Compact Steel Gate Valves—Flanged, Threaded, Welding, and Extended-Body Ends

API STANDARD 602
SEVENTH EDITION, OCTOBER 1998

American
Petroleum
Institute

**Helping You
Get The Job
Done Right.**SM

API ENVIRONMENTAL, HEALTH AND SAFETY MISSION AND GUIDING PRINCIPLES

The members of the American Petroleum Institute are dedicated to continuous efforts to improve the compatibility of our operations with the environment while economically developing energy resources and supplying high quality products and services to consumers. We recognize our responsibility to work with the public, the government, and others to develop and to use natural resources in an environmentally sound manner while protecting the health and safety of our employees and the public. To meet these responsibilities, API members pledge to manage our businesses according to the following principles using sound science to prioritize risks and to implement cost-effective management practices:

- To recognize and to respond to community concerns about our raw materials, products and operations.
- To operate our plants and facilities, and to handle our raw materials and products in a manner that protects the environment, and the safety and health of our employees and the public.
- To make safety, health and environmental considerations a priority in our planning, and our development of new products and processes.
- To advise promptly, appropriate officials, employees, customers and the public of information on significant industry-related safety, health and environmental hazards, and to recommend protective measures.
- To counsel customers, transporters and others in the safe use, transportation and disposal of our raw materials, products and waste materials.
- To economically develop and produce natural resources and to conserve those resources by using energy efficiently.
- To extend knowledge by conducting or supporting research on the safety, health and environmental effects of our raw materials, products, processes and waste materials.
- To commit to reduce overall emissions and waste generation.
- To work with others to resolve problems created by handling and disposal of hazardous substances from our operations.
- To participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.
- To promote these principles and practices by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of similar raw materials, petroleum products and wastes.

Compact Steel Gate Valves—Flanged, Threaded, Welding, and Extended-Body Ends

Manufacturing, Distribution and Marketing Department

API STANDARD 602
SEVENTH EDITION, OCTOBER 1998

American Petroleum Institute

Helping You Get The Job Done Right.SM

SPECIAL NOTES

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations under local, state, or federal laws.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. Sometimes a one-time extension of up to two years will be added to this review cycle. This publication will no longer be in effect five years after its publication date as an operative API standard or, where an extension has been granted, upon republication. Status of the publication can be ascertained from the API Manufacturing, Distribution and Marketing Department [telephone (202) 682-8000]. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the director of the Manufacturing, Distribution and Marketing Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

API standards are published to facilitate the broad availability of proven, sound engineering and operating practices. These standards are not intended to obviate the need for applying sound engineering judgment regarding when and where these standards should be utilized. The formulation and publication of API standards is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

FOREWORD

This standard covers flanged-end, threaded-end, socket-welding-end, and butt-welding-end compact steel gate valves, including extended-body, and bellows seal types, corresponding to nominal pipe sizes in ASME B36.10M or ASME B36.19M as defined herein.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to the director of the Manufacturing, Distribution and Marketing Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

CONTENTS

Page

Tables

NOTES TO PURCHASER

1. If the purchaser needs a valve that deviates from this standard, the purchaser is responsible for clearly defining such deviation and furnishing sufficient information to permit the manufacturer to complete the order.
2. If no exceptions to this standard are to be taken, the purchase order need only make reference to API Standard 602 and specify the items marked with an asterisk (*) in the list below. Items listed below not marked with an asterisk are options that may also be specified.

* a. Valve size (see 1.1).
* b. Class (see 1.1).
* c. Materials (see 4.6.1, Table 8; and for bellows material, Table A-1).
* d. End connections, including bore for butt-welding ends (see 4.2).
* e. Extension length for extended body (see 4.3).
* f. Male connection style and optional integral backing ring for extended-body valve (see 4.3, Table 4 and 5).
* g. Body type [inside screw with rising stem (ISRS) or outside screw and yoke (OS&Y) (see 1.1)].
* h. Body-bonnet joint (bolted, union, welded, or threaded-and-seal-welded; see 1.1 and 4.7.1).
  i. Integral flanges or flanges welded to body (see 4.2.4 and Note 3 below).
  j. Flange facing finish (see 4.2.6).
  k. Bolting materials other than standard (see 4.7.3 and Table 8).
  l. Body-bonnet joint gasket (see 4.7.5 and 4.7.6).
* m. Trim number (other than standard), nominal trim material, and any required exceptions to options permitted by the manufacturer (see 4.8.1; 4.8.2; and Tables 8, 9, and 10).
  n. Packing, including any special stem and/or packing-chamber finish requirements (see 4.10.4 and 4.18).
  o. Pressure-temperature rating for bellows-seal valve other than standard (see A4.1.4).
  p. Bellows features other than standard (see A4.21.2 and A4.21.3).
  q. Inspection by purchaser (see 5.1 and Note 4 below).
  r. Integral extension or extension welded to body (see 4.4.1, 4.4.2, and Note 3 below).
  s. Post-weld heat treatment of extension-to-body attachment welds, flange attachment welds, butt-welding stub-end attachment welds, and bonnet welds of P1 and P9 materials whose nominal wall thickness is less than or equal to $\frac{3}{4}$ inch (see 4.2.4.2, 4.4.3, 4.7.8, and Note 3 below).

3. It is the purchaser's responsibility to specify supplementary requirements for the welds, such as the need for special heat treatment and supplementary nondestructive examination of the welds.
4. See API Standard 598 for additional items that may need to be specified, including supplementary examination, the extent of inspection by the purchaser, the inspector's address, and the optional high-pressure closure test.

Compact Steel Gate Valves—Flanged, Threaded, Welding, and Extended-Body Ends

1 Scope

1.1 This standard covers flanged-end, threaded-end, socket-welding-end, and butt-welding-end compact steel gate valves, including extended-body type, corresponding to nominal pipe sizes in ASME B36.10M or ASME B36.19M as follows: a) flanged-end and butt-welding-end in sizes NPS 4 and smaller, b) threaded-end and socket-welding-end in sizes NPS $2^1/_2$ and smaller, and c) bellows seal bonnet types in sizes NPS 2 and smaller. The following valves are specifically covered by this standard:

a. Class 800 valve with threaded, socket-welding, or butt-welding ends; an inside screw with rising stem (ISRS) and threaded packing nut or an outside screw and yoke (OS&Y) with rising stem and bolted packing-gland flange; and a bolted, union, welded, or threaded-and-seal-welded bonnet.
b. Class 1500 valve with threaded, socket welding, butt-welding, or flanged ends; an OS&Y with rising stem and bolted packing-gland flange; and a bolted, welded, or threaded-and-seal-welded bonnet.
c. Class 150, 300, and 600 flanged-end or butt-welding-end OS&Y valves with rising stem; bolted packing-gland flange; and a bolted, welded, or threaded-and-seal-welded bonnet.
d. Class 800 and Class 1500 extended-body valves conforming to items a and b above, except with male by female ends in sizes NPS $1/2$, $3/4$, 1, $1^1/_2$, and 2 and in size NPS $3/4$ male by NPS $1/2$ female.
e. Threaded-end male extensions for Class 1500 or for size NPS $1/2$ in Class 800 are not covered by this standard.
f. Class 150, 300, 600, 800, and 1500 valves with bellows stem seal with the additional requirements covered in Appendix A.

1.2 Figures 1 and 2 present illustrations of a typical ISRS gate valve and an OS&Y gate valve. Figure 3 shows a typical extended-body valve. The illustrations should not be construed as sponsoring such designs in whole or in part or as discriminating against other designs offered that conform to the requirements of this standard.

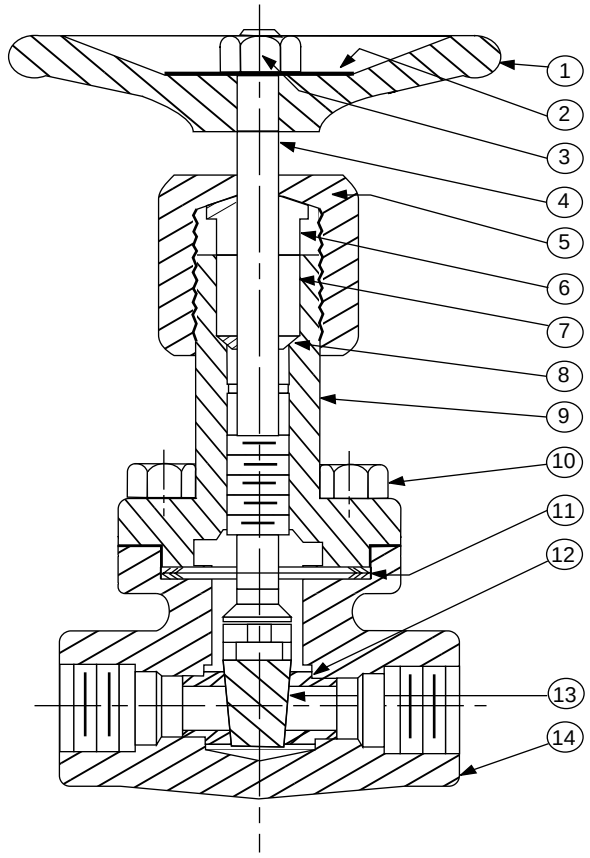
1.3 The illustrations in Tables 4 and 5 show some of the typical arrangements for the male end of extended-body valves. These illustrations should not be considered preferable to other arrangements that conform to the requirements of this standard.

