practice to dimension the location of hanger attachments from the building structure column lines. Refer to Annex B, Section 9 for complete description.

14.4.2 Semi-engineered hangers for which approximate locations are designated shall be so located.

14.4.3 Random hangers shall be located by the hanger installer in accordance with the allowable support spacing in Table 4.

14.4.4 When initially installed, all hangers shall be adjusted to establish the piping at the designated elevation.

14.5 ***Hanger Installation***

14.5.1 ***Rod Hangers***

14.5.1.1 Rod hangers, either rigid or spring type, are adjustable vertical assemblies consisting of structural attachment, hanger rod (with or without intermediate components), and pipe attachment.

14.5.1.2 Installation of rod hangers requires either direct attachment to building structure or to supplemental framing.

14.5.1.3 Attachment to the building structure may be by beam clamps, welding of clips to steel members or concrete embedded plates, and by use of concrete inserts or fasteners. Where there is a vibration or bending consideration, hanger rods should not be connected directly to driven or drilled concrete fasteners. In these instances an intermediate attachment should be used from which the rod can be suspended using a swing connection.

14.5.1.4 Welding or bolting of attachments to the building structural steel shall be in accordance with the AISC Steel Construction Manual, 13th Edition, Allowable Stress Design Section, or other recognized structural design standard. There shall be no drilling, punching or burning of holes in the building structural steel without prior approval by the Civil Design Engineer.

14.5.1.5 Supplemental framing may be angles, channels, tubular sections, or beams either bolted or welded to existing steel structure or attached to concrete.

14.5.1.6 Plates attached to uneven surfaces should be shimmed.

14.5.2 ***Brackets***

14.5.2.1 Brackets are cantilevered members with or without a kneebrace, designed to withstand the gravity load and horizontal forces.

14.5.2.2 When the installer has responsibility for design or selection of brackets, anticipated horizontal forces should be considered.

14.5.2.3 Brackets may be installed by welding or bolting to structure, poured in place embedments, or through the use of drilled concrete fasteners.

14.5.2.4 For bolted-on brackets, it is important to tighten threaded fasteners equally to assure proper load distribution.

14.5.3 ***Anchors***

14.5.3.1 Anchors may be weldments or clamp type.

14.5.3.2 Anchors are used to fix selected points on a piping system in order to control forces, moments, and thermal movement in each section of the total pipe run. Location shall be accurately maintained for both horizontal and vertical piping to preserve the Piping Design Engineer's flexibility concept.

14.5.3.3 Anchors shall not be added or relocated without the approval of the Piping Design Engineer.

14.5.3.4 Installation of anchors may be by bolting or welding to a rigid structure capable of withstanding all the design forces. Pipe is secured to the anchor by clamping, welding or both.

14.5.4 ***Guides***

14.5.4.1 Guides may be sliding, rolling, or spider types.

14.5.4.2 Guides are used to control piping movement, provide lateral stability, control sway, and assure proper piping alignment at expansion joints and loops. Spider guides used in the horizontal position are not normally considered to be pipe support elements.

14.5.4.3 Design is based upon thermal movement, load, direction of travel, and thickness of pipe insulation.

14.5.4.4 Installation of guides may be by bolting or welding the base, frame, or shroud to the supporting structure. Care must be taken at time of initial installation to maintain the proper alignment, elevation, and clearances. On insulated lines, saddles or fins should be attached to piping to prevent damage to insulation.

14.5.5 ***Base Type Support***

14.5.5.1 Base type supports are used to support the piping from below. They encompass a family of supports, guides, slides, anchors, springs, etc.

14.5.5.2 Attachment to pipe may be by bolted-on clamps, U-bolts, or welding. Load is transferred through the use of a cradle, pipe, or structural member which may be fastened directly to building structure or provided with a base plate suitable for incorporation into the particular type support involved.

14.5.5.3 When attaching to steel structure, proper piping elevation can be established by custom fitting the vertical member, or by using telescoping pipe or other means of adjustment.

14.5.5.4 When attaching to concrete structure, the use of leveling bolts under the base plate with subsequent grouting is an additional means to provide proper piping elevation.

14.5.5.5 During installation, the supported pipe should be adequately braced to maintain stability until the system is completely installed.

14.6 ***Hanger Adjustment***

14.6.1 To compensate for pipe elevation discrepancies, hangers are usually provided with means to permit vertical adjustment during and after installation. Threaded devices using turnbuckles, clevises, etc. provide this feature or the adjustment is inherently available in the hanger design. No adjustment shall be made that will result in less than full usable thread engagement.

14.6.2 Adjustability features also serve to facilitate pipe load distribution.

14.6.3 For small size piping, the necessity for adjustment can be detected visually. For large or heavy piping, the necessity for adjustment may not be as obvious and the installer must determine that each hanger or support substantially carries its proper load. Hanger drawings usually denote the operating and hydrostatic test load.

14.6.4 Upon completion of hanger installation, all adjustments having the possibility of turning shall be locked securely in place; double nutting being the most common means. It is not recommended to break threads or tack weld as a means of locking adjustment devices.

14.6.5 Hydrostatic testing, when required, should not be performed until all hanger assemblies have been properly installed, adjusted, and loaded in accordance with the hanger drawings. Built-in hydrostatic stops, or external means for supporting the added water weight, must be installed in accordance with the hydrostatic test procedures as typically found in project specifications.

14.6.6 After completion of hydrostatic tests of the piping, system, any devices (e.g., spring travel stops, temporary supports, etc.) furnished for hydrostatic test purposes must be removed.

14.6.7 Hangers for certain piping systems may be required to be checked for adjustment during initial run at operating temperature. Particular attention should be given to spring hangers and spring supports.

14.6.8 Constant type springs have specific load adjustment devices which can vary the spring effort by plus or minus some percentage from the factory set load. Variable type springs are usually provided with turnbuckles, threaded collars, or adjustment nuts to enable varying the spring effort. Load/travel scales on variable and constant type spring units are usually marked to show the position of the load/travel indicator in both the cold and hot positions. Reference should be made to the particular spring supplier's catalog for the location and operation of these devices.

14.6.9 If, at operating temperature, the load/travel indicator does not line up with the hot position marking, further adjustment may be required. However, before any adjustment is considered, the position of the load/travel indicator on all spring units on the system should be recorded (see Figure 3 for suggested form). The cause for the misalignment should then be investigated.

14.6.9.1 Prior to initial operation all spring hanger units are set to the cold position. This position of the load/travel indicator should be the initial entry in a permanent formal log. (See Figure 3 for suggested form.)

14.6.9.2 When the system reaches operating temperature a second set of load/travel indicator position readings should be recorded.

14.6.9.3 If, at operating temperature, the load/travel indicator does not line up with the hot position marking, it is recommended that a minor travel adjustment be made (either lengthen or shorten the hanger rod) to have the indicator line up with the hot marking. If the installation does not respond to this minor travel adjustment, then consult with an experienced hanger designer. A new set of load/travel position readings should be recorded with a notation on the log that adjustment has been made. This set of readings represents the system being supported in accordance with the designers initial design concept which is to have the piping properly supported in the hot position.

14.6.9.4 All future studies should use this final adjusted set of hot readings as the base line.

14.6.9.5 Subsequent sets of readings, taken after the system has been cycled through hot and cold conditions, will provide the opportunity to evaluate the possible need to make load adjustments on some group of adjacent hangers to bring a section of piping run to proper elevation. This evaluation should be made only by an experienced hanger designer.

14.6.9.6 The plant should establish a program to have a periodic inspection of critical piping support systems and load/travel indicator readings recorded and compared to the base line set of readings. Although the load/travel indicator may not line up exactly with the base line readings, the hanger may still be considered functional if the reading is close to the base reading.

14.6.9.7 Spring units must never be topped or bottomed out. This is an indication that the working travel range has been exceeded.

14.6.10 Some possible causes for improper alignment of the load/travel indicator at operating temperature include:

a) Improper load adjustment of hanger.

b) Improper load adjustment of adjacent hangers.

c) System not at full operating temperature.

d) Pipe fabrication error.

e) Improper cold springing.

f) Frictional effects of guides or sliding supports.

g) Discrepancies between design and "as built" conditions affecting hanger loads or movement.

h) Improper hanger installation or failure to remove temporary supports, restraints, or hanger travel stops.

i) Failure to clear piping system of obstructions

HANGER RECORD SHEET

PREPARED BY ____________

COMPANY ____________ SYSTEM ____________ SHEET ________ OF ____

LOCATION ____________ PLANT NAME ____________ DATE ____________

HANGER MARK NUMBER	N.S. E.W. (a)	HANGER DATA (b)				CONSTANT SUPPORT HANGER NAME PLATE DATA				VARIABLE SUPPORT NAME PLATE DATA		(e) ELEV INITIAL COLD	HANGER SCALE READING (d)						
		(c) TYPE	SIZE	FIG. NO.	MFR	CALIB LOAD	TOTAL TRAVEL	FACTORY (d) POSITION		LOAD			DATE						
													BY						
								H	C	H	C		COND (H, C)						

NOTES:

(a) TO IDENTIFY THE SPECIFIC UNIT WITHIN A MULTIPLE SUPPORT ASSEMBLY WHERE N = NORTH, S = SOUTH, E = EAST, W = WEST.

(b) HANGER SIZE TO BE TAKEN FROM NAME PLATE.

(c) FOR RIGID, SPRING (VARIABLE OR CONSTANT), ANCHOR, GUIDE, SLIDING OR OTHER TYPE ATTACHMENT, INDICATE BY LETTER R, VS OR CS, A, G, OR S, RESPECTIVELY.

(d) "0" INDICATES HIGHEST SCALE POSITION WITH "5" BEING MID-POINT AND "10" BEING LOWEST SCALE POSITION.

(e) ELEVATON OF CENTERLINE OF PIPE, OR OTHER REFERENCE POINT, AFTER COLD SPRINGING AND FINAL SETTINGS WITH LINE COLD

FIGURE 3

Suggested Form for Hanger Record Sheet

14.7 ***Installation Inspection***

14.7.1 ***Inspection after installation and prior to hydrostatic testing***

14.7.1.1 Each hanger assembly should be verified against the hanger drawing to assure that all components have been installed and are in their proper position. This also includes temporary hangers and supports that may be required for hydrostatic testing and spacer blocks for lines still to be insulated.

14.7.1.2 Threaded components of each hanger should be checked for proper thread engagement.

14.7.1.3 Locking nuts on threaded components, cotter pins, temporary locking devices (travel stops), and other locking means furnished with spring units should be properly engaged.

14.7.1.4 When possible, springs should be oriented for convenient reading of load/travel scales. Scales found to be damaged should be removed and replaced. Prior to removal, the exact position of the scale should be noted and replacement installed in the same location.

14.7.1.5 Restraint control devices utilizing hydraulic fluids should be checked for tight seals and proper amount of fluid. If it is found necessary to add fluid, it must be of the type specified by the restraint supplier.

14.7.1.6 Sliding supports using teflon, graphite, bronze, or steel to steel slide plates must be installed in strict accordance with hanger detail drawings with particular attention to offset dimensions and clearances when such are specified. All sliding surfaces must be free of foreign matter.

14.7.2 ***Inspection after hydrostatic testing and prior to heating up***

14.7.2.1 Spring locking devices and any temporary hangers and supports required for hydrostatic testing shall be removed.

14.7.2.2 Spring hangers should be checked to ensure that their load/travel indicators are approximately in their cold position setting and that the pipe is at the proper elevation.

14.7.2.3 Restraint control devices should be checked to ensure that their travel indicators are approximately at their cold position setting.

14.7.2.4 Actual cold positions of the load/travel indicators on springs and restraint control devices should be recorded in a permanent formal log. See Figure 3 for suggested form.

14.7.3 ***Inspection at operating conditions***

14.7.3.1 Piping systems should be inspected in their entirety to verify that no interference exists between the pipe and/or the pipe insulation and the building structure or equipment.

14.7.3.2 Spring hangers should be checked to ensure that their load/travel indicators are approximately in their hot position setting and that the pipe is at the proper elevation.

14.7.3.3 Restraint control devices should be checked to ensure that their travel indicators are approximately at their hot position setting.

14.7.3.4 Line temperature and actual hot positions of the load/travel indicators on springs and restraint control devices should be noted and recorded in a permanent formal log. See Figure 3 for suggested form. Upon completion of the work this log should be made available to the owner.

15. INSPECTION

15.1 *Description*

15.1.1 This section covers recommendations for quality control and inspection of pipe hanger components and assemblies.

15.2 *General*

15.2.1 There should be an inspection program to ensure that all aspects of work performed comply fully with all specified requirements.

15.3 *Inspection Program*

15.3.1 Table 8 designates the suggested check points that should be included in an inspection program.

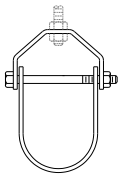
TABLE 8
Inspection Checklist

INSPECTION CATEGORIES	INSPECTION TYPES		
	Receiving	In-Process	Final
1. Drawings and/or Specifications		X	X
2. Material Identification	X	X	X
3. Fabrication Procedure		X	
4. Dimensions	X	X	X
5. Surface Finish	X	X	X
6. Surface Preparation		X	
7. Protective Coating	X	X	X
8. Performance		X	X
9. Marking	X	X	X
10. Documentation	X	X	X
11. Packaging		X	X

ANNEX A

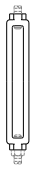
Reference Charts and Tables

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

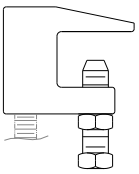


ADJUSTABLE STEEL
CLEVIS HANGER
TYPE - 1

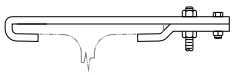
ADJUSTABLE STEEL BAND
HANGER
TYPE – 7



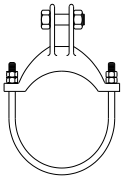
STEEL TURNBUCKLE
TYPE - 13



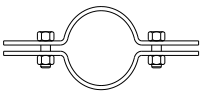
TOP BEAM C-CLAMP
AS SHOWN OR INVERTED
TYPE - 19



TOP BEAM CLAMP
TYPE - 25

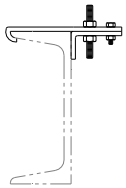


YOKE TYPE PIPE CLAMP
TYPE - 2

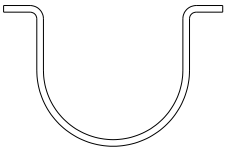


EXTENSION
RISER CLAMP
TYPE - 8

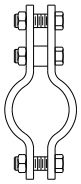
FORGED STEEL CLEVIS
TYPE - 14



CHANNEL CLAMP
TYPE - 20

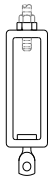


PIPE CLIP
TYPE - 26

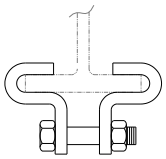


CARBON OR ALLOY STEEL
THREE BOLT PIPE CLAMP
TYPE - 3

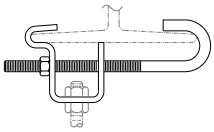
ADJUSTABLE BAND HANGER
TYPE - 9



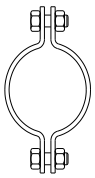
SWIVEL TURNBUCKLE
TYPE - 15



CENTER BEAM CLAMP
TYPE - 21

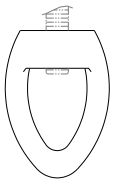


SIDE BEAM CLAMP
TYPE - 27

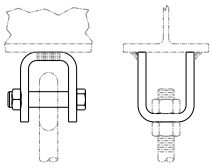


STEEL PIPE CLAMP
TYPE - 4

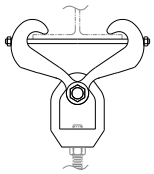
ADJ. SWIVEL RING BAND
HANGER
TYPE - 10



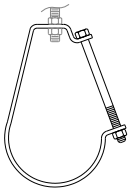
MALLEABLE IRON SOCKET
TYPE - 16



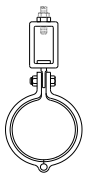
WELDED BEAM ATTACHMENT
WITH OR WITHOUT BOLT
TYPE - 22



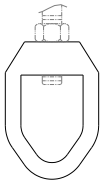
STEEL BEAM CLAMP
W / EYE NUT
TYPE - 28



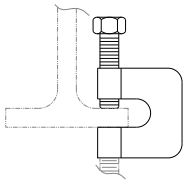
J - HANGER
TYPE - 5



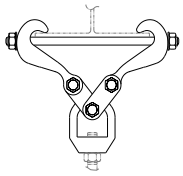
SPLIT PIPE RING WITH OR
WITHOUT TURNBUCKLE
TYPE - 11



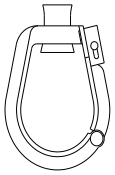
STEEL WELDLESS EYENUT
TYPE - 17



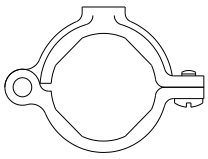
C - CLAMP
TYPE - 23



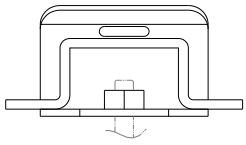
LINKED STEEL CLAMP
WITH EYE NUT
TYPE - 29



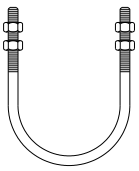
ADJUSTABLE SWIVEL PIPE
RING SPLIT RING OR SOLID
RING TYPE
TYPE - 6



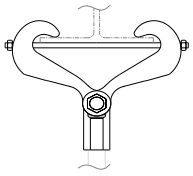
EXTENSION SPLIT PIPE
CLAMP HINGED OR TWO
BOLT
TYPE - 12



STEEL OR MALLEABLE
CONCRETE INSERT
TYPE - 18

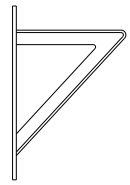


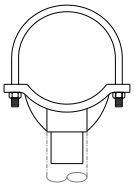
U - BOLT
TYPE - 24

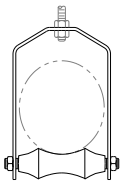


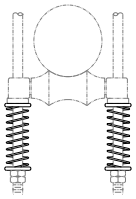
MALLEABLE BEAM CLAMP
W / EXTENSION PIECE
TYPE - 30

