

---

# CHAPTER B5

---

# PIPING SUPPORTS

---

**L. Di Giacomo, Jr.**

*Senior Engineer, Bechtel Power Corporation, Frederick, MD*

**J. R. Stinson**

*Supervisor, Engineering, LISEGA Inc., Newport, TN*

---

## **INTRODUCTION**

---

The correct and economical selection of the supports for any piping system usually presents difficulties of varying degrees, some relatively minor and others of a more critical nature. Proper support selection should be the objective of all phases of design and construction.

Many pipe support problems may be minimized or avoided if proper attention is given to the means of support during the piping layout design phase. The piping designer's familiarity with support problems, accepted practices, and commercially available pipe support components and their applications is extremely important. Good pipe support design begins with good piping design and layout. For example, other considerations being equal, piping should be routed to use the surrounding structure to provide logical and convenient points of support, anchorage, guidance, or restraint, with space available at such points for use of the proper component. Parallel lines, both vertical and horizontal, should be spaced sufficiently apart to allow room for independent pipe attachments for each line.

Pipe support specifications for individual projects must be written in such a way as to ensure proper support under all operating and environmental conditions and to provide for slope, expansion, anchorage, and insulation protection. Familiarity with standard practices, customs of the trade, and types and functions of commercial component standard supports and an understanding of their individual advantages and limitations, together with knowledge of existing standards, can be of great help in achieving the desired results.

### **Reference Codes and Standards**

In the United States the pipe support standards and their publishers are

- MSS SP-58, *Materials and Design of Pipe Supports*
- MSS SP-69, *Selection and Application of Pipe Supports*

- MSS SP-89, *Fabrication and Installation of Pipe Supports*
- PFI ES-26, *Welded Load Bearing Attachments to Pressure Retaining Boundaries*
- WRC Bulletin 198
- National Fire Protection Association (NFPA)
- American Welding Society (AWS)
- American Institute of Steel Construction (AISC)

In Britain the pipe support standards are

- BS 3974, *Specification for Pipe Supports, Parts 1, 2, and 3*
- BS 5135, *Process of Arc Welding of Carbon and Carbon Manganese Steels*

In Germany the pipe support standards are

- VGB-R510L
- DIN EN 288, *Specification and Approval of Procedures for Welding Metallic Materials*

In Japan it is *Meeting Notification 501*.

Piping systems must comply with the code(s) of jurisdiction.

Unless complete design details are provided by the engineer or piping system layout designer, the final responsibility for selection and design of pipe supports capable of completely satisfying the system requirements and job specifications rests with the pipe support engineer and/or designer. Any piping system is inoperable until the pipe hangers and supports have been selected and installed. Experience shows that a high percentage of pipe support problems cannot be recognized during a cursory examination of the piping drawings but await a detailed analysis by those responsible for the design of the support and the preparation of specific material lists and details. In the interest of properly coordinating support installations with the piping erection schedule, priority should be given to the selection, design, and procurement of pipe support components.

The dollar value of the support system is generally outweighed many times by the value of pipe, valves, and fittings which are to be supported. Failure to allow sufficient time for the design, procurement, and fabrication of the supports can lead to costly erection delays and the use of temporary supports.

Pipe supports are generally identified by a specification type number, such as a type 3 double-bolt pipe clamp, as in MSS SP-58, or by a manufacturer's part number, a descriptive name, and size. The latter depends upon the type of component; e.g., pipe attachments, such as clamps, are prescribed by pipe size, upper attachments are identified by rod size, and variable springs are sized by the calculated load to be supported. In addition, pipe support components vary in their load-carrying capacity. The load capacity of each type of pipe support component is given in most manufacturers' catalogs, load capacity data sheets, or design report summaries. Various components and their functions will be discussed in greater detail in subsequent sections.

## General Design Considerations

Hangers and supports must be designed to meet all static as well as dynamic operational conditions to which the piping and equipment may be subjected. The

support system must provide for and control, subject to the requirements of the piping configuration, the movement due to the thermal expansion and contraction of the piping and connected equipment. Proper design necessitates a thorough knowledge of the complete cyclical behavior of each section of piping to be supported as well as an awareness of the proximity of the pipe with respect to building structure, other piping systems, and equipment in the immediate vicinity.

A substantial reduction in the complexity of support design can be realized when piping support requirements are coordinated properly with the plant and piping design phases. Initial plant design should recognize that the support designer requires access to the piping, sufficient space in which to install the supporting equipment, and adequate structure from which to support the piping. Ideally the support designer should have the opportunity to offer comments on the piping design from the initial layout.

Starting with any given set of piping and structural drawings, it is necessary for the support designer to become familiar with the overall design concept and any special requirements that may be called for in the specifications.

- When one is dealing with a number of piping systems in an area, it is advisable to superimpose the piping (using a single-line representation) on the structural drawings.
- A preliminary study very often reveals that consideration has been given to the supporting phase and provisions have been made in the form of steel work patterns, anchor bolts or inserts in concrete, or runs of piping purposely routed near suitable supporting structure. Naturally, full advantage should be taken of such conditions.
- The piping should also be studied from the standpoint of possibly coordinating supports for one system or pipe run with those of another, thereby providing an orderly supporting arrangement. On the other hand, it may also be necessary, because of loading conditions, to purposely stagger supports in order to distribute the loads on the supporting structures.

All the above should be determined prior to the start of detailed support design for any piping system.

Once a tentative overall pattern of supports for a particular area has been established, it is advisable to begin specific design with the most critical or largest piping systems, thereby reserving the best possible supporting conditions for the most critical lines.

### **Location of Supports**

Of prime consideration in design is the determination of support location. Although supports are located ideally to suit the requirements of the piping configuration, some degree of compromise may be required to take the fullest advantage of the available supporting structure. First the piping system should be investigated as a whole. With the use of the allowable support spacing as dictated by code, practice, or special calculation (see Chap. B4), the support points are tentatively located, taking into consideration division of straight runs, concentrated loads, elimination of excessive overhanging sections or bends, and loads on terminal connections.

Next, the tentative locations are compared with the available supporting structure, modified as required, and recorded on the superimposed piping previously

sketched on the structural drawings. The recording of each support location, along with an indication of any supplementary steel required, serves as a valuable aid in checking clearances and coordinating supports during the course of design, especially when a number of designers are working on the same project.

It should be emphasized that the location of pipe supports is an iterative process in which several support configurations are investigated in succession, with the results of the analysis of one configuration being factored into the selection of the next configuration, until a satisfactory solution is reached.

### **Loading Considerations**

Once a satisfactory pattern of support locations has been established, the next step is to determine the loading and movement conditions existing at each support point. Here, coverage will be confined to the general considerations regarding only loads and movements. Recommended methods for obtaining or calculating specific loads and movements are covered later under “Determination of Loads and Movements.”

The magnitude and direction of the design load as determined by the methods of Chap. B4 are used to select and design the proper support or restraint at each selected point along the piping system.

### **Seismic, Dynamic, or Other Loadings**

The design of pipe support components and structural steel must include provisions for seismic, dynamic, or other occasional loadings where required. Applicable codes generally permit some increase in allowable stresses for seismic and dynamic loading conditions. Spring supports should be evaluated to determine if additional dynamic movement can be tolerated; if not, additional means such as limit stops or dynamic snubbers may be required.

### **Overloading from Various Causes**

ASME B31.1, *Power Piping Code*, allows an increase in the allowable stress values of 20 percent for short-time overloading during operation. However, it is appropriate to point out that where there is a possibility of two or more causes of short-time overloading (e.g., ice, wind, seismic shock, or vibration) occurring simultaneously, the combined overloading in excess of 20 percent must be added to the design load.

## ***DETERMINATION OF SUPPORT LOCATIONS***

---

Support locations are dependent on many considerations, such as pipe size, piping configuration, the location of heavy valves and fittings, and the structure that is available for support. No firm rules or limits exist which will positively fix the location of each support in a piping system. Instead, the engineer must exercise judgment to determine appropriate support locations.

