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ANSI/CAN/UL/ULC 1091:2022

JOINT CANADA-UNITED STATES
NATIONAL STANDARD

STANDARD FOR SAFETY

Butterfly Valves for Fire-Protection Service

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UL Standard for Safety for Butterfly Valves for Fire-Protection Service, ANSI/CAN/UL/ULC 1091

Seventh Edition, Dated April 20, 2022

Summary of Topics

The Seventh Edition of ANSI/CAN/UL/ULC 1091 dated April 20, 2022 has been issued to reflect the latest ANSI and SCC approval dates and to incorporate the proposal dated September 30, 2019.

The requirements are substantially in accordance with Proposal(s) on this subject dated September 30, 2019.

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CONTENTS

Preface	5
---------------	---

INTRODUCTION

1 Scope	7
2 Components	7
3 Units of Measurement	7
4 Referenced Publications	7
5 Glossary	9

CONSTRUCTION

6 Sizes	9
7 Working Pressures	9
8 Discs	9
9 Seats	9
10 Bodies	10
11 Shafts	10
12 Brass Materials	11
13 Actuator Assemblies	11
14 Electrically Operated Valve Monitor Switches	12

PERFORMANCE

15 General	13
16 Tests on Organic Coating Materials for Seating Surfaces	13
16.1 General	13
16.2 Air oven exposure	13
16.3 Water immersion	14
16.4 Sodium chloride immersion	14
16.5 Potassium biphthalate immersion	14
16.6 Sodium carbonate immersion	14
16.7 Impact test	15
17 Nonmetallic Materials Test	15
17.1 Plastic or other nonmetallic parts (excluding rubber, synthetic elastomers and coatings)	15
17.2 Elastomeric parts (except gaskets)	16
18 Leakage Test	16
19 Hydrostatic Test	17
20 Torque Tests	17
20.1 All valves	17
20.2 Valves with integral indicating and operating arrangements	17
20.3 Valve with wrench nut actuator	18
21 Operation Tests	18
22 Hydraulic Friction Loss Test	18
23 10-Day Moist Ammonia Air Stress Cracking Test	19
24 Cycling Test	20
25 Dezincification Test of Brass Parts	20
25.1 General	20
25.2 Reagent	20
25.3 Samples	20
25.4 Method	20

MANUFACTURING AND PRODUCTION TESTS

26	General	21
----	---------------	----

MARKING

27	General	21
----	---------------	----

INSTRUCTIONS

28	Installation Instructions	22
----	---------------------------------	----

ANNEX A (Informative) – GUIDELINES FOR CONDUCTING OPERATING TORQUE VALUE CALCULATIONS FOR BUTTERFLY VALVES

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Preface

This is the Seventh Edition of ANSI/CAN/UL/ULC 1091, Standard for Butterfly Valves for Fire-Protection Service.

UL is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO). ULC Standards is accredited by the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL/ULC 1091 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

Comments or proposals for revisions on any part of the Standard may be submitted at any time. Proposals should be submitted via a Proposal Request in the On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Hydrants, Gate, And Butterfly Valves For Fire Protection Service, STP 262.

This list represents the STP 262 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

STP 262 Membership

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Ken Bush	Office of the Maryland State Fire Marshal	AHJ/Regulator	USA
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This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

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INTRODUCTION

1 Scope

1.1 These requirements cover butterfly valves intended for use in piping systems supplying water for fire-protection service.

1.2 The valves covered by these requirements are intended for installation and use in accordance with the Standards for:

- a) Low, Medium and High Expansion Foam, NFPA 11;
- b) Installation of Sprinkler Systems, NFPA 13;
- c) Installation of Standpipe and Hose Systems, NFPA 14;
- d) Water Spray Fixed Systems for Fire Protection, NFPA 15;
- e) Foam-Water Sprinkler and Foam-Water Spray Systems, NFPA 16;
- f) Installation of Stationary Pumps for Fire Protection, NFPA 20;
- g) Water Tanks for Private Fire Protection, NFPA 22; and
- h) Installation of Private Fire Service Mains and Their Appurtenances, NFPA 24.