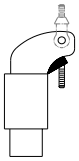
FIGURE A1
Type Chart

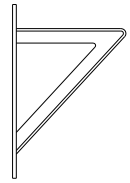

LIGHT WELDED STEEL BRACKET TYPE - 31

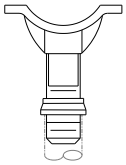

PIPE STANCHION SADDLE TYPE - 37

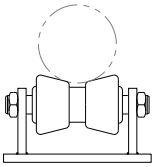

ADJUSTABLE ROLLER HANGER W/ OR W/O SWIVEL TYPE - 43

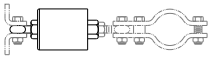

SPRING CUSHION ROLL TYPE - 49

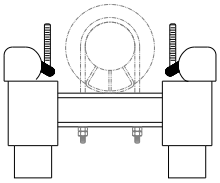

VERTICAL CONSTANT SUPPORT HANGER TYPE - 55

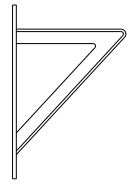

MEDIUM WELDED STEEL BRACKET TYPE - 32

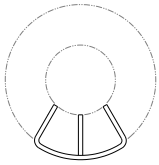

ADJUSTABLE PIPE SADDLE SUPPORT TYPE - 38

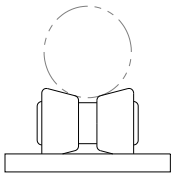

PIPE ROLL COMPLETE TYPE - 44

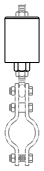

SPRING SWAY BRACE TYPE - 50


TRAPEZE CONSTANT SUPPORT HANGER TYPE - 56


HEAVY WELDED STEEL BRACKET TYPE - 33


STEEL PIPE COVERING PROTECTIVE SADDLE TYPE - 39


PIPE ROLL AND PLATE TYPE - 45


VARIABLE SPRING HANGER TYPE - 51

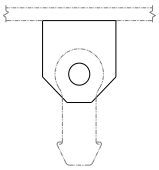
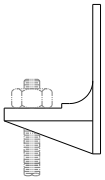
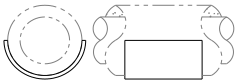
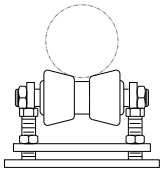
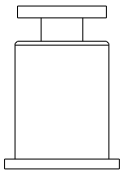


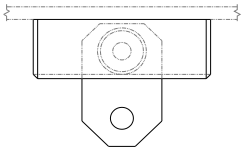
PLATE LUG TYPE - 57

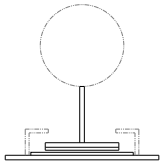

SIDE BEAM BRACKET TYPE - 34

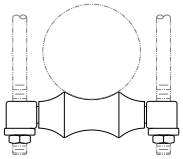

PROTECTION SHIELD TYPE - 40

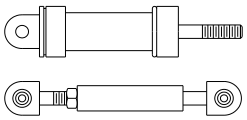

ADJUSTABLE PIPE ROLL AND BASE TYPE - 46

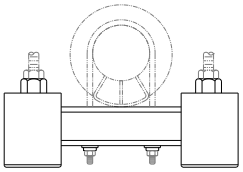

VARIABLE SPRING BASE SUPPORT TYPE - 52

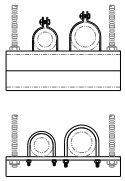

HORIZONTAL TRAVELER TYPE - 58

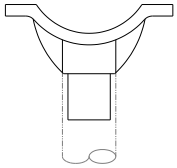

PIPE SLIDE & SLIDE PLATE TYPE - 35

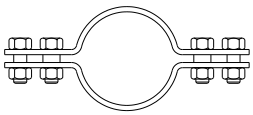

SINGLE PIPE ROLL TYPE - 41

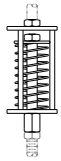

RESTRAINT CONTROL DEVICE TYPE - 47


VARIABLE SPRING TRAPEZE HANGER TYPE - 53


TRAPEZE HANGER TYPE - 59


PIPE SADDLE SUPPORT TYPE - 36


CARBON OR ALLOY STEEL RISER CLAMP TYPE – 42


SPRING CUSHION TYPE – 48

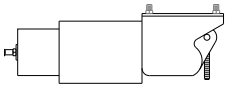

HORIZONTAL CONSTANT SUPPORT HANGER TYPE - 54

FIGURE A1
Type Chart (Continued)

TABLE A1

Hanger & Support Selections

(For Spring Hangers, See Table 5)

To find recommended hanger or support components,

1. Locate the system temperature and insulation condition in the two columns at left.
2. Read across the column headings for the type of component to be used.
3. Numbers in boxes refer to those types shown in Figure A1.

SYSTEM		HORIZONTAL PIPE ATTACHMENTS									
TEMP. RANGE °F (°C)	INSULATION	STEEL CLIPS A	MALLEABLE IRON RINGS B	STEEL BANDS C	STEEL CLAMPS D	CAST IRON HANGING ROLLS E	CAST IRON SUPPORTING ROLLS F	STEEL TRAPEZES G	STEEL PROTECTION SADDLES & SHIELDS H	STEEL OR CAST IRON STANCHIONS I	STEEL WELDED ATTACH-MENTS J
HOT A-1	COVERED NOTES a & f	24 W/ 39	NONE	1, 5, 7, 9, 10 W/ 39 OR 40	2, 3	41, 43 W/ 39 OR 40	44, 45, 46 W/ 39 OR 40	59 W/ 39 OR 40	39, 40	36, 37, 38 W/ 39 OR 40	35 NOTE c
120 (49) to 450 (232)	BARE	24, 26	6, 11, 12	1, 5, 7, 9, 10	3, 4	41, 43	44, 45, 46	59	NONE	36, 37, 38	
HOT A-2	COVERED NOTES a & f	24 W/ 39	NONE	1 W/ 39 OR 40	3	41 W/ 39 OR 40	44, 45, 46 W/ 39 OR 40	59 W/ 39 OR 40	39, 40	36, 37, 38 W/ 39 OR 40	35 NOTE c
451 (233) to 750 (399)	BARE	NONE	NONE	NONE	3, 4	NONE	NONE	NOTE c	NONE	NONE	
HOT A-3	COVERED NOTES a & f	NONE	NONE	1 W/ 40	ALLOY 2, 3	41, 43 W/ 40 OR ALLOY 39	44, 45, 46 W/ 40 OR ALLOY 39	59 W/ 40 OR ALLOY 39	40 ALLOY 39	36, 37, 38 W/ 40 OR ALLOY 39	ALLOY 35 NOTE c
OVER 750 (399)	BARE	NONE	NONE	NONE	ALLOY 2, 3, 4	NONE	NONE	NOTE c	NONE	NONE	
AMBIENT B	COVERED NOTES a & f	24, 26	NONE	1, 5, 7, 9, 10 W/ 39 OR 40	3, 4	41, 43 W/ 39 OR 40	44, 45, 46 W/ 39 OR 40	59 W/ 39 OR 40	39, 40	36, 37, 38 W/ 39 OR 40	35 NOTE c
60 (16) to 119 (48)	BARE	24, 26	6, 11, 12	1, 5, 7, 9, 10	3, 4	41, 43	44, 45, 46	59	NONE	36, 37, 38	
COLD C-1	COVERED NOTE a	26 W/ 40	NONE	1, 5, 7, 9, 10 W/ 40	3, 4 W/ 40	41, 43 W/ 40 NOTE d	44, 45, 46 W/ 40 NOTE d	59 W/ 40	40	36, 37, 38 W/ 40	NOTE c
33 (1) to 59 (15)	BARE	24, 26	6, 11, 12	1, 5, 7, 9, 10	3, 4	41, 43	44, 45, 46	NOTE c	NONE	36, 37, 38	
COLD C-2	COVERED NOTE a	NONE	NONE	1, 5, 7, 9, 10 W/ 40	NONE	41, 43 W/ 40 NOTE d	44, 45, 46 W/ 40 NOTE d	NOTES c & d W/ 40	40	36, 37, 38 W/ 40	NOTE c
-19 (-28) to 32 (0)	BARE	NONE	NONE	1, 5, 7, 9, 10	3, 4	41, 43	44, 45, 46	NOTE c	NONE	36, 37, 38	
COLD C-3 & C4	COVERED NOTE a	NONE	NONE	1, 5, 7, 9, 10 W/ 40	NONE	41, 43 W/ 40 NOTE d	44, 45, 46 W/ 40 NOTE d	NOTES b, c, d W/ 40	40	36, 37, 38 W/ 40	NOTES b & c
BELOW -19 (-28)	BARE	NONE	NONE	NOTES b & c	NOTES b & c	NONE	NONE	NOTES b & c	NONE	NOTES b & c	

TABLE A1

Hanger & Support Selections (Continued)

(For Spring Hangers, See Table 5)

To find recommended hanger or support components,

1. Locate the system temperature and insulation condition in the two columns at left.
2. Read across the column headings for the type of component to be used.
3. Numbers in boxes refer to those types shown in Figure A1.

SYSTEM	VERTICAL PIPE ATTACHMENTS			HANGER ROD FIXTURES			BUILDING STRUCTURE ATTACHMENTS				
TEMP. RANGE ºF (ºC)	STEEL RISER CLAMPS 2 BOLT K	STEEL RISER CLAMPS 4 BOLT L	WELDED ATTACHMENTS STEEL M	STEEL OR MALLEABLE IRON			STEEL OR MALLEABLE IRON				
				TURN BUCKLES N	SWING EYES O	CLEVISES P	INSERTS Q	C-CLAMPS R	BEAM CLAMPS S	WELDED ATTACHMENTS T	BRACKETS U
HOT A-1 120 (49) to 450 (232)	8	42 NOTE c	NOTE c	13, 15	16, 17	14	18 NOTE e	19, 23	20, 21, 25, 27 28, 29, 30	22, 57, 58 NOTE c	31, 32, 33, 34
HOT A-2 451 (233) to 750 (399)	NONE	42 NOTE c	NOTE c	13, 15	16, 17	14	18 NOTE e	NONE	20, 21, 25, 27 28, 29, 30	22, 57, 58 NOTE c	31, 32, 33, 34
HOT A-3 OVER 750 (399)	NONE	ALLOY 42 NOTE c	ALLOY NOTE c	13	17	14	NOTE c & e	NONE	20, 21, 25, 27 28, 29, 30	22, 57, 58 NOTE c	31, 32, 33, 34
AMBIENT B 60 (16) to 119 (48)	8	42 NOTE c	NOTE c	13, 15	16, 17	14	18 NOTE e	19, 23	20, 21, 25, 27 28, 29, 30	22, 57, 58 NOTE c	31, 32, 33, 34
COLD C-1 33 (1) to 59 (15)	8	42 NOTE c	NOTE c	13, 15	16, 17	14	18 NOTE e	19, 23	20, 21, 25, 27 28, 29, 30	22, 57, 58 NOTE c	31, 32, 33, 34
COLD C2 -19 (-28) to 32 (0)	8	42 NOTE c	NOTE c	13, 15	16, 17	14	18 NOTE e	19, 23	20, 21, 25, 27 28, 29, 30	22, 57, 58 NOTE c	31, 32, 33, 34
COLD C3 & C4 BELOW -19 (-28)	NOTES b & c	NOTES b & c	NOTES b & c	13, 15	16, 17	14	18 NOTE e	19, 23	20, 21, 25, 27 28, 29, 30	22, 57, 58 NOTE c	31, 32, 33, 34

NOTES:

a. Hangers on insulated systems shall incorporate protection saddles, shields, pipe clamps or welded lugs which project through the insulation to provide external attachment. (See Section 5.5)

b. The selection of type and material shall be made by the Piping Design Engineer.

c. The design shall be in accordance with this Standard Practice or as specified by the Piping Design Engineer.

d. For shields used with rollers or subject to point loading, see Table A3.

e. Continuous inserts, embedded plates, anchor bolts and concrete fasteners may be used as specified by the Piping Design Engineer.

f. The need to maintain a vapor barrier may be required because of ambient dew point considerations.

TABLE A2

Materials and Allowable Stresses

ASTM Spec	Grade	Material Composition	Condition	Minimum Tensile (KSI)	Minimum Yield (KSI)	Maximum Allowable Stressess in Tension (KSI) for Metal Temperatures Not Exceeding Degrees F												
						-20 to 450	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
STRUCTURAL STEEL																		
A36	-	Carbon Steel	HR	58	36	16.6	16.6	15.6	13.0									
(a) A500	B	Carbon Steel	CF	58	46	16.6	16.6	15.6	13.0									
(a A500	C	Carbon Steel	CF	62	50	17.1	15.8	15.3	13.0									
(a) A501	-	Carbon Steel	HR	58	36	16.6	16.6	15.6	13.0									
A572	50	Low Alloy	-	65	50	18.6	18.6	18.6										
A992	-	Carbon Steel	-	65	50	18.6	18.6	18.6										
RODS & BARS																		
A36	-	Carbon Steel	HR	58	36	16.6	16.6	15.6	13.0									
(a) A108	1018	Carbon Steel	CF	60	40	17.1	17.1											
(a) A108	1141	Carbon Steel	CF	90	80	23.1	23.1											
(a) A108	12L14	Carbon Steel	CF	78	60	20.0	20.0											
A276	304	18 CR - 8 Ni	-	75	30	13.3	12	11.7	11.5	11.2	11	10.8	10.6	10.4				
A276	316	16 CR - 12 Ni - 2 Mo	-	75	30	13.8	12.3	12.1	11.9	11.7	11.6	11.5	11.4	11.3				
A276	321	18 CR - 10 Ni - Ti	-	75	30	14.8	13.2	13	12.7	12.6	12.4	12.3	12.1	12				
A276	347	18 CR - 10 Ni - Cb	-	75	30	15.5	14	13.8	13.7	13.6	13.5	13.4	13.4	13.4				
A322	4130	1 CR - 1/5 Mo	A	81	52	20.8	20.8											
A322	4140	1 CR - 1/5 Mo	A	95	70	24.4	24.4											
A331	41L40	1 CR - 1/5 Mo	A	95	70	24.4	24.4											
(b) A479	304	18 CR - 8 Ni	-	75	30	13.3	12	11.7	11.5	11.2	11	10.8	10.6	10.4	10.1	9.8	7.7	6.1
(b) A479	316	16 CR - 12 Ni - 2 Mo	-	75	30	13.8	12.3	12.1	11.9	11.7	11.6	11.5	11.4	11.3	11.2	11	9.8	7.4
(b) A479	321	18 CR - 10 Ni - Ti	-	75	30	14.8	13.2	13	12.7	12.6	12.4	12.3	12.1	12	9.6	6.9	5.0	3.6
(b) A479	347	18 CR - 10 Ni - Cb	-	75	30	15.5	14	13.8	13.7	13.6	13.5	13.4	13.4	13.4	12.1	9.1	6.1	4.4
(f) A564	630	17-4PH	AH	145	125	34.8	33.7											
(a) A575	M1010	Carbon Steel	HR	47	26	12.1	12.1											
(a) A575	M1015	Carbon Steel	HR	50	27	12.9	12.9											
(a) A575	M1020	Carbon Steel	HR	55	30	14.1	14.1											
(a) A575	M1025	Carbon Steel	HR	58	32	14.9	14.9											
(a) A576	1010	Carbon Steel	HR	47	26	12.1	12.1											
(a) A576	1015	Carbon Steel	HR	50	25	13.9	12.4											
(a) A576	1020	Carbon Steel	HR	55	27.5	15.3	13.6											
(a) A576	1025	Carbon Steel	HR	60	30	16.7	14.8											
A675	60	Carbon Steel	HR	60	30	16.7	14.8	14.3	13.0									
A675	65	Carbon Steel	HR	65	32.5	18.1	16.1	15.5	13.9									
A675	70	Carbon Steel	HR	70	35	19.4	17.3	16.7	14.8									
PLATE																		
A36	-	Carbon Steel	HR	58	36	16.6	16.6	15.6	13.0									
(b,c) A240	304	18 CR - 8 Ni	-	75	30	13.3	12.0	11.7	11.5	11.2	11.0	10.8	10.6	10.4	10.1	9.8	7.7	6.1
(b,c) A240	316	16 CR - 12 Ni - 2 Mo	-	75	30	13.8	12.3	12.1	11.9	11.7	11.6	11.5	11.4	11.3	11.2	11.0	9.8	7.4
(b,c) A240	321	18 CR - 10 Ni - Ti	-	75	30	14.8	13.2	13.0	12.7	12.6	12.4	12.3	12.1	12.0	9.6	6.9	5.0	3.6
(b,c) A240	347	18 CR - 10 Ni - Cb	-	75	30	15.5	14.0	13.8	13.7	13.6	13.5	13.4	13.4	13.4	12.1	9.1	6.1	4.4
A285	A	Carbon Steel	HR	45	24	12.9	11.9	11.5	10.7									
A285	B	Carbon Steel	HR	50	27	14.3	13.3	12.5	11.2									
A285	C	Carbon Steel	HR	55	30	15.7	14.8	14.3	13.0									
(g) A387	22	2 1/4 CR - 1 Mo	-	60	30	16.6	16.6	16.6	16.6	16.6	16.6	13.6	10.8	8.0	5.7	3.8	2.4	1.4
(n) A387	91	9 CR - 1 Mo - V	-	85	60	24.1	23.4	22.9	22.2	21.3	20.3	19.1	17.8	16.3	14.0	10.3	7.0	4.3
(o) A387	91	9 CR - 1 Mo - V	-	85	60	24.1	23.4	22.9	22.2	21.3	20.3	19.1	17.8	16.3	12.9	9.6	7.0	4.3
A514	t ≤ 2.5in	Alloy Steel	QT	110	100	31.4	31.3	30.7										
A514	t > 2.5in	Alloy Steel	QT	100	90	28.5	28.4	28.0										
A515	60	Carbon Steel	HR	60	32	17.1	15.8	15.3	13.0									
A515	65	Carbon Steel	HR	65	35	18.6	17.3	16.7	13.9									
A515	70	Carbon Steel	HR	70	38	20.0	18.8	18.1	14.8									
A516	60	Carbon Steel	HR	60	32	17.1	15.8	15.3	13.0									
A516	65	Carbon Steel	HR	65	35	18.6	17.3	16.7	13.9									
A516	70	Carbon Steel	HR	70	38	20.0	18.8	18.1	14.8									
A517	t ≤ 2.5in	Alloy Steel	QT	115	100	32.8	32.7	32.2										
A517	t > 2.5in	Alloy Steel	QT	105	90	30.0	29.9	29.3										

Conditions: HR=Hot Rolled, CF=Cold Finished, QT=Quenched and Tempered, A=Annealed, AH=Age Hardened

TABLE A2

Materials and Allowable Stresses (Continued)

