



STANDARD PRACTICE

SP-120

FLEXIBLE GRAPHITE PACKING SYSTEM FOR RISING STEM STEEL VALVES (DESIGN REQUIREMENTS)

Developed and Approved
by the
Manufacturers Standardization Society
of the
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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 A.)

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FOREWORD

This Standard Practice (SP) was developed by a cooperative effort of representatives of Valve and Packing Manufacturers. This SP is intended primarily to be an aid for the manufacture and procurement of standardized packing system design features for rising stem steel valves that utilize flexible graphite packing. However, this does not preclude the use of these system features for other types of packing systems since this SP represents the consensus input from a broad spectrum of industry applications.

This SP shall not be construed to be effective for all pressures and types of services expected of ASME B16.34 valves. Special service applications such as low fugitive emissions control or toxic fluid may require additional or different design measures that are outside the scope of this standard practice.

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FLEXIBLE GRAPHITE PACKING SYSTEM FOR RISING STEM STEEL VALVES (DESIGN REQUIREMENTS)

1. SCOPE^(a)

1.1 This Standard Practice provides packing material and dimensional requirements for valve packing, packing chamber, packing gland, packing washer, bonnet, and stem as they relate to the total packing assembly.

1.2 This Standard Practice applies to standard, special, and limited Class 150 through Class 4500 (including intermediate classes) ASME B16.34 type steel gate, globe, and angle valves designed with rotating/rising, and non-rotating/rising stems.

1.3 This Standard Practice applies to valves in which a flexible graphite packing assembly is used as the primary stem sealing system.

1.4 This Standard Practice does not apply to valves that include a lantern ring as part of its packing system nor to bonnetless valves with split glands.

2. DEFINITIONS

See MSS SP-96 for definitions of terms used in this Standard Practice.

See Figure 2 for definitions of symbols used in this Standard Practice.

3. PACKING ASSEMBLY

3.1 The packing shall be composed of center and end rings or a cylinder of flexible graphite

and end rings. Flexible graphite packing assembly that is constructed with a braided carbon or graphite or metal mesh that reinforces the flexible graphite may not require end rings. The end rings shall serve as wipers and anti-extrusion devices to keep the flexible graphite in the packing chamber during operation, including stroking, of the valve. Individual center rings may contain up to 2 splits per ring to facilitate valve packing installation. Braided end rings shall contain a maximum of 1 split per ring and molded end rings shall contain a maximum of 2 splits per ring. The end ring properties shall be designed to deter the extrusion and/or erosion of the center flexible graphite rings during valve operation.

Packing assemblies of flexible graphite without end rings may be used; however, the diametrical clearance specified in Table 1 shall be reduced to a maximum of 50% of that required for higher than Class 300 valves. The packing shall also be qualified to the requirements of MSS SP-121, Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves.

3.2 The packing assembly shall contain a dispersed passive corrosion inhibitor, dispersed embedded active corrosion inhibitor or a suitable combination of inhibitors to minimize stem pitting caused by the galvanic corrosion phenomenon set up in a wet valve packing chamber. Inhibitors in end rings are optional unless otherwise specified by the purchaser.

3.3 The pre-installed density and dimensions of the flexible graphite packing shall be at the valve manufacturer's option. The final adjusted density and dimensions of the packing assembly shall be capable of sealing with no visible leakage when the valve is tested at a pressure equal to the valve's 100°F pressure rating at ambient conditions. The as-shipped remaining packing and packing gland adjustment (packing gland tight) shall be greater than 10% of the minimum depth of the packing chamber listed in Table 1.

NOTE:^(a) This standard is not intended to apply to valves developed for and predominantly used in instrument piping systems. (See MSS SP-99, Instrument Valves, and MSS SP-105, Instrument Valves for Code Applications.)

3.4 The dimensional requirements of the packing assembly shall be per Table 1. The minimum width "W" and minimum depth "L" are listed.

3.5 Smaller packing widths ("W") and/or smaller depths ("L") may be used when qualified to the requirements of MSS SP-121, Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves. All other provisions of this Standard Practice shall apply.

4. STEM

4.1 The maximum total stem dimensional tolerances (bilateral or unilateral) shall be per Table 1. The stem finish shall be 32 Ra (microinch) (0.80 micrometers) or smoother. These stem characteristics shall apply in the area that contacts the packing during the full stroking of the valve. The maximum stem O.D. tolerance as shown in Table 1 applies to the stem diameter that contacts the packing I.D.