**TABLE B5.1** Suggested Piping Support Spacing

NPS (DN)	Suggested maximum span, ft (m)	
	Water service	Steam, gas, or air service
1 (25)	7 (2.13)	9 (2.74)
2 (50)	10 (3.05)	13 (3.96)
3 (80)	12 (3.66)	15 (4.57)
4 (100)	14 (4.27)	17 (5.18)
6 (150)	17 (5.18)	21 (6.40)
8 (200)	19 (5.79)	24 (7.32)
12 (300)	23 (7.01)	30 (9.14)
16 (400)	27 (8.23)	35 (10.7)
20 (500)	30 (9.14)	39 (11.9)
24 (600)	32 (9.75)	42 (12.8)

**Pipe Support Spacing**

The suggested maximum spans between supports listed in Table B5.1 reflect the practical considerations involved in determining support spacings on straight runs of standard wall piping. The spans are based on a combined bending and shear stress of 1500 psi (10.35 MPa) when the pipe is filled with water, and 1/10-in (2.54-

**TABLE B5.2** Gravity Steel Pipe Support Spacing (Contents = Water)

Nominal pipe size, NPS	(DN)	Pipe sch.	Pipe span, ft-in (m)			
			No insul.	1-in (25 mm) insul.	1½-in (40 mm) insul.	2-in (50 mm) insul.
½	(15)	40	6-8 (2.03)	5-4 (1.63)	4-6 (1.37)	3-11 (1.19)
		80	6-7 (2.01)	5-5 (1.65)	4-7 (1.40)	4-0 (1.22)
		160	6-4 (1.93)	5-5 (1.65)	4-9 (1.45)	4-2 (1.27)
¾	(20)	40	7-5 (2.26)	6-3 (1.91)	5-6 (1.68)	4-10 (1.47)
		80	7-5 (2.26)	6-4 (1.93)	5-8 (1.73)	5-1 (1.55)
		160	7-3 (2.21)	6-4 (1.93)	5-9 (1.75)	5-2 (1.57)
1	(25)	40	8-3 (2.51)	7-0 (2.13)	6-4 (1.93)	5-9 (1.75)
		80	8-3 (2.51)	7-3 (2.21)	6-8 (2.03)	6-1 (1.85)
		160	8-1 (2.46)	7-3 (2.21)	6-9 (2.06)	6-2 (1.88)
1¼	(32)	40	8-3 (2.51)	7-0 (2.13)	6-4 (1.93)	5-9 (1.75)
		80	8-3 (2.51)	7-3 (2.21)	6-8 (2.03)	6-1 (1.85)
		160	8-1 (2.46)	7-3 (2.21)	6-9 (2.06)	6-2 (1.88)
1½	(40)	40	9-10 (3.00)	8-9 (2.67)	8-1 (2.46)	7-3 (2.21)
		80	9-10 (3.00)	9-1 (2.77)	8-6 (2.59)	7-7 (2.31)
		160	9-11 (3.02)	9-2 (2.79)	8-8 (2.64)	7-11 (2.41)
2	(50)	40	10-9 (3.28)	9-10 (3.00)	9-3 (2.82)	8-7 (2.62)
		80	11-1 (3.38)	10-2 (3.10)	9-9 (2.97)	9-2 (2.79)
		160	11-1 (3.38)	10-5 (3.18)	10-0 (3.05)	9-6 (2.90)

mm) sag is allowed between supports. Table spans do not apply where concentrated weights such as valves or heavy fittings exist, or where changes in direction of the piping system occur between support points.

Supports should be placed as close as possible to concentrated loads in order to keep piping stresses to a minimum. Where changes in piping direction occur between supports, it is good practice to keep the total length of pipe between the supports equal to or less than 0.75 times the full spans listed in Table B5.1. When practical, a support should be located immediately adjacent to any change in direction of the piping.

For economy in the support of low-pressure, low-temperature systems, support spans may be based on the code-allowable total stresses of the pipe and the amount of allowable deflection between supports.

In steam lines with long spans, the deflection caused by piping weight may be large enough to cause an accumulation of condensate at the low points. During plant start-up, these pockets of condensate can cause flashing and can result in undesirable dynamic loads on the system. Natural drainage can be provided by erecting the line with a slope in such a manner that succeeding supports are lower than the points of maximum deflection in preceding spans.

For fluids other than water, the bending stress can be found by using the formulas in Chap. B4. Spans for typical small-diameter piping based on the equations in Chap. B4 are found in Tables B5.2 and B5.3.

**TABLE B5.3** Gravity Steel Pipe Support Spacing (Pipe Empty, Air, Steam)

NPS	(DN)	Pipe sch.	No insul.	Pipe span, ft-in (m)		
				1-in (25 mm) insul.	1½-in (40 mm) insul.	2-in (50 mm) insul.
½	(15)	40	7-1 (2.16)	5-6 (1.68)	4-7 (1.40)	4-1 (1.24)
		80	6-10 (2.08)	5-6 (1.68)	4-9 (1.45)	4-2 (1.27)
		160	6-7 (2.01)	5-6 (1.68)	4-9 (1.45)	4-3 (1.30)
¾	(20)	40	8-1 (2.46)	6-8 (2.03)	5-9 (1.75)	5-0 (1.52)
		80	7-10 (2.39)	6-8 (2.03)	5-10 (1.78)	5-2 (1.57)
		160	7-5 (2.26)	6-7 (2.01)	5-10 (1.78)	5-4 (1.63)
1	(25)	40	9-2 (2.79)	7-6 (2.29)	6-9 (2.06)	6-0 (1.83)
		80	8-10 (2.69)	7-7 (2.31)	6-11 (2.11)	6-3 (1.91)
		160	8-6 (2.59)	7-5 (2.26)	6-11 (2.11)	6-4 (1.93)
1¼	(32)	40	9-2 (2.79)	7-6 (2.29)	6-9 (2.06)	6-0 (1.83)
		80	8-10 (2.69)	7-7 (2.31)	6-11 (2.11)	6-3 (1.91)
		160	8-6 (2.59)	7-5 (2.26)	6-11 (2.11)	6-4 (1.93)
1½	(40)	40	11-3 (3.43)	9-9 (2.97)	8-11 (2.72)	7-8 (2.34)
		80	11-0 (3.35)	9-10 (3.00)	9-2 (2.79)	8-1 (2.46)
		160	10-6 (3.20)	9-7 (2.92)	9-2 (2.79)	8-3 (2.51)
2	(50)	40	12-8 (3.86)	11-2 (3.40)	10-4 (3.15)	9-6 (2.90)
		80	12-5 (3.78)	11-3 (3.43)	10-7 (3.23)	9-11 (3.02)
		160	11-10 (3.61)	11-0 (3.35)	10-6 (3.20)	10-0 (3.05)

## **DETERMINATION OF LOADS AND MOVEMENTS**

---

The anticipated movement at each support point dictates the basic type of support required. Each type of support selected must be capable of accommodating movements obtained by one of the methods outlined later in this section. It is a good practice to select first the most simple or basic rigid support type and to add to the complexity only as conditions warrant. No advantage will be realized in upgrading a support when a simpler, more economical type can be shown to satisfy all the design requirements. Both vertical and horizontal movement must be evaluated.

When piping vertical movement is small, the use of simple rod hangers should be adequate. With small vertical movement and significant horizontal movement, the simple rod hanger will still suffice, provided the overall length is sufficient to keep the angular swing of the rod within reasonable limits—normally accepted as being 4° from the vertical. When one is calculating the total movement experienced by the support, both horizontal displacements and the vertical displacement must be combined and normalized to the axis of the support. Consideration should be given to relocating the upper connection some percentage (usually two-thirds) of the total movement as a means for reducing the angularity in the hot position. For piping supported from below, some form of slide must be incorporated to provide for the horizontal movement; or, in the case of ensured longitudinal movement, a pipe roll may be used. Rollers are usually only used on long runs of piping supported on racks such as found in refinery piping. Suspended hangers with considerable horizontal movement and low headroom will require either single- or double-direction trolleys or rollers. Where both longitudinal and lateral movements are large, consideration may be given to the use of a single-direction trolley oriented on the resultant movement vector.