ASTM Spec	Grade	Material Composition	Condition	Minimum Tensile (KSI)	Minimum Yield (KSI)	Maximum Allowable Stressess in Tension (KSI) for Metal Temperatures Not Exceeding Degrees F											
						-20 to 450	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
SHEET & STRIP																		
A109	#4	Carbon Steel	CF	48	--	12.3	12.3											
(b,c) A240	304	18 CR - 8 Ni	-	75	30	13.3	12	11.7	11.5	11.2	11	10.8	10.6	10.4	10.1	9.8	7.7	6.1
(b,c) A240	316	16 CR - 12 Ni - 2 Mo	-	75	30	13.8	12.3	12.1	11.9	11.7	11.6	11.5	11.4	11.3	11.2	11	9.8	7.4
(b,c) A240	321	18 CR - 10 Ni - Ti	-	75	30	14.8	13.2	13	12.7	12.6	12.4	12.3	12.1	12	9.6	6.9	5	3.6
(b,c) A240	347	18 CR - 10 Ni - Cb	-	75	30	15.5	14	13.8	13.7	13.6	13.5	13.4	13.4	13.4	12.1	9.1	6.1	4.4
(a) A446	A	Carbon Steel	HR	45	24	12.9	11.9											
(a) A526	-	Carbon Steel	HR	45	24	12.9	11.9											
(a) A569	(superceded by A1011 CS)																	
(a) A570	(superceded by A1011 SS)																	
(a) A635	1010	Carbon Steel	HR	47	26	12.1	12.1											
A653 SS	33	Pregalv. Steel	-	45	33	12.9	12.9											
(a,e) A653 CS	-	Pregalv. Steel	-	--	30	11.7	11.7											
(a) A659	1020	Carbon Steel	HR	50	27	14.3	13.3											
(f) A693	630	17-4PH	AH	145	125	39.8	38.5											
(a) A1011 SS	33	Carbon Steel	HR	52	33	14.9	14.9											
(a) A1011 SS	40	Carbon Steel	HR	55	40	15.7	15.7											
(a) A1011 CS	-	Carbon Steel	HR	--	30	13.5	13.5											
PIPE & TUBING																		
A53	A	Carbon Steel	HR	48	30	13.7	13.7	12.5	10.7									
A53	B	Carbon Steel	HR	60	35	17.1	17.1	15.6	13.0									
A106	A	Carbon Steel	HR	48	30	13.7	13.7	12.5	10.7									
A106	B	Carbon Steel	HR	60	35	17.1	17.1	15.6	13.0									
A106	C	Carbon Steel	HR	70	40	20.0	19.8	18.3	14.8									
(b) A312	304	18 CR - 8 Ni	-	75	30	11.3	10.2	10	9.8	9.6	9.4	9.2	9	8.8	8.6	8.3	6.6	5.2
(b) A312	316	16 CR - 12 Ni - 2 Mo	-	75	30	11.7	10.5	10.3	10.1	10	9.9	9.8	9.7	9.6	9.5	9.4	8.3	6.3
(b) A312	321	18 CR - 10 Ni - Ti	-	75	30	12.6	11.2	11	10.8	10.7	10.5	10.4	10.3	10.2	8.2	5.9	4.3	3.1
(b) A312	347	18 CR - 10 Ni - Cb	-	75	30	13.2	11.9	11.8	11.6	11.5	11.5	11.4	11.4	11.4	10.3	7.8	5.2	3.8
A335	P11	1 1/4 CR - 1/2 Mo	HR	60	30	16.5	15.4	15.1	14.8	14.4	14.0	13.6	9.3	6.3	4.2	2.8	1.9	1.2
A335	P22	2 1/4 CR - 1 Mo	HR	60	30	16.6	16.6	16.6	16.6	16.6	16.6	13.6	10.8	8.0	5.7	3.8	2.4	1.4
A335	P91	9 CR - 1 Mo - V	-	85	60	24.1	23.4	22.9	22.2	21.3	20.3	19.1	17.8	16.3	14.0	10.3	7.0	4.3
A513	1015	Carbon Steel	HR	50	32	14.3	14.3											
A513	1020	Carbon Steel	HR	50	32	14.3	14.3											
A513	1025	Carbon Steel	HR	55	35	15.7	15.7											
A519	1018	Carbon Steel	HR	50	32	14.3	14.3											
CASTINGS																		
A47	32510	Malleable Iron	A	50	32.5	11.4												
A47	35018	Malleable Iron	A	53	35	12.1												
A48	20	Gray Iron	-	20	--	2.0	(limited to 400°F)											
A48	25	Gray Iron	-	25	--	2.5	(limited to 400°F)											
A48	30	Gray Iron	-	30	--	3.0	(limited to 400°F)											
A126	A	Gray Iron	-	21	--	2.0	(limited to 400°F)											
A126	B	Gray Iron	-	31	--	3.0	(limited to 400°F)											
A126	C	Gray Iron	-	41	--	4.0	(limited to 400°F)											
A197	-	Malleable Iron	A	40	30	9.1												
A216	WCA	Carbon Steel	N	60	30	16.7	14.8	14.3										
A216	WCB	Carbon Steel	N	70	36	19.8	17.8	17.2										
A217	WC6	1 1/4 CR - 1/2 Mo	NT	70	40	20.0	20.0	20.0										
A217	WC9	2 1/4 CR - 1 Mo	NT	70	40	19.3	19.1	18.8										
A351	CF8	18 CR - 8 Ni	-	70	30	10.6	9.6	9.4	9.2	9.0								
A351	CF8C	18 CR - 10 Ni - Cb	-	70	30	12.4	11.2	11.0	11.0	10.9								
A351	CF8M	16 CR - 12 Ni - 2 Mo	-	70	30	11.0	9.8	9.7	9.5	9.4								
A395	-	Ductile Iron	-	60	40	13.7	13.7											
A536	65-45-12	Ductile Iron	-	65	45	14.9	14.9											

Conditions: HR=Hot Rolled, CF=Cold Finished, QT=Quenched and Tempered, A=Annealed, AH=Age Hardened

TABLE A2

Materials and Allowable Stresses (Continued)

ASTM Spec	Grade	Material Composition	Condition	Minimum Tensile (KSI)	Minimum Yield (KSI)	Maximum Allowable Stressess in Tension (KSI) for Metal Temperatures Not Exceeding Degrees F												
						-20 to 450	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
FORGINGS																		
A105	-	Carbon Steel	HT	70	36	19.8	17.8	17.2										
A181	70	Carbon Steel	-	70	36	19.8	17.8	17.2										
A182	F11	1 1/4 CR - 1/2 Mo - Si	A	70	40	20.0	20.0	20.0	19.7	19.2	18.7	13.7	9.3	6.3	4.2	2.8	1.9	1.2
A182	F22	2 1/4 CR - 1 Mo	A	75	45	20.5	20.2	20.0	19.7	19.3	18.7	15.8	11.4	7.8	5.1	3.2	2.0	1.2
(b) A182	F304	18 CR - 8 Ni	HT	75	30	13.3	12.0	11.7	11.5	11.2	11.0	10.8	10.6	10.4	10.1	9.8	7.7	6.1
(b) A182	F316	16 CR - 12 Ni - 2 Mo	HT	75	30	13.8	12.3	12.1	11.9	11.8	11.6	11.5	11.4	11.3	11.2	11.0	9.8	7.4
(b) A182	F321	18 CR - 10 Ni - Ti	HT	75	30	14.8	13.2	13.0	12.7	12.6	12.4	12.3	12.1	12.0	9.6	6.9	5.0	3.6
(b) A182	F347	18 CR - 10 Ni - Cb	HT	75	30	15.5	14.0	13.8	13.7	13.6	13.5	13.4	13.4	13.4	12.1	9.1	6.1	4.4
A668	A	Carbon Steel	-	47	--	13.4	13.4											
A668	B	Carbon Steel	A	60	30	17.1	17.1											
A668	C	Carbon Steel	A	66	33	18.8	18.8											
A668	D	Carbon Steel	N	75	37.5	21.4	21.4											
A668	E	Carbon Steel	DNT	83	43	23.7	23.7											
(p) A668	F	Carbon Steel	QT	90	55	25.7	25.7											
BOLTING																		
(j) A193	B7	1 CR - 1/5 Mo	HT	125	105	25	25	25	23.6	21	17	12.5	8.5	4.5				
(k) A193	B7	1 CR - 1/5 Mo	HT	115	95	23	23	23	22.5	20	16.3	12.5	8.5	4.5				
(l) A193	B7	1 CR - 1/5 Mo	HT	100	75	18.8	18.8	18.8	18.8	18	16.3	12.5	8.5	4.5				
(b,c,d) A193	B8	18 CR - 8 Ni	-	75	30	13.3	12	11.8	11.5	11.2	11	10.8	10.6	10.4	10.1	9.8	7.7	6
(b,c,d) A193	B8M	16 CR - 12 Ni - 2 Mo	-	75	30	13.8	12.3	12.1	11.9	11.7	11.6	11.5	11.4	11.3	11.2	11	9.8	7.4
(b,c,d) A193	B8C	18 CR - 10 Ni - Cb	-	75	30	15.2	14.1	13.8	13.7	13.6	13.5	13.5	13.4	13.4	12.1	9.1	6.1	4.4
(b,c,d) A193	B8T	18 CR - 10 Ni - Ti	-	75	30	14.8	13.3	12.9	12.7	12.5	12.4	12.3	12.1	12	9.6	6.9	5	3.6
A307	A	Carbon Steel	-	60	--	17.1	17.1											
A307	B	Carbon Steel	-	60	--	17.1	17.1											
(h) A325	TYPE 2	Carbon Steel	HT	120	--	34.3	34.3											
(i) A325	TYPE 2	Carbon Steel	HT	105	--	30.0	30.0											
(h) A449	-	Carbon Steel	QT	120	--	26.2	26.2											
(i) A449	-	Carbon Steel	QT	105	--	22.8	22.8											
(m) A449	-	Carbon Steel	QT	90	--	16.5	16.5											
A490	-	Alloy Steel	QT	150	130	42.9	42.9											
RIVETS & NUTS																		
A194	ALL	-	-	Product Specification														
A502	-	Carbon Steel	-	52	28	14.9	14.9											
A563	ALL	Carbon Steel	-	Product Specification														
SPRINGS	**See Figures 2 and 3 for Materials and Stresses**																	

Conditions: A=Annealed, N=Normalized, DNT=Double Normalized and Tempered, QT=Quenched and Tempered, HT=Heat Treated

NOTES:

a. Allowable stresses for these materials are based upon those of comparable materials of similar chemical properties.

b. For temperatures above 1000°F, these stress values apply only when the carbon content is 0.04% or higher based on heat analysis.

c. For temperatures above 1000°F, these stress values may be used only if the material is heat treated by treating it to a minimum temperature of 1900°F and quenching in water or rapidly cooling by other means.

d. Derived from Class 1.

e. Derived from Type B.

f. Age hardened at 1075°F.

g. For temperatures above 850°F, these stress values apply only when the carbon content is 0.05% or higher based on heat analysis.

h. For bolt diameters 1 inch and less.

i. For bolt diameters greater than 1 inch through 1 1/2 inch.

j. For bolt diameters 2 1/2 inch and less.

k. For bolt diameters greater than 2 1/2 inch through 4 inch.

l. For diameters greater than 4 inch.

m. For bolt diameters greater than 1 1/2 inch through 3 inch.

n. For material thickness 3 inch and less.

o. For material thickness greater than 3 inch.

p. For sizes 4 inch and less.

TABLE A2M

Materials and Allowable Stresses, Metric Units

ASTM Spec	Grade	Material Composition	Condition	Minimum Tensile (MPa)	Minimum Yield (MPa)	Maximum Allowable Stressess in Tension (MPa) for Metal Temperatures Not Exceeding Degrees C												
						-29 to 232	343	371	399	427	454	482	510	538	566	593	621	649
STRUCTURAL STEEL																		
A36	-	Carbon Steel	HR	400	248	114.5	114.5	107.6	89.6									
(a) A500	B	Carbon Steel	CF	400	317	114.5	114.5	107.6	89.6									
(a) A500	C	Carbon Steel	CF	427	345	117.9	108.9	105.5	89.6									
(a) A501	-	Carbon Steel	HR	400	248	114.5	114.5	107.6	89.6									
A572	50	Low Alloy	-	448	345	128.2	128.2	128.2										
A992	-	Carbon Steel	-	448	345	128.2	128.2	128.2										
RODS & BARS																		
A36	-	Carbon Steel	HR	400	248	114.5	114.5	107.6	89.6									
(a) A108	1018	Carbon Steel	CF	414	276	117.9	117.9											
(a) A108	1141	Carbon Steel	CF	621	552	159.3	159.3											
(a) A108	12L14	Carbon Steel	CF	538	414	137.9	137.9											
A276	304	18 CR - 8 Ni	-	517	207	91.7	82.7	80.7	79.3	77.2	75.8	74.5	73.1	71.7				
A276	316	16 CR - 12 Ni - 2 Mo	-	517	207	95.1	84.8	83.4	82.0	80.7	80.0	79.3	78.6	77.9				
A276	321	18 CR - 10 Ni - Ti	-	517	207	102.0	91.0	89.6	87.6	86.9	85.5	84.8	83.4	82.7				
A276	347	18 CR - 10 Ni - Cb	-	517	207	106.9	96.5	95.1	94.5	93.8	93.1	92.4	92.4	92.4				
A322	4130	1 CR - 1/5 Mo	A	558	359	143.4	143.4											
A322	4140	1 CR - 1/5 Mo	A	655	483	168.2	168.2											
A331	41L40	1 CR - 1/5 Mo	A	655	483	168.2	168.2											
(b) A479	304	18 CR - 8 Ni	-	517	207	91.7	82.7	80.7	79.3	77.2	75.8	74.5	73.1	71.7	69.6	67.6	53.1	42.1
(b) A479	316	16 CR - 12 Ni - 2 Mo	-	517	207	95.1	84.8	83.4	82.0	80.7	80.0	79.3	78.6	77.9	77.2	75.8	67.6	51.0
(b) A479	321	18 CR - 10 Ni - Ti	-	517	207	102.0	91.0	89.6	87.6	86.9	85.5	84.8	83.4	82.7	66.2	47.6	34.5	24.8
(b) A479	347	18 CR - 10 Ni - Cb	-	517	207	106.9	96.5	95.1	94.5	93.8	93.1	92.4	92.4	92.4	83.4	62.7	42.1	30.3
(f) A564	630	17-4PH	AH	1000	862	239.9	232.4											
(a) A575	M1010	Carbon Steel	HR	324	179	83.4	83.4											
(a) A575	M1015	Carbon Steel	HR	345	186	88.9	88.9											
(a) A575	M1020	Carbon Steel	HR	379	207	97.2	97.2											
(a) A575	M1025	Carbon Steel	HR	400	221	102.7	102.7											
(a) A576	1010	Carbon Steel	HR	324	179	83.4	83.4											
(a) A576	1015	Carbon Steel	HR	345	172	95.8	85.5											
(a) A576	1020	Carbon Steel	HR	379	190	105.5	93.8											
(a) A576	1025	Carbon Steel	HR	414	207	115.1	102.0											
A675	60	Carbon Steel	HR	414	207	115.1	102.0	98.6	89.6									
A675	65	Carbon Steel	HR	448	224	124.8	111.0	106.9	95.8									
A675	70	Carbon Steel	HR	483	241	133.8	119.3	115.1	102.0									
PLATE																		
A36	-	Carbon Steel	HR	400	248	114.5	114.5	107.6	89.6									
(b,c) A240	304	18 CR - 8 Ni	-	517	207	91.7	82.7	80.7	79.3	77.2	75.8	74.5	73.1	71.7	69.6	67.6	53.1	42.1
(b,c) A240	316	16 CR - 12 Ni - 2 Mo	-	517	207	95.1	84.8	83.4	82.0	80.7	80.0	79.3	78.6	77.9	77.2	75.8	67.6	51.0
(b,c) A240	321	18 CR - 10 Ni - Ti	-	517	207	102.0	91.0	89.6	87.6	86.9	85.5	84.8	83.4	82.7	66.2	47.6	34.5	24.8
(b,c) A240	347	18 CR - 10 Ni - Cb	-	517	207	106.9	96.5	95.1	94.5	93.8	93.1	92.4	92.4	92.4	83.4	62.7	42.1	30.3
A285	A	Carbon Steel	HR	310	165	88.9	82.0	79.3	73.8									
A285	B	Carbon Steel	HR	345	186	98.6	91.7	86.2	77.2									
A285	C	Carbon Steel	HR	379	207	108.2	102.0	98.6	89.6									
(g) A387	22	2 1/4 CR - 1 Mo	-	414	207	114.5	114.5	114.5	114.5	114.5	114.5	93.8	74.5	55.2	39.3	26.2	16.5	9.7
(n) A387	91	9 CR - 1 Mo - V	-	586	414	166.2	161.3	157.9	153.1	146.9	140.0	131.7	122.7	112.4	96.5	71.0	48.3	29.6
(o) A387	91	9 CR - 1 Mo - V	-	586	414	166.2	161.3	157.9	153.1	146.9	140.0	131.7	122.7	112.4	88.9	66.2	48.3	29.6
A514	t ≤ 6.35cm	Alloy Steel	QT	758	689	216.5	215.8	211.7										
A514	t > 6.35cm	Alloy Steel	QT	689	621	196.5	195.8	193.1										
A515	60	Carbon Steel	HR	414	221	117.9	108.9	105.5	89.6									
A515	65	Carbon Steel	HR	448	241	128.2	119.3	115.1	95.8									
A515	70	Carbon Steel	HR	483	262	137.9	129.6	124.8	102.0									
A516	60	Carbon Steel	HR	414	221	117.9	108.9	105.5	89.6									
A516	65	Carbon Steel	HR	448	241	128.2	119.3	115.1	95.8									
A516	70	Carbon Steel	HR	483	262	137.9	129.6	124.8	102.0									
A517	t ≤ 6.35cm	Alloy Steel	QT	793	689	226.1	225.5	222.0										
A517	t > 6.35cm	Alloy Steel	QT	724	621	206.8	206.2	202.0										

Conditions: HR=Hot Rolled, CF=Cold Finished, QT=Quenched and Tempered, A=Annealed, AH=Age Hardened

TABLE A2M

Materials and Allowable Stresses, Metric Units (Continued)

