Designation: F1970 – 12ε1

Standard Specification for Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems[1]

This standard is issued under the fixed designation F1970; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Section 2 was editorially updated in August 2013.

1. Scope*

1.1 This specification covers fittings, appurtenances and valves which are to be used with pipe and tubing complying with Specifications D1785, D2241, D2846/D2846M, F441/F441M or F442/F442M, or other piping as specified by the fittings manufacturer. These products, such as unions, flanges or valves, are not included in the scope of existing ASTM specifications. This specification includes minimum requirements for testing, materials, dimensions, workmanship, marking, and in-plant quality control.

1.2 Fittings or appurtenances covered by this specification are generally either molded, fabricated, or assembled from molded or machined components. The materials used in components include rigid thermoplastics, thermoplastic elastomers, elastomerics, and metals. The body or main portion of the fitting, appurtenance or valve is typically PVC, CPVC, PE or PA (nylon). All products covered by this standard are intended to be used in PVC or CPVC plastic piping systems, or as a transition from these to metal systems.

1.3 The application of these products to gas service is beyond the scope of this specification.

1.4 The products covered by this specification are intended for use with the distribution of pressurized liquids only, which are chemically compatible with the piping materials. Due to inherent hazards associated with testing components and systems with compressed air or other compressed gases some manufacturers do not allow pneumatic testing of their products. Consult with specific product/component manufacturers for their specific testing procedures prior to pneumatic testing.

NOTE 1—**Warning:** Pressurized (compressed) air or other compressed gases contain large amounts of stored energy which present serious safety which present serious safety hazards should a system fail for any reason.

1.5 Fittings which rely on heat fusion welding for connection to the piping system are outside the scope of this specification.

1.6 Check valves (including foot valves) covered by this specification shall not be considered backflow prevention devices and shall not be used for the protection of a potable water supply. For definitions and requirements of backflow prevention devices, consult model plumbing codes and ASSE.[2]

1.7 Due to the complex and installation-specific concerns surrounding chemical resistance and corrosion, this specification does not address the compatibility of the products with all possible end-use environments. Additional testing specific to the end-use environment is recommended if the system is conveying liquids other than potable water.

1.8 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are given for information only.

1.9 The following safety caveat applies only to the test methods and in-plant quality control portions, section of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.10

Current edition approved Nov. 1, 2012. Published December 2012. Originally approved in 1999. Last previous edition approved in 2005 as F1970–05. DOI: 10.1520/F1970-12.

[2] American Society of Sanitary Engineering, 28901 Clemens Rd., Suite 100, Westlake, OH 44145.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

D1600 Terminology for Abbreviated Terms Relating to Plastics
D1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
D1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D1898 Practice for Sampling of Plastics (Withdrawn 1998)[4]
D2000 Classification System for Rubber Products in Automotive Applications
D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D2241 Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
D2466 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
D2467 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D2846/D2846M Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
F412 Terminology Relating to Plastic Piping Systems
F438 Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
F439 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
F441/F441M Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
F442/F442M Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR–PR)
F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F1498 Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings

2.2 *ASME Standards:*
B1.20.1 Pipe Threads, General Purpose (Inch)[5]
B16.5 Pipe Flanges and Flanged Fittings[5]

2.3 *NSF Standards:*
NSF 14 Plastics Piping Components and Related Materials[6]
NSF 61 Drinking Water System Components - Health Effects[6]

2.4 *ISA Standard:*
ISA S75.02 Control Valve Capacity Test Procedure[7]

2.5 *ASQ Standard:*
ANSI/ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes[8]

[4] The last approved version of this historical standard is referenced on www.astm.org.
[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.
[6] NSF International, P.O. Box 130140, Ann Arbor, MI 48113-0140.
[7] Instrument Society of America, 67 Alexander Drive, Research Triangle Park, NC 27709.
[8] American Society for Quality, 611 East Wisconsin Ave., Milwaukee, WI 53201-3005.

3. Terminology

3.1 *General*—Definitions are in accordance with the Definitions in F412 and abbreviations are in accordance with D1600 unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *activation pressure*—the activation pressure of a check valve is that inlet pressure, exceeding the outlet pressure, required to open the check valve and allow water to flow.

3.2.2 *appurtenances*—accessories of a plastic piping system designed for special applications or end-uses. Appurtenances may include, but are not limited to pipes, fittings, valves, storage tanks, mechanical devices and expansion tanks.

