ASME B16.40-2002
[Revision of ANSI/ASME B16.40-1985 (R1994)]

MANUALLY OPERATED THERMOPLASTIC GAS SHUTOFFS AND VALVES IN GAS DISTRIBUTION SYSTEMS

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A N   A M E R I C A N   N A T I O N A L   S T A N D A R D

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The next edition of this Standard is scheduled for publication in 2007. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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FOREWORD

The B16 Standards Committee was organized in the spring of 1920 and held its organizational meeting on November 21 of that year. The group operated as a Sectional Committee (later redesignated as a Standards Committee) under the authorization of the American Engineering Standards Committee [subsequently named American Standards Association, United States of America Standards Institute, and now American National Standards Institute (ANSI)]. Sponsors for the group were the American Society of Mechanical Engineers, Manufacturers Standardization Society of the Valve and Fittings Industry, and the Heating and Piping Contractors Naational Association (later the Mechanical Contractors Association of America).

The American Gas Association determined that standardization of gas valves used in distribution systems was desirable and needed. The A.G.A. Task Committee on Standards for Valves and Shutoffs was formed and development work commenced in 1958. In 1968 it was determined that a more acceptable document would result if approval were gained from ANSI, and to facilitate such action the A.G.A. Committee became Subcommittee No. 13 of the B16 activity. This B16 group was later renamed Subcommittee L, which is its current designation.

The first standard developed by Subcommittee L was B16.33. The B16.38 standard was subsequently developed to cover larger sizes of gas valves and shutoffs. Since about 1965, the increased use of plastic piping in gas distribution systems brought with it the need for valves and shutoffs of compatible material. To fill this need, the present standard was developed and initially appeared as ANSI B16.40-1977. Subcommittee L began review of this document in 1982.

Editorial changes were made throughout the text to bring the format in line with the rest of the B16 series of standards and to clarify the intent of this Standard. Revisions include addition of rules for allowable pressure at temperatures above 74°F for valves of certain materials, updating of reference standards, and editorial changes to text and tables.

The cover, headings, and designation of the Standard have also been revised to reflect reorganization of the B16 Committee as an ASME Committee whose procedures are accredited by ANSI. This Standard is offered on a subscription service basis that includes interpretations and addenda up to the issuance of a new edition.

All requests for interpretations or suggestions for revisions should be sent to the Secretary, B16 Committee, The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016.

In 2001, after several years and iterations, B16 Subcommittee L produced a fully revised document. Among the many revisions were a new Definitions section, a new Impact Resistance section, and a nonmandatory Quality Systems Program Annex.

Following approval by the B16 Main Committee and the ASME Supervisory Board, this Standard was approved as an American National Standard by ANSI on February 6, 2002.

ASME B16 COMMITTEE
Standardization of Valves, Flanges, Fittings, Gaskets, and Valve Actuators

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B16 Main Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Interpretations. Upon request, the B16 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B16 Main Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings, which are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The B16 Main Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B16 Main Committee.

MANUALLY OPERATED THERMOPLASTIC GAS SHUTOFFS AND VALVES IN GAS DISTRIBUTION SYSTEMS

1 SCOPE

(a) This Standard covers manually operated thermoplastic valves in nominal sizes ½ through 6 (as shown in Table 5). These valves are suitable for use below ground in thermoplastic distribution mains and service lines. The maximum pressure at which such distribution piping systems may be operated is in accordance with the Code of Federal Regulation (CFR) Title 49, Part 192, Transportation of Natural and Other Gas by Pipeline; Minimum Safety Standards, for temperatrure ranges of −20°F to 100°F (−29°C to 38°C).

(b) This Standard sets qualification requirements for each nominal valve size for each valve design as a necessary condition for demonstrating conformance to this Standard.

(c) This Standard sets requirements for newly manufactured valves for use in below ground piping systems for natural gas [includes synthetic natural gas (SNG)], and liquefied petroleum (LP) gases (distributed as a vapor, with or without the admixture of air) or mixtures thereof.

(d) Standards and Specifications referenced under this Standard are shown in Appendix II.

(e) For the purpose of determining conformance with this Standard, the convention for fixing significant digits, where limits maximum or minimum values are specified, shall be "rounding off" as defined in ASTM Practice E 29. This requires that an observed or calculated value shall be rounded off to the nearest unit in the last right-hand digit used for expressing the limit. Decimal values and tolerances do not imply a particular method of measurement.