2 Referenced Publications

The most recent editions of the following standards, codes, and specifications shall, to the extent specified, form a part of this standard:

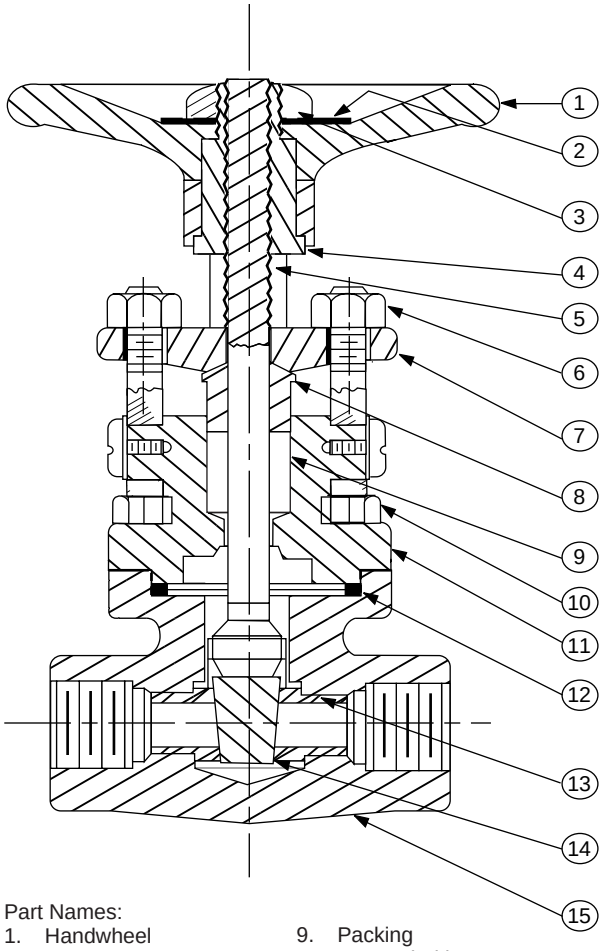
API	
Std 598	*Valve Inspection and Testing*
Std 600	*Steel Gate Valves—Flanged and Butt-Welding Ends, Bolted and Pressure Seal Bonnets*
ASME[1]	
B1.5	*Acme Screw Threads*
B1.8	*Stub Acme Screw Threads*
B1.20.1	*Pipe Threads, General Purpose (Inch)*
B16.5	*Pipe Flanges and Flanged Fittings*
B16.10	*Face-to-Face and End-to-End Dimensions of Valves*
B16.11	*Forged Fittings, Socket-Welding and Threaded*
B16.25	*Buttwelding Ends*
B16.34	*Valves—Flanged, Threaded, and Welding End*
B31.3	*Process Piping*
B36.10M	*Welded and Seamless Wrought Steel Pipe*
B36.19M	*Stainless Steel Pipe*
ASTM[2]	
A 105	*Forgings, Carbon Steel, for Piping Components*
A 182	*Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*
A 193	*Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service*
A 194	*Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service*
A 216	*Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service*
A 217	*Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts Suitable for High-Temperature Service*
A 240	*Standard Specification for Stainless and Heat Resisting Steel Plate, Sheet and Strip for Pressure Vessels*
A 276	*Stainless and Heat-Resisting Steel Bars and Shapes*
A 312	*Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes*
A 320	*Alloys-Steel Bolting Materials for Low-Temperature Service*

[1]American Society for Mechanical Engineers, 345 East 47th Street, New York, New York 10017.
[2]American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959.



Part Names:
1. Handwheel
2. Identification plate
3. Handwheel nut
4. Stem
5. Packing nut
6. Gland
7. Packing
8. Packing ring (when used)
9. Bonnet
10. Bonnet bolting
11. Gasket
12. Seat ring
13. Gate
14. Body

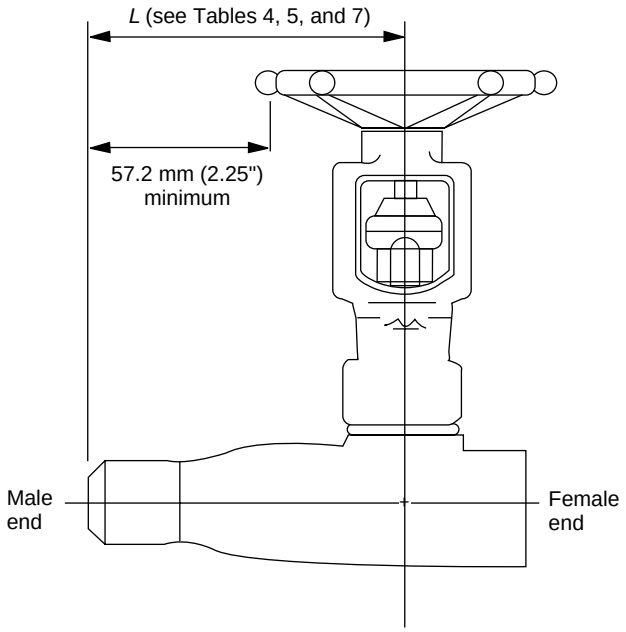
Figure 1—Typical Inside Screw With Rising Stem Gate Valve



Part Names:
1. Handwheel
2. Identification plate
3. Handwheel nut
4. Stem nut
5. Stem
6. Gland bolting
7. Gland flange
8. Gland
9. Packing
10. Bonnet bolting
11. Bonnet
12. Gasket
13. Seat ring
14. Gate
15. Body

Figure 2—Typical Outside Screw and Yoke Gate Valve

A 350	*Forgings, Carbon and Low-Alloy Steel, Requiring Notch Toughness Testing for Piping Components*
A 351	*Steel Castings, Austenitic, for High-Temperature Service*
A 352	*Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts Suitable for Low-Temperature Service*
A 582	*Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished*
B 127	*Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip*
B 165	*Standard Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube*
B 167	*Standard Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06690, N06025, and N06045) Seamless Pipe and Tube*
B 168	*Standard Specification for Nickel-Chromium-Iron-Alloys (UNS N06600, N06601, N06690, N06025, and N06045) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Plate, Sheet, and Strip*
B 443	*Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Plate, Sheet, and Strip*
B 473	*UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire*



Note: This figure references the appropriate tables that establish the required length and minimum wall thicknesses for extended-body valves.

Figure 3—Typical Extended-Body Valve

B 575 *Standard Specification for Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy, Plate, Sheet, and Strip*

B 622 *Standard Specification for Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube*

B 670 *Standard Specification for Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service*

E 10 *Test Method for Brinell Hardness of Metallic Materials*

AWS[3]

A5.9 *Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored and Stranded Welding Electrodes and Welding Rods*

A5.13 *Solid Surfacing Welding Rods and Electrodes*

3 Marking

3.1 Valves shall be marked in accordance with the requirements of ASME B16.34, except the identification plate may show the designation API 602 and shall include, but not be limited to, the requirements of 3.2, 3.3, and 3.4.

3.2 Valve bodies shall be marked as follows:

a. Threaded-end, socket-welding-end, or extended-body valves: 800 or 1500.
b. Flanged-end valves: 150, 300, 600, or 1500.
c. Butt-welding-end valves: 150, 300, 600, 800, or 1500.

3.3 Each valve shall have a securely attached corrosion-resistant metal identification plate giving the following information:

a. Manufacturer.
b. Manufacturer's model, type, or figure number.
c. Size.
d. Applicable pressure rating at 100°F (38°C).
e. Body material.
f. Trim material.
g. Extension material when different than body.

3.4 Valves made with welded extensions, stub ends, or flanges shall have "WLD" indicated on the identification plate or on the body. The material grade of each valve, along with the post-weld heat treatment conditions listed in Table 1, shall be indicated on the identification plate, the body, or both. The "WLD" identification when indicated on the body shall be shown separately from the material marking.

Table 1—Abbreviations for Post-weld Heat Treatment Conditions to be Used in Marking Valves

Condition	Abbreviation
Stress relieved	SR
Solution annealed	SA
Annealed	A
Normalized	N
Normalized/tempered	NT
Quenched/tempered	QT
Other	a

[a]As required by the ASTM specification for the body material.

4 Design

4.1 PRESSURE-TEMPERATURE RATINGS

4.1.1 The pressure-temperature ratings for Class 150, 300, 600, and 1500 valves shall conform to the corresponding standard class pressure-temperature ratings listed in ASME B16.34 for the appropriate valve material.

4.1.2 The pressure-temperature ratings for Class 800 valves shall be as shown in Table 2. The pressure-temperature ratings in Table 2 are a linear interpolation of Standard Class 600 and Standard Class 900 pressure-temperature ratings listed in ASME B16.34 for the appropriate valve material.

[3]American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33135.

Table 2—Pressure-Temperature Ratings for Class 800 Gate Valves
(See Material Group Numbers 2.1 through 2.5 next page)

Service Temperature		Material Group Number (see Table 8) 1.1		1.2		1.3		1.9		1.10		1.13		1.14	
		A 105[b, c] A 350-LF2[b] A 216-WCB[b]		A 350-LF3[d] A 352-LC2[d] A 352-LC3[d]		A 353-LCB[d]		A 182-F11-CL.2[e, f] A 217-WC6[e,g]		A 182-F22-CL.3[f] A 217-WC9[e, g]		A 182-F5 A 182-F5[a] A 217-C5[e]		A 182-F9 A 217-C12[e]	
°C	°F	MPa	psig	MPa	psig	MPa	psig	MPa	psig	MPa	psig	MPa	psig	MPa	psig
–29 to 38	–20 to 100	13.62	1975	13.79	2000	12.79	1855	13.79	2000	13.79	2000	13.79	2000	13.79	2000
93.5	200	12.41	1800	13.79	2000	12.06	1750	13.79	2000	13.79	2000	13.69	1985	13.79	2000
149.0	300	12.07	1750	13.38	1940	11.72	1700	13.28	1925	13.38	1940	13.17	1910	13.38	1940
204.5	400	11.65	1690	12.96	1880	11.34	1645	12.76	1850	12.97	1880	12.96	1880	12.96	1880
260.0	500	11.00	1595	12.24	1775	10.69	1550	12.24	1775	12.24	1775	12.24	1775	12.24	1775
315.5	600	10.07	1460	11.14	1615	9.79	1420	11.14	1615	11.14	1615	11.14	1615	11.14	1615
343.5	650	9.86	1430	10.82	1570	9.62	1395	10.82	1570	10.82	1570	10.82	1570	10.82	1570
371.0	700	9.79	1420	—	—	—	—	10.45	1515	10.45	1515	10.45	1515	10.45	1515
399.0	750	9.27	1345	—	—	—	—	9.79	1420	9.79	1420	9.72	1410	9.79	1420
426.5	800	7.58	1100	—	—	—	—	9.34	1355	9.34	1355	9.21	1355	9.34	1355
454.5	850	4.93	715	—	—	—	—	8.96	1300	8.96	1300	8.90	1290	8.96	1300
482.0	900	3.17	460	—	—	—	—	8.27	1200	8.27	1200	6.79	985	8.27	1200
510.0	950	1.90	275	—	—	—	—	5.86	850	6.93	1005	5.07	735	6.93	1005
538.0	1000	0.96	140	—	—	—	—	3.97	575	4.79	695	3.66	530	4.66	675
565.5	1050	—	—	—	—	—	—	2.66	385	3.21	465	2.66	385	3.17	460
593.5	1100	—	—	—	—	—	—	1.76	255	2.03	295	1.83	265	2.07	300
621.0	1150	—	—	—	—	—	—	1.14	165	1.24	180	1.14	165	1.38	200
649.0	1200	—	—	—	—	—	—	0.69	100	0.76	110	0.66	95	0.97	140