### **Use of Variable Spring and Constant Spring Supports**

Piping which is subject to significant vertical movement requires the incorporation of variable springs or constant support springs. Variable supports will normally suffice for spring hangers except for certain systems in power plants, refineries, and some specialized lines in process and chemical plants which may have large vertical movements where the change in load between installed and operating is unacceptable. (In these cases, the use of constant supports is required.) As the name *variable support* implies, the supporting effect varies in relation to the vertical movement of the suspended piping and the resultant compression or extension of the spring coil. The change in supporting force is in proportion to the spring rate and to the amount of movement. When variable supports are used, the loss or gain in supporting force should be considered with respect to added stress on the piping system. For normal installations, various industries have established conventions concerning the use of variable spring supports and constant spring supports which may be regarded as standard practice. For example, the following would be conventional guidelines for power plant piping:

At support locations subject to vertical movement, springs of suitable design to prevent excessive variation in supporting effect should be used to provide for the movement. The amount of variation that can be tolerated should be based on such considerations as pipe-bending effect, control of piping elevation, and allowable terminal connection loadings. In general, the deviation in supporting effect should be limited to  $\pm 6$  percent for systems such as main steam, hot and cold reheat,

extraction lines over 750°F (400°C), discharge in the vicinity of the pumps, and boiler terminal connection. On other systems, the variations in supporting effect should be limited to 25 percent.

For all systems, a greater allowance in percentage variation is permissible at points of support where the variation in supporting effect is transferred directly to a rigid support or terminal connection specifically designed for the resulting loading condition.

When the load and movement at each selected support location are determined, detailed design of the individual supports can be undertaken. The movement determines the basic type of support (such as spring or rigid, slide or roller); the piping, its temperature, and ambient temperature determine the pipe attachment and remaining support material, respectively; the proximity to supporting structure and available clearance determines the support configuration such as single- or double-rod hanger, stanchion, or bracket-type support; and the load determines the required size for each component of the support.

The design should take full advantage of commercially available load-rated and tested support components to the greatest extent possible. An effort should be made to maintain uniformity and simplicity in design. The support should be functional, provide means for piping elevation adjustment, and be easily installed using normal field labor and equipment.

For economic reasons, the use of commercial catalog items available from piping support manufacturers eliminates the need for detail design of the numerous types and varying sizes of components required to complete a typical piping support installation.

## **MSS SP-58 Hanger and Support Types**

Refer to Fig. B5.1.

- |        |  |
|--------|--|
| Type 1 | <i>Adjustable steel clevis hanger</i><br>A pipe attachment for suspension of horizontal stationary lines and providing a means for vertical adjustment.  |
| Type 2 | <i>Yoke-type pipe clamp</i><br>A pipe attachment for suspension of horizontal stationary insulated lines. This type of clamp is also made to accommodate pipe of nonstandard size when designed with a filler plate. |
| Type 3 | <i>Carbon- or alloy-steel three-bolt pipe clamp</i><br>A pipe attachment for suspension of horizontal stationary lines.  |
| Type 4 | <i>Steel pipe clamp</i><br>A pipe attachment for suspension of horizontal stationary insulated lines.  |
| Type 5 | <i>Pipe hanger</i><br>A pipe attachment for suspension of horizontal stationary lines either using a hanger rod or bolting to wall from the T slot provided in the side of the strap.                                |
| Type 6 | <i>Adjustable swivel pipe, split ring type or solid ring type</i><br>A pipe attachment for suspension of horizontal stationary lines.  |
| Type 7 | <i>Adjustable steel band hanger</i><br>A pipe attachment for suspension of horizontal stationary lines and providing a means for vertical adjustment.  |

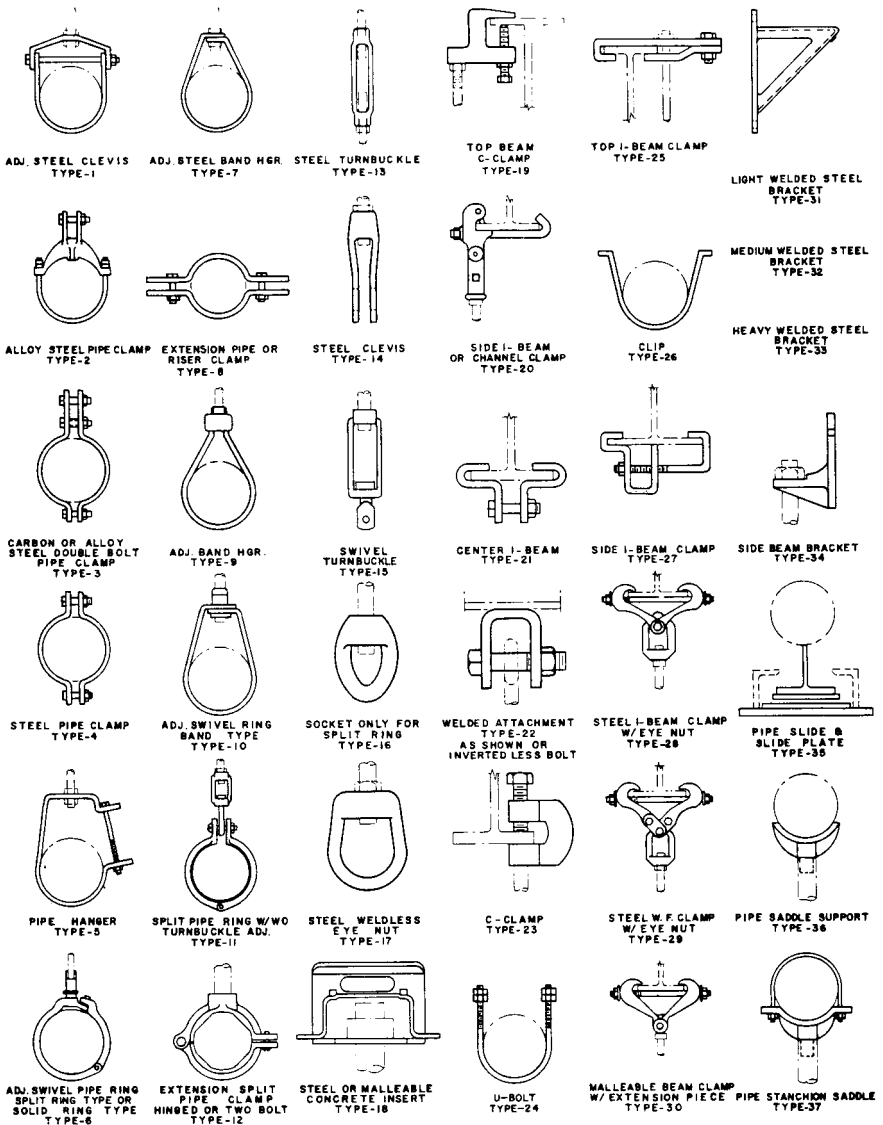


FIGURE B5.1 Type chart.

Types of pipe supports (MSS SP-58).

Type 8 *Extension pipe or riser clamp*

A pipe attachment for suspension of vertical stationary lines without the use of hanger rods. The transfer of piping load is accomplished by resting the ears of the clamp on a bearing surface.

Type 9 *Adjustable band hanger*

A pipe attachment for suspension of horizontal stationary lines.