4.2 The stem O.D. dimensional tolerance shall be such that the maximum diametrical clearance between the packing gland or follower I.D. ("B") and bonnet or packing washer ("C") as required in Table 1 is not exceeded.

4.3 The stem O.D. that contacts the packing during the full stroking of the valve shall meet circularity, taper, and straightness requirements encompassed in a cylindricity tolerance of 0.003" (0.08mm) for 3" and smaller stems and 0.004" (0.10mm) for stems larger than 3". (See Figure 1.)

4.4 The stem surface that contacts the packing during full stroking of the valve shall be free of scratches, pits, or voids deeper than 0.002" (0.05mm).

5. PACKING GLAND

The dimensional tolerances of the gland or follower I.D. and O.D. shall be such that the maximum diametrical clearance between the stem and gland or follower ("B") and packing chamber bore and gland or follower ("A") illustrated in Table 1 are not exceeded.

6. PACKING CHAMBER

6.1 The dimensional tolerance of the packing chamber shall be such that the maximum diametrical clearance between gland or follower and the packing chamber ("A") illustrated in Table 1 is not exceeded. The packing depth 4W or 5W illustrated in Table 1 refers to the equivalent of 4 or 5 square rings of packing which includes the top and bottom end rings. The packing chamber surface finish shall be 125 Ra (microinch) (3.2 micrometers) or smoother, as illustrated in Table 1.

A chamfer or radius may be used at the entrance of the packing chamber.

6.2 The packing chamber bore shall meet squareness to the bonnet gasket surface, or other appropriate datum surface encompassed in a perpendicularity tolerance of 0.006" (0.15mm) regardless of bore size. (See Figure 1.)

6.3 The packing chamber bore shall meet circularity, taper and straightness requirements encompassed in a cylindricity tolerance of 0.006" (0.15mm). (See Figure 1.)

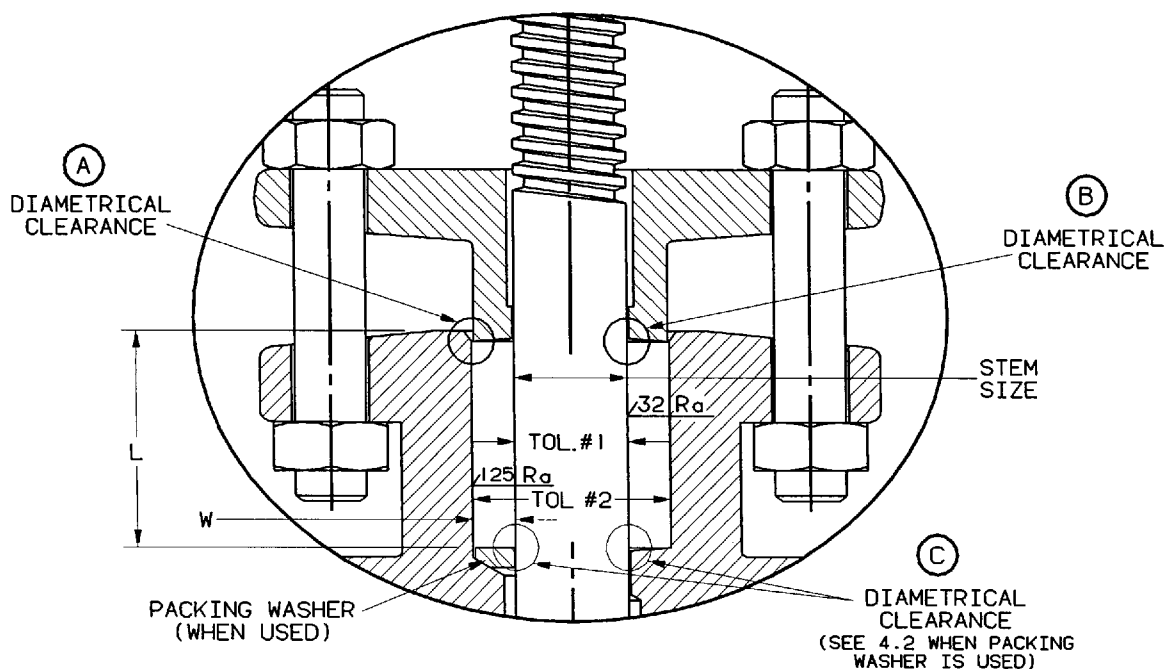
6.4 The packing chamber bore and bonnet stem hole shall be concentric within a positional tolerance of $\phi 0.005"$ (0.13mm) as presented in Figure 1.