(f) The values stated in either inch units or metric units are to be regarded separately as standard. Within the text, the values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.1 Definitions

fasteners: nuts, bolts, washers, clip rings, and other devices used in the assembly of valves.

pressure: unless otherwise stated, pressure is gauge pressure.

production pressure tests: pressure tests that include seat and closure member and shell tests.

seat and closure-member test: an internal pressure test of closure-sealing elements (seats, seals, and closure members such as gate, disc, ball, or plug).

shell test: an internal pressure test of the pressure containing envelope.

1.2 Quality Systems

Nonmandatory requirements relating to the product manufacturer's Quality System Program are described in Appendix A.

2 CONSTRUCTION

2.1 General

(a) The workmanship employed in the manufacture and assembly of each valve shall provide gas tightness, safety and reliability of performance, and freedom from injurious imperfections and defects.

(b) Design details not addressed in this Standard are the responsibility of the manufacturer.

2.2 Materials

2.2.1 Valve Shell Parts. Pressure-containing valve shell parts shall be made from materials specified in and qualified to the requirements for pipe and fittings as listed in ASTM D 2513, Specifications for Thermoplastic Gas Pressure Pipe, Tubing and Fittings. Other thermoplastic materials may be used for such parts provided they satisfy the following requirements from Appendix X1 of ASTM D 2513:

(a) an ASTM material specification, and

(b) a long-term hydrostatic-strength, determined in accordance with an appropriate test method such as Test Method D-2837.

In addition, evidence shall be presented to demonstrate that such materials will perform satisfactorily in fuel gas environments as listed in para. 1(c).

2.2.2 Parts Other Than Valve-Shell Parts. Parts other than shell parts, which contribute to pressure containment or to retaining differential pressure across the closure element, shall be resistant to the gases in para. 1(c). Such parts shall be designed to withstand normal valve-operating loads and, in addition, shall provide long-term pressure-containment integrity consistent with valve-shell parts. The sustained pressure tests of paras. 3.3.3(a) and 3.3.3(b) shall qualify the material selections for these parts, which include, but are not limited to, the closure member, stems or shafts (if they are designed to retain pressure), and fasteners retaining shell sections.

2.2.3 Lubricants and Sealants. Lubricants and sealants shall be resistant to the action of gases referred to in para. 1(c).

2.2.4 Responsibility. When service conditions, such as gases having high hydrogen content or compounds likely to form condensate, dictate special materials considerations, it is the users' responsibility to specify this information to the manufacturer.

2.3 Configuration

2.3.1 Operating Indication

(a) Valves designated for one-quarter turn operation shall be designed to visually show the open and closed position of the valve. A rectangular stem head or an arrow thereon or a separate position indicator shall indicate the closed position of the valve port when the longitudinal axis of the stem head or indicator is perpendicular to the axis of the connecting pipe. If a separate indicator is employed, it shall be designed such that it cannot be assembled to incorrectly indicate the position of the valve.

(b) Valves designed for more than one-quarter turn operation shall close by clockwise stem rotation, unless otherwise specified by the user. The direction for closing the valve shall be indicated.

2.3.2 Valve End Design. Valve ends shall be designed to one or more of the following, unless otherwise specified by the user:

(a) polyethylene valve stub-ends that conform to the applicable dimensions listed in Tables 1, 2, and 3 of ASTM D 3261;

(b) polyethylene valve stub-ends that conform to the applicable dimensions listed in Tables 1, 2, and 3 of ASTM D 2513;

(c) polyethylene socket ends that conform to the applicable dimensions listed in Tables 1 and 2 of ASTM D 2683;

(d) Schedule 40 PVC socket ends that conform to applicable dimensions given in Table 1 of ASTM D 2466;

(e) Schedule 80 PVC socket ends that conform to applicable dimensions given in Table 1 of ASTM D 2467;

(f) integral mechanical joints that meet the requirements of the applicable paragraphs under CFR, Title 49, Part 192, Subpart F, Joining of Material Other than by Welding.