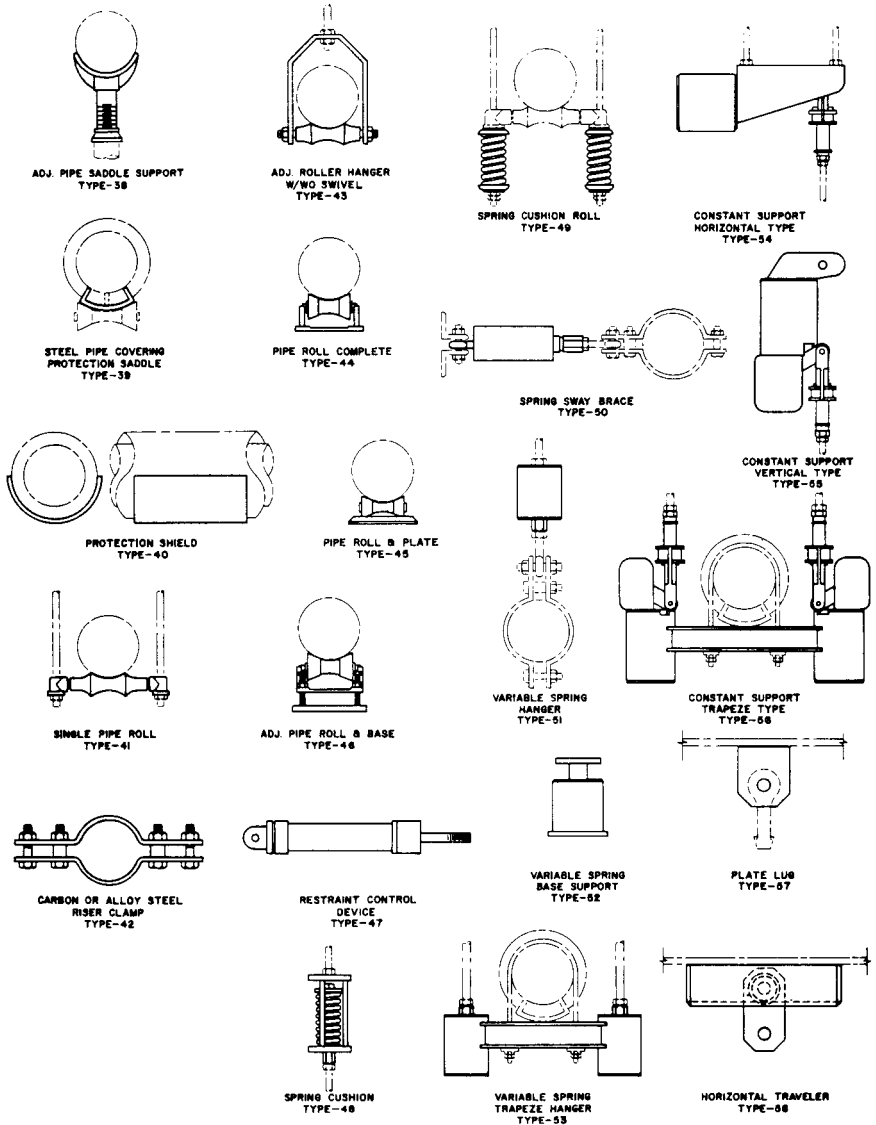


FIGURE B5.1 (Continued) Type chart.

- Type 10 *Adjustable swivel ring, band type*  
A pipe attachment for suspension of horizontal stationary lines and providing a means for vertical adjustment.
- Type 11 *Split pipe ring with or without turnbuckle adjustment*  
A pipe attachment for suspension of horizontal stationary lines permitting installation before or after pipe is in place.

- Type 12 *Extension split pipe clamp, hinged or two-bolt*  
A pipe attachment for suspension of horizontal stationary lines used in conjunction with a pipe nipple.
- Type 13 *Steel turnbuckle*  
A device with one left-hand internal threaded end and one right-hand internal threaded end, used to join two threaded rods and providing for vertical adjustment.
- Type 14 *Steel clevis*  
A device which provides for the attachment of a threaded rod to a bolted or pinned connection.
- Type 15 *Swivel turnbuckle*  
A device which provides flexibility at the pipe connection and a means of vertical adjustment.
- Type 16 *Malleable iron socket*  
A device for attaching threaded rods to various types of building attachments.
- Type 17 *Steel weldless eye nut*  
A forged-steel device which provides for the attachment of a threaded rod to a bolt or pin connection.
- Type 18 *Steel or malleable concrete insert*  
A cast-in-place device which provides for a rod attachment capable of nominal lateral adjustment.
- Type 19 *Top beam C-clamp*  
A device requiring no welding which attaches to the top flange of a structural shape where the vertical rod is required to be offset from the edge of the flange.
- Type 20 *Side beam or channel clamp*  
A device requiring no welding which attaches to the bottom flange of a structural shape where the vertical rod is required to be at the edge of the flange.
- Type 21 *Center beam*  
A device requiring no welding which attaches to the bottom flange of a structural shape where the vertical rod is required to be centered on the structural shape.
- Type 22 *Welded beam attachment (as shown or inverted less bolt)*  
A structural attachment welded to the bottom of steel beams and used as a means for connecting hanger rods to the beams.
- Type 23 *C-clamp*  
A device requiring no welding which attaches to a flange of a structural shape and provides for attaching a threaded rod.
- Type 24 *U-bolt*  
A U-shaped rod with threaded ends used as a support or guide.
- Type 25 *Top beam clamp*  
A device requiring no welding which attaches to the top flange of a structural shape where the vertical rod is required to be at the edge of the flange.
- Type 26 *Pipe clip*  
A pipe attachment for suspension of horizontal stationary lines by

bolting the clip directly to a structure. Also referred to as a pipe strap or strap.

Type 27

*Side beam clamp*

A device requiring no welding which attaches to the bottom flange of a structural shape where the vertical rod is required to be offset from the center of the shape.

Type 28

*Steel beam clamp with eye nut*

A device requiring no welding which attaches to the bottom flange of a structural shape where the vertical rod is required to be centered on the structural shape.

Type 29

*Linked steel clamp with eye nut*

A device requiring no welding which attaches to the bottom flange of a structural shape where the vertical rod is required to be centered on the structural shape.

Type 30

*Malleable beam clamp with extension piece*

A device requiring no welding which attaches to the bottom flange of a structural shape where the vertical rod is required to be centered on the structural shape.

Type 31

*Light welded steel bracket*

A braced cantilever device intended for supporting a gravity load from rod-type hangers. This device is typically bolted to a wall and may be installed with the brace either above or below the horizontal member.

Type 32

*Medium welded steel bracket*

A braced cantilever device intended for supporting maximum gravity loads and/or horizontal loads up to 1500 lb (6670 newton, N). Loads may be applied anywhere along the main member. This device is typically bolted to a wall and may be installed with the brace above, below, or on either side of the main member.

Type 33

*Heavy welded steel bracket*

A braced cantilever device intended for supporting maximum gravity loads and/or horizontal loads up to 3000 lb (13,340 newton, N). Loads may be applied anywhere along the main member. This device is typically bolted to a wall and may be installed with the brace above, below, or on either side of the main member.

Type 34

*Side beam bracket*

A device requiring no welding which attaches to the sides of steel or wooden members and provides a means for vertical adjustment.

Type 35

*Pipe slide and slide plate*

A device for supporting piping having horizontal movements and where a low coefficient of friction is necessary.

Type 36

*Pipe saddle support*

A device having a curved base for cradling horizontal pipe and which slips into a nominal diameter pipe stanchion.

Type 37

*Pipe stanchion saddle*

A device having a curved base for cradling horizontal pipe and which slips into a nominal diameter pipe stanchion. The U-bolt yoke provides stability.