6.5 The packing chamber bore shall be free of scratches, pits, or voids deeper than 0.006" (0.15mm).

7. PACKING WASHER OR VALVE BONNET

The tolerance on the valve bonnet or the packing washer, when a packing washer is used, shall be such that the maximum diametrical clearance between the stem and the bonnet or packing washer ("C"), illustrated in Table 1, is not exceeded.

TABLE 1 — PACKING SYSTEM DETAILS (U.S. UNITS)

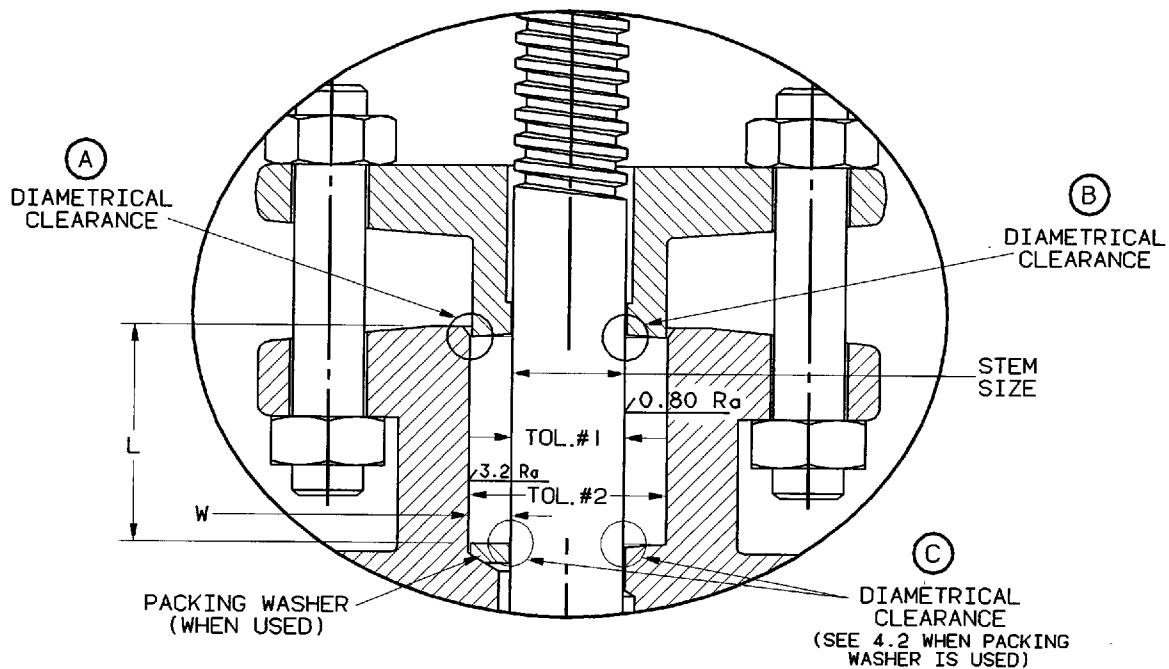


NOTE: DIMENSIONS IN INCHES			WIDTH & DEPTH OF PACKING		DIAMETRICAL CLEARANCE-MAXIMUM		
STEM SIZE ϕ	STEM TOL. #1-MAXIMUM	PACKING CHAMBER I.D. TOL. #2-MAXIMUM	W MINIMUM	L MINIMUM	(A) ^(a)	(B) ^(a)	(C) ^(a)
1/4" thru 1/2"	0.008	0.010	1/8	4W	.020	.040	.040
> 1/2" thru 1 1/16"	0.008	0.010	3/16	4W	.020	.040	.040
> 1 1/16" thru 1 1/4"	0.008	0.010	1/4	4W	.025	.050	.050
> 1 1/4" thru 2"	0.009	0.010	5/16	5W	.025	.050	.050
> 2" thru 3"	0.009	0.010	3/8	5W	.025	.050	.050
> 3" thru 3 1/2"	0.011	0.015	7/16	5W	.030	.065	.065
> 3 1/2" thru 4 1/4"	0.011	0.015	1/2	5W	.030	.065	.065
> 4 1/4" thru 5"	0.011	0.015	9/16	5W	.030	.065	.065
> 5" thru 7"	0.011	0.015	5/8	5W	.030	.065	.065