2.4 Pressure Rating

2.4.1 Maximum Pressure Rating. The maximum pressure rating of each valve made from a given material shall be expressed as a standard dimension ratio (SDR) equivalent number corresponding to the SDR of the maximum pressure rating of the pipe with which the valve is rated by pressure testing in this Standard, on the basis that the pipe is made of the same material as the valve. The valve's SDR equivalent number is equal to:

$$\text{SDR} = D/t$$

where

D = standard specified outside diameter of the pipe with which the valve is rated by pressure testing in this Standard

t = standard minimum wall thickness for highest pressure rated pipe (i.e., thickest wall) of outside diameter D with which the valve is rated by pressure testing in this Standard assuming the strength of the pipe material is equal to that of the valve material

2.4.2 Design Pressure. The design pressure of the valve, for purposes of production and qualification testing, shall be equal to the maximum service pressure permitted for the pipe of the same material and SDR number as the valve, as defined in the jurisdictional code, the United States Minimum Federal Safety Standards cited in para. 1(a). Typical design pressures for representative materials and valve SDR equivalent number are given in Table 1.

TABLE 1 PRESSURE RATINGS FOR VALVES FOR SERVICE TEMPERATURES FROM −20 TO 73°F (−29 TO 23°C)

SDR Equivalent	PB2110		PE2406		PE3408		PVC1120 PVC1220		PVC2110	
	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar
6	...	...	100	6.9	100	6.9	...	...	...	...
9.3	...	...	96	6.6	100	6.9	...	...	...	...
10	...	...	89	6.1	100	6.9	...	...	...	...
11	100	6.9	80	5.5	100	6.9	100	6.9	100	6.9
13.5	100	6.9	64	4.4	81	5.6	100	6.9	100	6.9
17	80	5.5	50	3.4	64	4.4	100	6.9	80	5.5
21	64	4.4	40	2.8	51	3.5	100	6.9	64	4.4
26	...	...	...	...	...	...	100	6.9	51	3.5

GENERAL NOTES:
(a) See Appendix I.
(b) 1 bar = 10^5 Pa.

2.4.3 Temperature Derating. Valves used at service temperatures above 73°F (23°C) are usually derated.

2.5 Lubrication (Sealant)

Valves, which require pressure lubrication (by the insertion through fittings of lubricant to the sealing surfaces of the valve), shall be capable of being lubricated while subjected to the design pressure. This provision can be met if lubrication can be accomplished with the valve in both the fully opened and fully closed position.

2.6 Marking

2.6.1 Identification Markings. Each valve shall be clearly marked to show the following:

(a) the manufacturer's name or trademark;

(b) the designation B16.40;

(c) the size;

(d) the pressure shell material designation code as specified in ASTM D 2513;

(e) SDR equivalent;

(f) each molded pressure shell part shall be marked with the date it was molded. Shell parts which are not molded shall be stamped with the date of manufacture using low stress stamping.

Each molded pressure shell part shall be marked as specified in paras. (a) and (f) above and shall be permenently affixed to or be incorporated as part of the valve.

(g) Other markings may be affixed to the valve by any means, provided they do not impair the structural integrity or the operation of the valve.

3 PRODUCTION AND QUALIFICATION TESTING

3.1 General

(a) Gas tightness of production valves shall be demonstrated by subjecting each valve to shell and seat tests in accordance with para. 3.2.

(b) Each basic valve design shall be qualified by testing randomly selected production valves of each size, type, and pressure shell material in accordance with para. 3.3.

(c) The term *design pressure* is defined in para. 2.4.2.

3.2 Production Testing

3.2.1 Shell Test. Each valve shall be tested at 4 ± 2 psi (0.28 ± 0.14 bar) and at a minimum of 1.5 times the design pressure. The test pressure shall be applied to all pressure-containing areas of the valve (including stem seals and valve ends). This may require that the valve be in the partialy open position. The test fluid shall be air or other gas and there shall be no visible leakage (no breaking away or buildup of bubbles) as measured by the immersion or leak detection solution methods. If immersion is used, the depth from the water surface shall be no more than 12 in. (300 mm). Other means of leak detection may be used, provided they can be shown to be equivalent in leak-detection sensitivity. The shell test shall be conducted at a temperature of 73 ± 15°F (23 ± 8°C). The test fixturing shall not restrain the valve against any mode of failure or leakage. The minimum duration of each of the two shell tests shall be as shown in Table 2.