ASTM Spec	Grade	Material Composition	Condition	Minimum Tensile (MPa)	Minimum Yield (MPa)	Maximum Allowable Stressess in Tension (MPa) for Metal Temperatures Not Exceeding Degrees C											
						-29 to 232	343	371	399	427	454	482	510	538	566	593	621	649
SHEET & STRIP																		
A109	#4	Carbon Steel	CF	331	--	84.8	84.8											
(b,c) A240	304	18 CR - 8 Ni	-	517	207	91.7	82.7	80.7	79.3	77.2	75.8	74.5	73.1	71.7	69.6	67.6	53.1	42.1
(b,c) A240	316	16 CR - 12 Ni - 2 Mo	-	517	207	95.1	84.8	83.4	82.0	80.7	80.0	79.3	78.6	77.9	77.2	75.8	67.6	51.0
(b,c) A240	321	18 CR - 10 Ni - Ti	-	517	207	102.0	91.0	89.6	87.6	86.9	85.5	84.8	83.4	82.7	66.2	47.6	34.5	24.8
(b,c) A240	347	18 CR - 10 Ni - Cb	-	517	207	106.9	96.5	95.1	94.5	93.8	93.1	92.4	92.4	92.4	83.4	62.7	42.1	30.3
(a) A446	A	Carbon Steel	HR	310	165	88.9	82.0											
(a) A526	-	Carbon Steel	HR	310	165	88.9	82.0											
(a) A569	(superceded by A1011 CS)																	
(a) A570	(superceded by A1011 SS)																	
(a) A635	1010	Carbon Steel	HR	324	179	83.4	83.4											
A653 SS	33	Pregalv. Steel	-	310	228	88.9	88.9											
(a,e) A653 CS	-	Pregalv. Steel	-	--	207	80.7	80.7											
(a) A659	1020	Carbon Steel	HR	345	186	98.6	91.7											
(f) A693	630	17-4PH	AH	1000	862	274.4	265.4											
(a) A1011 SS	33	Carbon Steel	HR	359	228	102.7	102.7											
(a) A1011 SS	40	Carbon Steel	HR	379	276	108.2	108.2											
(a) A1011 CS	-	Carbon Steel	HR	--	207	93.1	93.1											
PIPE & TUBING																		
A53	A	Carbon Steel	HR	331	207	94.5	94.5	86.2	73.8									
A53	B	Carbon Steel	HR	414	241	117.9	117.9	107.6	89.6									
A106	A	Carbon Steel	HR	331	207	94.5	94.5	86.2	73.8									
A106	B	Carbon Steel	HR	414	241	117.9	117.9	107.6	89.6									
A106	C	Carbon Steel	HR	483	276	137.9	136.5	126.2	102.0									
(b) A312	304	18 CR - 8 Ni	-	517	207	77.9	70.3	68.9	67.6	66.2	64.8	63.4	62.1	60.7	59.3	57.2	45.5	35.9
(b) A312	316	16 CR - 12 Ni - 2 Mo	-	517	207	80.7	72.4	71.0	69.6	68.9	68.3	67.6	66.9	66.2	65.5	64.8	57.2	43.4
(b) A312	321	18 CR - 10 Ni - Ti	-	517	207	86.9	77.2	75.8	74.5	73.8	72.4	71.7	71.0	70.3	56.5	40.7	29.6	21.4
(b) A312	347	18 CR - 10 Ni - Cb	-	517	207	91.0	82.0	81.4	80.0	79.3	79.3	78.6	78.6	78.6	71.0	53.8	35.9	26.2
A335	P11	1 1/4 CR - 1/2 Mo	HR	414	207	113.8	106.2	104.1	102.0	99.3	96.5	93.8	64.1	43.4	29.0	19.3	13.1	8.3
A335	P22	2 1/4 CR - 1 Mo	HR	414	207	114.5	114.5	114.5	114.5	114.5	114.5	93.8	74.5	55.2	39.3	26.2	16.5	9.7
A335	P91	9 CR - 1 Mo - V	-	586	414	166.2	161.3	157.9	153.1	146.9	140.0	131.7	122.7	112.4	96.5	71.0	48.3	29.6
A513	1015	Carbon Steel	HR	345	221	98.6	98.6											
A513	1020	Carbon Steel	HR	345	221	98.6	98.6											
A513	1025	Carbon Steel	HR	379	241	108.2	108.2											
A519	1018	Carbon Steel	HR	345	221	98.6	98.6											
CASTINGS																		
A47	32510	Malleable Iron	A	345	224	78.6												
A47	35018	Malleable Iron	A	365	241	83.4												
A48	20	Gray Iron	-	138	--	13.8	(limited to 204°C)											
A48	25	Gray Iron	-	172	--	17.2	(limited to 204°C)											
A48	30	Gray Iron	-	207	--	20.7	(limited to 204°C)											
A126	A	Gray Iron	-	145	--	13.8	(limited to 204°C)											
A126	B	Gray Iron	-	214	--	20.7	(limited to 204°C)											
A126	C	Gray Iron	-	283	--	27.6	(limited to 204°C)											
A197	-	Malleable Iron	A	276	207	62.7												
A216	WCA	Carbon Steel	N	414	207	115.1	102.0	98.6										
A216	WCB	Carbon Steel	N	483	248	136.5	122.7	118.6										
A217	WC6	1 1/4 CR - 1/2 Mo	NT	483	276	137.9	137.9	137.9										
A217	WC9	2 1/4 CR - 1 Mo	NT	483	276	133.1	131.7	129.6										
A351	CF8	18 CR - 8 Ni	-	483	207	73.4	66.2	64.5	63.4	61.8								
A351	CF8C	18 CR - 10 Ni - Cb	-	483	207	85.5	77.2	76.1	75.6	75.0								
A351	CF8M	16 CR - 12 Ni - 2 Mo	-	483	207	75.6	67.8	66.7	65.6	64.5								
A395	-	Ductile Iron	-	414	276	94.5	94.5											
A536	65-45-12	Ductile Iron	-	448	310	102.7	102.7											

Conditions: HR=Hot Rolled, CF=Cold Finished, A=Annealed, AH=Age Hardened, N=Normalized, NT=Normalized and Tempered

TABLE A2M

Materials and Allowable Stresses, Metric Units (Continued)

ASTM Spec	Grade	Material Composition	Condition	Minimum Tensile (MPa)	Minimum Yield (MPa)	Maximum Allowable Stressess in Tension (MPa) for Metal Temperatures Not Exceeding Degrees C												
						-29 to 232	343	371	399	427	454	482	510	538	566	593	621	649
FORGINGS																		
A105	-	Carbon Steel	HT	483	248	136.5	122.7	118.6										
A181	70	Carbon Steel	-	483	248	136.5	122.7	118.6										
A182	F11	1 1/4 CR - 1/2 Mo - Si	A	483	276	137.9	137.9	137.9	135.8	132.4	128.9	94.5	64.1	43.4	29.0	19.3	13.1	8.3
A182	F22	2 1/4 CR - 1 Mo	A	517	310	141.3	139.3	137.9	135.8	133.1	128.9	108.9	78.6	53.8	35.2	22.1	13.8	8.3
(b) A182	F304	18 CR - 8 Ni	HT	517	207	91.7	82.7	80.7	79.3	77.2	75.8	74.5	73.1	71.7	69.6	67.6	53.1	42.1
(b) A182	F316	16 CR - 12 Ni - 2 Mo	HT	517	207	95.1	84.8	83.4	82.0	81.4	80.0	79.3	78.6	77.9	77.2	75.8	67.6	51.0
(b) A182	F321	18 CR - 10 Ni - Ti	HT	517	207	102.0	91.0	89.6	87.6	86.9	85.5	84.8	83.4	82.7	66.2	47.6	34.5	24.8
(b) A182	F347	18 CR - 10 Ni - Cb	HT	517	207	106.9	96.5	95.1	94.5	93.8	93.1	92.4	92.4	92.4	83.4	62.7	42.1	30.3
A668	A	Carbon Steel	-	324	--	92.4	92.4											
A668	B	Carbon Steel	A	414	207	117.9	117.9											
A668	C	Carbon Steel	A	455	228	129.6	129.6											
A668	D	Carbon Steel	N	517	259	147.5	147.5											
A668	E	Carbon Steel	DNT	572	296	163.4	163.4											
(p) A668	F	Carbon Steel	QT	621	379	177.2												
BOLTING																		
(j) A193	B7	1 CR - 1/5 Mo	HT	862	724	172.4	172.4	172.4	162.7	144.8	117.2	86.2	58.6	31.0				
(k) A193	B7	1 CR - 1/5 Mo	HT	793	655	158.6	158.6	158.6	155.1	137.9	112.4	86.2	58.6	31.0				
(l) A193	B7	1 CR - 1/5 Mo	HT	689	517	129.6	129.6	129.6	129.6	124.1	112.4	86.2	58.6	31.0				
(b,c,d) A193	B8	18 CR - 8 Ni	-	517	207	91.7	82.7	81.4	79.3	77.2	75.8	74.5	73.1	71.7	69.6	67.6	53.1	41.4
(b,c,d) A193	B8M	16 CR - 12 Ni - 2 Mo	-	517	207	95.1	84.8	83.4	82.0	80.7	80.0	79.3	78.6	77.9	77.2	75.8	67.6	51.0
(b,c,d) A193	B8C	18 CR - 10 Ni - Cb	-	517	207	104.8	97.2	95.1	94.5	93.8	93.1	93.1	92.4	92.4	83.4	62.7	42.1	30.3
(b,c,d) A193	B8T	18 CR - 10 Ni - Ti	-	517	207	102.0	91.7	88.9	87.6	86.2	85.5	84.8	83.4	82.7	66.2	47.6	34.5	24.8
A307	A	Carbon Steel	-	414	--	117.9	117.9											
A307	B	Carbon Steel	-	414	--	117.9	117.9											
(h) A325	TYPE 2	Carbon Steel	HT	827	--	236.5	236.5											
(i) A325	TYPE 2	Carbon Steel	HT	724	--	206.8	206.8											
(h) A449	-	Carbon Steel	QT	827	--	180.6	180.6											
(i) A449	-	Carbon Steel	QT	724	--	157.2	157.2											
(m) A449	-	Carbon Steel	QT	621	--	113.8	113.8											
A490	-	Alloy Steel	QT	1034	896	295.8	295.8											
RIVETS & NUTS																		
A194	ALL	-	-	Product Specification														
A502	-	Carbon Steel	-	359	193	102.7	102.7											
A563	ALL	Carbon Steel	-	Product Specification														
SPRINGS	**See Figures 2 and 3 for Materials and Stresses**																	

Conditions: A=Annealed, N=Normalized, DNT=Double Normalized and Tempered, QT=Quenched and Tempered, HT=Heat Treated

NOTES:

a. Allowable stresses for these materials are based upon those of comparable materials of similar chemical properties.

b. For temperatures above 538°C, these stress values apply only when the carbon content is 0.04% or higher based on heat analysis.

c. For temperatures above 538°C, these stress values may be used only if the material is heat treated by treating it to a minimum temperature of 1038°C and quenching in water or rapidly cooling by other means.

d. Derived from Class 1.

e. Derived from Type B.

f. Age hardened at 579°C.

g. For temperatures above 454°C, these stress values apply only when the carbon content is 0.05% or higher based on heat analysis.

h. For bolt diameters 2.54 cm and less.

i. For bolt diameters greater than 2.54 cm through 3.81 cm.

j. For bolt diameters 6.35 cm and less.

k. For bolt diameters greater than 6.35 cm through 10.16 cm.

l. For diameters greater than 10.16 cm.

m. For bolt diameters greater than 3.81 cm through 7.62 cm.

n. For material thickness 7.62 cm and less.

o. For material thickness greater than 7.62 cm.

p. For sizes 10.16 cm and less

TABLE A3

Type 40 Protection Shields for Insulated Pipe and Tubing

NOM. PIPE SIZE	DN	SHIELD LENGTH		SHIELD THICKNESS			SPACING	
in	mm	in	mm	gage	in	mm	ft	m
1/2 to 1 1/4	15 to 32	12	305	18	.048	1.22	7*	2.1*
1 1/2	40	12	305	18	.048	1.22	9*	2.7*
2 to 3 1/2	50 to 90	12	305	18	.048	1.22	10	3.0
4	100	12	305	16	.060	1.52	10	3.0
5 to 6	125 to 150	18	457	16	.060	1.52	10	3.0
8 to 14	200 to 350	24	610	14	.075	1.91	10	3.0
16 to 24	400 to 600	24	610	12	.105	2.67	10	3.0
NOM. TUBE SIZE	DN	SHIELD LENGTH		SHIELD THICKNESS			SPACING	
in	mm	in	mm	gage	in	mm	ft	m
1/4 to 3/4	6 to 20	12	305	18	.048	1.22	5*	1.5*
1	25	12	305	18	.048	1.22	6*	1.8*
1 1/4	32	12	305	18	.048	1.22	7*	2.1*
1 1/2 to 2	40 to 50	12	305	18	.048	1.22	8*	2.4*
2 1/2	65	12	305	18	.048	1.22	9*	2.7*
3 to 3 1/2	80 to 90	12	305	18	.048	1.22	10	3.0
4	100	12	305	16	.060	1.52	10	3.0
5 to 6	125 to 150	18	457	16	.060	1.52	10	3.0
8	200	24	610	14	. 075	2.67	10	3.0

NOTES:

The listed spans and shield lengths are based on insulation with a compressive strength of 15 psi (103 kPa). For insulation with compressive strengths greater than 15 psi (103 kPa), span may be increased proportionately up to the maximum allowable as listed in Table 4. Spans marked * are the maximum allowable.

Protection shield gages listed are for use with band type hangers only. For point loading, increase shield thickness and length. When shields are used with rollers, shield thickness shall be adjusted accordingly and shield lengths shall be increased to keep rolling point of contact within the middle one-third of the shield length. For compressive strengths other than 15 psi (103 kPa), shield dimensions may be adjusted accordingly.

ANNEX B
PIPE HANGER ASSEMBLY DRAWINGS

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

1. **DESCRIPTION**

1.1 This Annex contains recommendations for minimum data which should appear on hanger drawings to enable the fabricator to furnish, and the erector to install the hanger assembly, as intended by the job specification or purchase order conditions.

2. **GENERAL**

2.1 The conventional 8 ½ x 11 inch hanger drawing shall contain the information necessary for shop fabrication and field installation of the hanger assembly. In the case of complex assemblies, supplementary or larger 11 x 17 inch sheets may be used.

2.2 The data shown on the hanger drawing should consist of:

a) Drawing of the assembly (Section 3)

b) Bill of material (Section 4)

c) Load and movement data (Section 5)

d) Supplementary steel (Section 6)

e) Field and shop welds (Section 7)

f) Protective coatings (Section 8)

g) Location plan (Section 9)

h) Identification (Section 10)

i) Reference drawings (Section 11)

3. **DRAWING OF THE ASSEMBLY**

3.1 Drawing shall be a pictorial representation of the assembly showing each component part identified to a bill of material item.

3.2 Dimensioning of the hanger assembly depends upon the complexity of the design. As a minimum, the following data should be shown:

a) The overall dimension from the supporting structure to the centerline or bottom of the pipe.

b) The orientation, elevation, size and type of supporting structure.

c) Pipe size (nominal pipe size unless otherwise noted) and insulation thickness as applicable.

d) Pipe elevation.

e) Other dimensions necessary for the fabrication and installation of the complete hanger assembly.

f) Unless otherwise required, all dimensions shall be to the nearest one-eighth inch (3 mm).

4. **BILL OF MATERIAL**

4.1 An itemized bill of material shall be provided listing all components of the hanger assembly. Identification of standard catalog components shall be made by manufacturer's figure number, type and size. Appropriate material specification shall be shown for special components.

5. **LOAD AND MOVEMENT DATA**

5.1 When required, the maximum operating load to be supported by the assembly shall appear on the drawing. Hydrostatic test loads, greater than operating loads, shall also be shown. When special loading conditions are considered, these loads shall also be shown.

5.2 When variable spring or constant support hangers are used, the direction from cold to hot and amount of vertical movement shall be shown.

5.3 When applicable, the amount of movement in all three directions shall be shown.

6. **SUPPLEMENTARY STEEL**

6.1 When supplementary steel is furnished as a part of the hanger assembly, it shall be listed in the bill of material.

6.2 When supplementary steel is required, but not furnished as part of the hanger contract, it should be so noted.

7. **FIELD AND SHOP WELDS**

7.1 All shop welds of non-catalog items and all field welds shall be indicated on the drawing.

7.2 It is recommended that American Welding Society (AWS) standard weld symbols be used.

7.3 Welds required to provide final installation, access around pipe, or necessary to accommodate shipping and handling limitations, shall be specified as field welds.

8. **PROTECTIVE COATINGS**

8.1 Where required, the type and/or specification of protective coating shall be indicated on the drawing, or other referenced documents.

9. **LOCATION PLAN**

9.1 The location plan shows the relationship of the pipe and hanger to applicable reference lines, such as column lines, center lines of equipment, etc. (See Figures B1 and B1M). The location of the structural attachment is usually indicated by an "X" and is dimensioned to the north-south and east-west reference lines. A north arrow is usually shown.

9.2 Where horizontal piping displacement exceeds 1 inch (25 mm), it is common practice to offset the pipe attachment or structural attachment by the amount of anticipated displacement or a percentage thereof (See Figures B1 and B1M, Illustrations 2, 4, and 6).