- Type 38 *Adjustable pipe saddle support*  
A device having a curved base for cradling horizontal pipe and which threads into a nominal diameter pipe stanchion. This device provides vertical adjustment.
- Type 39 *Steel pipe-covering protection saddle*  
A device used on insulated piping which is designed to minimize heat losses and prevent damage to insulation.
- Type 40 *Protection saddle*  
A metal device intended to prevent crushing of insulation and/or breaching of the vapor barrier. It is typically used at support points.
- Type 41 *Single pipe roll*  
A device used for supporting horizontal piping from two rods, allowing for vertical adjustment and consisting of a roller that allows for axial movement with virtually no frictional resistance.
- Type 42 *Carbon- or alloy-steel riser clamp*  
A pipe attachment for supporting vertical piping through the use of shear lugs welded to the pipe. Load bolts are provided to transfer the pipe load to the rod hanger assembly.
- Type 43 *Adjustable roller hanger with or without swivel*  
A device used for supporting horizontal piping from a single rod, allowing for vertical adjustment and consisting of a roller that allows for axial movement with virtually no frictional resistance.
- Type 44 *Pipe roll complete*  
A device used for supporting horizontal piping where vertical adjustment is unnecessary and consisting of a roller that allows for axial movement with virtually no frictional resistance.
- Type 45 *Pipe roll and plate*  
A device used to support horizontal piping, having minimal axial movement, from beneath and where no vertical adjustment is necessary.
- Type 46 *Adjustable pipe roll and base*  
A device used to support horizontal piping, having axial movement, from beneath and where vertical adjustment is necessary.
- Type 47 *Restraint control device*  
A rigid, mechanical, spring, or hydraulic device used for absorbing shock loading and/or controlling sway in piping systems.
- Type 48 *Spring cushion*  
A noncalibrated, rod-type, single-coil spring support used where a cushioning effect is desired.
- Type 49 *Spring cushion roll*  
A noncalibrated, rod-type, double-coil rod spring support used where a cushioning effect is desired along with a pipe roll.
- Type 50 *Spring sway brace*  
A spring device used for absorbing shock loading and/or controlling sway in piping systems.
- Type 51 *Variable spring hanger*  
A device having a single-spring coil which supports the gravity loads of piping systems that are subjected to vertical thermal movements. This device produces a varying load when the piping moves from the

cold position to the hot position. This type of spring hanger supports the pipe from above.

- Type 52 *Variable spring base support*  
A device having a single-spring coil which supports the gravity loads of piping systems that are subjected to vertical thermal movements. This device produces a varying load when the piping moves from the cold to the hot position. This type of spring hanger supports the pipe from below.
- Type 53 *Variable spring trapeze hanger*  
A device having double-spring coils which support the gravity loads of piping systems that are subjected to vertical thermal movements. This device produces a varying load when the piping moves from the cold position to its hot position. This type of spring hanger supports the pipe from above with two rods.
- Type 54 *Constant support hanger, horizontal type*  
A device having a single-spring coil working in conjunction with counterbalancing mechanisms to support the gravity loads of piping systems that are subjected to vertical thermal movements. This device produces a constant load when the piping moves from the cold position to the hot position. This type of constant hanger has the spring coil in the horizontal position and supports the pipe from above.
- Type 55 *Constant support hanger, vertical type*  
A device having a single-spring coil working in conjunction with counterbalancing mechanisms to support the gravity loads of piping systems that are subjected to vertical thermal movements. This device produces a constant load when the piping moves from the cold position to the hot position. This type of constant hanger has the spring coil in the vertical position and supports the pipe from above.
- Type 56 *Constant support hanger, trapeze type*  
A device having double-spring coils working in conjunction with counterbalancing mechanisms to support the gravity loads of piping systems that are subjected to vertical thermal movements. This device produces a constant load when the piping moves from the cold position to the hot position. This type of constant hanger has the spring coil in the vertical position and supports the pipe from below with two rods.
- Type 57 *Plate lug*  
A structural attachment which provides a means of connecting rod-type hangers to structural steel members via a pin or bolt through the hole of the lug.
- Type 58 *Horizontal traveler*  
A device which permits the structural attachment end of rod-type hangers to accommodate horizontal piping movements in conditions where offsetting of conventional structural attachments is not practical due to limited space.

## **SELECTION OF PIPE-SUPPORTING DEVICES**

---

**Piping Systems: Temperature Classification.** Piping systems, for the purposes of this chapter, are divided into the following temperature categories, in order to provide a basis for the selection of supports, anchors, or restraints and guides.

### 1. *Hot systems*

Hot systems operate above 120°F (49°C) and are grouped as follows:

**a.** The temperature range is from 120 to 450°F (49 to 232°C). Typical examples are low-pressure steam, hot water, and certain process piping.

For Type 1a systems, MSS-SP-58 support Types 1 and 3 through 12 are used for suspending from above. Rollers, used for supporting from below, should be MSS-SP-58 Types 41, and 43 through 46 with appropriate saddles of MSS-SP-58 Type 39; and sliding supports should be of MSS-SP-58 Types 35 through 38.

**b.** The temperature range is from 450 to 650°F (232 to 343°C). Typical examples are boiler plant and industrial steam and hot-water piping systems.

For Type 1b systems, MSS-SP-58 support Types 1, 3, 4, and 42 are used. Rollers should be of MSS-SP-58 Types 41 and 43 through 46, with appropriate saddles of MSS-SP-58 Type 39.

**c.** The temperature ranges from 750°F (400°C) upward. A typical example is a high-pressure steam power plant piping system.

For Type 1c systems, alloy supports are used as required by the line temperature. Supports should be of MSS-SP-58 Type 2, 3, or 42 with saddles of MSS-SP-58 Type 39, and rollers of MSS-SP-58 Types 41 through 47. [In the temperature range 650°F (343°C) and higher, there is the possibility of metallurgical change if unalloyed carbon-steel components are used. It is suggested that those portions of hangers, anchors, and supports in direct contact with piping which operates at or above 650°F (343°C) be made of materials suitable for these extreme service temperatures.]

### 2. *Ambient systems*

Ambient systems are systems in which the contents of the line are not heated or cooled by mechanical means. Temperatures range up to 120°F (49°C). Plant air and service water are typical systems.

For Type 2 systems, hangers can be of MSS-SP-58 Types 1 and 3 through 12, with supports of MSS-SP-58 Types 24, 26, and 35 through 38.

### 3. *Cold systems*

Cold systems typically operate below 70°F (21°C).

**a.** The temperatures range from 32 to 70°F (0 to 21°C). A typical example is chilled water piping. Refer to Chap. C9.

**b.** The temperature ranges from 32 to -20°F (0 to -29°C), as in brine systems. Refer to Chap. C9.

**c.** Temperatures below -20°F (-29°C), as in cryogenic systems. Refer to Chap. C8.

For Type 3 systems, the hanger or support must be outside the insulation, and the vapor barrier must be left undisturbed. An MSS-SP-58 Type 40 insulation protection shield (or similar device) must be used to distribute the loading on the insulation. Supports sized for the outside diameter of the insulation can be of MSS-SP-58 Type 1, 4, 6, 7, 9, 10, or 11. For Type 3c systems, the welded attachment must be of an alloy material which is compatible with the material of the piping system itself.

**Pipe Attachments.** Supports for the various systems described above may be selected from Fig. B5.1.

**Pipe-Covering Protection Saddles.** Where insulation is used on the piping system, it is frequently necessary to make some modification at the point of attachment of the support. Since different methods and practices exist for hot lines as contrasted to low-temperature lines (chilled water and brine), they should be treated separately.

Caution must be exercised in the support of insulated piping to ensure that a firm attachment is provided. Particularly, with respect to high-temperature lines, provision in the form of pipe protection saddles is made to ensure that the pipe supports do not become overheated. Protection saddles, Type 39 for use with high-temperature insulation, should be 12 in (305 mm) long and have approximately 60° of arc. Metal is normally 1/8 in (3 mm) thick for pipe sizes up to 5 in (125 mm) and 3/16 in (5 mm) thick for larger pipe sizes. These saddles and matching rollers are available commercially for most sizes and insulation thicknesses. Refer to Chap. B7 for insulation thicknesses.