3.2.3 *connections*—the portion of the fitting intended to join the fitting with the rest of the piping system (see 5.1).

3.2.4 *CTS*—abbreviation for "copper tube size", indicating an outside-diameter controlled tubing with outside diameter dimensions meeting the tube specifications given in Specification D2846/D2846M.

3.2.5 *IPS*—abbreviation for "iron pipe size", indicating an outside-diameter controlled tubing with outside diameter dimensions meeting the requirements of schedule 40 pipe (see Specification D1785 for dimensions of schedule 40 pipe).

3.2.6 *lot size*—the total number of completely finished fittings or appurtenances that are manufactured under conditions of production that are considered uniform.

3.2.7 *referee test*—testing conducted to compare performance of the product against all requirements of this specification. In-plant QC testing is not considered referee testing.

4. Materials and Manufacture

4.1 The elastomeric seals designed for push-on joints, which require no internal or external pressure to effect the initial seal, shall comply with the requirements of Specification F477, Table 1 for thermoset, Table 2 for thermoplastic.

4.2 All other elastomeric seals shall be designed to meet the product performance requirements stated within this document and be specified in accordance with Classification D2000.

4.3 Materials used in components which provide structural integrity of the fitting or appurtenance shall meet the requirements of 4.3.1, 4.3.2, or 4.4.

NOTE 2—Components which provide structural integrity include the body; connections such as sockets, compression joint components, saddles, and flanges.

4.3.1 PVC materials shall meet the minimum requirements for a cell-classification of 12454, 13354, 11443 or 14333 as defined by Specification D1784.

4.3.2 CPVC materials shall meet the minimum requirements for a cell-classification of 23447 or 23448 as defined in Specification D1784.

4.4 *Rework Material*— The manufacturers shall use only their own clean rework fitting material and the fittings produced shall meet the requirements of this specification. Materials containing contaminants from other base materials or elastomerics shall not be used in the manufacture of fittings or appurtenances under this specification.

5. Requirements

5.1 *Dimensions:*

5.1.1 *Seal Dimensions*— Seal dimensions shall be in accordance with the manufacturer's standard design dimensions and tolerances. The seal shall be designed to provide an adequate compressive force against the mating parts after assembly to effect a positive seal under all combinations of permitted fitting and seal tolerances.

5.1.2 *Solvent-Weld Connections*—Sockets shall comply with the fittings dimensions applicable to the size of pipe being joined. Dimensioning of sockets shall be conducted in accordance with 8.2.

5.1.2.1 Socket connections for solvent-weld to IPS pipe shall comply with the socket dimensions given in Specification D2467 for Sch 80 PVC, Specification D2466 for Sch 40 PVC, Specification F439 for Sch 80 CPVC or Specification F438 for Sch 40 CPVC.

5.1.2.2 Socket connections for solvent-weld to CTS pipe shall comply with the socket dimensions given in D2846/D2846M.

5.1.3 *Threaded Connections*—For all thermoplastic components having taper pipe threads, thermoplastic threads shall conform to Specification F1498 and be gaged in accordance with 8.2.2. The tolerance on thermoplastic threads, when measured using gages, shall be ±1.5 turns. For all metallic components having taper pipe threads, threads shall conform to ANSI/ASME B1.20.1. The tolerance on metallic threads when measured using gages shall be ±1 turn.

5.1.4 *Flange Connections*—Flanges and flange-connections on assemblies shall meet the bolt-pattern requirements of ANSI/ASME B16.5.

5.1.5 *Spigot Connections*—Spigot ends of fittings shall meet the requirements for average outside diameter, out-of-roundness and minimum wall thickness of the corresponding pipe.

5.1.6 Other dimensions shall be in accordance with the manufacturer's standard dimensions and tolerances.

5.2 *Internal Pressure Tests*—Fittings shall meet the minimum requirements for resistance to hydrostatic pressure when tested in accordance with 8.2.

5.2.1 *Valves*—Valves shall be tested in both the open (shell test) and shut-off (seat test) configurations for compliance with this section. Valves without a specified flow direction shall be tested in shut-off position from each possible flow direction. For operating (test) temperatures above 145°F (63°C), the 1000-h test on the valves shall be conducted only in the open (shell test) configuration.

5.2.2 *Blind Flanges*— Blind flanges shall be tested in addition to any other flange configurations for compliance with this section.