2 Components

2.1 Except as indicated in [2.2](#), a component of a product covered by this standard shall comply with the requirements for that component.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3 Units of Measurement

3.1 Where values of measurement are specified in both SI and U.S. Customary units, it is the responsibility of the user of this standard to determine the unit of measurement appropriate for the user's needs.

4 Referenced Publications

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

4.2 The following standards are referenced in this standard, and portions of these referenced standards may be essential for compliance.

ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*

ASME B1.20.3, *Dryseal Pipe Threads (Inch)*

ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings*

ASME B 16.42, *Ductile Iron Pipe Flanges and Flanged Fittings*

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard*

ASTM A 53/A 53M, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*

ASTM A 135/A 135M, *Standard Specification for Electric-Resistance-Welded Steel Pipe*

ASTM A 795/A 795M, *Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use*

ASTM B689, *Standard Specification for Electroplated Engineering Nickel Coatings*

ASTM D2794, *Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation*

ASTM E145, *Standard Specification for Gravity-Convection and Forced-Ventilation Ovens*

ASTM G62, *Standard Test Methods for Holiday Detection in Pipeline Coatings*

AWWA C207, *Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In.*

AWWA C504-87, *Rubber-Seated Butterfly Valves*

AWWA C606, *Grooved and Shouldered Joints*

NFPA 11, *Low-, Medium-, and High-Expansion Foam*

NFPA 13, *Installation of Sprinkler Systems*

NFPA 14, *Installation of Standpipe and Hose Systems*

NFPA 15, *Water Spray Fixed Systems for Fire Protection*

NFPA 16, *Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*

NFPA 20, *Installation of Stationary Pumps For Fire Protection*

NFPA 22, *Water Tanks for Private Fire Protection*

NFPA 24, *Installation of Private Fire Service Mains and Their Appurtenances*

UL 38, *Manual Signaling Boxes for Fire Alarm Systems*

UL 157, *Gaskets and Seals*

UL 753, *Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service*

5 Glossary

5.1 For the purpose of this Standard, the following definitions apply.

5.2 NPS (NOMINAL PIPE SIZE) — A dimensionless designator for pipe sizes defined in standards including ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; ASTM A 135/A 135M, Standard Specification for Electric-Resistance-Welded Steel Pipe and ASTM A 795/A 795M, Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use. Used to replace terms such as "Nominal Diameter" and "Nominal Size."

CONSTRUCTION

6 Sizes

6.1 A valve shall be constructed for use with standard pipe of 1 NPS or larger.

6.2 Valve sizes refer to the nominal pipe size, NPS, of the waterway through the inlet and outlet connections and to the nominal pipe size for which the connections are intended.

7 Working Pressures

7.1 A valve shall be constructed for a minimum rated working pressure of:

- a) 175 psig (1206 kPa) for 12 NPS or smaller; and
- b) 150 psig (1034 kPa) for 14 NPS or larger.

8 Discs

8.1 A valve disc shall be either metallic or resilient covered and comply with the following:

- a) A metallic disc shall be cast or fabricated from materials having corrosion resistance at least equivalent to cast iron; and
- b) A disc shall be constructed to resist leakage and rupture. See Leakage Test, Section [18](#), and Hydrostatic Test, Section [19](#).

8.2 A resilient covered disc shall have the resilient material mechanically secured, bonded, or vulcanized to a metallic disc, and the material shall comply with the Nonmetallic Materials Test, Section [17](#).

9 Seats

9.1 The seating surfaces of a valve shall be constructed to resist leakage. See Leakage Test, Section [18](#).

9.2 A seating surface that is contacted by a resilient material shall:

- a) Be made of bronze, brass, ni-resist, or ductile iron having a nickel coating in accordance with Electroplated Engineering Nickel Coatings, ASTM B689 with at least 0.003 in (0.08 mm) thickness, or other metal or coating (including other nickel coating processes with less thickness) that has at least equivalent corrosion resistance;
- b) Have a protective organic coating complying with Tests on Organic Coating Materials for Seating Surfaces, Section [16](#); or
- c) Be a nonmetallic part complying with the requirements specified in Nonmetallic Materials Test, Section [17](#).