Note: MPa = megapascals; psig = pounds per square inch gauge
[a]For a material shown in Table 2 that is acceptable for low temperature service, the pressure rating for a service at any temperature below –29°C (–20°F) shall be no greater than the rating shown in Table 2 for –29°C to 38°C (–20°F to 100°F).
[b]Upon prolonged exposure to temperatures above 427°C (800°F), the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 427°C (800°F).
[c]Only killed steel shall be used over 454°C (850°F).
[d]Not to be used over 343°C (650°F).
[e]Use normalized and tempered material only.
[f]Permissible but not recommended for prolonged use above 593°C (1100°F).
[g]Not to be used over 593°C (1100°F).

4.1.3 For butt-welding end valves, the final wall thickness resulting from the required bore for the end connection weld preparation shall be taken into account when establishing the valve pressure class as Class 800, 600, 300, or 150. See ASME B16.34, paragraph 6.2.

4.2 END CONNECTIONS

4.2.1 Threaded-end valves, as well as the female threaded ends of extended-body valves, shall be internally taper-threaded as specified in ASME B1.20.1. All internal threads shall be countersunk a distance of approximately one-half the pitch of the thread at an angle of approximately 45 degrees with the axis of the thread. Countersinking shall be concentric with the threads. The minimum wall thickness of female threaded ends shall be in accordance with the Class 800 or Class 1500 requirements of Table 4 of ASME B16.34.

4.2.2 Socket-welding-end preparation, including the female ends of extended-body valves, shall conform to ASME B16.11. The bottom of the socket shall be square and flat. The minimum wall thickness of female socket-welding ends shall be in accordance with the Class 800 or Class 1500 requirements of Table 4 of ASME B16.34.

4.2.3 End flange dimensions shall conform to ASME B16.5.

4.2.4 Flanged-end valves may have the flanges integral with or welded to the body. When the flanges are welded to the body, the welding procedure and the welder or welding operator shall be qualified under the provisions of ASME B31.3. Weld quality shall conform to the acceptance standards of Paragraph 341 of ASME B31.3 for 100% visual examination for piping in Normal Fluid Service. The examination shall be performed in accordance with Paragraph 344 of ASME B31.3.

4.2.4.1 Flanges may be welded to the body with full penetration groove butt-welding or with inertia-welding. Socket welding of flanges to the valve body is not permitted by this standard. Integral centering (backing) rings used to facilitate welding shall be removed by machining after welding. There shall be no abrupt change in the internal diameter; no transition shall be more than 1 to 4, radial to axial. The final thickness of the weld shall not be less than the body wall thickness listed in Table 3.

Table 2—Pressure-Temperature Ratings for Class 800 Gate Valves (Continued)

Service Temperature [a]		Material Group Number (see Table 8)							
		2.1		2.2		2.3		2.5	
		A 182-F304[h] A 182-F304H A 351-CF3[i] A351-CF8[h]		A 182-F316[h] A 351-CF3M[j] A 351-CF8M[h]		A 182-F304L[i] A 182-F316L		A 182 F347H[k] A 351-CF8C[h]	
°C	°F	MPa	psig	MPa	psig	MPa	psig	MPa	psig
–29 to 38	–20 to 100	13.24	1920	13.24	1920	11.03	1600	13.24	1920
93.5	200	11.03	1600	11.41	1655	9.31	1350	12.14	1760
149.0	300	9.93	1440	10.31	1495	8.34	1210	11.31	1640
204.5	400	9.14	1325	9.45	1370	7.58	1100	10.55	1530
260.0	500	8.55	1240	8.79	1275	7.03	1020	9.93	1440
315.5	600	8.03	1165	8.31	1205	6.62	960	9.45	1370
343.5	650	7.89	1145	8.17	1185	6.45	935	9.28	1345
371.0	700	7.83	1135	8.00	1160	6.31	915	9.10	1320
399.0	750	7.62	1105	7.86	1140	6.17	895	9.03	1310
426.5	800	7.41	1075	7.76	1125	6.03	875	8.97	1300
454.5	850	7.27	1055	7.69	1115	5.93	860	8.93	1295
482.0	900	7.13	1035	7.62	1105	—	—	8.28	1200
510.0	950	7.03	1020	7.10	1030	—	—	7.10	1030
538.0	1000	5.89	855	6.45	935	—	—	6.69	970
565.5	1050	5.65	820	6.31	915	—	—	6.62	960
593.5	1100	4.72	685	5.62	815	—	—	5.93	860
621.0	1150	3.65	530	4.34	630	—	—	5.07	735
649.0	1200	2.86	415	3.41	495	—	—	3.17	460
676.5	1250	2.07	300	2.69	390	—	—	2.28	330
704.5	1300	1.55	225	2.14	310	—	—	1.72	250
732.0	1350	1.14	165	1.76	255	—	—	1.24	180
760.0	1400	0.90	130	1.38	200	—	—	1.00	145
788.0	1450	0.66	95	1.07	155	—	—	0.76	110
815.5	1500	0.48	70	0.76	110	—	—	0.66	95

[h]At temperature over 538°C (1000°F), use only when the carbon content is 0.04% or higher.
[i]Not to be used over 427°C (800°F).
[j]Not to be used over 454°C (850°F).
[k]For temperature over 538°C (1000°F), use only if the material is heat treated by heating to a minimum temperature of 1093°C (2000°F).

Table 3—Body and Bonnet Wall Thickness

Valve Size NPS	Minimum Wall Thickness			
	Classes 150, 300, 600, and 800		Class 1500	
	Millimeters	Inches	Millimeters	Inches
¼	3.1	0.12	3.8	0.15
⅜	3.3	0.13	4.3	0.17
½	4.1	0.16	4.8	0.19
¾	4.8	0.19	6.1	0.24
1	5.6	0.22	7.1	0.28
1¼	5.8	0.23	8.4	0.33
1½	6.1	0.24	9.7	0.38
2	7.1	0.28	11.9	0.47
2½	8.4	0.33	14.2	0.56
3	9.7	0.38	16.5	0.65
4	11.9	0.47	21.3	0.84

4.2.4.2 All valve bodies with welded-on flanges or butt-welding stub ends (see 4.2.7) shall be post-weld heat treated in accordance with the provisions of 4.4.3 for extension-to-body attachment welds. Valves with welded-on flanges or butt-welding stub ends that have been post-weld heat treated shall have the type of post-weld heat treatment indicated on the identification plate, or stamped on the body, or both, in accordance with the requirements of 3.4.

4.2.5 Flanged-end valves shall have face-to-face dimensions conforming to ASME B16.10.

4.2.6 The facing finish of end flanges shall be in accordance with the requirements of ASME B16.5. When a more restrictive facing finish is required, it shall be specified on the purchase order.

4.2.7 The end-to-end dimensions for Class 150, 300, 600, and 1500 butt-welding-end valves shall conform to ASME B16.10. Butt-welding-end valves may have stub ends integral with or welded to the body. Welded stub ends shall be welded onto the body in accordance with 4.2.4.

4.2.8 The end-to-end dimensions for Class 800 and Class 1500 socket-welding-end and threaded-end valves and for Class 800 butt-welding-end valves shall be the manufacturer's standard.

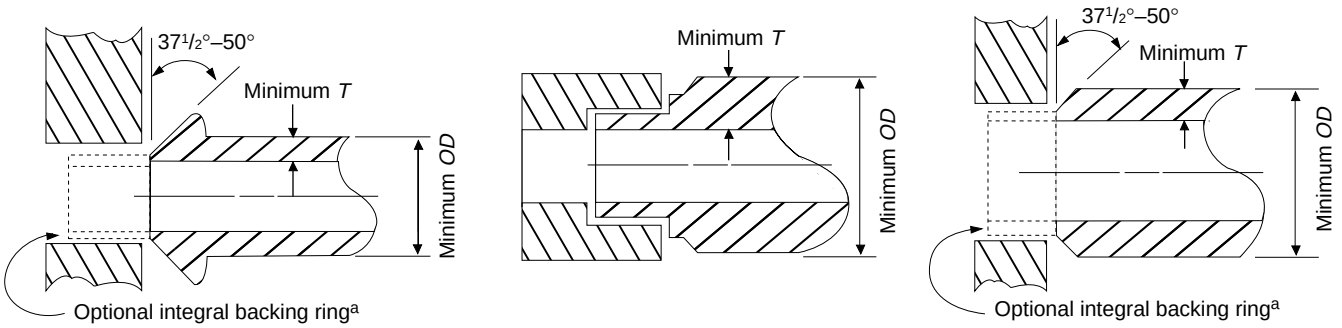
4.2.9 Butt-welding ends shall conform to ASME B16.25 for the bore specified in the purchase order for use without backing rings.