5.3 *Valves and Check Valves:*

5.3.1 *Pressure Drop Across Valves and Check Valves*—When tested in accordance with 8.4, the pressure drop across the valve shall not exceed the manufacturer's published values at 25, 50, 75 and 100 % of maximum flow. The maximum flow rate shall be either as specified by the manufacturer, or the flow achieved with 80 psig (550 kPa) inlet (at no flow condition) pressure and pipe of the same nominal size as the valve. For valves with more than one flow direction, testing shall be conducted in each flow configuration.

5.3.2 *Leakage Through Reverse Direction of Valves*—This requirement is applicable to valves with a specified flow direction, and check valves. The reverse flow rate (leakage, L) through the valve shall not exceed 0.01 % of the flow that would exist if the valve were not installed (F), when tested in accordance with 8.5. That is, L shall be less than or equal to 0.0001(F), or alternatively, the leakage percentage, P, shall be less than or equal to 0.01 %.

5.3.3 *Activation Pressure of Check Valves*—The activation pressure of check valves shall be within ± 5 % or ± 2 in. (mm) water column of the manufacturer's published value, whichever is greater, when tested in accordance with 8.6.

5.4 *Joint Tightness*— Fittings utilizing push-on joints with elastomeric seals shall not leak or fail when tested in accordance with 8.3.

6. Workmanship, Finish, and Appearance

6.1 The requirements of this section are verified by visual (non-magnified) inspection of the components and surfaces.

6.2 All surfaces of the fitting or assembly against which a seal may rest shall be free of imperfections that could adversely affect the performance of the fitting or assembly.

6.3 The surfaces of all thermoplastic and metallic components shall be free from defects which will adversely affect the performance and service of the fitting or assembly.

6.4 The thermoplastic materials, after molding or fabrication, shall be as uniform as commercially practical in color and opacity.

7. Sample Conditioning

7.1 For referee testing, all samples shall be conditioned at 73 ± 3.6°F (23 ± 2°C) for not less than 40 hours immediately preceding testing.

7.2 For in-plant quality control testing purposes, samples shall be conditioned at ambient temperature.

8. Test Methods

8.1 *Dimensioning:*

8.1.1 Measure dimensions in accordance with D2122. For those part dimensions that are not covered by Test Method D2122, note the method of determining dimensions on the test report.

8.1.2 *Threads*—Gage all thermoplastic taper pipe threads in accordance with Specification F1498.

8.1.3 *Threads*—Gage all metal taper pipe threads in accordance with ANSI/ASME B1.20.1.

8.2 *Resistance to Hydrostatic Pressure :*

8.2.1 Test specimens shall consist of assemblies of fittings and pipe, using pipe sufficient to withstand the internal hydrostatic pressure until completion of the test. The assemblies used for each test shall contain the same fittings in the same configuration. Each individual assembly shall contain at least two of each fitting being tested.

8.2.2 The test temperature, with a tolerance of ± 3.6°F (2°C), shall be the maximum operating temperature for which the piping system component's recommended maximum operating pressure is being verified.

8.2.3 Conduct hydrostatic pressure testing in accordance with the method and at the times and pressures given in Table 1. Specimens which include an elastomeric seal shall be conditioned for one h at 50% of the test pressure immediately prior to conducting th 1-h and 1000-h tests.

8.2.4 For the 1-h and 1000-h tests, failure is defined as any loss of pressure in the assembly, due to failure of any component of the fittings under test. For the burst test, some loss of pressure due to seepage in a valve stem area is acceptable, provided no failure or leakage occurs in the body or connections areas of the fitting.

NOTE 3—Loss of pressure which can be corrected by tightening of threads or valve seals without removal of the fitting from the assembly, is not considered failure of a component, as specified in 8.2.4.

8.2.5 Consider all fittings used to construct the assemblies as evaluated upon completion of this test. All fittings from which this representative sample was drawn will also be considered as evaluated upon completion of this test.

8.3 *Joint Tightness:*

8.3.1 Conduct testing on two specimens of the same fitting size/configuration.

8.3.2 Use water as the internal pressurizing fluid. The external fluid shall be either air or water. The internal and external fluid temperatures shall be the maximum temperature for which the fittings nominal pressure was verified with a tolerance of ± 3.6°F (2°C).