9.3 A rubber seat shall be clamped, mechanically secured, bonded, or vulcanized to the valve body or disc.

10 Bodies

10.1 The body of a valve shall be made of a material having corrosion resistance at least equivalent to cast iron.

10.2 A casting shall be smooth and free from scale, lumps, cracks, blisters, sand holes, and defects of any nature that could make it unfit for use. A casting shall not be plugged or filled, but may be impregnated to remove porosity.

10.3 The dimensions of all flanges, flange pipe joints, and threaded body openings shall conform to the following standards, as applicable or to other national standards that apply where the valve is intended to be installed. The flange class shall be at least equal to the rated pressure of the valve.

- a) Pipe Threads, General Purpose (Inch), ASME B1.20.1.
- b) Dryseal Pipe Threads (Inch), ASME B1.20.3.
- c) Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250), ASME B16.1 (Class 125 or higher).
- d) Ductile Iron Pipe Flanges and Flanged Fittings, Class 150 and 300, ASME B 16.42.
- e) Steel Pipe Flanges for Waterworks Service, 4 – 144 inches, AWWA C207, [for valves having a maximum rated working pressure of 175 psig (1206 kPa)]; Pipe Flanges and Flanged Fittings, NPS 1/2 Through NPS 24 Metric/Inch Standard, ASME B16.5, [for valves having a maximum rated working pressure greater than 175 psig (1206 kPa)].

10.4 Valve bodies with grooved ends shall conform to Grooved and Shouldered Joints, AWWA C606.

10.5 A wafer type valve shall be constructed to fit between flanges made in accordance with the requirements for Class 125 or higher flanges in Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250), ASME B16.1.

11 Shafts

11.1 The shaft of a valve shall be constructed of AISI Series 300 or 400 stainless steel or equivalent material.

Exception: A valve can incorporate a shaft constructed of ductile iron, carbon steel or equivalent material provided:

- a) *The shaft is not exposed to an internal water source;*
- b) *The valve is installed in above ground applications only; and*
- c) *No binding, rubbing, or friction occurs between the shaft and body as a result of shaft corrosion.*

11.2 Shaft extensions shall be constructed of AISI Series 300 or 400 stainless steel, carbon steel or equivalent material.

11.3 The shaft of a valve shall be capable of transmitting the maximum operating torque without exceeding a torsional shear stress of:

- a) 40 % of the yield strength; and
- b) 18 % of the ultimate tensile strength of the shaft material.

See Operation Tests, Section [21](#).

12 Brass Materials

12.1 Parts that are exposed to water under service conditions and that are made of drawn, cast, or machined brass containing more than 15 % zinc shall resist cracking. See 10-Day Moist Ammonia Air Stress Cracking Test, Section [23](#).

12.2 Parts that are exposed to water under service conditions and that are made of brass containing more than 15 % zinc shall resist dezincification. See Dezincification Test of Brass Parts Test, Section [25](#).

13 Actuator Assemblies

13.1 A valve shall be equipped with a worm gear or traveling nut actuator.

13.2 An actuator shall be equipped with either of the following:

- a) An indicating arrangement that will positively indicate when the valve is in the open and closed position. The indicator shall be visible from two positions 180° apart, at a distance to 50 ft (15.2 m). The valve and the actuator shall be constructed so that the valve cannot be assembled with the indicator showing the disc orientation incorrectly.
- b) A wrench nut constructed for connection to a separate butterfly valve indicator post.

13.3 A valve incorporating an integral actuator/indicating arrangement as specified in [13.2\(a\)](#) shall be constructed such that it can be locked in the open position after installation.