10. **IDENTIFICATION**

10.1 Identification on the hanger drawing shall consist of, but not be limited to, the following:

10.1.1 Project identification

10.1.2 Piping system

10.1.3 Hanger mark number

10.1.4 Drawing and revision number

11. **REFERENCE DRAWINGS**

11.1 As a minimum, reference should be made to pertinent piping and/or structural drawings, including revision number.

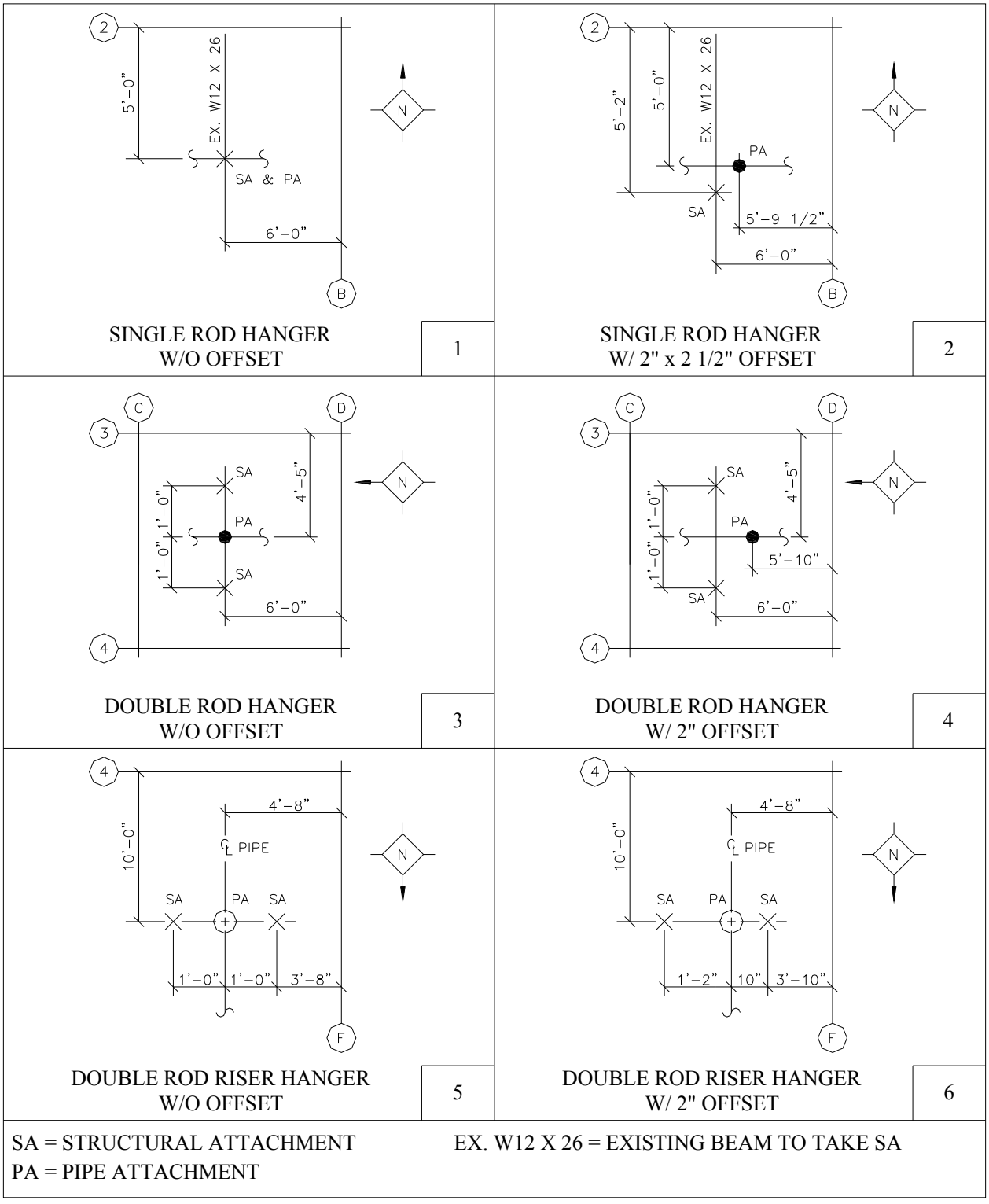
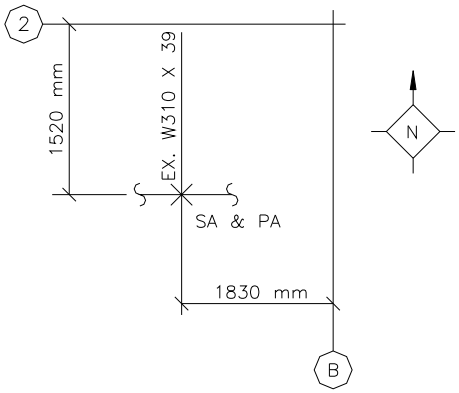
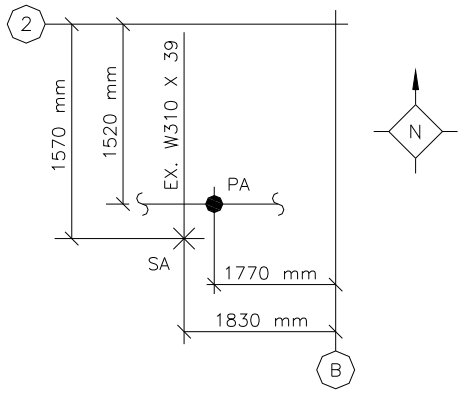


FIGURE B1
Typical Hanger Location Plans



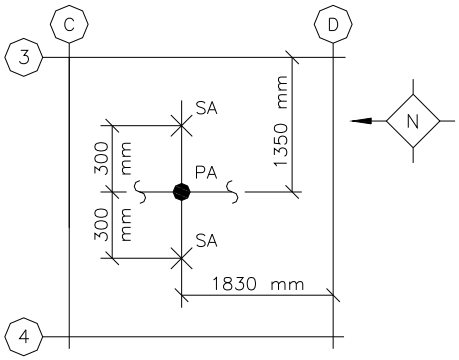
SINGLE ROD HANGER
W/O OFFSET

1



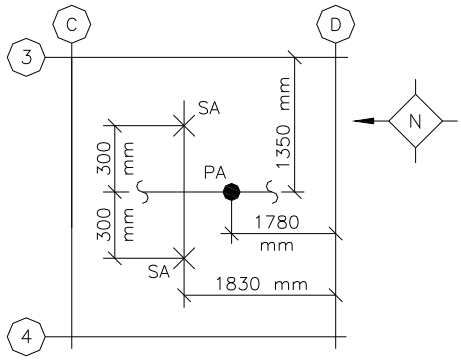
SINGLE ROD HANGER
W/ 50 mm x 60 mm OFFSET

2



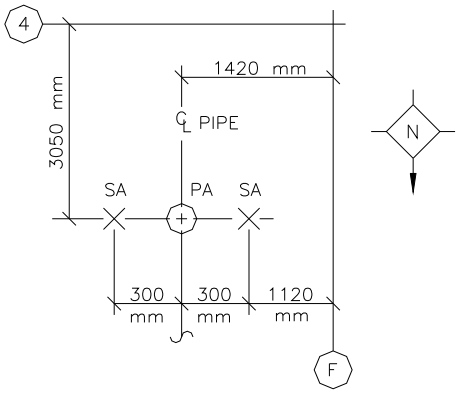
DOUBLE ROD HANGER
W/O OFFSET

3



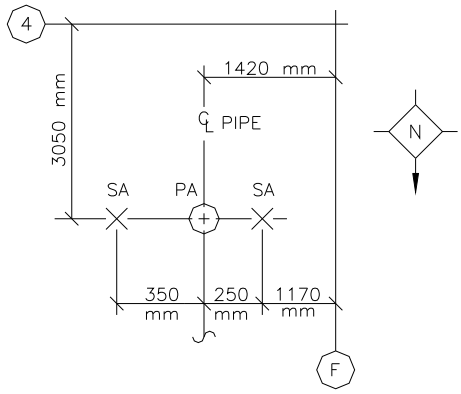
DOUBLE ROD HANGER
W/ 50 mm OFFSET

4



DOUBLE ROD RISER HANGER
W/O OFFSET

5



DOUBLE ROD RISER HANGER
W/ 50 mm OFFSET

6

SA = STRUCTURAL ATTACHMENT
PA = PIPE ATTACHMENT

EX. W310 X 39 = EXISTING BEAM TO TAKE SA

FIGURE B1M
Typical Hanger Location Plans, Metric Units

ANNEX C
Referenced Standards and Applicable Dates

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

AISC

AISC-325-05	Steel Construction Manual, Thirteenth Edition

ANSI/MSS

SP-69-2003	Pipe Hangers and Supports – Selection and Application

ASME

B1.1-2003	Unified Inch Screw Threads (UN and UNR Thread Form)
B1.13M-2005	Metric Screw Threads-M Profile
B1.20.1-1983 (2001)	Pipe Threads, General Purpose
B31.1a-2005	Power Piping
B31.3-2004	Process Piping
B31.4-2006	Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
B31.5a-2004	Refrigeration Piping and Heat Transfer Components
B31.8-2003	Gas Transmission and Distribution Piping Systems
B31.8S-2004	Managing System Integrity of Gas Pipelines
B31.9-2004	Building Services Piping
Y14.38-1999 (a2002)	Abbreviations and Acronyms
ASME-2004 (a2006)	Boiler and Pressure Vessel Code

ASTM

A 6/A 6M-06	General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
A 123/A 123M-02	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 125-96(01)	Steel Springs, Helical, Heat Treated
A 153/A 153M-05	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 194/A 194M-07	Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High Temperature Service. or Both
A 227/A 227M-06	Standard Specification For Steel Wire, Cold-Drawn For Mechanical Springs
A 229/A 229M-99(05)	Standard Specification For Steel Wire, Oil-Tempered For Mechanicalsprings
A 242/A 242 M-04	Standard Specification For High-Strength Low-Alloy Structural Steel
A 370-06	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
A 403/A 403M-06	Wrought Austenitic Stainless Steel Piping Fittings
A 653/A 653M-06a	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A 689-97(02)	Standard Specification For Carbon And Alloy Steel Bars For Springs
B 242-99(04)	Preparation of High-Carbon Steel for Electroplating
B 633-07	Electrodeposited Coatings of Zinc on Iron and Steel
B 695-04	Coatings of Zinc Mechanically Deposited on Iron and Steel
B 766-86(03)	Electrodeposited Coatings of Cadmium
F 1941-00(06)	Standard Specification For Electrodeposited Coatings On Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))

AWS

D1.1/D1.1M-2006	Structural Welding Code Steel

ANNEX C
Referenced Standards and Applicable Dates (Continued)

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

Federal Standard

H28A-2001	Screw Thread Standards for Federal Services

FM

FM1951/ 1952/1953 (2003)	Approval Standard for Pipe Hanger Components for Automatic Sprinkler Systems

MFMA

MFMA-4-2004	Metal Framing Standards Publication

MSS

SP-127-2001	Bracing For Piping Systems Seismic – Wind – Dynamic Design, Selection, Application

NFPA

NFPA 11-2005	Low-Expansion Foam
NFPA 12-2005	Carbon Dioxide Extinguishing Systems
NFPA 13-2007	Installation of Sprinkler Systems
NFPA 14-2007	Installation of Standpipe, Private Hydrant, and Hose Systems
NFPA 15-2007	Water Spray Fixed Systems for Fire Protection
NFPA 16-2006	Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 17-2002	Dry Chemical Extinguishing Systems

PFI

ES-26-2005	Welded Load-Bearing Attachments to Pressure Retaining Piping Materials

SMI

GUIDE-2000	Compression, Extension, Torsion and Garter Springs

UL

UL203-2005	Pipe Hanger Equipment for Fire Protection Service

ANNEX C

Referenced Standards and Applicable Dates (Continued)

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

Publications of the following organizations appear in the preceding list:

AISC	American Institute of Steel Construction One East Wacker Drive, Suite 700, Chicago, IL 60601-1802, Phone: (312) 670-2400 www.aisc.org
ANSI	American National Standards Institute 1819 L Street, NW, 6th Floor, Washington, D.C., 20036, Phone: (202) 293-8020 www.ansi.org
ASME	ASME International Three Park Avenue, New York, NY 10016-5990, Phone: (800) 843-2763 www.asme.org
ASTM	ASTM International 100 Bar Harbor Drive, West Conshohocken, PA 19428-2959, Phone: (610) 832-9500 www.astm.org
AWS	American Welding Society 550 NW LeJeune Road, Miami, FL 33126, Phone: (800) 443-9353 www.aws.org
FM	FM Global 1301 Atwood Avenue, Johnston, RI 02919, Phone: (401) 275-3000 www.fmglobal.com
MFMA	Metal Framing Manufacturers Association 401 N. Michigan Avenue, Chicago, IL 60611, Phone: (312) 644-6610 www.metalframingmfg.org
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park Street, N.E., Vienna, VA 22180, Phone: (703) 281-6613 www.mss-hq.org
NFPA	National Fire Protection Association 1 Batterymarch Park, Quincy, MA 02169-7471, Phone: (617) 770-3000 www.nfpa.org
PFI	Pipe Fabrication Institute 511 Avenue of Americas, #601, New York, NY 10001, Phone: (866) 913-3434 www.pfi-institute.org
SMI	Spring Manufacturers Institute 2001 Midwest Road, Suite 106, Oak Brook, IL 60523-1335, Phone: (630) 495-8588 www.smihq.org
UL	Underwriters Laboratories 333 Pfingsten Road, Northbrook, IL 60062-2096, Phone: (847) 272-8800 www.ul.com

APPENDIX X1
CONTRACTUAL RELATIONSHIPS (formerly SP-77)

NOTE: THIS APPENDIX IS SUPPLEMENTARY AND DOES NOT INCLUDE MANDATORY REQUIREMENTS

1. **SCOPE**

1.1 This Appendix establishes practical and recognizable guidelines relative to defining area of responsibility for pipe hanger contractors, purchaser's engineers, and pipe fabricators and/or erectors.

2. **OBJECTIVE**

2.1 To be used as a basis for contractual requirements, if agreeable to both parties, where there is a lack of definition in the job specification.

2.2 To furnish guidance and practical observations in order to minimize common misunderstandings which may occur between participating groups. When used in this context, the word 'shall' is to be interpreted as 'should'.

3. **FUNCTIONS OF PIPE HANGER CONTRACTOR**

3.1 To design, detail and furnish pipe hangers, anchors and guides as specified in the hanger contract, and to comply with all provisions of the pipe hanger specifications and applicable codes.

3.2 To work in close cooperation with the purchaser's engineer, the pipe fabricator and the pipe erector.

3.3 ***Pipe Hanger Design*** is the development of a supporting system to properly support and control each piping system for all conditions of operation delineated by the purchaser's engineers. As it is not possible to anticipate location and types of vibration which may occur during operation of a piping system, vibration control devices are excluded from the basic hanger contract unless specifically defined and located.

3.3.1 The pipe hanger design shall be based on the following:

a) When a formal stress and thermal analysis of the piping system is provided by the purchaser's engineers, the hanger contractor shall design a supporting system in accordance with that analysis.

b) In the absence of or requirements for a formal stress and thermal analysis by the purchaser's engineers, the hanger contractor may locate and provide hangers to satisfy movement and load conditions as determined by approximate methods.

3.3.2 The pipe hanger design shall include the following:

a) Selection and sizing of hanger and support components to accommodate pipe movement and loading conditions, and which are appropriate for the piping system being supported.

b) In the absence of other requirements, supplementary steel shall be designed in accordance with AISC specifications.

c) Selection of materials which are appropriate for the intended service and specified environment.

d) Providing a design which precludes any interference with the structure, equipment and appurtenances for which drawings and/or details were furnished by the purchaser's engineers at the time that the hanger design was initiated.

e) For cold sprung systems, the location of the final welds are used to determine the proper pipe elevations and provide the required amount of hanger adjustment.

3.3.3 Specific requirements and recommendations, relative to pipe hanger design, are covered in this Standard Practice.

3.4 ***Pipe Hanger Assembly Drawings***, when required, shall include the following:

a) An illustration of the pipe hanger assembly in its installed position, correctly oriented with respect to piping and building structure. Elevations of supporting structure and pipe shall be shown.

b) Location of pipe hanger assembly with reference to building column lines. Where required to compensate for horizontal movements, offset locations of attachments to building structure and/or pipe shall be shown.

c) Complete bill of material.

d) Setting and installation data for specialty products such as variable spring and constant support hangers, and snubbers, which require either field adjustment or verification of the installed position.

e) Design load and, when applicable, special loadings such as hydrostatic test.

f) Weld sizes and, when required, special notations.

g) A unique hanger mark number, including revision level and, when required, other identification information.

h) Where job requirements permit, typical details and approximate hanger locations may be used in lieu of individual drawings.

3.4.1 Detailed requirements and recommendations relative to pipe hanger assembly drawings are covered in Annex B.

3.5 ***Pipe Hanger Shop Fabrication, Coating, Packaging, Marking and Shipping*** shall include the following:

3.5.1 ***Shop Fabrication***

a) Materials shall be cut to size, and shall be formed, drilled, punched, threaded and welded in accordance with the requirements of the pipe hanger assembly drawings.

b) Dimensional tolerances shall be in accordance with this Standard Practice, Section 9.

c) Formed components may be furnished in the ‘as formed’ condition without any further mechanical work.

d) Welded pipe attachments shall be shaped to contour, whenever practical. For non-standard configurations such as attachments to reducers, reducing ells and fabricated pipe bends, the attachment should be provided with additional length for custom fitting by the pipe fabricator.

3.5.2 ***Coating***

a) Unless otherwise noted, fabricated material, specified to be painted, shall receive one shop coat of fabricator’s standard primer.

b) Unless otherwise noted, material surfaces shall be prepared for coating by removal of loose scale, loose weld spatter, oils and other foreign material.

c) Applications of coating shall be in accordance with fabricator’s approved painting and coating procedures or the coating manufacturer’s recommendations.

d) Rod threads for field adjustment shall not be painted; bolt threads in assemblies may be painted. When specified, external adjustment threads shall receive a coating of rust preventive compound.

e) Stainless steel or other corrosion resistant materials should not be painted unless specified by the customer.

f) Small items such as beam attachments which are to be welded to existing steel need not be painted.

3.5.3 ***Packaging, Marking and Shipping***

a) Hangers should be assembled to the degree practical, taking into account shipping and handling limitations.

b) Hanger assemblies or subassemblies shall be properly marked with identifying numbers. Random material may be identified in bulk.

c) Each hanger shipment shall contain a packing list identifying the material included in the shipment, also noting the total number of boxes, bundles, bags, etc. making up the shipment.

d) Where possible, each hanger assembly should be shipped complete.

e) Constant supports, variable springs and similar items may be packaged, skidded and shipped separate from the rigid components of an assembly.

3.5.4 Detailed requirements and recommendations relative to pipe hanger shop fabrication, coating, packaging, marking and shipping are covered in this Standard Practice, Sections 12 and 13.

3.6 ***Coordination and Consultation*** shall include the following:

a) Information relative to engineering, fabrication and delivery shall be provided as required.

b) Notification of material procurement delays and possible material substitutions.

c) Notification to the purchaser's engineers, any questionable situations which may become apparent.

4. FUNCTIONS OF PURCHASER'S ENGINEER

4.1 To delineate the scope of the hanger design work, establish complete piping support specifications and monitor the progress of the design to ensure compliance.

4.2 To maintain a current working knowledge of available hanger products and design criteria in order to properly coordinate the pipe support phase with all other phases of the plant design.