8.3.3 Subject the joint to 20 psig (140 kPa) for 1 h, and then raised to 2.5 times the nominal pressure of the fitting and maintained for 1 h. For those products requiring joint tightness testing, this test replaces the 1-h hydrostatic test shown in Table 1.

8.3.4 Any leakage or failure of the fitting during the full test duration constitutes failure of this test.

8.4 *Pressure Drop Across Valves :*

8.4.1 Conduct testing on a single specimen of the configuration/size being evaluated.

8.4.2 Water shall be used as the internal pressurizing fluid. The water temperature shall be 73 ± 4°F (23 ± 2°C).

8.4.3 The test systems shall be in accordance with ANSI/ISA S75.02 (see Fig. 1). The test procedure shall be in accordance with the C_v Procedure of ANSI/ISA S75.02.

8.4.4 Conduct testing at 25, 50, 75, and 100 % of maximum flow as defined in 5.3.1. The internal cross-sectional area of the pipe shall be no less than the smallest cross-section in the flow path through the valve. This will ensure that the greatest restriction to flow is the valve under test, rather than the pipe portion of the test assembly.

TABLE 1 Hydrostatic Testing

Test Pressure, psi	Time	Test Method
3.2×(P[A]) minimum burst pressure	60 s	D1599[B]
2.5×(P[A]) ± 10 psi	1 h	D1598
2.1×(P[A]) ± 10 psi	1000 h	D1598

[A]P is the manufacturer's recommended pressure as marked on the fitting. It is the responsibility of the manufacturer to establish a recommended maximum operating pressure.
[B]Testing may be stopped upon reaching the minimum required pressure, rather than taking the sample to failure.

8.5 *Leakage In Reverse Direction for Valves:*

8.5.1 Conduct testing on a single specimen of the configuration/size being evaluated. Connect the fitting to the test system as shown in Fig. 2.

8.5.2 The water temperature shall be 73 ± 4°F (23 ± 2°C).

8.5.3 With the upstream test valve connection open to atmosphere, apply pressure to the downstream test valve connection equal to the 1.5 times the nominal pressure of the valve and begin the timer.

8.5.4 Collect any water leaking through the valve over a 60 min period, in a graduated cylinder or other container capable of measuring accurately to 0.0003 gal (1 mL).

8.5.5 Calculate the leakage rate in gal/min (gpm) or litres per min (Lpm). Record this as "L".

8.5.6 Remove the test valve from the system and determine the flow rate (gpm or Lpm) with the piping open to atmosphere as shown in Fig. 3, with a flow velocity of 5 ft/s. Alternatively, the inside diameter of the pipe, and the density of the water shall be determined, and the flow rate calculated based on a 5 ft/s flow velocity. Record this open flow value as "F".

8.5.7 Calculate the leakage rate as a percentage of the flow rate determined in 8.5.6, using the equation $P = (L/F) \times 100$ %.

8.6 *Activation Pressure of Check Valves:*

8.6.1 Conduct testing on a single specimen of the configuration/size being evaluated. Install the valve as shown in Fig. 1. For valves which can be installed either horizontally or vertically, this test must be conducted with the valve in three configurations; vertical flow up, vertical flow down, and horizontal. For vertical flow testing, the pressure differential must be corrected for the relative difference in height of the pressure sensors.

8.6.2 The water temperature shall be 73 ± 4°F (23 ± 2°C).

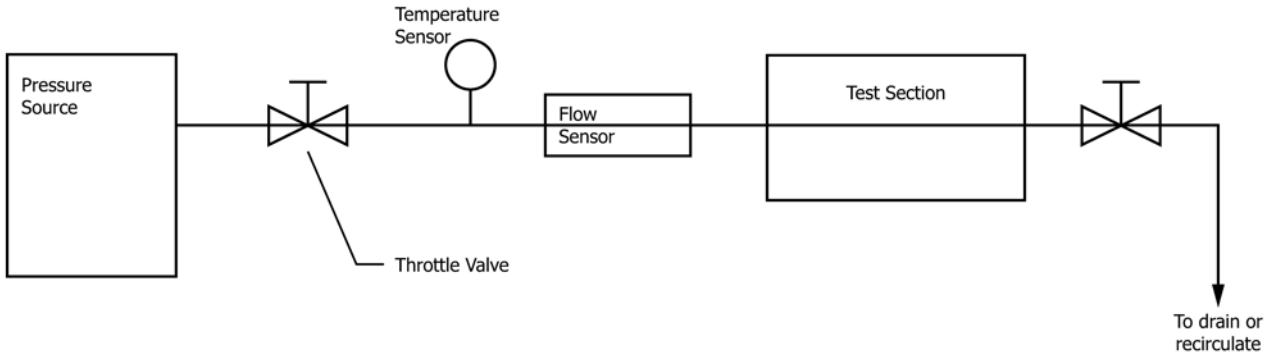
8.6.3 Increase the pressure differential across the valve at a rate not exceeding 6 psi/min (690 Pa/s) until the check opens and flow is detected at the outlet. Record this differential as the activation pressure.