NOTE (a)

THE MANUFACTURER MAY NEED TO REVISE DIAMETRICAL CLEARANCES FOR SEVERE SERVICES AND/OR HIGH PRESSURE APPLICATIONS.

TABLE 1M — PACKING SYSTEM DETAILS (METRIC UNITS)



NOTE: DIMENSIONS IN MILLIMETERS			WIDTH & DEPTH OF PACKING		DIAMETRICAL CLEARANCE—MAXIMUM		
STEM SIZE ϕ	TOL. #1—MAXIMUM	PACKING CHAMBER I.D. TOL. #2—MAXIMUM	W MINIMUM	L MINIMUM	(A) ^(a)	(B) ^(a)	(C) ^(a)
6.4 thru 12.7	0.20	0.25	3.2	4W	0.51	1.02	1.02
> 12.7 thru 17.5	0.20	0.25	4.8	4W	0.51	1.02	1.02
> 17.5 thru 31.8	0.20	0.25	6.4	4W	0.64	1.27	1.27
> 31.8 thru 50.8	0.23	0.25	7.9	5W	0.64	1.27	1.27
> 50.8 thru 76.2	0.23	0.25	9.5	5W	0.64	1.27	1.27
> 76.2 thru 88.9	0.28	0.38	11.1	5W	0.76	1.65	1.65
> 88.9 thru 108.0	0.28	0.38	12.7	5W	0.76	1.65	1.65
> 108.0 thru 127.0	0.28	0.38	14.3	5W	0.76	1.65	1.65
> 127.0 thru 178.0	0.28	0.38	15.9	5W	0.76	1.65	1.65

NOTE (a)

THE MANUFACTURER MAY NEED TO REVISE DIAMETRICAL CLEARANCES FOR SEVERE SERVICES AND/OR HIGH PRESSURE APPLICATIONS.