4.2.10 The design of integrally reinforced ends for extended-body valves shall comply with the requirements of Paragraph 304.3.2 of ASME B31.3.

4.3 EXTENSION DIMENSIONS

4.3.1 Table 4 shows the required dimensions for extensions without threaded ends. Table 5 shows the more restrictive requirements for extensions with threaded ends. Figure 3

Table 4—Dimensions for Welded-End Connections on Class 800 and Class 1500 Extended-Body Valves



	Length, L[a, c]		Minimum Outside Diameter, OD		Minimum Wall Thickness, T			
					Class 800		Class 1500	
Extension (NPS)	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches
½	≤100	≤4.0	23.1	0.91	5.6	0.22	5.6	0.22
	105–165	4.1–6.5	26.9	1.06	6.4	0.25	6.4	0.25
	170-205[d]	6.6–8.0[d]	31.7	1.25	6.4	0.25	6.4	0.25
¾	≤140	≤5.5	25.9	1.02	4.8	0.19	6.1	0.24
	145-205	5.6–8.0	31.7	1.25	7.5	0.30	7.5	0.30
1	≤230	≤9.0	32.5	1.28	5.6	0.22	7.1	0.28
1½	≤230	≤9.0	47.5	1.87	6.2	0.25	9.6	0.38
2	≤255	≤10.0	59.4	2.34	7.6	0.30	11.9	0.47

[a]The length of the optional integral backing ring is not included in L (see 4.3.2 and Figure 3).
[b]See Table 6 for dimensions of end connection.
[c]Extensions with lengths longer than the tabulated values are not permitted.
[d]The maximum extension length for NPS ½ extensions with socket-welding ends is 165 millimeters (6.5 inches).

illustrates the length dimensions. When the extension is intended to be socket-welded and the outside diameter of the extension exceeds the outside diameter of the corresponding pipe, the male end of the extension shall have the profile shown in Table 6. Table 7 shows comparative wall thicknesses for extensions and pipe and is for reference only.

4.3.2 The dimensions labeled "minimum" in Tables 4 and 5 are the minimum required for acceptable service. Any extension that does not meet or exceed these dimensions shall be rejected. The length of the extension is the length of the extended body from the axis of the valve stem to the outer end of the male extension (*L* in Figure 3). The integral backing ring shown in Table 4 is optional unless otherwise specified in the purchase order, and its length is not included in *L* in Figure 3 or Table 4. The minimum distance from the handwheel to the end of the extension shall be 57.2 millimeters (2.25 inches), as shown in Figure 3.

4.3.3 Threaded-end male extensions are not permitted for Class 1500 or for NPS ½ in Class 800. Threaded-end extensions shall be threaded in accordance with ASME B1.20.1. Threaded ends shall be free from tears and other visible imperfections.

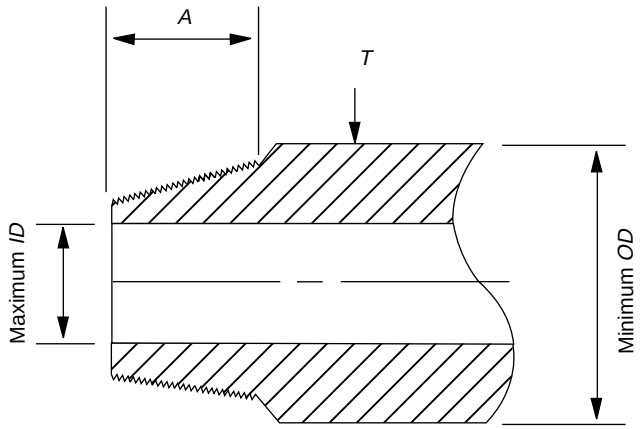
4.4 EXTENSIONS ATTACHED BY WELDING

4.4.1 Unless otherwise specified in the purchase order, extensions may be either integral with the valve or attached to the body by welding. When the extension is welded to the body, the welding procedure and the welder or welding operator shall be qualified in accordance with ASME B31.3. Weld quality shall conform to the acceptance standards of Paragraph 341 of ASME B31.3 for 100% visual examination for piping in Normal Fluid Service. The examination shall be performed in accordance with Paragraph 344 of ASME B31.3.

4.4.2 Extensions may be welded to the body with full penetration groove butt welding or with inertia welding. Other welding processes may be used by agreement between the purchaser and the manufacturer. Integral centering (backing) rings used to facilitate welding shall be removed by machining after welding. There shall be no abrupt change in the internal diameter; no transition shall be more than 1 to 4, radial to axial. The final thickness of the weld shall not be less than that required for the extension by Tables 4 and 5.

4.4.3 For all austenitic stainless steel valves, the extension-to-body attachment weld shall be solution annealed unless both the body and the extension piece are L grades or stabilized grades of stainless steel. For all valves of P4 and P5 materials (see note), the extension-to-body attachment weld, irrespective of the thickness of the weld joint, shall be post-weld heat treated in accordance with the requirements of ASME B31.3. For valves of P1 and P9 materials whose nominal wall thickness is greater than 19.1 millimeters (¾ inch) at the weld joint, the extension-to-body attachment weld shall be

Table 5—Dimensions for Threaded-End Connections on Class 800 Extended-Body Valves



Extension (NPS)[a]	Maximum Length, *L*[b]		Maximum Inside Diameter, *ID*		Minimum Outside Diameter, *OD*		Minimum Wall Thickness, *T*		Maximum End Connection Length, *A*	
	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches
¾	≤115	≤4.5	16.5	0.65	25.9	1.02	4.8	0.19	23.4	0.92
1	≤180	≤7.0	21.3	0.84	32.5	1.28	5.6	0.22	28.2	1.11
1½	≤230	≤9.0	38.1	1.50	47.5	1.87	6.1	0.24	29.2	1.15
2	≤255	≤10.0	47.5	1.87	59.4	2.34	7.1	0.28	30.0	1.18

[a]NPS ½ threaded-end male extensions are not covered by this standard.
[b]See Figure 3 for "*L*" dimension illustration.

post-weld heat treated in accordance with ASME B31.3. For valves of P1 and P9 materials whose nominal wall thickness is less than or equal to 19.1 millimeters (3/4 inch), post-weld heat treatment of the extension-to-body attachment weld is not required unless specified in the purchase order. Valves with welded extensions shall be marked as required in 3.4.

Note: For an explanation of P numbers, see ASME B31.3.

4.5 BODY EXTENSION MATERIALS

Extensions to be welded to the body shall be fabricated from one of the product forms listed in Table 1, ASME B16.34 that is in the same material group, with the same nominal chemistry as the body and have an equal or greater pressure rating. When a tubular form is used it shall be of a seamless construction.

4.6 BODY AND BONNET

4.6.1 The valve body and bonnet (also the union nut in a union bonnet design) shall be made of a forging or casting material specified in the purchase order using a material specification as listed in Table 8, except that bonnet nuts, welded and threaded-and-seal-welded bonnets, and bonnets for ISRS valves may also be made from bar stock material. The bar stock material shall be listed in and meet the requirements of Tables 1 and 2 of ASME B16.34, including the notes, for the appropriate material group. Free machining material shall not be used.

4.6.2 The minimum body wall thickness at any point, except at end connections (see 4.2.1, 4.2.2, and 4.3.1), shall not be less than the values shown in Table 3.

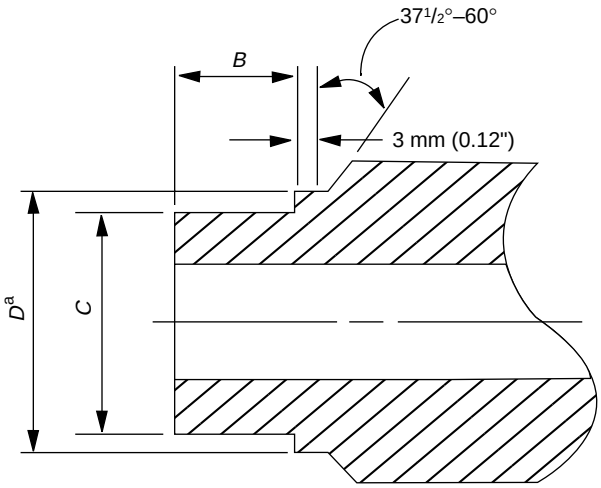
4.6.3 The minimum bonnet wall thickness at any point below the bottom ring of backing shall not be less than the values listed in Table 3.

4.7 BODY-BONNET JOINT

4.7.1 The body-bonnet joint design shall be either bolted, union, welded, or threaded-and-seal-welded. Bolted and threaded-and-seal-welded bonnet valve designs shall meet the design requirements of Paragraph 6.4 of ASME B16.34.

4.7.2 The bolted body-bonnet joint design shall have a minimum of four cap screws, studs, or stud bolts. Cap screws shall be suitable for external wrenching only.

Table 6—Dimensions for Socket-Welding End Connections on Class 800 and Class 1500 Extended-Body Valves



Extension (NPS)	Male End					
	Length, *B*		Diameter, *C*		Step Diameter, *D*[a]	
	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches
½	7.9	0.31	21.3	0.84	22.9	0.90
¾	11.2	0.44	26.7	1.05	28.2	1.11
1	11.2	0.44	33.3	1.31	35.1	1.38
1½	11.2	0.44	48.3	1.90	49.8	1.96
2	14.2	0.56	60.2	2.37	62.0	2.44

Note: The tolerances for the tabulated dimensions are +0.2, –0.8 millimeter (+0.01, –0.03 inch) for NPS ½ through NPS 1½; and ±0.8 millimeter (±0.03 inch) for NPS 2.
[a]See 4.3.1.

Table 7—Comparative Wall Thicknesses of Extended-Body Valves

Extension (NPS)	Shortest Welding-End Extension				Longest Welding-End Extension			
	Class 88		Class 1500		Class 800		Class 1500	
	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches
½	5.6	0.22	5.6	0.22	6.4	0.25	6.4	0.25
¾	4.8	0.19	6.1	0.24	7.6	0.30	7.6	0.30
1	—	—	—	—	5.6	0.22	7.1	0.28
1½	—	—	—	—	6.4	0.25	9.6	0.38
2	—	—	—	—	7.6	0.30	11.9	0.47

Note: This table is for information only. The tabulated thicknesses are minimum.