TABLE 2 DURATION OF TEST

Nominal Valve Size	Minimum Time Duration, sec
2 and smaller	15
Larger than 2	30

3.2.2 Seat Test. Each valve shall be seat closure tested at 4 ± 2 psi (0.28 ± 0.14 bar) and at a minimum of 1.5 times the design pressure. These pressures shall be applied successively on each side of the valve seat(s) to check the valve-sealing performance in both directions. The full test differential pressure shall be applied across the downstream seat if there is more than one seat. The test fluid shall be air or other gas and there shall be no visible leakage (no breaking away or buildup of bubbles) at the downstream seat as measured by the water over air or a leak detection solution method. If immersion is used, the depth from the water surface shall be no more than 12 in. (300 mm). Other means of leak detection may be used, provided they can be shown to be equivalent in leak-detection sensitivity. The seat test shall be conducted at a temperature of 73 ± 15°F (23 ± 8°C). The seat test's fixturing shall not restrain the valve against any mode of failure or leakage. The minimum duration of each portion of the test shall be as shown in Table 2.

3.3 Qualification Testing

3.3.1 Operational Test. It shall be demonstrated that each nominal size of each valve design is capable of successfully passing the seat leakage tests of para. 3.2.2, after having completed ten fully opened/fully closed cycles at 73 ± 15°F (23 ± 8°C). The valve shall be pressurized with air or other gas to the design pressure at one port with the other port open to atmosphere before opening on each cycle. At the start of each cycle, the operating torque shall be measured and shall not exceed those in Table 3 for −20°F (−29°C).

3.3.2 Temperature Resistance. It shall be demonstrated that each nominal size of valve of each valve design is capable of being operated at temperatures of −20 ± 5°F (−29 ± 3°C) and 100 ± 5°F (38 ± 3°C) without visible leakage to atmosphere and without affecting the internal seat-sealing performance of the valve. The method of test is as follows. A closed valve shall be cooled to a temperature of −20 ± 5°F (−29 ± 3°C) and held there for 18 hr minimum. The valve shall then be pressurized with air or gas to a differential pressure across the seat equal to the design pressure. The valve shall then be opened against the applied-differential pressure, using a torque less than or equal to that of Table 3 at the −20°F (−29°C) values and then closed (no differential pressure across the seat required). The valve shall then be tested to meet the requirements of para. 3.3.2 while at −20°F (−29°C), except nonfreezing leak-detection agents shall be used. The valve shall then be heated to a temperature of 100 ± 5°F (38 ± 3°C) and held there for 18 hr minimum. The closed valve shall then be pressurized with air or other gas to a differential pressure across the seat equal to the design pressure. The valve shall then be opened against the applied-differential pressure using a torque equal to that of Table 3 100°F (38°C) values and then closed (no differential pressure across the seat required). The valve shall then be tested to and meet the requirements of para. 3.3.2, while at 100°F (38°C).

3.3.3 Sustained-Pressure Test. Each basic valve design shall be subjected to sustained-pressure tests to determine the effects of 1,000 hr pressure loading. Each variation in material, size, or configuration of molded pressure-containing parts shall constitute a different basic design. Where minor design variations are produced by differences in machining of valve-end connections to match pipe of different size or SDR rating, only valves with the lowest SDR rating (corresponding to the SDR equivalent rating of the valve) and in the largest size need to be tested.

(a) Pressure-Boundary Tests. Six samples of each basic valve design shall be connected at both ends to thermoplastic pipe of appropriate wall thickness of a length of at least five times its outside diameter or 20 in. (510 mm), whichever is less. These assemblies shall be subjected to a sustained-pressure test for 1,000 hr (valves in open position), using water at 73 ± 4°F (23 ± 2°C) as described in the Sustained-Pressure Test section of ASTM D 2513. The SDR equivalent for the valve shall be used in determining the test pressure from Table 4A. Failure of two of the six samples tested shall constitute failure in the test. Failure of one of the six samples tested is cause for retest of six additional samples. Failure of one of the six samples in retest shall constitute failure in the test. Evidence of failure shall be as defined in ASTM D 1598 applied to a valve test sample.

An additional six samples of each basic valve design shall also be subjected to a similar sustained-pressure test for 1,000 hr, using water at a temperature of 100 ± 4°F (38 ± 2°C) and an appropriate test pressure from Table 4B. Criteria for failure shall be the same as described above for the 73°F (23°C) test.

TABLE 3 MAXIMUM OPERATING TORQUE VALUES

Nominal Valve Size [Note (1)]	Maximum Operating Torque at 100°F (38°C)		Maximum Operating Torque at -20°F (-29°C)	
	lb_f-in.	N·m	lb_f-in.	N·m
½	130	15	390	45
¾	160	18	480	54
1	300	34	600	68
1¼	400	45	800	90
1½	500	56	1,000	112
2	600	68	1,200	136
3	900	102	1,350	153
4	1,200	136	1,800	204
5	1,350	153	2,025	229
6	1,500	169	2,250	253

NOTE:
(1) For valves having different size inlet and outlet, the smaller size shall determine the maximum operating torque.