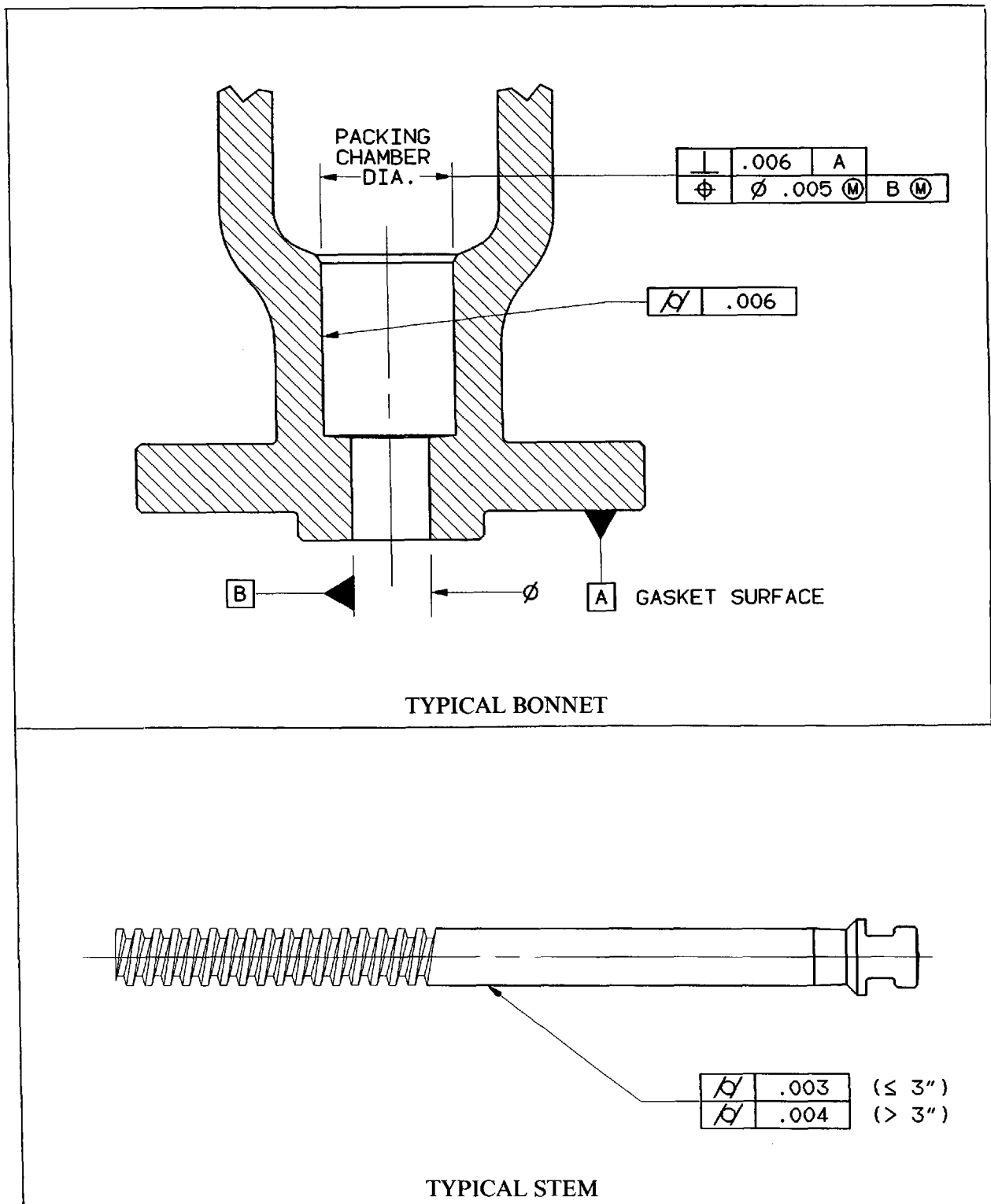


FIGURE 1
STEM/BONNET DETAILS
(U.S. UNITS)

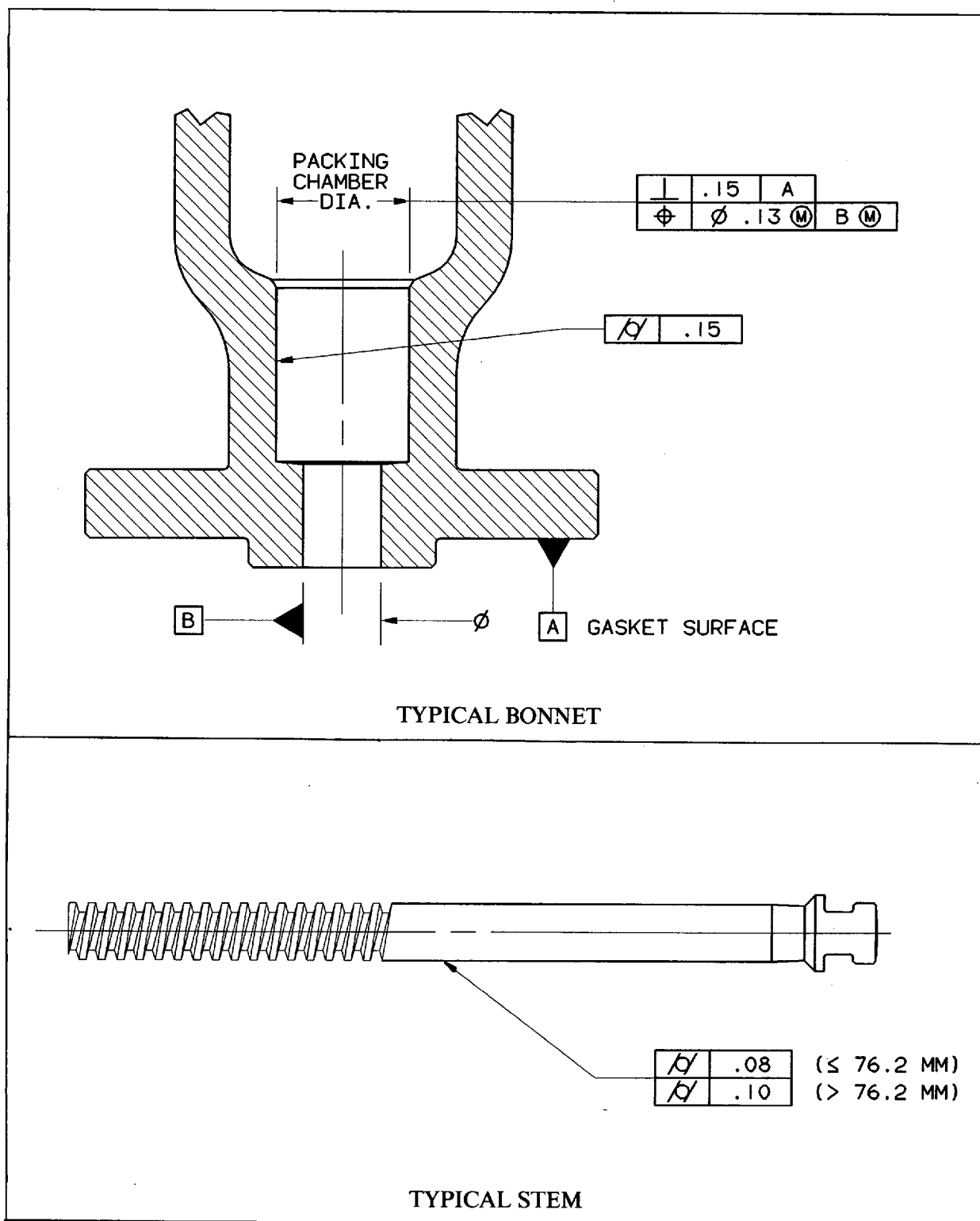
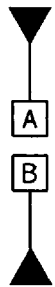