9. Rejection and Rehearing

9.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again only by agreement between the purchaser and seller. Under such agreement, minimum requirements shall not be lowered, changed, or modified, nor shall specification limits be changed. If upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

10. In-Plant Quality Control

10.1 *Sampling*—A sufficient quantity of fittings or appurtenances, as agreed upon between the purchaser and seller, shall be selected from each lot or shipment and tested to determine conformance with this specification (see Practice D1898). In the case of no prior agreement, the quantity of samples shown in Table 2 shall be selected randomly and



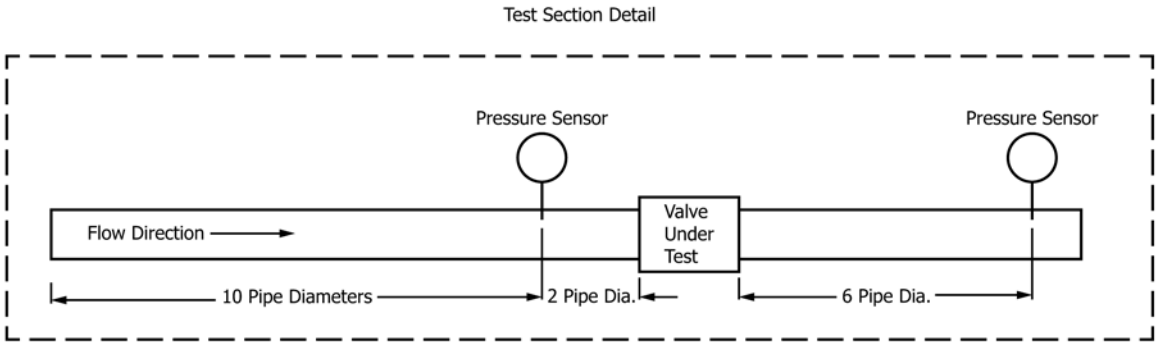


FIG. 1 Pressure LossTest System

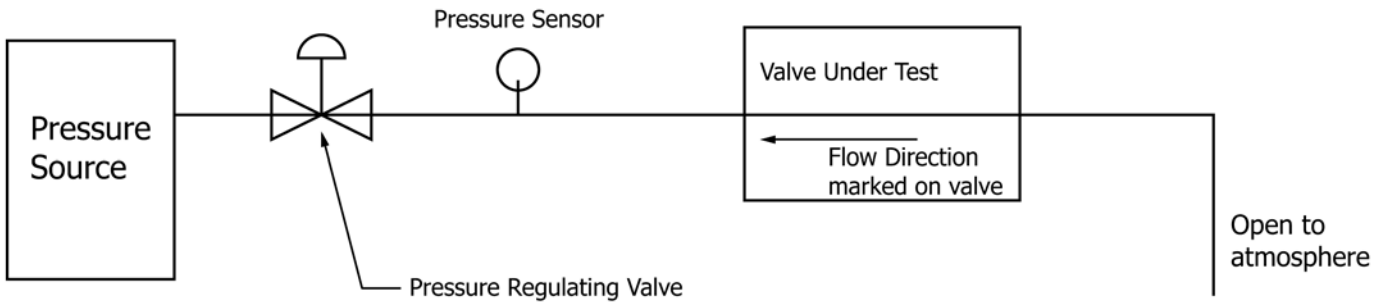


FIG. 2 Reverse Direction Leakage Test

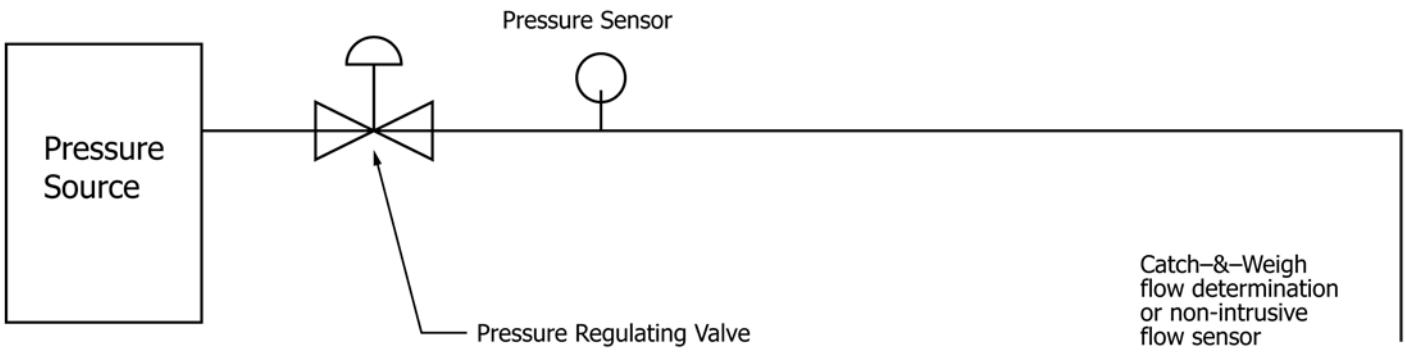


FIG. 3 Flow Without Test Valve

tested. The values shown in Table 2 for dimensions are based on Practice D1898, sampling for attributes, random sampling, and the sample size based on the lot size of finished products using General Inspection Level I. Larger lot sizes and sampling

TABLE 2 Sample Size for In-Plant QC Testing

Lot Size[A]	Number of Dimensions Specimens	Number of Burst Specimens
16 to 25	3	1
26 to 90	5	1
91 to 150	8	2
151 to 280	13	3
281 to 500	20	5
501 to 1200	32	8

[A]For products manufactured under a single continuous process without further assembly or fabrication required, dimensions shall be conducted at start-up and once per 24 h, and burst testing shall be conducted at start-up and once per week.

plans are given in D1898. Additionally, based on historical testing data, allowance shall be made for tightening or reducing the Inspection Level, as described in Practice D1898 and ANSI/ASQC Z1.4.

10.2 Dimensions shall comply with 5.1, when determined in accordance with 8.1.

10.3 Hydrostatic burst testing shall be conducted using Test Method D1599, with the exception that the test can be stopped upon reaching the burst pressure given in Table 1, rather than taking the fitting or appurtenance to failure. The minimum required burst pressure is as given in Table 1.