TABLE 4A MINIMUM SUSTAINED PRESSURE TEST REQUIREMENTS AT 73°F (23°C)

SDR Equivalent	PE2406		PE3408		PVC1120 PVC1220		PVC2110	
	psi	bar	psi	bar	psi	bar	psi	bar
6	530	36.4	640	44.1	...	...	...	...
9.3	320	21.9	385	26.5	...	...	...	...
10	295	20.2	355	24.5	...	...	...	...
11	265	18.3	320	22.0	840	59.9	460	31.7
13.5	210	14.5	260	17.6	670	46.2	370	25.5
17	165	11.4	200	13.8	530	36.5	290	20.0
21	...	...	160	11.0	420	29.0	230	15.9
26	...	...	...	...	340	23.4	180	12.4

GENERAL NOTES:
(a) Long-term stress values are found in Appendix I.
(b) 1 bar = 10^5 Pa.

TABLE 4B MINIMUM SUSTAINED PRESSURE TEST REQUIREMENTS AT 100°F (38°C)

SDR Equivalent	PE2406		PE3408		PVC1120 PVC1220		PVC2110	
	psi	bar	psi	bar	psi	bar	psi	bar
6	430	29.6	530	36.4	...	...	...	...
9.3	260	17.9	320	21.1	...	...	...	...
10	240	16.5	295	20.2	...	...	...	...
11	215	14.8	245	18.2	680	47.0	375	25.7
13.5	170	11.7	215	14.5	545	37.6	300	20.6
17	135	9.3	145	11.3	425	29.4	235	16.1
21	110	7.6	135	9.1	340	23.5	190	12.9
26	...	...	...	...	275	18.8	150	10.3

GENERAL NOTES:
(a) Long-term stress values are found in Appendix I.
(b) 1 bar = 10^5 Pa.

TABLE 5 FLOW AND HEAD LOSS COEFFICIENTS

Nominal Valve Size [Note (1)]	Coefficients: Minimum Gas Flow at Reference Condition [Note (2)] ft³/hr	m³/h	Flow Coefficient, C_v, Min. [Note (3)]	Head Loss in Velocity Heads, K, Max. [Note (4)]	Equivalent Length of SDR 11 Pipe, Max. ft	m
½	190	5.4	6	5.0	10	3.0
¾	290	8.2	10	5.0	15	4.6
1	600	17.0	20	3.0	12	3.7
1¼	1,200	34.0	39	2.0	11	3.4
1½	1,500	42.5	51	2.0	13	4.0
2	2,400	68.0	80	2.0	17	5.2
3	6,000	170.0	200	1.5	21	6.4
4	9,900	280.0	330	1.5	28	8.5
5	1,500	425.0	440	1.5	37	11.3
6	1,900	538.0	650	1.9	57	17.4

NOTES:

(1) For valves having different size inlet and outlet, the smaller size shall determine the coefficient.

(2) Minimum gas flow in standard cubic feet per hour (cubic meters per hour) with the valve in the fully opened position at an inlet pressure of 0.5 psi (0.035 bar), 70°F (21.1°C), 0.64 specific gravity, and 0.3 in. (7.6 mm) water column net valve pressure drop, assuming valve in SDR 11 pipe.

(3) C_v = flow of water at 60°F (16°C) in U.S. gallons per minute which a valve will pass at a pressure drop of 1.0 psi (0.07 bar).

(4) K = head loss coefficient consistent with the equation:

$$h_L = K(V^2/2g_c);\ K = (29.9d^2/C_v)^2$$

where

h_L = head loss produced by valve, ft (m)
V = fluid velocity in pipe, ft/sec (m/s)
g_c = 32.2 ft/sec² (9.81 m/s²)
d = pipe inside diameter for which the value of fluid velocity V is associated, in.

(b) Valve Closure Test. An additional valve of each basic valve design (para. 3.3.3) shall be subjected to the 100°F (38°C) test defined in para. 3.3.3(a), but with the valve in the closed position and with a test pressure equal to 110% of the design pressure applied at one port and the other port open to the atmosphere.