4.3 To retain responsibility for the piping design such that the stresses generated by pressure, thermal expansion and local pipe wall stresses induced by welded piping attachment loading are within the allowable stress range.

4.4 ***Plant Design*** During the initial design phase, consideration shall be given to the pipe hanger requirements. Some of the requirements are as follows:

a) Piping shall be routed to provide ample space around piping for installation of standard hanger products and to allow for both vertical and horizontal pipe movement.

b) Building structure shall be adequate for sup-porting piping loads, as generated by maximum recommended spans, including hydrostatic test loads.

c) Secondary systems, valves, cable trays, etc., should be located so as not to interfere with the accessibility of principal structural members which may be used for the support or anchorage of primary systems.

4.5 ***Scope of Work*** The scope of hanger support work required in any project shall be clearly defined in the form of drawings covering piping, equipment and structure; specifications covering design and material; applicable codes; and a statement defining design services to be furnished by hanger contractor.

4.5.1 Any conditions which may necessitate special consideration or any operational procedure which may produce abnormal loading or movement shall be specifically noted.

4.5.2 Other factors to be covered in the scope are hanger design drawing requirements, approval procedures, quality assurance requirements, inspection requirements, construction schedule and shipping stipulations.

4.5.3 Drawings and Supplemental Data, whether in paper or electronic form, should include, but not be limited to the following:

a) Piping drawings and immediate notification of any intended revisions.

b) Piping composites, if available, for checking clearances.

c) Flow diagrams.

d) All structural drawings including plans and elevations, column and girder schedules, turbine foundation, concrete floor plans, trenches, embedded plates, etc.

e) Architectural and general arrangement drawings.

f) Cable tray drawings.

g) HVAC and duct drawings.

h) Equipment drawings, which may include boiler, turbine, condenser, deaerator, heaters, etc., should be available on request.

i) Piping flexibility analyses, when available, including pipe line deflections.

j) Movements and allowable loadings at terminal points such as boiler headers, economizer inlets and other equipment connections, should be available on request.

k) Piping specifications, including piping sizes, schedules, materials, temperatures and pressures.

l) Valve and Specialty list including pressure ratings, manufacturer and figure numbers, and weights.

m) Insulation specification including material, thickness and density for pipe sizes and temperatures.

n) Seismic design requirements.

o) Cut shorts, if required, and the location of final welds.

4.5.4 ***Pipe hanger specifications*** should include the following when applicable:

a) Reference to codes and standards, such as: ASME B31 Codes for Pressure Piping, ASME Boiler Codes, MSS SP-127, and this Standard Practice.

b) Customer standards.

c) Painting and protective coating requirements.

d) Identification of piping systems which will undergo hydrostatic test.

e) Special material requirements.

f) Packing, marking and shipping instructions.

4.6 ***Scheduling*** Hanger design contract should be awarded as soon as possible to provide necessary lead time for design, approval, fabrications and delivery of hangers.

4.6.1 In order to coordinate hanger shipments with job requirements, the hanger contractor shall be provided with the following:

a) Erection schedule with immediate notification of changes.

b) Piping arrangement drawing release schedules.

c) Time schedule for approval of hanger details.

5. FUNCTIONS OF PIPE FABRICATOR AND/OR ERECTOR

5.1 The pipe fabricator and/or erector shall work in close cooperation with the pipe hanger contractor and the purchaser's engineer to effect a hanger installation that meets the purchaser's requirements.

5.2 When the pipe fabricator and/or the pipe erector has the contractual responsibility for the purchase and furnishing of the hangers, he should serve as liaison between the pipe hanger contractor and the purchaser's engineer.

5.3 The pipe fabricator shall provide prompt information concerning any deviations or additions to the engineer's piping arrangement drawings and erection schedules.

5.4 The pipe fabricator shall provide actual weights and dimensions of specially fabricated pipe, fittings and valves, so that pipe hangers may be properly sized and loads accurately calculated. In order to avoid delays in design and delivery, it is imperative that this information be made available as early as possible.

5.5 The pipe erector, in order to ensure that pipe hangers are available when required and function properly when installed, shall be responsible for the following:

5.5.1 ***Receiving of hanger assemblies and components*** shall be in accordance with the following:

a) The receiving clerk should be responsible for verifying agreement between the bill of lading and the shipment as received. Any damage or shortage of the shipment per se should be noted on the bill of lading and the shipper and carrier immediately notified.

b) Unloading should be done with reasonable care, taking note of any precautionary notices on the containers. Items of shipment should not be dropped.

5.5.2 ***Storage of hanger assemblies and components*** shall be in accordance with the following:

a) It is recommended that containers be opened and contents verified against the packing list before they are placed in the storage area. Any damage or shortage should be noted and the pipe hanger contractor immediately notified.

b) Storage should be in a dry area and protected from the direct effects of weather and dirt.

c) It is recommended that a system be established to facilitate retrieval of material from storage.

d) It should be noted, that even with the best of storage conditions, hangers that receive a shop coat of rust inhibitive primer, may begin to deteriorate after six months. It is, therefore, recommended that within this period of time, the hangers be installed and finish coated, or that they be inspected and reprimed if required.

5.5.3 ***Hanger installation practices*** shall include the following:

a) Installation in accordance with the pipe hanger assembly drawing. For welded pipe attachments requiring non-standard contours, the attachments will be furnished overlength to facilitate custom fitting.

b) Relocation and reorientation of any hanger or restraint from the specified location shall not be permitted beyond that which is established by the responsible hanger designer, without his express permission.

c) Installed hangers or hanger components shall be used only for their intended purpose. They shall not be used for rigging or erection purposes.

d) ***Planned installation sequence***

The piping erector should be cognizant of the total amount of piping and equipment to be installed in any given area. He should develop an installation sequence giving priority to major components and strata of piping closest to the supporting structure. The piping erector also should review routing of field run piping in order to reserve space for known components to be installed at some later date in order to minimize revamp work. He should coordinate erection of all piping with other trades to maintain erection clearances and availability of building structure for supporting functions.

e) ***Hanger adjustment***

1) To compensate for pipe elevation discrepancies, hangers are usually provided with means to permit vertical adjustment during and after installation. Threaded devices using turnbuckles, clevises, etc. provide this feature or the adjustment is inherently available in the hanger design. No adjustment shall be made that will result in less than full usable thread engagement.

2) For small size piping, the necessity for adjusting can be detected visually. For large or heavy piping, the necessity for adjustment may not be as obvious and the installer must determine that each hanger or support substantially carries its proper load. Hanger drawings usually denote the operating and hydrostatic test loads.

3) Adjustment devices or features are usually provided with means for locking; lock nuts being the most common means. Upon completion of hanger adjustment, adjustment features should be locked or lock nuts should be properly tightened. It is not recommended to break threads or tack weld as a means of locking unless so specified on hanger drawings.

4) Hydrostatic testing, when required, should not be performed until all hanger assemblies have been properly installed, adjusted and loaded in accordance with the hanger drawings.

5) After completion of hydrostatic tests of the piping system, any devices (e.g., spring travel stops, temporary supports, etc.) furnished for hydrostatic test purposes must be removed.

6) Hangers for certain piping systems may be required to be checked for adjustment during initial run at operating temperature. Particular attention should be given to spring hangers and spring supports.

g) ***Inspection***

1) Each installed hanger should be verified against the hanger drawing to assure that all components are undamaged and have been properly installed prior to startup.

2) Threaded components used for adjustment of each hanger should be checked for operability and inspected for possible damage. Damaged components shall be replaced.

3) Lock nuts on threaded components, cotter pins, temporary locking devices (travel stops) and other locking means furnished with spring units should be properly engaged.

2) Restraint devices utilizing hydraulic fluids should be checked for proper amount of fluid. If it is found necessary to add fluid, it must be of the type specified by the restraint supplier.

3) Verify that spring locking devices and any temporary hangers and supports required for hydrostatic testing are removed and stored.

4) Spring hangers should be checked in both the cold and hot position to ensure that their load/travel indicators are approximately where the pipe hanger assembly drawings indicate that they should be and that the pipe is at the proper elevation.

f) ***Field run piping and equipment***

The hanger designer assumes responsibility for avoiding hanger interference with all piping, electrical trays, ducts and equipment specifically dimensioned on drawings supplied to him. Studies are made to avoid such interferences during the design phase of pre-engineered hangers; however the hanger designer cannot control avoidance of interference caused by field run piping, electrical conduits, instrumentation, added steel framing, etc. If modifications are made in the field, the hanger designer shall be so advised in writing.

5.5.4 Detailed requirements and recommendations relative to receiving, storage and installation of pipe hanger assemblies are covered in this Standard Practice Sections 13 and 14.

APPENDIX X2
GUIDELINES ON TERMINOLOGY FOR PIPE HANGERS AND SUPPORTS (formerly SP-90)

NOTE: THIS APPENDIX IS SUPPLEMENTARY AND DOES NOT INCLUDE MANDATORY REQUIREMENTS

1. **SCOPE**

1.1 This Appendix lists and defines the principle terms and abbreviations used to describe pipe hangers and supports. Users of this Standard Practice should consult the specific manufacturer for inherent limitations in the use of their products. This Appendix is comprised of separate sections which contain:

1.2 Abbreviation acronyms for organizations whose documents are applicable to pipe hangers and supports.

1.3 A glossary of terms used in pipe hanger and support design, manufacture, installation and application.

1.4 Abbreviations commonly applicable to pipe hangers and supports.

2. **PRODUCT DOCUMENT SOURCES**

2.1 A number of technical societies, trade associations, and government agencies in the United States and Canada promulgate codes, standards or specifications which are pertinent to pipe hangers and supports. The organizations most frequently referenced include:

ABS	American Bureau of Shipping
AGA	American Gas Association
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APFA	American Pipe and Fittings Association
API	American Petroleum Institute
ASM	American Society for Metals
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASPE	American Society of Plumbing Engineers
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BOCA	Building Officials and Code Administrators
CSA	Canadian Standards Association
DOD	Department of Defense
DOT	Department of Transportation
EAMI	Expansion Anchors Manufacturers Institute
EJMA	Expansion Joint Manufacturers Association
FM	FM Global
GSA	General Services Administration
IBC	International Building Code
ICBO	International Congress of Building Officials
ICC	International Code Council

(Continued Next Page)

IFI	Industrial Fasteners Institute
ISO	International Standardization Organization
MCA	Mechanical Contractors Association
MFMA	Metal Framing Manufacturer's Association
MSS	Manufacturers Standardization Society of the Valve & Fittings Industry
NACE	National Association of Corrosion Engineers
NASFCA	National Automatic Sprinkler & Fire Control Association, Inc.
NFPA	National Fire Protection Association
NIST	National Institute for Standards
NRC	Nuclear Regulatory Commission
OSHPD	CA Office of Statewide Health Planning and Development
PFI	Pipe Fabrication Institute
SAE	Society of Automotive Engineers
SBCCI	Southern Building Code Congress International
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SMI	Spring Manufacturers Institute
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratories
ULC	Underwriters Laboratories of Canada
USCG	United States Coast Guard
USN	United States Navy
VA	Veterans Administration

3. GLOSSARY PREFACE

3.1 Section 4 lists and defines terms commonly used in the design, manufacture, installation and application of pipe hangers and supports. Where more than one term is used to describe an item, the preferred term is defined, and synonymous terms are referred to the preferred terms.

3.2 Terms which are used in a definition, and which are underlined, are also defined in Section 4.

3.3 Any term for which an illustration appears in Figure A1 (Type Chart) has reference to a Hanger Type Number noted below that item.

3.4 “Pipe Hangers”, “Pipe Supports” and “Pipe Braces” are generic terms used to describe any device which transmits loads, forces or moments from the pipe to the building structure.

4. GLOSSARY

TERMS	DEFINITION
(A)	
Acceleration Limited:	A term relating to Snubbers in which acceleration is the means of control.
Accumulator:	A container used in conjunction with a single piston rod Hydraulic Snubber used to accommodate the difference in displaced fluid volume on each side of the piston. Also serves as a fluid Reservoir.
Adjustable:	Having linear adjustment capability (usually with threads).
Adjustment Device:	Components which provide for linear adjustability (e.g. Turnbuckle, Hanger Rod and Nut, Load Coupling on spring unit).
All Thread Rod:	A rod threaded its full length. Threads may be rolled or cut.
Alloy Pipe Clamp: Ref.: Types 2, 3, 42	A Pipe Clamp made from low chrome-moly (less than 5% chrome) materials for the purpose of resisting the effects of piping temperatures in the 750°F to 1100°F range (399°C to 593°C).
Anchor:	A rigid device used to prevent essentially all pipe rotation and displacement at the point of application.
Anchor Bolt:	A bolt which is embedded in concrete and is used for attachment to a concrete structure.
Architect/Engineer:	The agency normally responsible for the overall design of a project.
As Built:	Actual installed location and configuration of the Pipe Hanger Assembly.
Assemble & Tag:	See Bundle & Tag.
Auxiliary Steel:	See Supplementary Steel.
Auxiliary Stop:	See Travel Stop.
Axial Brace:	See Longitudinal Brace.
(B)	
Bag & Tag:	A method of shipping Pipe Hangers to a project whereby identical Components are placed in the same bag or carton and clearly marked.
Band Hanger: Ref.: Types 7, 9, 10	A Pipe Attachment providing for vertical adjustment, consisting principally of a formed strap.
Base Support:	A Pipe Support.
Beam Clamp: Ref.: Types 19, 20, 21, 23, 25, 27, 28, 29, 30	A clamping device used to connect the remainder of a Pipe Hanger Assembly to a structural beam, without requiring welding.

TERMS	DEFINITION
Bleed Rate:	A term relating to Hydraulic Snubbers and indicates the piston rod velocity at unit rated load.
Bolting:	Bolts, studs, and nuts used in a fastener application.
Brace:	See Brace Assembly.
Brace Assembly:	An assembly made of Pipe Support components designed to restrain a piping system. See Lateral Brace and Longitudinal Brace.
Bracing Drawing:	A Drawing of a Brace Assembly, which contains a drawing of the assembly, a bill of material, load and movement data, and a general identification.
Bracket: Ref.: Types 31, 32, 33 , 34	Cantilevered member, with or without a Kneebrace, designed to withstand a gravity load and/or horizontal forces.
Bulk Material:	Material which has been packaged in a manner in which identical items are grouped together and are identified only by quantity, size and/or manufacturer's figure number.
Bundle & Tag:	A method of shipping Pipe Hangers to a project whereby individual components of hanger assemblies are pre-assembled (when practical) for shipment and clearly marked.
(C)	
C-Clamp: Ref.: Types 19, 23	"C" shaped Beam Clamp which attaches to a flange of a structural member and provides for attaching a threaded rod.
Cable:	A component used to brace piping systems. Also called Wire Rope.
Cantilever:	A structural member supported and fixed at only one end.
Center Beam Clamp: Ref.: Types 21, 28, 29, 30	A jaw type Beam Clamp for use with I-beams and wide flange beams which provides a centered beam connection for the remainder of the Pipe Hanger Assembly.
Channel Clamp: Ref.: Type 20	A Side Beam Clamp w/channel adapter and hook rod, which attaches to the flange of a channel beam and provides a connection for the remainder of the Pipe Hanger Assembly.
Clamp, Beam:	See Beam Clamp.
Clamp, C:	See C-Clamp.
Clamp, Channel:	See Channel Clamp.
Clamp, Double Bolt Pipe:	See Three Bolt Pipe Clamp.
Clamp, Double Bolt Riser:	See Riser Clamp.

TERMS	DEFINITION
Clamp, Pipe:	See Pipe Clamp.
Clamp, Riser:	See Riser Clamp.
Clamp, Three Bolt Pipe:	See Three Bolt Pipe Clamp.
Clevis:	See Forged Clevis.
Clevis Hanger: Ref.: Type 1	A Pipe Attachment providing vertical adjustment, consisting of a clevis type top bolted to a formed steel bottom strap.
Clip, Pipe:	See Pipe Clip.
Cold Piston Setting:	An indicated piston position on a Hydraulic Snubber, denoting proper installation setting of the unit with the piping in the cold position.
Cold Pull:	See Cold Spring.
Cold Setting:	The position at which a Spring Hanger or Mechanical Snubber indicator is set denoting the proper installation setting of the unit with the piping in the cold position.
Cold Shoe:	A Pipe Shoe with an integral insulation insert which has been designed for cold temperature piping system application.
Cold Spring:	The act of pre-stressing a piping system during installation in order that the equipment reactions will be lower in the operating condition. This pre-stress is accomplished by the proper closure of the Cut Short gaps.
Commercial Piping System:	A piping system located in a commercial building structure which generally includes fire protection, plumbing, heating and cooling piping systems**.**
Completely Engineered Hanger Assembly:	Pipe Hanger Assembly which has been designed, detailed and provided with complete bill of material.
Component:	Any of a range of devices which are used to make up a Pipe Hanger Assembly.
Concrete Fastener:	A device installed in concrete by means of a drilled hole, to which a Pipe Hanger can be attached.
Concrete Insert Box: Ref.: Type 18	A cast-in-place Insert which provides for a rod attachment capable of nominal lateral adjustment.
Continuous Insert:	A cast-in-place channel Insert of varying length, permitting the attachment of more than one Hanger Rod.
Constant Support Hanger: Ref.: Types 54, 55, 56	A mechanical and spring coil device which produces a relatively constant supporting effect, while permitting vertical pipe movement.

TERMS	DEFINITION
Copper Finish:	A generic term to describe a copper colored finish. The purpose of the copper color is to identify that the product is sized for copper tubing.
Copper Plating:	An electroplating process whereby copper is deposited on a substrate.
Corrosion:	A generic term used to describe oxidation of a base metal.
Covering Protection Saddle:	See Pipe Covering Protection Saddle.
Covering Protection Shield:	See Protection Shield.
Critical Piping Systems:	See Primary Systems.
Cut Short:	The amount by which a section of a piping system is shortened (or lengthened) to provide for the Cold Spring of a piping system.
(D)	
Desiccant:	A drying agent such as calcium chloride used to remove moisture from packaged products.
Deviation:	A term used to describe the accuracy of a Constant Support Hanger which is a measure of the maximum difference between the actual and specified supporting effect, through its travel cycle, expressed as a percentage.
Double Acting:	That which provides resistance in both tension and compression.
Double Bolt Pipe Clamp:	See Three Bolt Pipe Clamp.
Drag:	A term relating to both Hydraulic and Mechanical Snubbers which refers to the force required to extend and retract the unit at a low velocity. For devices with an actuated control means, drag is measured in the un-actuated condition.
Drawing:	A pictorial representation of a part or assembly.
Dynamic Force:	Any additional loading condition that must be taken into consideration beyond steady state loading. See Pipe Hanger Load.
(E)	
Elbow Lug:	A Pipe Attachment welded to an elbow, for the purpose of attaching the remainder of the Pipe Hanger Assembly.
Electro Galvanized:	A protective coating of electroplated zinc in accordance with ASTM B 633 or ASTM F 1941 for fasteners.
Electrolysis:	See Galvanic Corrosion.
Electroplated:	Plating by the electro deposition process.