11. Product Marking

11.1 Fittings shall be marked with the following:

11.1.1 Manufacturer's name or trademark,

11.1.2 Material designation,

11.1.3 Fittings intended for the transport of potable water shall include the seal or mark of the laboratory making the evaluation for this purpose,

11.1.4 Manufacturer's recommended pressure, and the temperature for which the pressure is applicable. For fittings intended to be used at 100 psi/180°F (hot water supply) the word HOT is acceptable rather than the pressure and temperature,

11.1.5 Nominal size, and

11.1.6 If the fitting is intended to be used only with certain SDR, Schedule, or pressure-class pipe within one of the standards given in 1.1, marking shall indicate this.

NOTE 4—Fittings need only be marked with the schedule or SDR of the pipe with the highest pressure rating for which they are intended. All thinner-wall schedules and SDR's need not be marked on the fitting.

11.1.7 This designation number (F1970).

11.2 The manufacturer's literature shall include assembly instructions which provide adequate information to achieve a connection which will meet the nominal pressure given in 5.1.

12. Quality Assurance

12.1 Where the product is marked with this designation, F1970, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

13. Keywords

13.1 appurtenances; check valves; CPVC; elastomeric joints; elastomers; fittings; flanges; PVC; SE; special-engineered; unions; valves

SUPPLEMENTARY REQUIREMENTS

This requirement applies whenever a Regulatory Authority or user calls for product to be used to convey or to be in contact with potable water.

S1. Potable Water Requirement

S1.1 *Potable Water Requirement*—Products intended for contact with potable water shall be evaluated, tested and certified for conformance with ANSI/NSF Standard No. 61 or the health effects portion of ANSI/NSF Standard No. 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F1970–05) that may impact the use of this standard.

(1) Specification D3350 and Classification D4066 were removed from Section 2.

(2) 4.3.3 and 4.3.4 were deleted.