At the conclusion of this test, this valve shall be tested to show that it can be operated at differential pressure of 0 psi (0 bar) and design pressure in Table 1. Any failure, e.g., excessive torque or leakage through a closure part, shall constitute failure.

3.3.4 Flow Capacity. The shape, size, and configuration of the valve when in the fully opened position shall be designed to provide flow- and head-loss coefficients specified in Table 5. A valve of each size and type shall be tested to verify the coefficient when installed in a straight run of pipe of the size and wall thickness for which the valve is designed to be conducted, following a procedure such as ANSI/ISA S75.02.

The test fluid and the type of test facility and instrumentation are the responsibility of the manufacturer. Flow test reports shall be available for purchaser's review at the manufacturer's facility.

3.3.5 Impact Resistance. This test shall be performed on each nominal valve size of each basic design (para. 3.3.3).

A valve shall not develop leakage or otherwise exhibit impairment of operation, when subjected to impacts according to the following test procedure.

The valve shall be firmly supported with stem vertical, while in the upright position, resting on ¾ in. (19 mm) plywood. The valve shall be conditioned for a minimum of 18 hr at a temperature of 0 ± 5°F (−18 ± 3°C).

An impact shall be applied to the valve stem or operating nut perpendicular to the top of the valve operating nut, using a type "B" 20 lb tup as described in ASTM D 2444 dropped from a height of 3 ft (914 mm). The valve shall be impacted five consecutive times within 2 min of removing the valve from the conditioning environmental chamber. The ambient test conditions shall not exceed 88°F (31°C). Following the impacts, the valve shall be operable and shall comply with para. 3.3.2.

The entire test shall be repeated with the impacts applied at a temperature of 100 ± 5°F (38 ± 3°C), on a second valve which has been conditioned at that temperature for a minimum of 18 hr.

MANDATORY APPENDIX I
DESIGN PRESSURE FOR VALVES

The design pressure p listed in Table 1 for the various materials and SDR equivalents were derived as follows:

$$\text{Design pressure, } p = 2SF/(\text{SDR} - 1) \text{ [psi (bar)]}$$

where

S = Hydrostatic Design Basis (HDB) at 73°F (23°C) as awarded by the PPI Hydrostatic Stress Board and as published in PPI TR4. The method of determining HDB is described in ASTM D 2837.

SDR = Standard Dimension Ratio as defined in para. 2.4

F = a service (design) derating factor (see example below)

EXAMPLE:
If the material is PE2406 and SDR is 11; from the table below, S = 1,250 psi. (The design factor 0.32, used for this example is taken from the United States Code, Title 49 CFR Part 192.121.)

Then:

$$p = 2 \times 1250 \times 0.32/(11/1) = 80 \text{ psi}$$

	HDB	
Material	psi	MPa
PE2406	1,250	8.6
PE3408	1,600	11.0
PVC1120 and PVC1220	4,000	27.6
PVC2110	2,000	13.6
PA323	2,500	17.24

GENERAL NOTES:
(a) The code of Federal Regulations, CFR Title 49, Part 192.123, limits the design pressure to 100 psi (6.9 bar) for plastic pipe used in Gas Distribution Systems.
(b) 1 MPa = 10 bar

MANDATORY APPENDIX II
REFERENCES

The following is a list of publications referenced in this Standard.

ASTM D 1598-97, Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
ASTM D 2444-99, Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D 2466-99, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467-99, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2513-99a, Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2683-98, Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2837-98a, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM D 3261-97, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM E29-93a (1999), Standard Practice for Using Significant Digits in Test Data to Determine Conformance With Specifications

Publisher: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428

ANSI/ISA S75.02-1996, Control Valve Capacity Test Procedures

Publisher: Instrument Society of America (ISA), 40 Stanwix Street, Pittsburgh, PA 15222

ISO 9000-1: 1994, Quality management and quality assurance standards — Part 1: Guidelines for selection and use
ISO 9000-2: 1997, Quality management and quality assurance standards — Part 2: Generic guidelines for the application of ISO 9001, ISO 9002, and ISO 9003
ISO 9000-3: 1997, Quality management and quality assurance standards — Part 3: Guidelines for the application of ISO 9001 to the development, supply, installation, and maintenance of computer software
ISO 9001: 1994, Quality systems — Model for quality assurance in design, development, production, installation, and servicing
ISO 9002: 1994, Quality systems — Model for quality assurance in production, installation, and servicing
ISO 9003: 1994, Quality systems — Model for quality assurance in final inspection and test
Publisher: International Organization for Standardization (ISO), 1 rue de Varembé, Case postale 56, CH-1211 Genève 20, Switzerland/Suisse