FIGURE 1M

STEM/BONNET DETAILS
(METRIC UNITS)



- DATUM FEATURE SYMBOL

DEF. - A DATUM FEATURE SYMBOL IS USED TO DESIGNATE A DATUM SURFACE OR FEATURE.



- CYLINDRICITY

DEF. - CYLINDRICITY IS A CONDITION OF A SURFACE OF REVOLUTION IN WHICH ALL POINTS OF THE SURFACE ARE EQUIDISTANT FROM A COMMON AXIS.



- POSITION

DEF. - A POSITION TOLERANCE DEFINES A ZONE WITHIN WHICH THE AXIS OR CENTER PLANE OF A FEATURE IS PERMITTED TO VARY FROM ITS THEORETICALLY EXACT POSITION.



- PERPENDICULARITY

DEF. - PERPENDICULARITY IS THE CONDITION OF A SURFACE, AXIS OR LINE WHICH IS 90° FROM A DATUM PLANE AXIS.



- MAXIMUM MATERIAL CONDITION

DEF. - MAXIMUM MATERIAL CONDITION IS THAT CONDITION WHERE A FEATURE OF SIZE CONTAINS THE MAXIMUM AMOUNT OF MATERIAL WITHIN THE STATED LIMITS OF SIZE. e.g., SMALLEST HOLE; BIGGEST SHAFT.

FIGURE 2

GEOMETRIC SYMBOL DEFINITIONS

**ANNEX A
REFERENCED STANDARDS**

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

ASME PUBLICATIONS (Approved as American National Standards)

ASME B16.34-1996 Valves — Flanged, Threaded, and Welding End

MSS PUBLICATIONS

SP-96-1996	Guidelines on Terminology for Valves and Fittings
SP-99-1994	Instrument Valves
SP-105-1996	Instrument Valves for Code Applications
SP-121-1997	Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves

Publications of the following organizations appear above:

ASME	The American Society of Mechanical Engineers 345 East 47th Street, New York, NY 10017
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MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park Street, N.E., Vienna, VA 22180
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Publications appearing above which have been approved as American National Standards may be obtained from:

ANSI	American National Standards Institute, Inc. 11 West 42nd Street, New York, NY 10036
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**List of MSS Standard Practices
(Price List Available Upon Request)**

(03/97)