Table 7—Comparative Wall Thicknesses of Extended-Body Valves (Continued)

Extension (NPS)	Threaded Extension (Class 800)		Schedule 80 Pipe		Schedule 160 Pipe		XXS Pipe	
	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches
½	—	—	3.3	0.13	4.1	0.16	6.6	0.26
¾	4.8	0.19	3.6	0.14	4.8	0.19	6.9	0.27
1	5.6	0.22	4.1	0.16	5.6	0.22	7.9	0.31
1½	6.1	0.24	4.6	0.18	6.4	0.25	8.9	0.35
2	7.1	0.28	4.8	0.19	7.6	0.30	9.7	0.38

Note: This table is for information only. The tabulated thicknesses are minimum.

4.7.3 Bolting shall conform to Table 8, but other bolting combinations (not listed in Table 8) may be used by agreement between the purchaser and the manufacturer.

4.7.4 Bolted and union body-bonnet joints shall be designed to confine the gasket and prevent overcompression.

4.7.5 Unless otherwise specified in the purchase order, the bonnet joint shall be fitted with a spiral wound gasket of Type 304, 304L, 316, or 316L stainless steel winding and filler material suitable for the conditions specified in 4.7.6. The metallic portion of the gasket exposed to the service environment shall be of a material whose corrosion resistance is at least equal to that of the shell.

4.7.6 Unless otherwise specified in the purchase order, the gasket shall be suitable for the pressure rating of the valve within a valve design temperature range of –29°C (–20°F) to 538°C (1000°F).

4.7.7 Where the bonnet is welded to the body, the welding procedure and the welder or welding operator shall be qualified under the provisions of ASME B31.3. Weld quality shall conform to the acceptance standards of Paragraph 341 of ASME B31.3 for 100% visual examination for piping in Normal Fluid Service. The examination shall be performed in accordance with Paragraph 344 of ASME B31.3.

4.7.8 Bonnet welds (including seal welds) shall be post-weld heat treated in accordance with the provisions of 4.4.3. Unless otherwise specified in the purchase order, seal welds of P4 and P5 materials are exempt from post-weld heat treatment requirements if techniques and procedures are used to provide a weld hardness not to exceed 235 HB. Solution annealing of any type of bonnet weld cannot be performed and is exempt from post-weld heat treatment requirements. Valves with bonnet welds that have been post-weld heat treated shall have the type of post-weld heat treatment indicated on the identification plate, or on the body, or both, in accordance with 3.4. Multiple post-weld heat treat markings are not required for valves marked under 3.4.

4.8 TRIM

4.8.1 The valve trim shall consist of stem, gate seat surface, and seat ring surface.

4.8.1.1 If an overlay weld-deposit is used for the gate seat and/or seat ring seating surface, the corrosion resistance of the base material of the gate and/or seat ring shall be at least equal to the corrosion resistance of the material of the valve body.

4.8.1.2 Table 9 lists the nominal seating surface materials, categorized by trim numbers, available under this standard. Table 10 lists the stem materials that shall correspond with Table 9 trim numbers.

4.8.1.3 Except as provided in items a through d below, the standard trim number shall be as specified in Table 8. When a trim other than standard is desired, it shall be specified on the

purchase order by a trim number from Tables 9 and 10. The typical specifications included in Tables 9 and 10 are for materials whose nominal compositions represent some acceptable grades.

a. If a trim number is specified (as a standard trim or in the purchase order), an alternative trim number as shown in Table 11 may be furnished.

b. If a single trim (Trim Numbers 1, 101, 2, 3, 4, 104, 5, 105, 5A, 105A, 9, 10, 13, 15, 16, 17, or 18) is furnished, both the seating surface of the body seat ring and the seating surface of the gate shall be made of the type of material shown in Table 9.

c. If a combination trim (Trim Numbers 6, 106, 7, 107, 8, 108, 8A, 108A, 11, 12, or 14) is furnished, the seating surface of the body seat ring shall be made of one of the two types of material shown in Table 9, and the seating surface of the gate shall be made of the other type of material.

d. The stem trim number shall correspond to the nominal seating surface trim number and shall be of the material type and hardness listed in Table 10. The stem shall be of a wrought material.

4.8.2 Other trims not listed in Tables 9 and 10 may be used by agreement between the purchaser and the manufacturer.

4.9 GATE

The gate shall be of a solid wedge design. Gates made of nominal trim F6 as listed in Table 9 (Trim Numbers 1, 101, 6, 106, 7, 107, 8, 108, 8A, and 108A) shall have a maximum hardness of 520HB.

Table 8—Material Specifications and Applicable ASTM Specifications

Material Group No.	Nominal Designation Steel	Forgings Specification	Casting Specification	Standard Trim No. (from Table 9)	Standard Bonnet Bolting A 193/A 194[a]
1.1	C-Si	A 105	A 216-WCB	8, 8A	B7/2H
	C-Mn-Si	A 350-LF2	—	8, 8A	B8M-CL2/8M[b,c,d]
1.2	$2^1/_2$Ni	—	A 352-LC2	10	B8M-CL2/8M[b,c,d]
	$3^1/_2$Ni	A 350-LF3	A 352-LC3	10	B8M-CL2/8M[b,c,d]
1.3	C-Si	—	A 352-LCB	8, 8A	B8M-CL2/8M[b,c,d]
1.9	$1^1/_4$Cr-$^1/_2$Mo-Si	A 182-F11-CL2		8	B16/8M[e]
	$1^1/_4$Cr-$^1/_2$Mo		A 217-WC6		
1.10	$2^1/_4$Cr-$^1/_2$Mo	A 182-F22-CL3	A 217-WC9	8	B16/8M[e]
1.13	5Cr-$^1/_2$Mo	A 182-F5[a]	A 217-C5	8	B16/8M[e]
		A 182-F5	—		
1.14	9Cr-1 Mo	A 182-F9	A 217-C12	8	B16/8M[e]
2.1	18Cr-8Ni	A 182-F304	A 351-CF3	2	B8M-CL2/8M[c, d]
		A 182-F304H	A 351-CF8		
2.2	16Cr-12Ni-2Mo	A 182-F316	—	10	B8M-CL2/8M[c, d]
	16Cr-12Ni-2Mo	—	A 351-CF3M	10	B8M-CL2/8M[c, d]
			A 351-CF8M		
2.3	18Cr-8Ni	A 182-F304L	—	10	B8M-CL2/8M[c, d]
	16Cr-12Ni-2Mo	A 182-F316L	—		
2.5	18Cr-10Ni-Cb	A 182-F347H		10	B8M-CL2/8M[c, d]
			A 351-CF8C		

[a]Temperature limitations on bolting are as follows: Gr B7, 538°C (1000°F); Gr L7, 538°C (1000°F); Gr B16, 595°C (1100°F); Gr B8-CL 1, Gr B8A-CL 1A, Gr B8M-CL 1, and Gr B8MA-CL 1A, 816°C (1500°F); Gr B8-CL 2, Gr B8M-CL 2, Gr B8M2-CL 2B and Gr B8M3-CL 2C, 538°C (1000°F).

[b]ASTM A 320, Gr L7 bolts, and ASTM A 194, Gr 4 nuts are also acceptable.

[c]ASTM A193, Gr B8-CL 1, Gr B8A-CL 1A, Gr B8M-CL 1, Gr B8MA-CL 1A, Gr B8M2-CL 2B, and Gr B8M3-CL 2C bolting may be substituted providing that the requirements of 4.7.1 are met.

[d]ASTM A 193, Gr B8-CL2 bolts are also acceptable.

[e]ASTM A 194, Gr 7 nuts are also acceptable.

Source: This table is extracted from ASME B16.34, Table 1, except for standard trim and bolting columns. Reprinted by courtesy of the American Society of Mechanical Engineers, 345 East 47th Street, New York, New York 10017.

Table 9—Nominal Seating Surface Materials

Trim Number	Nominal Trim	Seat Surface Hardness HB Minimum[a]	Material Type	Typical Specification (Grade)		
				Cast	Forged	Welded
1; 101[b]	F6	[c]	13Cr	ASTM A217 (CA15)	ASTM A182 (F6a)	AWS A5.9 ER410
2	304	[d]	18Cr-8Ni	ASTM A351 (CF8)	ASTM A182 (F304)	AWS A5.9 ER308
3	F310	[d]	25Cr-10Ni	*	ASTM A182 (F310)	AWS A5.9 ER310
4; 104[b]	Hard F6	750[e]	Hard 13Cr	*	[h]	*
5; 105[b]	Hardfaced	350[e]	Co-Cr A[g]	[l]	*	AWS A5.13 E or R CoCrA
5A; 105A[b]	Hardfaced	350[e]	Ni-Cr	*	*	[j]
6; 106[b]	F6 and Cu-Ni	250[f] 175[f]	13Cr Cu-Ni	ASTM A217 (CA15) *	ASTM A182 (F6a) [i]	AWS A5.9 ER410 *
7; 107[b]	F6 and Hard F6	250[f] 750[f]	13Cr Hard 13Cr	ASTM A217 (CA15) *	ASTM A182 (F6a) [h]	AWS A5.9 ER410 *
8; 108[b]	F6 and Hardfaced	250[f] 350[f]	13Cr Co-Cr A[g]	ASTM A217 (CA15) [l]	ASTM A182 (F6a) *	AWS A5.9 ER410 AWS A5.13 E or R CoCrA
8A; 108A[b]	F6 and Hardfaced	250[f] 350[f]	13Cr Ni-Cr	ASTM A217 (CA15) *	ASTM A182 (F6a) *	AWS A5.9 ER410 [j]
9	Monel	[d]	Ni-Cu alloy	*	Manufacturer's Standard	*
10	316	[d]	18Cr-8Ni	ASTM A351 (CF8M)	ASTM A 182 (F316)	AWS A5.9 ER316
11	Monel and Hardfaced	[d] 350[f]	Ni-Cu alloy Trim 5 or 5A	* *	Manufacturer's Standard *	* See Trim 5 or 5A
12	316 and Hardfaced	[d] 350[f]	18Cr-8Ni Trim 5 or 5A	ASTM A351 (CF8M) *	ASTM A 182 (F316) *	AWS A5.9 ER316 See Trim 5 or 5A
13	Alloy 20	[d]	19Cr-29Ni	ASTM A351 (CN7M)	ASTM B473	AWS A5.9 ER320
14	Alloy 20 and Hardfaced	[d] 350[f]	19Cr-29Ni Trim 5 or 5A	ASTM A351 (CN7M) *	ASTM B473 *	AWS A5.9 ER320 See Trim 5 or 5A
15	Hardfaced[k]	350[e]	Co-Cr A[g]	[l]	*	AWS A5.13 E or R CoCrA
16	Hardfaced[k]	350[e]	Co-Cr A[g]	[l]	*	AWS A5.13 E or R CoCrA
17	Hardfaced[k]	350[e]	Co-Cr A[g]	[l]	*	AWS A5.13 E or R CoCrA
18	Hardfaced[k]	350[e]	Co-Cr A[g]	[l]	*	AWS A5.13 E or R CoCrA