CFR, Title 49, Part 192-2000, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Standards

Publisher: U.S. Government Printing Office, Superintendent of Documents, Mail Stop SSOP, Washington, DC 20402-9328

PPI TR4-2000b, HDB/PDB/MRS Listed Materials
Publisher: Plastics Pipe Institute (PPI), 1825 Connecticut Ave., NW, Suite 680, Washington, DC 20009

Publications appearing above which have been approved as American National Standards may be obtained from the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036

NONMANDATORY APPENDIX A
QUALITY SYSTEM PROGRAM

The products manufactured in accordance with this Standard shall be produced under a quality system program following the principles of an appropriate standard from the ISO 9000 series.[1] A determination of the need for registration and/or certification of the product manufacturer's quality system by an independent organization shall be the responsibility of the manufacturer. The detailed documentation demonstrating program compliance shall be available to the purchaser at the manufacturer's facility. A written summary description of the program utilized by the product manufacturer shall be available to the purchaser upon request. The product manufacturer is defined as the entity whose name or trademark appears on the product in accordance with the marking or identification requirements of this Standard.

[1] The series is also available from the American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC) as American National Standards that are identified by a prefix "Q" replacing the prefix "ISO." Each standard of the series is listed under Appendix II, References.

AMERICAN NATIONAL STANDARDS FOR PIPING, PIPE FLANGES, FITTINGS, AND VALVES

Scheme for the Identification of Piping Systems	A13.1-1996
Pipe Threads, General Purpose (Inch)	B1.20.1-1983(R1992)
Dryseal Pipe Threads (Inch)	B1.20.3-1976(R1998)
Cast Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250	B16.1-1998
Malleable Iron Threaded Fittings: Classes 150 and 300	B16.3-1998
Gray Iron Threaded Fittings: Classes 125 and 250	B16.4-1998
Pipe Flanges and Flanged Fittings (NPS $\frac{1}{2}$ Through NPS 24)	B16.5-1996
Factory-Made Wrought Buttwelding Fittings	B16.9-2001
Face-to-Face and End-to-End Dimensions of Valves	B16.10-2000
Forged Fittings, Socket-Welding and Threaded	B16.11-2001
Cast Iron Threaded Drainage Fittings	B16.12-1998
Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads	B16.14-1991
Cast Bronze Threaded Fittings: Classes 125 and 250	B16.15-1985(R1994)
Cast Copper Alloy Solder Joint Pressure Fittings	B16.18-2001
Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed	B16.20-1998
Nonmetallic Flat Gaskets for Pipe Flanges	B16.21-1992
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	B16.22-1995
Cast Copper Alloy Solder Joint Drainage Fittings — DWV	B16.23-1992
Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500, and 2500	B16.24-2001
Buttwelding Ends	B16.25-1997
Cast Copper Alloy Fittings for Flared Copper Tubes	B16.26-1988
Wrought Steel Buttwelding Short Radius Elbows and Returns	B16.28-1994
Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings — DWV	B16.29-1994
Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psig (Sizes $\frac{1}{2}$ Through 2)	B16.33-1990
Valves — Flanged, Threaded, and Welding End	B16.34-1996
Orifice Flanges	B16.36-1996
Large Metallic Valves for Gas Distribution (Manually Operated, NPS $2\frac{1}{2}$ to 12, 125 psig Maximum)	B16.38-1985(R1994)
Malleable Iron Threaded Pipe Unions	B16.39-1998
Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems	B16.40-2002
Functional Qualification Requirements for Power Operated Active Valve Assemblies for Nuclear Power Plants	B16.41-1983(R1989)
Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300	B16.42-1998
Manually Operated Metallic Gas Valves for Use in House Piping Systems	B16.44-1995
Cast Iron Fittings for Sovent® Drainage Systems	B16.45-1998
Large Diameter Steel Flanges (NPS 26 Through NPS 60)	B16.47-1996
Steel Line Blanks	B16.48-1997
Factory-Made Wrought Steel Buttwelding Induction Bends for Transportation and Distribution Systems	B16.49-2000
Power Piping	B31.1-2001
Fuel Gas Piping (not an ANSI standard)	B31.2-1968
Process Piping	B31.3-2002
Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids	B31.4-1998
Refrigeration Piping and Heat Transfer Components	B31.5-2001
Gas Transmission and Distribution Piping Systems	B31.8-1999
Building Services Piping	B31.9-1996
Slurry Transportation Piping Systems	B31.11-1989(R1998)
Manual for Determining the Remaining Strength of Corroded Pipelines	B31G-1991
Welded and Seamless Wrought Steel Pipe	B36.10M-1996
Stainless Steel Pipe	B36.19M-1985(R1994)
Self-Operated and Power-Operated Safety-Related Valves Functional Specification Standard	N278.1-1975(R1992)