Number

SP-6-1996	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP-9-1997	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-1993	Standard Marking System for Valves, Fittings, Flanges and Unions
SP-42-1990	(R 95) Class 150 Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt Weld Ends
SP-43-1991	(R 96) Wrought Stainless Steel Butt-Welding Fittings
SP-44-1996	Steel Pipeline Flanges
SP-45-1992	Bypass and Drain Connections
SP-51-1991	(R 95) Class 150LW Corrosion Resistant Cast Flanges and Flanged Fittings
SP-53-1995	Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
SP-54-1995	Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Radiographic Examination Method
SP-55-1996	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Eval. of Surface Irregularities
SP-58-1993	Pipe Hangers and Supports - Materials, Design and Manufacture
SP-60-1991	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
SP-61-1992	Pressure Testing of Steel Valves
SP-65-1994	High Pressure Chemical Industry Flanges and Threaded Stubs for Use with Lens Gaskets
SP-67-1995	Butterfly Valves
SP-68-1988	High Pressure-Offset Seat Butterfly Valves
SP-69-1996	Pipe Hangers and Supports - Selection and Application
SP-70-1990	Cast Iron Gate Valves, Flanged and Threaded Ends
SP-71-1990	Cast Iron Swing Check Valves, Flanged and Threaded Ends
SP-72-1992	Ball Valves with Flanged or Butt-Welding Ends for General Service
SP-73-1991	(R 96) Brazing Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings
SP-75-1993	Specification for High Test Wrought Butt Welding Fittings
SP-77-1995	Guidelines for Pipe Support Contractual Relationships
SP-78-1987	(R 92) Cast Iron Plug Valves, Flanged and Threaded Ends
SP-79-1992	Socket-Welding Reducer Inserts
SP-80-1997	Bronze Gate, Globe, Angle and Check Valves
SP-81-1995	Stainless Steel, Bonnetless, Flanged, Knife Gate Valves
SP-82-1992	Valve Pressure Testing Methods
SP-83-1995	Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
SP-85-1994	Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-86-1987	(R 92) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators
SP-87-1991	(R 96) Factory-Made Butt-Welding Fittings for Class 1 Nuclear Piping Applications
SP-88-1993	Diaphragm Type Valves
SP-89-1991	Pipe Hangers and Supports - Fabrication and Installation Practices
SP-90-1986	(R 91) Guidelines on Terminology for Pipe Hangers and Supports
SP-91-1992	(R 96) Guidelines for Manual Operation of Valves
SP-92-1987	(R 92) MSS Valve User Guide
SP-93-1987	(R 92) Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components - Liquid Penetrant Examination Method
SP-94-1992	Quality Standard for Ferritic and Martensitic Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Ultrasonic Examination Method
SP-95-1986	(R 91) Swage (d) Nipples and Bull Plugs
SP-96-1996	Guidelines on Terminology for Valves and Fittings
SP-97-1995	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Buttwelding Ends
SP-98-1996	Protective Coatings for the Interior of Valves, Hydrants, and Fittings
SP-99-1994	Instrument Valves
SP-100-1997	Qualification Requirements for Elastomer Diaphragms for Nuclear Service Diaphragm Type Valves
SP-101-1989	Part-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-102-1989	Multi-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-103-1995	Wrought Copper and Copper Alloy Insert Fittings for Polybutylene Systems
SP-104-1995	Wrought Copper Solder Joint Pressure Fittings
SP-105-1996	Instrument Valves for Code Applications
SP-106-1990	(R 96) Cast Copper Alloy Flanges and Flanged Fittings, Class 125, 150 and 300
SP-107-1991	Transition Union Fittings for Joining Metal and Plastic Products
SP-108-1996	Resilient-Seated Cast Iron-Eccentric Plug Valves
SP-109-1991	Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1996	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-1996	Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1993	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 at \$19.00 each. Same quantity discounts apply on total order.
SP-113-1994	Connecting Joint between Tapping Machines and Tapping Valves
SP-114-1995	Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000
SP-115-1995	Excess Flow Valves for Natural Gas Service
SP-116-1996	Service Line Valves and Fittings for Drinking Water Systems
SP-117-1996	Bellows Seals for Globe and Gate Valves
SP-118-1996	Compact Steel Globe & Check Valves - Flanged, Flangeless, Threaded & Welding Ends (Chemical & Petroleum Refinery Service)
SP-119-1996	Belled End Socket Welding Fittings, Stainless Steel and Copper Nickel
SP-120-1997	Flexible Graphite Packing System for Rising Stem Steel Valves (Design Requirements)
SP-121-1997	Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves

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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