For support from above, either a conventional type of pipe clamp may be used directly on the pipe and the arms of the clamp (MSS-SP-58 Type 3) extended outside the insulation, or a larger clamp (MSS-SP-58 Type 1 or 4) may be used and lined with saddles or noncrushable insulation material.

Lugs may be welded to the pipe and extended outside the insulation to a steel clevis (MSS-SP-58 Type 14) or, if supported from below, to a sliding shoe or guided roller. The important point is to have the actual attachment or supporting member outside the insulation so that movement of the line will not result in insulation damage.

For low-temperature service, in addition to heat loss or gain, the problem of atmospheric condensation must be considered, and such lines are usually insulated with a material that has an outer covering or seal called a *vapor barrier*. This barrier prevents the insulation from absorbing moisture. For this reason it is not permissible to penetrate the insulation with load-carrying members such as the legs of a conventional high-temperature saddle or a pipe clamp. Since most low-temperature insulations have low compressive strength, it is necessary to provide shields to line the piping insulation and to spread out the bearing area sufficiently to prevent crushing of the insulation. Such shields should fit the outer diameter of the insulation and cover 180° of arc. Shield lengths and thicknesses are given in Table B5.4, taken from MSS-SP-69.

**TABLE B5.4** Minimum Dimensions: Shields for Insulation Protection

NPS (DN)	Skill length, in (mm)	Thickness, in (mm)
1/2 to 3/2 (15 to 90)	12 (300)	0.048 (1)
4 (100)	12 (300)	0.060 (2)
5 (125)	18 (450)	0.060 (2)
6 (150)	18 (450)	0.060 (2)
8 (200)	24 (600)	0.075 (2)

**Attachments to Buildings or Other Structures.** When piping is to be hung from steel, Types 20 through 23, 25, and Types 27 through 30 beam clamps and Type 57 plate lug should be used.

When piping is hung from concrete, malleable iron or steel inserts of Type 18 or a continuous strip insert may be used. Embedded anchor bolts may also be used under specific conditions. For wall supports on either concrete or steel brackets, Types 31 through 33 may be used.

In many cases, it is necessary to provide additional structure as a means of upper attachment. Such structure must be designed for the particular load and can be of structural angle, beam, or channel.

Structural steel for pipe supports must meet the allowable stress requirements of the AISC specification.

### Multiple-Pipe Runs

Where the bottoms of the various lines are approximately at the same elevation, common supports are advantageous. The supports take the form of trapeze hangers fabricated from structural-steel shapes. Multiple-pipe runs are also supported on fabricated bents or frames. This is quite common for oil refinery or tunnel work where multiple runs of pipe are relatively near grade. Steel or concrete sleepers are used.

On all multiple-pipe runs, provisions should be made to keep the lines in their relative positions by the use of either clamps or clips. Lines subject to thermal expansion must be free to slide or roll.

### Spring Supports

When there is an appreciable temperature difference between the operating and nonoperating conditions of a piping system, there is a resultant expansion or contraction of the pipe caused by the thermal change. When the system consists entirely of horizontal piping, the differential expansion can be taken care of entirely by means of rollers or by swinging rods of sufficient length. For vertical portions of the piping system, the thermal change in length causes elevation changes. Movement of terminal points or of the structure to which the supports are attached will also result in elevation changes. These elevation changes must be accommodated by some sort of variable spring or constant support.

Helical-coil springs are commonly used for such supports. The degree of variation to be provided by the spring support depends on the conditions of the piping system. For systems which operate at temperatures below 750°F (400°C), a good rule is that the variation in supporting force be limited to 25 percent of the load. It is important to select a spring coil which has been age-processed to eliminate residual stresses resulting from the coiling operation. A conventional helical coil which has not been age-processed will lose more than 10 percent of its supporting effect over its life.

It is not economical to design custom springs. A more prudent approach is to select spring devices which are available commercially. Commercial spring supports are made in three general types. *Spring cushion hangers*, MSS-SP-58 Types 48 and 49, are made for light to medium loads and for ¼-in (6-mm) maximum vertical movement. Generally, this type is used in systems in which the temperature does not exceed 450°F (232°C).

Variable spring supports, MSS-SP-58 Types 51, 52, and 53, are available for a wide range of loads, from about 50 to 30,000 lb (222 to 133,446 N). This type of hanger is used on piping systems in which the resulting variation in supporting force can be tolerated. The commercial varieties available provide a selection of variability.

Constant load supports, MSS-SP-58 Types 54, 55, and 56, are spring devices in which the varying force of the spring is compensated so that the support variability

is within the range of  $\pm 6$  percent. This type of support is used on systems in which there are large thermal movements or critical stress conditions or a combination of both. Such conditions exist on high-pressure, high-temperature steam lines in electric generating stations. These supports are made for loads of approximately 50 to 50,000 lb (222 to 222,410 N) and for vertical movements up to 16 in (406 mm). The variability of these supports is not dependent on vertical movement, and the support is adjusted at the factory for specified load and travel. Therefore, extreme care should be taken in determining loads and travel for the selection of hanger size.

Vibration arising from pump pulse and similar conditions can be a problem in piping systems. Where such vibrations are in resonance with a spring-supported system, the results can be serious. Such conditions can usually be avoided by judicious use of commercially available spring hangers. Systems that respond to exciting vibrations can be controlled satisfactorily by the use of dampening devices. There are two general types to consider: the coiled spring and the hydraulic vibration dampener.

There are two types of coiled-spring vibration dampeners: the opposed-spring type and the double-acting spring type, MSS-SP-58 Type 50. These devices should be arranged so that the springs are in the neutral position during normal operating conditions of the system.

The hydraulic vibration control is a unit which operates by means of a controlled flow of fluid through an orifice. Resistance to movement increases with the speed of displacement. One distinct advantage of the hydraulic device is that there is a minimum of resistance to thermal movement of the piping.

Both spring and hydraulic cylinder devices may be used to control sway and absorb shocks. These same devices may be used to resist reactions from safety valve discharges and similar applications. Both the spring and hydraulic types are available commercially in several sizes. Manufacturers' literature gives comprehensive data for selection and performance characteristics.

## Hanger Rod

Rods used for pipe support purposes are usually hot-rolled steel with standard 60° cut threads conforming to ASME B1.1, *Unified Inch Screw Threads*, coarse thread series (UNC). Rolled threads to the same standard may be used. It must be pointed out that the length of a rolled thread cannot be increased by running a die over it, since the basic diameter of the rod is less than the size of the threaded portion (smaller than the thread major diameter).

Safe load capacities of threaded rods are based on the area at the root of the thread. A generally accepted standard for such capacities is given in Table B5.5, taken from MSS-SP-58.

For convenience in ordering and assembling various items, most cataloged pipe support products have a definite relationship between rod size and pipe size, as shown in Table B5.6.

Table B5.6 conforms to Underwriters' Laboratories and Factory Mutual requirements in pipe sizes up to NPS 12 (DN 300). In general, rod sizes less than  $\frac{3}{8}$  in (10 mm) should never be used to support piping, regardless of its diameter. However, this does not hold true for supports designed for a thoroughly analyzed piping system (i.e., computer-modeled and analyzed). Where exact loads are calculated, the rods and springs are selected on the basis of the load and movement, not pipe size.