Note: Cr = chromium; Ni = nickel; Co = cobalt; Cu = copper

*Not applicable.

[a] HB (formerly BHN) is the symbol for the Brinell hardness number per ASTM E 10.

[b] Trims 101, 104, 105, 105A, 106, 107, 108, and 108A denote trims that permit the use of free machining grades of 13 percent Cr material. Specify trims 1, 4, 5, 5A, 6, 7, 8, and 8A when the use of free-machining grades of 13Cr materials is not desired.

[c] Body and gate seat surfaces should be 250 HB minimum with a 50 HB minimum differential between the body and gate seat surfaces.

[d] Manufacturer's standard hardness.

[e] Differential hardness between the body and gate seat surfaces is not required.

[f] Hardness differential between the body and gate seat surfaces shall be the manufacturer's standard.

[g] This classification includes such trademarked materials as Stellite 6™, Stoody 6™, and Wallex 6™.

[h] Case hardened by nitriding to a thickness of 0.13 millimeters (0.005 inch) minimum.

[i] Manufacturer's standard with 30Ni minimum.

[j] Manufacturer's standard hardfacing with a maximum iron content of 25 percent.

[k] Stem material differs. See Table 10.

[l] Solid cast Co-CrA gates may be used.

Table 10—Stem Material

Trim Number[a]	Material Type	Hardness (HB)	Typical Specification (Type)
1	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420
101	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
2	18Cr-8Ni	Manufacturer's Standard	ASTM A 276-T304
3	25Cr-20Ni	Manufacturer's Standard	ASTM A 276-T310
4 through 8A	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420
104	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
105	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
105A	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
106	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
107	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
108	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
108A	13Cr	200 min., 275 max.	ASTM A 276-T410 or T420 ASTM A 582-T416
9 and 11	Ni-Cu alloy	Manufacturer's Standard	Manufacturer's Standard
10 and 12	18Cr-8Ni	Manufacturer's Standard	ASTM A 276-T316
13 and 14	19Cr-29Ni	Manufacturer's Standard	ASTM B 473
15	18Cr-8Ni	Manufacturer's Standard	ASTM A 276-T304
16	18Cr-8Ni	Manufacturer's Standard	ASTM A 276-T316
17	18Cr-8Ni	Manufacturer's Standard	ASTM A 276-T347
18	19Cr-29Ni	Manufacturer's Standard	ASTM B 473

[a]Trims 1, and 4 through 8A, denote trims that prohibit free-machining grades of 13 percent Cr material.

Table 11—Trim Numbers and Alternative Trim Numbers

Specified Trim Number	Alternative Trim Number
1	8 or 8A
101	108 or 108A
2	10
5A	5
105A	105
6	8
106	108
8A	8
108A	108
15	16

4.10 STEM

4.10.1 The stem shall have a shoulder that will backseat against the bonnet in the fully open position.

4.10.2 The stem diameter (measured at the section that passes through the packing) shall not be less than that shown in Table 12.

4.10.3 The threads of stem and stem nut shall be (a) ACME type conforming to ASME B1.5 or (b) 60-degree stub threads conforming to ASME B1.8 (minor modifications are permitted for either thread). The ACME thread major diameter may be undersized by a maximum of 1.6 millimeters ($1/16$ inch) from the diameter of the stem shown in Table 12.

4.10.4 The stem shall have a surface finish R_a of 0.80 micrometers (32 microinches) or smoother in the area in contact with the packing.

4.11 STEM-TO-GATE CONNECTION

4.11.1 The stem-to-gate connection for an ISRS valve shall be a button, and for an OS&Y valve the connection shall be a T-head-and-slot arrangement. The stem, including the button or T-head, shall be one piece. Stems formed from welding two or more pieces are not permitted.

4.11.2 For an OS&Y valve, the stem train (stem, gate, stem nut, handwheel, and handwheel nut) shall be designed to fail outside the pressure boundary in the event of a locked gate. The strength of the stem (in tension) outside the pressure boundary shall not be less than the calculated (theoretical) failure load based on the thread root area and the minimum ultimate tensile strength of the stem material. The strength (in tension) of the stem-to-gate connection and of all parts of the stem within the pressure boundary shall be greater than the strength of the stem at the root of the threads.

4.11.3 For an ISRS valve, the stem and stem-to-button head connection shall be designed to assure that stem failure occurs outside the valve pressure boundary in the event of a locked gate.

4.12 GATE GUIDING

The gate shall be accurately guided throughout the travel distance to its seat.

4.13 SEAT RINGS

Seat rings shall be pressed and/or rolled into the body.

4.14 PORT OPENING

The bore of the seat rings shall not be less than that shown in Table 13.

4.15 THREADED PACKING-GLAND ASSEMBLY

4.15.1 The packing-gland assembly shall include a steel gland located under the packing nut. A separate packing ring or washer at the base of the packing is permitted and shall be of a material whose nominal composition is equal to that of the valve bonnet or trim.

4.15.2 Packing nuts shall be made of a material whose corrosion resistance is at least equal to that of the bonnet.

4.16 BOLTED PACKING-GLAND ASSEMBLY

4.16.1 The packing gland shall be retained by bolting and shall be of the one-piece type or of the two-piece self-aligning type consisting of a gland flange and a gland.

4.16.2 Gland flanges shall be made of steel and shall be provided with holes for gland bolts. Open slots are not acceptable.

Table 12—Minimum Stem[a] Diameter

Valve Size NPS	Classes 150, 300, 600, and 800		Class 1500	
	Millimeters	Inches	Millimeters	Inches
1/4	7.1	9/32	10.3	13/32
3/8	7.1	9/32	10.3	13/32
1/2	8.7	11/32	10.3	13/32
3/4	9.5	3/8	11.1	7/16
1	11.1	7/16	14.3	9/16
1 1/4	12.7	1/2	15.9	5/8
1 1/2	14.3	9/16	15.9	5/8
2	15.9	5/8	16.7	21/32
2 1/2	17.5	11/16	19.1	3/4
3	19.1	3/4	25.4	1
4	22.2	7/8	28.6	1 1/8

[a]See 4.10.2. A finish machining undertolerance of 0.13 millimeter (0.005 inch) is permitted.

4.16.3 Gland bolts shall be made of Types 302, 304, 316, 410, 416, or 420 stainless steel in either a stud-bolt or swinging-eyebolt design. Gland-bolt nuts shall be hex head and shall conform to ASTM A 194, Grade 2H, or shall be made of Types 302, 303, 304, 316, 410, 416, or 420 stainless steel.

4.16.4 Stud bolts shall be adequately retained. Swinging eyebolts should be of either the hinge-pin or trunnion type. Hinge pins shall be made of one of the materials specified for gland bolts (see 4.16.3).

4.17 PACKING MATERIAL

4.17.1 Unless otherwise specified in the purchase order, the packing shall be suitable for steam and petroleum fluid for the pressure rating of the valve within a design temperature range of –29°C (–20°F) to 538°C (1000°F). The packing shall contain a corrosion inhibitor.

4.17.2 The minimum depth of packing material furnished shall be as listed in Table 14. Packing-gland adjustment length remaining after testing and with the gland tight shall be greater than 25 percent of the minimum packing depth listed in Table 14.

4.18 STUFFING BOX

The stuffing box finish R_a shall be 3.2 micrometers (125 microinches) or smoother unless otherwise specified in the purchase order.

4.19 STEM NUT

Stem nuts for OS&Y gate valves shall be made of a material highly resistant to galling and corrosion and shall have a minimum melting point of 954°C (1750°F). Gray cast iron is prohibited.

Table 13—Port Opening

Valve Size NPS	Minimum Seat Ring Bore[a]			
	Classes 150, 300, 600, and 800		Class 1500	
	Millimeters	Inches	Millimeters	Inches
1/4	6.4	1/4	6.4	1/4
3/8	6.4	1/4	6.4	1/4
1/2	9.5	3/8	9.5	3/8
3/4	12.7	1/2	12.7	1/2
1	17.5	11/16	15.9	5/8
1 1/4	23.8	15/16	22.2	7/8
1 1/2	28.6	1 1/8	27.0	1 1/16
2	36.5	1 7/16	34.9	1 3/8
2 1/2	44.5	1 3/4	38.1	1 1/2
3	50.8	2	47.6	1 7/8
4	69.9	2 3/4	63.5	2 1/2

[a]For extended body valves, an additional 0.8 millimeter (1/32 inch) undersize from dimension shown will be permitted.