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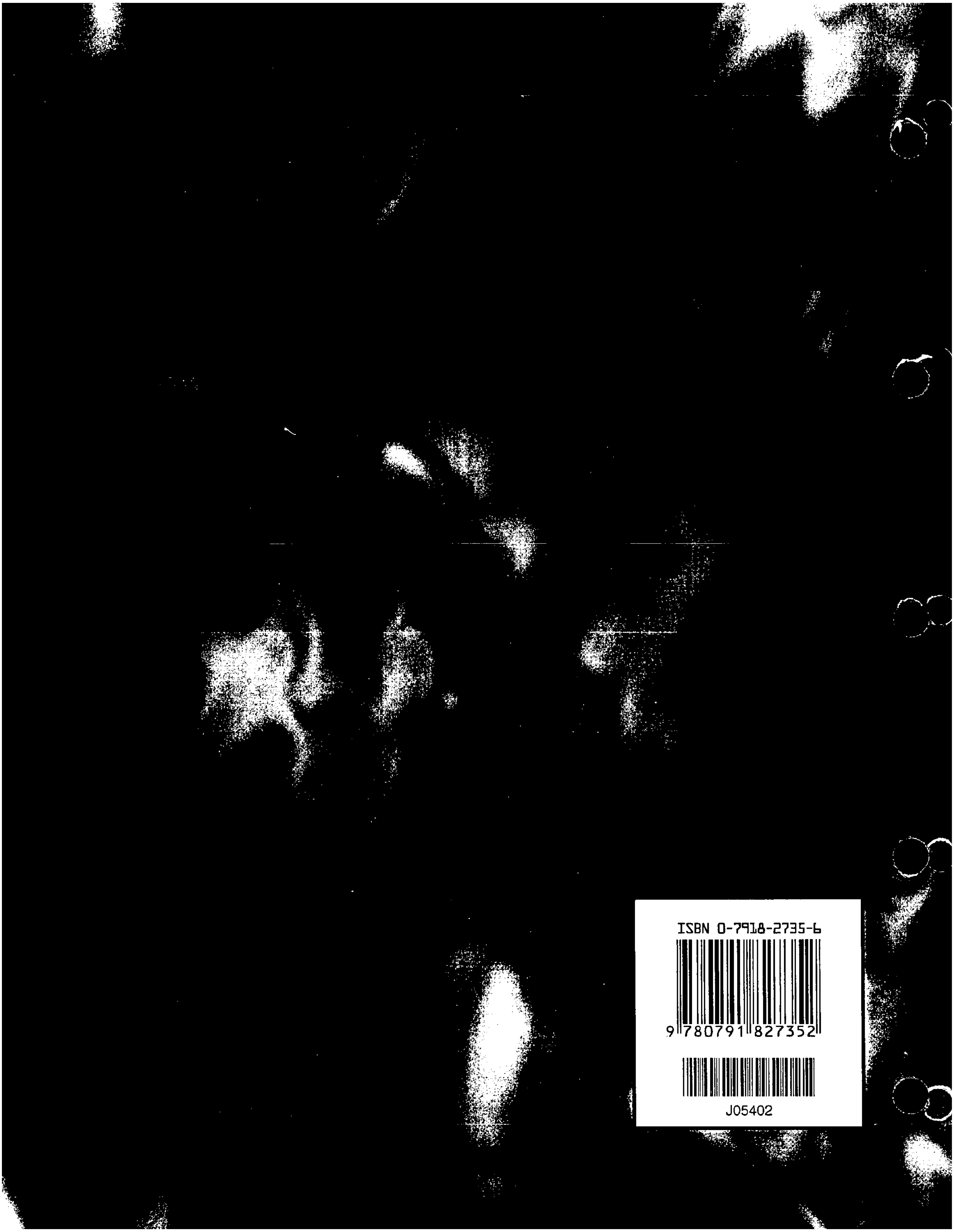

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