**TABLE B5.5** Load Rating of Threaded Hot-Rolled Steel Conforming to ASTM A36 or A575 Grade 1020

Nominal rod diameter, in (mm)	Root area of thread		Maximum safe load at rod temp of 650°F (343°C)	
	in <sup>2</sup>	(mm <sup>2</sup> )	lb	(Newton)
¼ (6)	0.027	(17)	240	(1,068)
⅝ (8)	0.046	(30)	410	(1,824)
⅜ (10)	0.068	(44)	610	(2,713)
½ (15)	0.126	(81)	1,130	(5,026)
⅝ (16)	0.202	(130)	1,810	(8,051)
¾ (20)	0.302	(195)	2,710	(12,055)
⅞ (22)	0.419	(270)	3,770	(16,770)
1 (25)	0.552	(356)	4,960	(22,063)
1¼ (32)	0.889	(574)	8,000	(35,586)
1½ (40)	1.293	(834)	11,630	(51,733)
1¾ (44)	1.744	(1,125)	15,690	(69,792)
2 (50)	2.292	(1,479)	20,690	(92,033)
2¼ (57)	3.021	(1,949)	27,200	(120,991)
2½ (65)	3.716	(2,397)	33,500	(149,015)
2¾ (70)	4.619	(2,980)	41,600	(185,045)
3 (80)	5.621	(3,626)	50,600	(225,079)
3¼ (83)	6.720	(4,335)	60,500	(269,116)
3½ (90)	7.918	(5,108)	71,260	(316,979)

**Snubbers**

A snubber, or shock arrestor, MSS-SP-58 Type 47, is a mechanical or hydraulic type of support that is used to restrain dynamic loads. Such loads can result from a seismic event, water hammer, steam hammer, or relief valve thrust.

The primary advantage of the snubber is that it can be installed at locations where thermal displacement precludes the use of a “rigid” support. Under the slow and gradual displacement of the pipe due to thermal action, a snubber is designed to slowly telescope (in or out) to accommodate the movement of the pipe. When, however, a sudden impact load acts upon the snubber, internal braking devices

**TABLE B5.6** Relation between Pipe and Rod Sizes

NPS	(DN)	Rod size, in (mm)
2 and smaller	(50 and smaller)	⅜ (10)
2½ to 3½	(65 to 90)	½ (15)
4 and 5	(100 and 125)	⅝ (16)
6	(150)	¾ (20)
8 to 12	(200 to 300)	⅞ (22)
14 and 16	(350 and 400)	1 (25)
18 and 20	(450 and 500)	1¼ (29)
24	(600)	1½ (40)

engage, thus controlling the movement of the pipe. The snubber is said to “lock up.” In this condition, the snubber acts as though it were a rigid restraint.

Snubbers are not capable of supporting gravity loads. Under certain circumstances, the weight of the snubber bearing on the pipe should be included in the piping stress analysis.

## Riser Supports

A riser or vertical section of a piping system often creates special support problems. The support of service water lines and fire protection systems is governed in the first case by the local building codes and in the latter case by National Fire Protection Association (NFPA) codes. These codes dictate the type and frequency of riser supports used on those systems; however, piping systems that are subject to thermal movement present more complicated support problems, and each case must be considered separately.

Risers are equivalent to concentrated loads in a piping system; however, in the support of this load, several important points must be considered:

1. Is the support to take the entire riser weight, or is the riser weight to be distributed among several supports?
2. Are hydrostatic test conditions more severe than service conditions? That is, will the cold-water-filled condition impose stresses on the support higher than allowable (in cold condition), compared with the hot operating condition and the imposed stresses? When this decision is made, the system erection sequence should be considered and a determination made of whether other supports are effective or ineffective during hydrostatic testing.
3. Is the support to be located at a point of zero vertical movement and hence to be considered a rigid support? If this is the case, then the horizontal and vertical movements of riser end points must be analyzed. Pure horizontal movement can be provided for by long support rods that are allowed to swing. However, if vertical movement exists, it may cause tipping, and then it must be assumed that the entire load can transfer to one support rod. In this case, the riser support should be designed for twice the calculated load.

The support arms of the pipe attachment or the riser clamp, MSS-SP-58 Type 42, must extend out from the pipe far enough to clear any insulation. If springs are part of the support assembly, then the arms must be long enough to provide clearance between the pipe insulation and the springs used.

The final consideration in the design of a riser support is its attachment to the pipe. Since a thermal change occurs between the operating and nonoperating conditions of the pipe, the frictional grip of the clamp on the pipe cannot be relied upon, and there must be some positive means of engagement between the pipe and the clamp. Sometimes a complete ring is welded to the pipe. The more usual procedure is to use four lugs welded to the pipe, positioned at points which bear on the clamp. These lugs are normally made of material compatible to the pipe material and are to be welded on three sides. Suggestions for the selection of welded lugs can be found in PFI ES-26.

## **SUPPORT REQUIREMENTS FOR SPECIFIC PIPING MATERIALS**

---

### **Ductile-Iron Pressure Pipe**

Hanger sizes depend upon the outer diameter of pipe which is to be supported. The diameter of cast-iron pressure pipe exceeds that of nominal-size steel pipe and varies with its class or intended service. Therefore, selection of supports must take into consideration the actual outside diameter of the piping being installed.

### **Ductile-Iron Soil Pipe**

Support sizes correspond to sizes for steel pipe. MSS-SP-58 Types 1, 7, 8, and 11 are normally used.

### **Asbestos-Cement Pressure Pipe**

Support sizes depend upon the class of pipe to be supported. The outer diameter of this pipe exceeds that of steel pipe and varies with its class or service.

For all three categories (i.e., ductile-iron pressure pipe, ductile-iron soil pipe, and asbestos-cement pressure pipe) support spacing should provide at least one support for each length of pipe (piping lengths are a maximum of 20 ft, or 6.1 m, with the support preferably located adjacent to the joint). Also, each change of direction or branch connection should be supported.

For ductile-iron pipe with bell and spigot ends, using either a push-on type of joint or a mechanical joint, the pipe support engineer must consider the following:

- Both joint types use a rubber gasket to seal the joint, and they allow a certain amount of deflection and longitudinal displacement while maintaining the seal.
- To prevent leaks caused by misalignment of the pipe section at a joint, pipe supports are positioned immediately behind the pipe bell.
- Supports are normally not placed under spigots adjacent to bells, owing to possible undesirable effects on the joint.
- Pipe supports should cradle the pipe in a saddle.
- The saddle must follow the contour of the pipe in order to minimize stress concentrations.
- A saddle angle between 90° and 120° is desirable, with a minimum saddle width (i.e., the length along the longitudinal axis of the pipe) of

$$(2Dt_e)^{0.5}$$

where  $D$  = actual outside diameter of pipe, in (mm);  $t_e$  = nominal pipe wall thickness, in (mm).

Pipe supports should prevent any lateral and vertical movement of the pipe in order to prevent possible failure of the pipeline. Thermal expansion of ductile-iron pipe is not usually a concern because of the nature of the push-on or mechanical joint.

Buried lines are usually supported by tamped backfill, except that lines buried

under building slabs are sometimes supported from the slab with hairpin straps or rods suitable to the soil characteristics.

Special consideration is required in cases where movement occurs either at the terminal points or in the structure to which supports are attached. Spring hangers may be required to allow for deflection.

### **Copper Tubing**

Since supports made for copper tubing are designed to fit the tubing diameter, it is not recommended that supports which have been formed for piping be improvised as tubing supports. Most supports for copper tubing are electroplated with copper for easy identification. MSS-SP-58 Types 1, 8, 9, 10, 11, and 12 are available in tubing sizes.

Where there are indications that electrolysis may occur because the support and tubing are made of dissimilar metals, the support should be lined to prevent such action.

### **Fire Protection Systems**

Sprinkler supports will usually be subject to the consideration and approval of the same insurance agencies that have jurisdiction over the sprinkler-system piping and layout. The supports will be required to conform closely to the standards specified in the National Fire Codes published by the National Fire Protection Association.

Some of the important fire protection codes and standards of concern to the pipe support engineer follow:

- NFPA 11, *Foam Extinguishing Systems*
- NFPA 12, *Carbon Dioxide Extinguishing Systems*
- NFPA 12 A/B, *Halon Fire Extinguishing Systems*
- NFPA 13, *Sprinkler Systems*
- NFPA 14, *Standpipe and Hose Systems*
- NFPA 15, *Water Spray Fixed Systems*
- NFPA 16, *Foam-Water Sprinkler and Spray Systems*
- NFPA 17, *Dry Chemical Extinguishing Systems*

If the system is other than a standard building water-sprinkler system, the particular standard should also be consulted; e.g., in the design or selection of supports for a foam fire extinguishing system, NFPA 11 should be consulted.