Table 14—Minimum Depth of Packing

Valve Size (NPS)	Classes 150, 300, 600 and 800				Class 1500	
	Outside Screw and Yoke Valves		Inside Screw with Rising Stem Valves		Outside Screw and Yoke Valves	
	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches
1/4	12.7	1/2	12.7	1/2	22.2	7/8
3/8	12.7	1/2	12.7	1/2	22.2	7/8
1/2	15.9	5/8	15.9	5/8	22.2	7/8
3/4	15.9	5/8	15.9	5/8	25.4	1
1	25.4	1	22.2	7/8	30.2	1 3/16
1 1/4	25.4	1	23.8	15/16	38.1	1 1/2
1 1/2	28.6	1 1/8	23.8	15/16	38.1	1 1/2
2	28.6	1 1/8	28.6	1 1/8	38.1	1 1/2
2 1/2	31.8	1 1/4	—	—	44.5	1 3/4
3	38.1	1 1/2	—	—	47.6	1 7/8
4	44.5	1 3/4	—	—	50.8	2

4.20 HANDWHEEL

Handwheels shall have a spoked design; shall be made of carbon steel, ductile iron, or malleable iron; and shall be of ample size for easy opening and closing. Clockwise rotation of the handwheel shall close the valve. Cast iron or nonferrous materials shall not be used.

5 Inspection, Examination, and Test

5.1 INSPECTION AND EXAMINATION

If inspection by the purchaser is specified in the purchase order, inspection shall be in accordance with API Standard 598. Examination by the manufacturer shall be as specified in API Standard 598.

5.2 PRESSURE TEST

Each valve shall be pressure tested as specified in API Standard 598.

5.3 REPAIR OF DEFECTS

Defects in the shell of a cast or forged valve that are revealed by inspection or test may be repaired as permitted by the applicable material specification.

6 Shipment

6.1 PROTECTION OF FEMALE THREADED AND SOCKET-WELDING ENDS

Except for individually packaged valves, the female ends of threaded, socket-welding, and extended-body valves shall be protected with metal, wood, or plastic plugs.

6.2 PROTECTION OF MALE EXTENSION

The male extension shall be protected by a metal or plastic cap.

6.3 PROTECTION OF END FLANGES AND BUTT-WELDING ENDS

End flanges and butt-welding ends shall be fully blanked to protect the gasket surfaces or welding ends and valve internals during shipment and storage. Protective covers shall be wood, wood fiber, plastic, or metal and shall be securely attached to the valve ends by bolting, steel straps, steel clips, or suitable friction locking devices. Covers shall be of such design that the valve cannot be installed without complete removal of the protective cover.

APPENDIX A—TO API 602-98—ADDITIONAL REQUIREMENTS FOR COMPACT BELLOWS-SEAL GATE VALVES

This appendix contains additional requirements for compact bellows seal gate valves. Provisions and requirements of the base standard apply to bellows-seal gate valves except as modified in this appendix. The organization, content, and paragraph designations correspond to those in the main body of this standard.

A.1 Scope

A.1.1 This appendix covers outside screw and yoke (OS&Y) flanged-end, threaded-end, socket-welding-end, butt-welding-end and extended-body compact steel gate valves equipped with bellows seal. Bellows-seal gate valves covered by this standard are limited to NPS 2 and smaller.

A.1.2 Figure A-1 is an illustration of a bellows-seal gate valve for the purpose of identifying nomenclature used in this appendix for valve components.

A.2 The most recent edition of the following standard to the extent specified herein shall apply to bellows-seal gate valves constructed under this appendix.

MSS[4]

MSS-SP-117 *Bellows Seals for Globe and Gate Valves*

A.3.5 Marking of valves with bellows-seal installed shall indicate the bellows material and any limitation of pressure or temperature imposed by the bellows material or design.

A.4 Design

A.4.0 The bellows seal assembly shall meet the design, materials, fabrication, and qualification requirements of MSS-SP-117, except as modified herein, before installation into a bellows-seal gate valve covered by this appendix.

A.4.1.4 Unless otherwise specified in the purchase order, the pressure-temperature ratings for Class 800 bellows seal gate valves shall be in accordance with Table 2. The pressure-temperature ratings for Class 150, 300, 600, and 1500 bellows-seal valves shall conform to the corresponding Standard Class ratings listed in ASME B16.34 for the appropriate valve material.

Any limitation on the maximum service temperature of bellows-seal gate valves due to bellows material or design shall be shown on the valve nameplate. See paragraph 3.1.

Bellows installed in valves rated as Class 150, 300, and 600 that conform to this standard shall be designed to meet the pressure-temperature ratings for Class 800 valves of the same body material as the valve in which it is installed.

[4]Manufacturer Standardization Society, 127 Park Street, N.E., Vienna, VA 22180.

A.4.6.1 Body/bonnet extensions for bellows stem seal valves may be made from a forging, casting, bar stock, or a tubular product. Forgings and castings shall be per the material specification listed in Table 8 for the appropriate valve material group. The bar stock material shall be from the same material group as the body and shall be listed in and meet the requirements of Tables 1 and 2, ASME B16.34, including the applicable notes. Free machining bar stock shall not be used. The tubular product shall be listed in and meet the requirements of Tables 1 and 2, ASME B16.34, including the applicable notes, and have the same nominal chemistry as the body and bonnet.

A.4.6.3 The minimum wall thickness of the body/bonnet extension shall be determined in accordance with paragraph 6.1.3 of ASME B16.34; but in no case shall the wall thickness be less than the body and bonnet minimum wall thickness listed in Table 3 for the applicable valve size and pressure class.

If the extension is fabricated from a tubular product from a Material Group other than that of the valve body/bonnet and if, at any corresponding listed temperature, the tubular product has a pressure rating lower than the valve body/bonnet material pressure rating, then its required minimum thickness shall be increased accordingly as required by paragraph 2.6 of ASME B16.34, including all reference paragraphs.

If a tubular product is used for a body/bonnet extension for Class 800 valves, the Class 800 rating for the tubular product is to be determined by interpolation. By a series of interpolations, the tubular product interpolated Pressure Class is determined for which all values of rated pressure are equal to or greater than those of the valve body/bonnet material. The interpolated Pressure Class, along with the inside diameter of the tubular extension, are used with paragraph 6.1.3 and Table 3 of ASME B16.34 to find the required minimum wall thickness for the body/bonnet extension.

Records of calculations that demonstrate the body/bonnet extension minimum wall thickness complies with ASME B16.34 shall be made available to the purchaser on request.

A.4.7.9 The attachment welds of bellows and/or bellows end fittings to the valve bonnet shall be exempt from post-weld heat treatment requirements. Unless otherwise specified in the purchase order, this exemption includes P4 and P5 materials if techniques and procedures are used to provide a weld hardness not to exceed 235 HB.

A.4.8.1 The bellow seal gate valve trim shall consist of the stem, gate seat surface and seat ring surface. The bellows assembly shall include the bellows and bellows end fitting(s) required to interface the bellows to the stem, body and/or bonnet. The bellows shall be manufactured from one of the typical materials listed in Table A-1.

A.4.8.1.3

d. The stem trim number shall correspond to the nominal seating surface trim number and shall be of the material type and hardness listed in Table 10 or by agreement between purchaser and manufacturer, the stem may be made from a material having an equivalent chemistry and heat treatment as the bellows. The stem shall be of a wrought material.

A.4.10.2 The cross-sectional area of the stem shall be designed to provide adequate strength to operate the valve at the valve's 100°F rating taking into consideration the stem hydraulic load imposed by the bellows design. The stem diameter (measured at the section that passes through the packing) shall not be less than shown in Table 12.

A.4.11.1 The stem-to-gate connection design for bellows-seal gate valves shall accommodate the assembly of the bellows assembly into the valve. A button or T-head and slot arrangement is acceptable. The stem, including the button and T-head, shall be one piece. Stems formed from welding two or more pieces are not permitted.

A.4.21 Bellows Construction

A.4.21.1 The bellows material shall be free of repair welding.

A.4.21.2 Unless otherwise specified in the purchase order, the bellows shall be either seamless or longitudinally butt-welded type construction.

A.4.21.3 Unless otherwise specified in the purchase order, the bellows shall be of multi-ply construction.

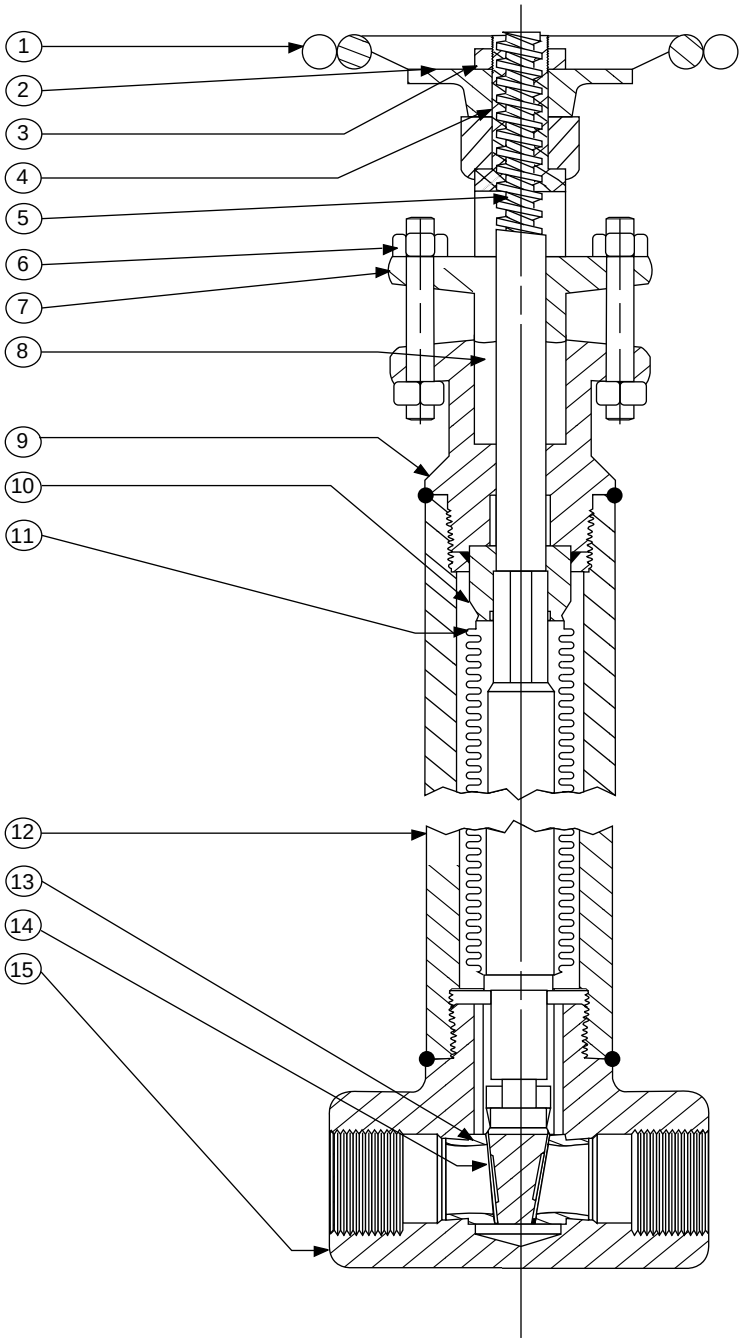
A.4.22 Bellows Design Qualification Testing