TERMS	DEFINITION
Elevation, Pipe:	See Pipe Elevation.
Embedded Plate:	A steel plate which is cast in place in a concrete structure.
Engineered Hanger Assembly:	See Completely Engineered or Semi-Engineered Hanger Assembly.
Erection:	The activity associated with maneuvering piping assemblies into their proper position in an installation, connecting them together, and installing Pipe Hanger Assemblies for the support of the piping.
Erector:	The contractor who is directly responsible for the installation of Pipe Hanger Assemblies and the Erection of piping.
Extension Riser Clamp:	See Riser Clamp.
Extension Split Clamp: Ref.: Type 12	A Pipe Clamp primarily used on non-insulated piping and provided with a female threaded attachment.
Export Pack:	Packaging and documentation requirement for transportation of products to foreign destinations.
Eye Nut:	See Weldless Eye Nut.
Eye Rod:	A Hanger Rod having an end formed in a circular or pear shape, permitting attachment to other Components by means of a bolt or pin. The eye may be forged, welded or non-welded.
Eye Socket: Ref.: Type 16	A device which provides for the attachment of a threaded Hanger Rod to the bolt of another component.
(F)	
Fabrication:	A term used to refer to a part constructed or manufactured out of standard parts or raw materials.
Fabricated Steel:	Fabrication which is made from steel plate and standard shapes.
Fabricated Clevis:	A Clevis manufactured by cutting and machining of steel plate or welding of components.
Fabricated Turnbuckle:	A Turnbuckle manufactured by cutting and machining of steel plate or welding of components.
Fabricator:	A business engaged in producing fabricated Pipe Supports.
Forged Steel Clevis: Ref.: Type 14	A device which provides for the attachment of a threaded Hanger Rod to a bolted or pinned connection.
Forged Eye Nut:	See Weldless Eye Nut.

TERMS	DEFINITION
Four-way Brace:	A Brace Assembly which is designed to control the pipe from moving in four directions. A Brace Assembly which consists of both a Lateral Brace and a Longitudinal Brace.
Framing Channel:	Roll formed metal shapes.
Framing Steel:	See Supplementary Steel.
(G)	
Galvanic Corrosion:	The producing of Corrosion by differences in electrical potential between dissimilar materials, in the presence of moisture.
Galvanized:	A zinc coating applied to steel for Corrosion protection.
Gang Hanger:	See Multiple Support.
Guide:	A device used to permit pipe movement in a predetermined direction while restraining movement in other directions.
(H)	
Hanger:	See Pipe Hanger.
Hanger Designer:	A designer tasked to develop a piping support system. (Typically, the Architect/Engineer has this responsibility for a given piping project, unless otherwise designated.)
Hanger Loads:	See Pipe Hanger Loads.
Hanger Location:	See Pipe Hanger Locations.
Hanger Rod:	Round steel bar normally threaded used to connect other Components to make up a Pipe Hanger Assembly.
Heavy Bracket: Ref.: Type 33	A Bracket used for the support of heavy loads.
Hinged Pipe Clamp:	See Split Ring.
Horizontal Traveler: Ref.: Type 58	Any device which will permit the upper end of a Pipe Hanger to move in a manner which will accommodate horizontal piping movement.
Hot Dip Galvanized:	A Corrosion protection coating of zinc in accordance with ASTM A 123 or A 153 for threaded items.
Hot Piston Setting:	The position at which the piston on a Hydraulic Snubber should be with the piping in the hot or operating position.
Hot Setting:	The position at which the indicator on a Spring Hanger or Mechanical Snubber should be with the piping in the hot or operating position.

TERMS	DEFINITION
Hot Shoe:	A Pipe Shoe with an integral insulation insert which has been designed for high temperature piping systems application.
Hydraulic Snubber:	A hydraulic cylinder or rotating vane device used for the control of shock or sway in piping systems, while allowing for normal thermal expansion.
Hydrostatic Lock:	See Travel Stop.
Hydrostatic Test:	A pre-operational test, whereby the piping system is subjected to a pressurized fluid test in excess of the operational pressure to assure the integrity of the system.
Hydrostatic Test Load:	A temporary loading condition consisting of a total of the gravitational piping, insulation and test fluid weights for piping systems subjected to hydrostatic tests.
(I)	
Industrial Piping Systems:	A piping system located in an industrial complex which generally refer to process or steam piping systems.
Insert:	A device, embedded in concrete, to which a Pipe Hanger Assembly can be attached.
Insert Box:	See Concrete Insert Box.
Insert, Continuous:	See Continuous Insert.
Insert Nut:	A female threaded device which locks into position in an Insert and receives a threaded Hanger Rod.
Insulation Protection Saddle:	See Pipe Covering Protection Saddle.
Integral Attachment:	See Welded Pipe Attachment.
Intermediate Anchor:	An Anchor located between two anchors on a flexible piping system. It is used to control proper distribution of loading and movement.
Invert:	Elevation, bottom of pipe.
(J)	
Jacket:	A non-load bearing metal covering placed around the insulation to protect it against damage.
(K)	
Kneebrace:	A diagonal structural member used to transfer load or provide stability.

TERMS	DEFINITION
(L)	
Lateral Brace:	A two-way Brace Assembly designed to restrain a piping system against transverse loads.
Lateral Stability:	The state or degree of control of a piping system transverse to the run of the pipe.
Light Bracket: Ref.: Type 31	A Bracket used for the support of light loads.
Limit Stop:	An internal device built into a Variable Spring Hanger or Constant Support Hanger to prevent the over stressing of the spring coil, over-travel, or release of the load.
Liner:	Material placed between pipe and Pipe Attachment to protect piping from damage or other undesirable effects.
Load Adjustment Scale:	A scale used on a Constant Support Hanger to indicate the load adjustment.
Load Bolt or Pin:	A bolt or pin which is used to support the weight being carried by the Pipe Hanger Assembly; e.g., the top pin or bolt in a Three Bolt Pipe Clamp.
Load Coupling:	An Adjustment Device used to connect the Hanger Rod to a Variable Spring Hanger or Constant Support Hanger.
Load Indicator:	The load plate or other means used to indicate the reading on the Load Scale of a Variable Spring Hanger.
Load Rated:	The rating of a particular size of component or assembly to withstand a specified force with a Safety Factor applied.
Load Scale:	A scale attached to a Variable Spring Hanger to provide a means of indicating the supported load.
Load Variation:	A term associated with Variable Spring Hangers used to describe the difference in supporting effect between the hot and cold elevations of the support point.
Loads:	See Pipe Hanger Loads.
Locations:	See Pipe Hanger Locations.
Lock Up:	A term relating to Snubber control devices becoming actuated.
Longitudinal Brace:	A two-way Brace Assembly designed to restrain a piping system against axial loads.
Lug:	See Plate Lug.

TERMS	DEFINITION
(M)	
Mark No.:	A unique number used to identify Pipe Hangers.
Mechanical Snubber:	A mechanical device used for the control of shock or sway in piping systems, while allowing for normal thermal expansion.
Medium Bracket: Ref.: Type 32	A Bracket used for the support of moderate loads.
Metal Framing Channel:	A cold formed structural member used to support or brace piping.
Metric Hanger:	A Pipe Hanger that contains a metric threaded connection.
Mill Galvanized:	A Corrosion protection coating of zinc in accordance with ASTM A 653.
Multiple Support: Ref.: Type 59	A Pipe Hanger Assembly consisting of a common cross member used to support parallel runs or banks of piping.
(N)	
Negligible Movement:	A calculated movement at a support point where the use of a Rigid Hanger or Rigid Support will suffice because of the inherent flexibility of the piping system.
Nominal Size:	The identified size which may vary from the actual size.
Non-Integral Attachment:	Any Pipe Attachment not requiring welding to the pipe.
Nut, Eye:	See Weldless Eye Nut.
Nut, Insert:	See Insert Nut.
(O)	
Offset:	A relative displacement between the Structural Attachment and Pipe Attachment, which may be incorporated into the design of the Pipe Hanger Assembly to accommodate the piping movement.
(P)	
Pipe Attachment:	Any device used to connect the pipe to the remainder of the Pipe Hanger Assembly.
Pipe Brace:	See Brace Assembly.
Pipe Clamp: Ref.: Types 2, 3, 4, 8, 12, 42	A bolted Pipe Attachment which clamps around the pipe to connect the pipe to the remainder of a Pipe Hanger Assembly.
Pipe Clip: Ref.: Type 26	A Pipe Attachment used to hold the pipe directly to a structure, also referred to as a Strap or Pipe Strap. This term is also used in Europe to refer to a Pipe Clamp.

TERMS		DEFINITION
Pipe Covering Protection Saddle: Ref.: Type 39		A device used to prevent damage to the insulation at the support point.
Pipe Elevation:	Design	The elevation at which the piping is normally shown on the piping drawings.
	Erected	The elevation at which the piping is installed prior to Cold Pull closure of the final weld gap.
	After Cold Pull	The elevation of the piping after the final weld gap has been closed and the piping has been positioned to its proper cold elevation.
	Cold	The final elevation at which the piping is installed. If there are no Cut Short requirements, this elevation is the same as the design and erected elevation.
	Hot	The elevation of the piping at full operating conditions.
Pipe Hanger:		**(1)** A device which is normally suspended from a structure and is used to carry the piping load in tension. (See also Section 3.4 of this Appendix.) **(2)** May also describe any device used to transmit the piping load to a structure.
Pipe Hanger Assembly:		A general term used to describe a series of assembled components which make up a Pipe Hanger, Pipe Support, Restraint, Anchor, Guide, etc.
Pipe Hanger Drawing:	Engineered Drawing	A Drawing of a Pipe Hanger Assembly or a Brace Assembly which contains a drawing of the assembly, a bill of material, load and movement data, location plan and a unique identification.
	Semi-Engineered Drawing	A Drawing of a Pipe Hanger Assembly or Brace Assembly which contains a drawing of the assembly, a bill of material, load and movement data, and a general identification.
	Typical Drawing	A Drawing of a Pipe Hanger Assembly or Brace Assembly which contains a drawing of the assembly, a bill of material, and a general identification. This type of drawing is associated with Random Hanger and Brace materials.
Pipe Hanger Force:		See Pipe Hanger Load.
Pipe Hanger Load:	Cold Load	Loading at ambient temperature, resulting from the use of Variable Spring Hangers in the support of a piping system. The cold load equals the Operating Load plus or minus the Load Variation.
	Cold Spring Load	An additional force that may occur at a support point as a result of the Cold Spring of a piping system.
	Deadweight Load	Loading condition which considers only the weight of the piping, insulation and contents.

TERMS		DEFINITION
Pipe Hanger Load (cont'd):	Design Load	The combination of operating and other loads as defined by job specification.
	Dynamic Load	Temporary loading resulting from internal and/or external forces which tend to place the pipe in motion.
	Friction Load	Loading as a result of frictional forces that exist between sliding surfaces.
	Hot Load	Operating Load on a Variable Spring Hanger. (Normally represents deadweight under operating conditions.)
	Hydrostatic Load	Loading associated with the Hydrostatic Testing of a piping system. (Includes weights of piping, insulation and testing fluid.)
	Operating Load	Loading associated with "normal" operating conditions. (Includes Deadweight Load, and thermal and/or pressure forces.)
	Safety Valve Thrust Load	Temporary loading resulting from a reaction to the discharge of a safety valve, relief valve, or rupture disc.
	Seismic Load	Temporary loading associated with the occurrence of an earthquake.
	Thermal Load	Loading introduced by the restraint of a piping system against thermal expansion or contraction.
	Turbine Trip-Out Load	Temporary loading resulting from the sudden stoppage of steam flow to the turbine.
	Wind Load	Loading introduced by wind blowing against outdoor piping system.
	Water Hammer Load	Temporary loading resulting from a change in the flow rate of the piping contents.
Pipe Hanger Location:	Cold	The location of the Pipe Attachment with reference to the adjacent structure with the piping in the installed position, if there are no Cut Short requirements.
	After Cold Pull	The location of the Pipe Attachment with reference to the adjacent structure, after the Cut Short pipes have been welded together.
	Hot	The location of the Pipe Attachment with reference to the adjacent structure, when the piping is in its hot or operating position.
Pipe Hanger Plan Location:	Design	The nominal location at which the Piping Attachment is shown on the piping drawing with reference to the adjacent structure.
	Without Offset	When both piping and structural attachments are installed at the design location and also used at points of support with nominal thermal movements.

TERMS	DEFINITION
Pipe Hanger Plan Location (cont'd): With Offset	When installation is made with relative displacement between the pipe and structural attachment. Offset may be calculated as some percentage of the anticipated thermal growth at the support point to obtain the optimum operating position.
Pipe Rack:	A structural frame that is used to support piping systems.
Pipe Roll: Ref.: Types 41, 43, 44, 45, 46	A roller device used to support horizontal piping and provide for axial movement.
Pipe Saddle Supports: Ref.: Types 36, 37, 38	A Stanchion utilizing a curved section for cradling the pipe.
Pipe Shoe:	Normally a Tee section attached to the pipe to transmit the load or forces to the adjacent structure.
Pipe Size:	Reference to nominal pipe size (NPS), unless otherwise noted.
Pipe Sleeve:	A short piece of pipe cast in concrete which piping systems subsequently pass through. It eliminates the need to core holes in concrete.
Pipe Slide: Ref.: Type 35	A device consisting of a Pipe Attachment and a Slide Plate, to accommodate horizontal pipe movement.
Pipe Strap:	See Pipe Clip.
Pipe Support:	**(1)** A device by which piping is normally carried from beneath and is used to carry the piping weight in compression. (See also Section 3.4 of this Appendix.) **(2)** May also describe any device used to transmit the piping load to a structure.
Plate Lug: Ref.: Type 57	An attachment welded to a structural member or piping, to provide for a pinned or bolted connection to the remainder of a Pipe Hanger Assembly.
Point Loading:	The point of application of a load between a curved and flat surface.
Pre-Galvanized:	See Mill Galvanized.
Pre-Insulated Shield:	A rigid insulation insert attached to a Protection Shield designed to support the Pipe Hanger Load.
Pre-Insulated Support:	A Pipe Support with an integral insulation insert which has been designed for insulated piping systems.
Preset:	Pre-positioning of an adjustable product to its prescribed installation setting to provide ease of installation.
Primary System:	Main Steam, Hot & Cold Reheat, Boiler Feed Discharge System and others that may be designated by the Architect/Engineer.
Protection Saddle:	See Pipe Covering Protection Saddle.

TERMS	DEFINITION
Protection Shield: Ref.: Type 40	A metal shield used to maintain the integrity of the Vapor Barrier and/or protect the insulation at support locations.
(R)	
Random Hanger:	Pipe hanger whose location and type are determined by the Erector. These hangers are field fabricated, utilizing Bulk Material provided for this purpose.
Random Material:	See Bulk Material.
Reservoir:	A container used in conjunction with a fluid device used to provide a continuous supply of reserve fluid.
Restraint:	Any device which prevents, resists or limits the free movement of the piping.
Restraining Control Device: Ref.: Types 47, 50	Any hydraulic, mechanical, spring, or rigid device used for the control of shock and sway in piping systems.
Residential Piping System:	A piping system located in a residential building which generally refers to plumbing and heating piping systems.
Resilient Support:	See Spring Hanger.
Retaining Strap:	A device used to secure C-Clamps to structural steel.
Rigid Brace:	Brace Assembly capable of providing restraint in both tension and compression as opposed to a cable.
Rigid Hanger:	A Pipe Hanger which does not accommodate vertical movement.
Rigid Support:	A Pipe Support which does not accommodate vertical movement.
Rigging:	Any temporary device such as chain, rope, cable, etc. used to erect piping and install Pipe Hangers.
Ring Band: Ref.: Types 9, 10	A Pipe Attachment consisting of a formed steel Strap and a knurled swivel nut used for vertical adjustment.
Ring, Split:	See Split Ring.
Riser:	Any vertical portion of a piping system.
Riser Clamp: Ref.: Types 8, 42	**(1)** A Pipe Clamp for the support of vertical piping having separate Load Bolts, to transfer the piping load to the remainder of the Pipe Hanger Assembly. (Type 42) **(2)** A Pipe Clamp for the support of vertical piping, whose ears have been extended to permit the transfer of the piping load to a bearing surface upon which the ears of the clamp will rest. (Type 8) Also known as Extension Riser Clamp.

TERMS	DEFINITION
Riser Hanger:	A Pipe Hanger or Pipe Support connected to the Riser.
Rod:	See Hanger Rod.
Rod Coupling:	A tapped device used to join two threaded rods.
Rod Hanger:	An adjustable vertical assembly consisting of Structural Attachment, Hanger Rod (with or without intermediate Components), and Pipe Attachment.
Rod Stiffener:	A device used to increase the lateral stiffness of a Hanger Rod.
Roll Stand: Ref.: Types 44, 46	A Pipe Roll mounted in a stand, used to support horizontal piping from beneath and providing for axial movement.
Roll and Plate: Ref.: Type 45	A Pipe Roll and bearing plate used for minimal axial movement where no vertical adjustment is necessary.
Roll Hanger: Ref.: Types 41, 43	Pipe Attachment which utilizes a Pipe Roll for axial movement and is used in a Suspension Hanger.
Roll Plate: Ref.: Type 45	A flat device which provides a bearing surface for a Pipe Roll.
Roll Trapeze:	See Single Pipe Roll.
(S)	
Saddle:	See Pipe Covering Protection Saddle.
Safety Factor:	The ultimate strength of a material divided by the allowable stress. Also the ultimate strength of a device divided by the rated capacity.
Scale Plate:	A load or movement scale which is attached to Spring Hangers.
Secondary Systems:	Those piping systems which are not considered to be Primary Systems.
Seismic Control Device:	Any device used to provide structural stability to a piping system during an earthquake.
Semi-Engineered Hanger Assembly:	A Pipe Hanger Assembly which has been indicated on a piping drawing and has been designated as a specific type; i.e. rigid, spring, etc. with Spring Hangers indicating load, movement, spring type and size. This hanger assembly is field fabricated utilizing Bulk Material where applicable.
Service Conditions:	Operating pressures and temperatures for piping systems. Also describes the environmental conditions in which the Pipe Hanger Assembly is located.
Shear Lug:	A welded Pipe Attachment subjected primarily to shear stress, transferring axial pipe load to the supporting member.