The rules are explicit with respect to support spacing, fasteners, and method of fastening. NFPA also regulates the material used in the construction of supports. Underwriters' Laboratories, Inc., Factory Mutual Engineering Division, and Underwriters' Laboratories, Inc., of Canada have tested and listed or approved all types of supports necessary to meet the various conditions of construction.

The placing of supports along the pipe is an important consideration to ensure adequate support for the piping. In addition to the consideration of pipe support, consideration must be given to sway bracing especially in deluge systems, riser supports, soundness of the attachment, vibration, and pipe slope for drainage. The stability of the support during a fire, corrosion, and aging are also of prime impor-

tance. A sprinkler system may be installed for many years before it is operated, and it must always operate in the manner for which it was designed.

### Plastic Pipe

There are many types of plastic pipe, both rigid and semirigid. Under normal conditions, rigid plastic pipe can be supported using conventional supports with the spacing half that used with steel pipe or as recommended by pipe manufacturers. The support of plastic pipe or tubing should be continuous if, owing to the nature of the plastic, it will become flexible from elevated temperatures or from line contents. The continuous support can be in the form of a light angle or channel into which the plastic pipe is laid.

In some cases, wear shoes or pads should be added to plastic pipe where it may rub against steel supports. The use of wear pads will prevent the abrasive action caused by thermal movement, thus preventing damage to the pressure boundary.

It is suggested that recommendations of the manufacturer of the specific plastic pipe also be followed. Refer to Part D of this handbook.

### Glass Pipe

Glass pipe is used for laboratory service, food processing, and many industrial applications which require the durability or chemical resistance of glass pipe. Because of the nature of glass, special consideration of supports and attachments is necessary.

Standard pipe support components can be used; however, in all cases the support, even if it is painted or electroplated, must have a padding or cushion to avoid scratching the pipe. The support should fit loosely around the pipe, yet contact the pipe in a manner to distribute the load over the largest possible area. Point loading must be avoided. The system of supports must be designed with the fewest rigid anchor points possible.

Glass pipe will generally require two supports per 10-ft (3.05-m) section. One extra support will be required if there are three or more couplings in a 10-ft (3.05-m) section. For maximum protection and accessibility, supports should be placed about 1 ft (0.3 m) from each joint or coupling.

Glass pipe supports and layouts should be designed in accordance with general fundamentals applicable to other piping materials. However, extreme care must be taken to minimize strain and scratching of the glass. The pipe manufacturer and reputable support manufacturers should be consulted in the design of support systems for glass pipe.

## DESIGN DETAIL CONSIDERATIONS

---

### ASME Code for Pressure Piping

Specific design requirements for piping support are included in the sections of ASME B31, *Code for Pressure Piping*, listed below:

- B31.1, *Power Piping*
- B31.2, *Fuel Gas Piping*

- B31.3, *Process Piping*
- B31.4, *Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols*
- B31.5, *Refrigeration Piping*
- B31.8, *Gas Transmission and Distribution Piping Systems*
- B31.9, *Building Services Piping*
- B31.11, *Slurry Transportation Piping Systems*

In addition, ASME Boiler and Pressure Vessel Code, Section III, defines rules for piping supports used in nuclear power plants.

These requirements must be adhered to on piping installations when piping must conform to these codes. In most cases, supports conforming to MSS-SP-58 are acceptable for these installations.

### **Government Specifications**

The Federal Specification WWH-171, of the latest issue and entitled “Hangers and Supports, Pipe,” is the governing specification for all federal agencies. This specification illustrates types of pipe hangers and supports and lists the requirements of certain applications.

### **Design Temperature**

Design temperatures for parts of hangers and supports in direct contact with pipe shall be the temperature of the fluid contained in the pipe. Parts of hangers and supports not in direct contact with pipe may be designed to a temperature reduced by 100°F per 1 in (55°C per 25 mm) away from the pipe wall. Allowable stresses for materials commonly used in the design of pipe hangers and supports are listed in applicable codes and standards.

### **Welded Fabrication**

Welded fabrication shall be accomplished with good engineering practice as prescribed by the appropriate welding code. In the United States, the American Welding Society (AWS) and the American Society of Mechanical Engineers, Section IX, are the governing codes. In Germany, DIN EN 288 controls welding, and in Britain it is BS 5135. Attachments welded directly to the pipe must be of appropriate (compatible) chemical composition, and the process of attachment must conform to the requirements for fabrication of the pipe regarding preheating, welding, and stress relieving.

### **Cold Spring**

The cold-springing procedure for piping systems involves, basically, the cutting short of each segment of piping in an amount equal to some specific percentage of the normal thermal growth of the segment, with proper allowance to compensate

for possible terminal connection movements. The cumulative effect results in an offset gap between the piping ends at the point of final field closure. The drawing together and alignment of the piping ends by the application of required forces and moments are called *cold pull* and result in a slight relocation of all points along the entire piping system. This relocation is the only effect that cold springing has on supports. The piping is then considered to be in the cold-sprung position, which is equivalent to the cold operating position. The movement at all support points from the erected to the cold-sprung position must be calculated, and provision made for this movement in the form of hanger rod adjustment.

### **Adjustment**

It is necessary to provide vertical adjustment to attain the desired elevation of the piping system. On piping supported from above, it may suffice to adjust an MSS-SP-58 Type 1, 5, 6, 9, or 10 support through the yoke portion by raising or lowering the nut on the rod. For larger ranges of adjustments, it is necessary to provide a turnbuckle, MSS-SP-58 Type 13 or 15, in the hanger rod. It is also practical to select a top attachment whereby adjustment can be made at the top of the hanger rod.

On piping which is supported from below, provision for adjustment can be made with screw thread stanchions, MSS-SP-58 Type 38, or by shims or grout.

### **Protective Coatings**

Protective coatings are normally applied to pipe supports for corrosion resistance. Metallic coatings may be applied by either the electroplating or the hot-dip process. Nonmetallic coatings, if selected for specific purposes, should be applied as recommended by the manufacturer. Consideration must be given to coatings used on threaded parts that are to be assembled after coating.

## ***OTHER PIPE SUPPORT CONSIDERATIONS***

---

### **Transportation and Storage**

Transportation and storage should be carried out with care to avoid damage to the hanger components, especially load calibration bolts and connection threads. If stored in the open, all components should be protected from dirt and water.

### **Assembly**

All items should be assembled as completely as possible on the ground. Hanger rod threads should be greased prior to assembly to allow easy adjustability under load.

### **Installation**

Locate, position, and connect the structural attachment to the steel or concrete. Be careful to orient the structural attachment pin or bolt in the right direction.

Next, move the hanger assembly into position and secure, using the connection parts. When installing an item which contains a nameplate, load scale, adjustment bolts, travel stops, or other device which requires accessibility, be sure to install the item so that these features are visible and accessible. Locate the position for the pipe attachment and assemble it to the pipe. Complete the connection between the hanger and the pipe attachment.

### **Adjustment**

Adjust the hanger rods or adjustment parts to take up the pipe load by the hanger components. Be sure to achieve minimum thread engagement before taking up full load. When installing springs, continue to take up on the load until the spring setting balances with the supporting load. When all adjustments and evaluations are complete, lock all required items using locknuts, retainers, clips, or other locking item supplied. After all pipeline testing is complete and prior to operation, adjust the springs until the travel stops can be removed by hand. Remove the travel stops prior to operation to allow the spring to move freely.

### **Inspection**

The following items should be verified prior to operation:

1. The support is installed in the correct location.
2. The travel and load positions are correct for springs.
3. The travel stops are removed, and the spring is ready for operation.
4. The minimum thread engagement is met on all threaded items.
5. All locknuts or other locking devices are in place.
6. All connection pins and connection bolts are properly loaded and secured.