In addition to the required bellows design qualification cycle testing required by paragraph 4.1, MSS SP-117, three (3) prototype bellows assemblies shall also be high temperature cycle tested at 427°C (800°F) or the maximum rated temperature, whichever is higher, at the valve's pressure rating at the test temperature. The high temperature cycle tests shall be performed on bellows assemblies that have not been exposed to the ambient temperature cycle testing. The post-cycle leak test of MSS SP-117, paragraph 4.1.3, shall be a helium leakage test. The bellows assembly minimum cycle life for the ambient and high temperature tests shall be 2000 cycles.

A.5 Inspection and Test

A.5.1 Inspection and test of the bellows assembly before installation into a bellows-seal gate valve shall be per MSS SP-117.

A.5.2 Each bellows seal gate valve shall be pressure tested as specified in API 598; however, during the testing the gland bolting shall be totally removed or gland nuts removed for swing type bolting. The gland bolting shall be installed and adjusted following the successful conclusion of the API 598 test.



Part Names:
1. Handwheel
2. Identification plate
3. Handwheel nut
4. Stem nut
5. Stem
6. Gland bolting
7. Gland
8. Packing
9. Bonnet
10. Bellows end fitting
11. Bellows
12. Body/Bonnet extension
13. Seat ring
14. Gate
15. Body

Figure A-1 Typical Outside Screw and Yoke Bellows-Seal Gate Valve

Table A-1 Bellows Material Chart

Bellows Material No.	Material	Typical Specifications	Acceptable for Use in API 602 Trim Nos.
A1	304 STAINLESS	ASTM 240/ASTM A312	1, 2, 4, 5, 5A, 6, 7, 8, 8A, 15, 17, 101, 104, 105, 105A, 106, 107, 108 & 108A
A2	304L STAINLESS	ASTM 240/ASTM A312	1, 2, 4, 5, 5A, 6, 7, 8, 8A, 15, 17, 101, 104, 105, 105A, 106, 107, 108 & 108A
A3	316 STAINLESS	ASTM 240/ASTM A312	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 10, 12, 15, 16, 17, 101, 104, 105, 105A, 106, 107, 108 & 108A
A4	316L STAINLESS	ASTM 240/ASTM A312	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 10, 12, 15, 16, 17, 101, 104, 105, 105A, 106, 107, 108 & 108A
A5	321 STAINLESS	ASTM 240/ASTM A312	1, 2, 4, 5, 5A, 6, 7, 8, 8A,15, 17, 101, 104, 105, 105A, 106, 107, 108 & 108A
A6	347 STAINLESS	ASTM A240/ASTM A312	1, 2, 4, 5, 5A, 6, 7, 8, 8A,15, 17, 101, 104, 105, 105A, 106, 107, 108 & 108A
A7	ALLOY 600	ASTM B167/ASTM B168	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 101, 104, 105, 105A, 106, 107, 108 & 108A
A8	ALLOY 625	ASTM B443	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 101, 104, 105, 105A, 106, 107, 108 & 108A
A9	ALLOY 718	ASTM B670	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 101, 104, 105, 105A, 106, 107, 108 & 108A
A10	ALLOY 400	ASTM B127/ASTM B165	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 101, 104, 105, 105A, 106, 107, 108 & 108A
Al l	ALLOY C22	ASTM B575/ASTM B622	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 101, 104, 105, 105A, 106, 107, 108 & 108A
A12	ALLOY C276	ASTM B575/ASTM B622	1, 2, 3, 4, 5, 5A, 6, 7, 8, 8A, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 101, 104, 105, 105A, 106, 107, 108 & 108A

API Related Publications Order Form

Date: _____ *(Month, Day, Year)*

❑ API Member *(Check if Yes)*

Invoice To – ❑ Check here if same as "Ship To"

Company:

Name/Dept.:

Address:

City: State/Province:

Zip: Country:

Customer Daytime Telephone No.:

Fax No.:

Ship To – (UPS will not deliver to a P.O. Box)

Company:

Name/Dept.:

Address:

City: State/Province:

Zip: Country:

Customer Daytime Telephone No.:

Fax No.:

(Essential for Foreign Orders)

❑ Payment Enclosed $ _____

❑ Payment By Charge Account:

❑ MasterCard ❑ Visa ❑ American Express

Account No.:

Name (As It Appears on Card):

Expiration Date:

Signature:

❑ Please Bill Me

P.O. No.:

Customer Account No.:

State Sales Tax – The American Petroleum Institute is required to collect sales tax on publications mailed to the following states: AL, AR, CT, DC, FL, GA, IL, IN, IA, KS, KY, ME, MD, MA, MI, MN, MO, NE, NJ, NY, NC, ND, OH, PA, RI, SC, TN, TX, VT, VA, WV, and WI. Prepayment of orders shipped to these states should include applicable sales tax unless a purchaser is exempt. If exempt, please print your state exemption number and enclose a copy of the current exemption certificate.

Exemption Number: State:

Quantity	Order Number	Title	SO*	Unit Price	Total
	C58900	Std 589, *Fire Test for Evaluation of Valve Stem Packing*		$ 40.00	
	C59807	Std 598, *Valve Inspection and Testing*		$ 40.00	
	C59904	Std 599, *Metal Plug Valves—Flanged and Welding Ends*		$ 30.00	
	C60010	Std 600, *Steel Gate Valves—Flanged and Butt-Welding Ends, Bolted and Pressure Seal Bonnets*		$ 40.00	
	C60300	Std 603, *Cast, Corrosion-Resistant, Flanged-End Gate*		$ 30.00	
	C60700	Std 607, *Fire Test for Soft-Seated Quarter-Turn Valves*		$ 40.00	
	C60802	Std 608, *Metal Ball Valves—Flanged, Threaded and Butt-Welding*		$ 40.00	
	C60905	Std 609, *Butterfly Valves: Double Flanged, Lug- and Wafer-Type*		$ 40.00	

Shipping and Handling – All orders are shipped via UPS or First Class Mail in the U.S. and Canada. Orders to all other countries will be sent by Airmail. U.S. and Canada, $5 per order handling fee, plus actual shipping costs. All other countries, for Airmail (standard service) add 25% of order value. All other countries, for UPS Next Day, add an additional 10% of order value.

Rush Shipping Charge – FedEx, $10 in addition to customer providing FedEx account number: _____. UPS Next Day, $10 plus the actual shipping costs (1-9 items). UPS Second Day, add $10 plus the actual shipping costs (1-9 items).

Rush Bulk Orders – 1-9 items, $10. Over 9 items, add $1 each for every additional item.

NOTE: Shipping on foreign orders cannot be rushed without FedEx account number.

Subtotal	
State Sales Tax *(see above)*	
Rush Shipping Charge *(see left)*	
Shipping and Handling *(see left)*	
Total *(in U.S. Dollars)*	

**To be placed on Standing Order for future editions of this publication, place a check mark in the space provided. Pricing and availability subject to change without notice.*

Mail Orders: American Petroleum Institute, Order Desk, 1220 L Street, N.W., Washington, DC 20005-4070
Fax Orders: (202) 962-4776 Phone Orders: (202) 682-8375

To better serve you, please refer to this code when ordering: L A 4 4 2 7 1 0 9 8

The American Petroleum Institute provides additional resources and programs to industry which are based on API Standards. For more information, contact:

• Training and Seminars	Ph: 202-682-8490 Fax: 202-682-8222
• Inspector Certification Programs	Ph: 202-682-8161 Fax: 202-962-4739
• American Petroleum Institute Quality Registrar	Ph: 202-962-4791 Fax: 202-682-8070
• Monogram Licensing Program	Ph: 202-962-4791 Fax: 202-682-8070
• Engine Oil Licensing and Certification System	Ph: 202-682-8233 Fax: 202-962-4739
• Petroleum Test Laboratory Accreditation Program	Ph: 202-682-8064 Fax: 202-962-4739

In addition, petroleum industry technical, patent, and business information is available online through API EnCompass™. Call 212-366-4040 or fax 212-366-4298 to discover more.

To obtain a free copy of the API Publications, Programs, and Services Catalog, call 202-682-8375 or fax your request to 202-962-4776. Or see the online interactive version of the catalog on our World Wide Web site – http://www.api.org.

American Petroleum Institute

Helping You Get The Job Done Right.

Additional copies available from API Publications and Distribution:
(202) 682-8375

Information about API Publications, Programs and Services is available on the World Wide Web at: http://www.api.org

American
Petroleum
Institute

1220 L Street, Northwest
Washington, D.C. 20005-4070
202-682-8000

Order No. C60207