TERMS	DEFINITION
Shield:	See Protection Shield.
Side Beam Bracket: Ref: Type 34	A Bracket provided with a hole in the vertical leg for bolting to the building structure and a hole in the horizontal leg to receive a threaded Hanger Rod.
Side Beam Clamp: Ref: Types 25, 27	A Beam Clamp that attaches to a flange of an I-beam or wide flange beam and provides an off-center attachment for the remainder of a Pipe Hanger Assembly.
Significant Movement:	A calculated movement at a support point, sufficient to require Offset or a type of support which will accommodate the movement.
Single Acting:	That which provides resistance in tension or compression, but not both.
Single Pipe Roll: Ref.: Type 41	A Pipe Attachment which utilizes a Pipe Roll for axial movement and is used in a Trapeze Hanger or Support.
Sleeper:	A horizontal beam, usually located at grade, upon which horizontal pipe runs are supported.
Slenderness Ratio:	For compression members, the term denotes the unbraced effective length in inches divided by the least radius of gyration in inches. It is used in the determination of allowable compressive stress due to buckling considerations.
Slide Plate: Ref.: Type 35	A flat plate whose surface has been prepared in a manner which will facilitate a sliding motion.
Slide, Pipe:	See Pipe Slide.
Sliding Support:	A device providing support from beneath by offering no resistance, other than frictional, to horizontal movement.
Slip Fitting:	A device used in Brace Assemblies which provides for some movement of the piping system being braced.
Snubber:	A hydraulic, mechanical, or spring device used for the control of shock and sway in piping systems.
Special Component:	Any Component which is designed and fabricated on an "as required" basis.
Spider Guide:	A Pipe Attachment for insulated piping used for maintaining alignment of piping through its axial expansion and contraction cycles.
Split Ring: Ref.: Types 6, 11	A Pipe Clamp primarily used on non-insulated piping, provided with a hinge which permits installation before or after the piping is in place.
Spring Cushion Hanger: Ref.: Type 48	A simple, non-calibrated, single rod spring support, used for providing a cushioning effect.

TERMS	DEFINITION
Spring Cushion Roll: Ref.: Type 49	A pair of spring coils with retainers, for use with a Single Pipe Roll.
Spring Hanger: Ref.: Types 48, 49, 51-56	A Pipe Hanger, using a spring or springs, to permit vertical movement in a piping system.
Spring Snubber:	See Spring Sway Brace.
Spring Sway Brace: Ref.: Type 50	A spring device used for the control of vibration or shock, or bracing against sway in piping systems.
Stanchion:	A Pipe Support using a vertical member in compression.
Stop:	A device used to limit pipe movement in a specific direction.
Strap:	See Pipe Clip.
Stress Analysis:	An analytical report which evaluates the material stress levels in piping systems or structural components.
Strip Insert:	See Continuous Insert.
Structural Attachment:	A device used to connect the remainder of the Pipe Hanger Assembly to the structure.
Strut:	A rigid tension/compression member. Also a generic term/name for Metal Framing Channel.
Strut Clamp:	A type of Pipe Clip used to secure a pipe to a Metal Framing Channel member.
Supplementary Steel:	A structural steel member, normally less than 10 feet in length, used between existing members as a means of providing for the attachment of a Pipe Hanger.
Support:	See Pipe Support.
Suspension Hanger:	A Pipe Hanger.
Sway Brace:	See Restraint Control Device. Also a generic name for a Lateral Brace.
Swivel Pipe Ring:	See Ring Band.
Swivel Turnbuckle: Ref.: Type 15	A device which provides flexibility at the pipe connection, in addition to linear adjustment for Suspension Hanger.

TERMS	DEFINITION
(T)	
Three Bolt Pipe Clamp: Ref.: Type 3	A Pipe Clamp normally used for horizontal insulated piping, which utilizes clamping bolts to attach the clamp to the pipe and a separate Load Bolt to transfer the piping weight to the remainder of the Pipe Hanger Assembly from a point outside the insulation. (Formerly referred to as a Double Bolt Pipe Clamp)
Top Beam Clamp: Ref.: Types 19, 25	A Beam Clamp which attaches to the top of a structural beam and provides an attachment to the remainder of the Pipe Hanger Assembly from the side of the beam.
Transverse Brace:	See Lateral Brace.
Trapeze Hanger: Ref: Type 59	A Pipe Hanger consisting of parallel vertical rods which are suspended from a structure and connected at their lower ends by a horizontal member from which the pipe is supported. Some of its uses are for clearing overhead obstructions or where insufficient vertical space is available to accommodate a single Suspension Hanger.
Trapeze Hanger - Constant Support: Ref.: Type 56	A Trapeze Hanger utilizing Constant Support Hanger.
Trapeze Hanger - Variable Spring: Ref.: Type 53	A Trapeze Hanger utilizing Variable Spring Hanger.
Travel Device:	See Horizontal Traveler.
Travel Indicator:	For Constant Support Hangers: A device used to indicate the reading on the Travel Scale in order to show the vertical pipe movement. For Variable Spring Hangers: The spring load plate which indicates the reading on the Travel Scale in order to show the vertical pipe movement.
Travel Scale:	A device attached to a spring unit, whose purpose is to provide for an indication of the vertical pipe movement.
Travel Stop:	A device which temporarily locks the moveable parts of a Spring Hanger in a fixed position, enabling a load to be transferred through the Spring Hanger to the supporting structure while maintaining the piping at a desired elevation during Erection and/or Hydrostatic Testing.
Turnbuckle: Ref.: Type 13	A device with one left-hand female threaded end and one right-hand female threaded end, used to join two threaded rods and provide linear adjustment.
Turnbuckle Adjuster:	See Swivel Turnbuckle.
Two-way Brace:	A Brace Assembly which is designed to control the pipe from moving back and forth in two directions. See Lateral Brace or Longitudinal Brace.

TERMS	DEFINITION
(U)	
U-Bolt: Ref.: Type 24	A U-shaped rod with threaded ends, that fits around a pipe and is attached to a supporting member.
(V)	
Vapor Barrier:	An uninterrupted covering for an insulated pipe to preclude the introduction of moisture into insulation.
Variability:	The Load Variation of a Variable Spring Hanger divided by the Hot Load expressed as a percentage.
Variable Spring Hanger: Ref.: Types 51, 52, 53	A spring coil device which produces a varying supporting effect while permitting vertical pipe movement.
Velocity Limited:	A term relating to Snubbers in which velocity is the means of control.
Vibration Control Device:	A device used to reduce and/or control the transmission of vibration from a piping system or piece of equipment, to the building structure.
Vibration Isolation Device:	See Vibration Control Device.
(W)	
Welded Beam Attachment: Ref.: Type 22	A U-shaped flat bar device, normally welded to a steel beam used to connect the remainder of a Pipe Hanger Assembly.
Welded Pipe Attachment:	A Pipe Attachment which requires welding to the pipe in order to connect the pipe to the remainder of the Pipe Hanger Assembly.
Weldless Eye Nut: Ref.: Type 17	A forged steel device which provides for the attachment of a threaded Hanger Rod to a bolt or pin connection.
Wide Flange Beam Clamp w/Links: Ref.: Type 29	A steel Beam Clamp for the suspension of pipe loads from structural beams.
Wire Hook:	A type of Pipe Hanger which is simply a bent piece of heavy wire and is usually associated with Residential Piping Systems.
Wire Rope:	See Cable.

5. ABBREVIATIONS

5.1 The following abbreviations or acronyms are intended for use on engineering drawings. Abbreviations are to be used only where necessary to save time and space. Since abbreviations may have to be interpreted by people of varying backgrounds, they should be used only where their meaning is unquestionably clear to the intended reader. Where any doubt exists the word should be spelled out.

In the case of multiple abbreviations, the first is per ASME Y14.38, and the others are popular trade usage.

Additional abbreviations may be found in applicable industry publications.

Term	Abbreviation
ACTUAL TRAVEL	AT
ADDITIONAL	ADDL
ADJUSTMENT	ADJ
AFTER COLD PULL	ACP
ALLOWABLE	ALLOW
ALLOW TO SLIDE	ATS
ANCHOR	ANCH
ANGLE	ANG
ARCHITECT/ENGINEER	A/E
ASSEMBLY	ASSY
ATTACHMENT	ATTCH
BACK TO BACK	B-B
BEAM	BM
BEAM ATTACHMENT	BA
BEFORE COLD PULL	BCP
BILL OF MATERIAL	B/M
BOTTOM OF PIPE	BOP
BOTTOM OF STEEL	BOS
BRACKET	BRKT
CAST IRON	CI
CENTER To CENTER	C-C
CENTERLINE	CL
CHECK	CHK
COLD FINISH	CF
COLDLOAD	CL
COLD PISTON SETTINGS	CPS
COLD ROLLED	CR
COLUMN	COL
CONCRETE	CONC
CONNECTION	CONN
CONSTANT	CONST
CONSTANT SUPPORT	CS
CONTINUE	CONT
COPPER TUBING	CT
COUPLING	CPLG

Term	Abbreviation
DESIGN	DSGN
DETAIL	DET
DIAGONAL	DIAG
DIAMETER	DIA
DIMENSION	DIM
DOUBLE	DBL
DOWN	DN
DRAIN, WASTE, AND VENT PIPING	DWV
DRAWING	DWG
ELBOW	ELL
ELEVATION	EL
ERECTED	ERECT
EXISTING	EXST
EXPANSION	EXP
EXTENSION	EXT
EXTRA HEAVY	XH
EYE ONE END	EOE
FABRICATE	FAB
FAR SIDE	FS
FIGURE	FIG
FLANGE	FL, FLG
GRADE	GR
GRIND CORNERS ROUND	GCR
GROUND	GND
HANGER	HGR
HEAVY	HVY
HEXAGONAL HEAD	HEX HD
HEX NUT	HN
HORIZONTAL	HORIZ
HOT LOAD	HL
HOT PISTON SETTING	HPS
HOT ROLLED	HR
INSIDE DIAMETER	ID
INSULATION	INSUL
INVERT	INV

Term	Abbreviation
IRON PIPE SIZE	IPS
JAM NUT	JN
JOINT	JT
LEFT HAND	LH
LENGTH	LG
LONG	L, LG
LONG LEG HORIZONTAL	LLH
LONG LEG VERTICAL	LLV
LONG RADIUS ELBOW	LR-ELL
LONG SIDE VERTICAL	LSV
LOOSE FIT	LF
MATERIAL	MATL
MAXIMUM	MAX
MINIMUM	MIN
MISCELLANEOUS	MISC
MOVEMENT	MVT
NEAR SIDE	NS
NOMINAL	NOM
NOMINAL PIPE SIZE	NPS
NOT TO SCALE	NTS
NUMBER	NO
OPERATING	OPER
OUTSIDE DIAMETER	OD
PENETRATION	PEN
PIPE ATTACHMENT	PA
PLATE	PL
POUNDS	LBS
PROTECTION	PROT
RADIUS	RAD
RECTANGULAR	RECT
REDUCER	RDCR
REFERENCE	REF
REQUIRED	REQD
REVISION	REV
RIGHT HAND	RH
ROUND	RND
SCHEDULE	SCH, SCHED
SECTION	SECT
SHEET	SH
SHOP WELD	SW
SHORT RADIUS ELBOW	SR-ELL
SKETCH	SK

Term	Abbreviation
SNAP OFF END FASTENER	SOEF
SPECIAL	SPCL
SPECIFICATION	SPEC
SPRING	SPG
SQUARE	SQ
STAINLESS STEEL	SS
STANDARD	STD
STEEL	STL
STIFFENER	STIF
STRAIGHT	STR
STRAIGHT PIPE THREAD	NPSL, NPSM
STRUCTURAL	STRL
STRUCTURAL ATTACHMENT	SA
STRUCTURE	STRUCT
SUPPLIED	SUPP
SUPPORT	SPRT
TAKE OUT	TO
TANGENT	TAN
TAPER PIPE THREAD	NPT
THICK	THK
THREAD	THD
THREAD BOTH ENDS	TBE
THREAD FULL LENGTH	TFL
THREAD ONE END	TOE
TIGHT FIT	TF
TOP OF CONCRETE	TOC
TOP OF STEEL	TOS
TOTAL	TOT
TOTAL TRAVEL	TT
TRAPEZE	TRAP
TRAVEL STOP	TS
TURBINE	TURB
TURNBUCKLE	TRNBKL, TBKL
TYPICAL	TYP
VARIABLE SPRING	VS
VERTICAL	VERT
WITH	W/
WITHOUT	W/O
WORKING POINT	WP

List of MSS Standard Practices
(Price List Available Upon Request)

Number	
SP-6-2007	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP-9-2008	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-2008	Standard Marking System for Valves, Fittings, Flanges and Unions
SP-42-2009	Class 150 Corrosion Resistant Gate, Glove, Angle and Check Valves with Flanged and Butt Weld Ends
SP-43-2008	Wrought and Fabricated Butt-Welding Fittings for Low Pressure, Corrosion Resistant Applications
SP-44-2006	Steel Pipeline Flanges
SP-45-2003	(R 08) Bypass and Drain Connections
SP-51-2007	Class 150LW Corrosion Resistant Flanges and Cast Flanged Fittings
SP-53-1999	(R 07) Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
SP-54-1999	(R 07) Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Radiographic Examination Method
SP-55-2006	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Evaluation of Surface Irregularities
SP-58-2009	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
SP-60-2004	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
SP-61-2009	Pressure Testing of Valves
SP-65-2008	High Pressure Chemical Industry Flanges and Threaded Stubs for Use with Lens Gaskets
SP-67-2002a	Butterfly Valves
SP-68-1997	(R 04) High Pressure Butterfly Valves with Offset Design
SP-69-2003	Pipe Hangers and Supports - Selection and Application (ANSI/MSS Edition)
SP-70-2006	Gray Iron Gate Valves, Flanged and Threaded Ends
SP-71-2005	Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-72-1999	Ball Valves with Flanged or Butt-welding Ends for General Service
SP-75-2008	Specification for High Test Wrought Butt Welding Fittings
SP-78-2005a	Gray Iron Plug Valves, Flanged and Threaded Ends
SP-79-2009	Socket-Welding Reducer Inserts
SP-80-2008	Bronze Gate, Globe, Angle and Check Valves
SP-81-2006a	Stainless Steel, Bonnetless, Flanged, Knife Gate Valves
SP-83-2006	Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
SP-85-2002	Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-86-2002	Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators
SP-88-1993	(R 01) Diaphragm Valves
SP-91-2009	Guidelines for Manual Operation of Valves
SP-92-1999	MSS Valve User Guide
SP-93-2008	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components - Liquid Penetrant Examination Method
SP-94-2008	Quality Std for Ferritic and Martensitic Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Ultrasonic Examination Method
SP-95-2006	Swage(d) Nipples and Bull Plugs
SP-96-2001	(R 05) Guidelines on Terminology for Valves and Fittings
SP-97-2006	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Buttwelding Ends
SP-98-2001	(R 05) Protective Coatings for the Interior of Valves, Hydrants, and Fittings
SP-99-1994	(R 05) Instrument Valves
SP-100-2002	Qualification Requirements for Elastomer Diaphragms for Nuclear Service Diaphragm Valves
SP-101-1989	(R 01) Part-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-102-1989	(R 01) Multi-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-104-2003	Wrought Copper Solder Joint Pressure Fittings
SP-105-1996	(R 05) Instrument Valves for Code Applications
SP-106-2003	Cast Copper Alloy Flanges and Flanged Fittings, Class 125, 150 and 300
SP-108-2002	Resilient-Seated Cast-Iron Eccentric Plug Valves
SP-109-1997	(R 06) Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1996	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-2001	(R 05) Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1999	(R 04) Quality Standard for Evaluation of Cast Surface Finishes -Visual and Tactile Method. This SP must be sold with a 10-surface, three Dimensional Cast Surface Comparator, which is a necessary part of the Standard. Additional Comparators may be sold separately.
SP-113-2001	(R 07) Connecting Joint between Tapping Machines and Tapping Valves
SP-114-2007	Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000
SP-115-2006	Excess Flow Valves, 1 1/4 NPS and Smaller, for Fuel Gas Service
SP-116-2003	Service Line Valves and Fittings for Drinking Water Systems
SP-117-2006	Bellows Seals for Globe and Gate Valves
SP-118-2007	Compact Steel Globe & Check Valves - Flanged, Flangeless, Threaded & Welding Ends (Chemical & Petroleum Refinery Service)
SP-119-2003	Factory-Made Belled End Socket Welding Fittings
SP-120-2006	Flexible Graphite Packing System for Rising Stem Steel Valves (Design Requirements)
SP-121-2006	Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves
SP-122-2005	Plastic Industrial Ball Valves
SP-123-1998	(R 06) Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube
SP-124-2001	Fabricated Tapping Sleeves
SP-125-2000	Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves
SP-126-2007	Steel In-Line Spring-Assisted Center Guided Check Valves
SP-127-2001	Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
SP-128-2006	Ductile Iron Gate Valves
SP-129-2003	(R 07) Copper-Nickel Socket-Welding Fittings and Unions
SP-130-2003	Bellows Seals for Instrument Valves
SP-131-2004	Metallic Manually Operated Gas Distribution Valves
SP-132-2004	Compression Packing Systems for Instrument Valves
SP-133-2005	Excess Flow Valves for Low Pressure Fuel Gas Appliances
SP-134-2006a	Valves for Cryogenic Service Including Requirements for Body/Bonnet Extensions
SP-135-2006	High Pressure Steel Knife Gate Valves
SP-136-2007	Ductile Iron Swing Check Valves
SP-137-2007	Quality Standard for Positive Material Identification of Metal Valves, Flanges, Fittings, and Other Piping Components
SP-138-2009	Quality Standard Practice for Oxygen Cleaning of Valves & Fittings

(R-YEAR) Indicates year standard reaffirmed without substantive changes

A large number of former MSS Practices have been approved by the ANSI or ANSI Standards, published by others. In order to maintain a single source of authoritative information, the MSS withdraws its Standard Practices in such cases.

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