13.4 If a valve incorporates a stem extension, it shall be integral with the valve. The stem extension housing shall be made of material having physical and corrosion resistant properties at least equivalent to 0.27 in (0.7 mm) thick ductile iron or steel. The outside diameter of the stem extension housing shall not be less than 2.75 in (69.8 mm).

13.5 The actuator of a valve complying with [13.2\(b\)](#) shall be:

- a) Grease packed and sealed to prevent contamination of the actuator operating mechanism;
- b) Constructed to open and close the valve at the rated maximum working pressure with a maximum input of 80 lbf-ft (108 N·m) applied to the wrench nut;

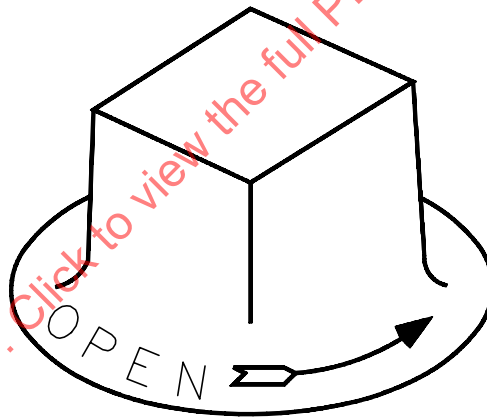
- c) Constructed to support the external loads imposed by the butterfly valve indicator post; and
- d) Provided with a 5-in (127-mm) diameter round sleeve for accepting the butterfly valve indicator post. Provision for drainage shall be provided between the sleeve and the indicator post connection.

13.6 A valve incorporating a wrench nut actuator shall be fitted with sleeve type bearings. The maximum distance from the inside metal surface of the valve body to the inside end of the sleeve bearing shall not exceed 1/8 in (3.17 mm).

13.7 A wrench nut shall be made of material having strength and resistance to corrosion equivalent to cast iron. It shall be secured to the actuator input shaft by a pin, key, or the equivalent.

13.8 A wrench nut shall be 1-15/16 in (49 mm) square at the top and 2 in (51 mm) square at the base of a section 1-3/4 in (45 mm) high. The nut shall incorporate a cast arrow at least 2 in long, showing the direction of opening and the word "OPEN" in distinct letters. See Section 28, Installation Instructions, and [Figure 13.1](#).

Figure 13.1
Wrench Nut



14 Electrically Operated Valve Monitor Switches

14.1 An electrically operated switch assembly, intended to indicate a valve's position, shall comply with the applicable requirements in the Standard for Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service, UL 753. A switch assembly intended for outdoor use shall also comply with the applicable requirements in the Standard for Manual Signaling Boxes for Fire Alarm Systems, UL 38.

14.2 A switch shall provide a signal within the first two revolutions of a valve's handwheel in the direction of closing the valve.

14.3 A valve position monitor switch assembly shall be constructed to provide:

- a) Duplicate terminals or leads for each incoming and each outgoing alarm initiating circuit connection; or
- b) Equivalent means to achieve electrical supervision.

A common terminal may be used for connection of both incoming and outgoing wires, provided that the construction of the terminal does not permit an uninsulated section of a single conductor to be looped around the terminal and serve as two separate connections, thereby precluding supervision of the connection in the event that the wire becomes dislodged from under the terminal. A notched clamping plate under a single securing screw, where separate conductors of an initiating circuit are intended to be inserted in each notch, is acceptable, but this arrangement shall be supplemented by additional marking in the wiring area or on the installation wiring diagram specifying the intended connections to the terminals.

PERFORMANCE

15 General

15.1 Representative samples of valves are to be subjected to the tests described in these requirements. Samples of parts constructed of nonmetallic material, such as rubber seals, are required for physical and chemical tests.

16 Tests on Organic Coating Materials for Seating Surfaces

16.1 General

16.1.1 Organic coating material used as a seating surface shall show no signs of disbondment or blistering when tested as specified in [16.2](#) – [16.6](#), shall show no evidence of base metal corrosion outside the scribed area when tested as specified in [16.3](#), and shall show no signs of cracking when tested as specified in [16.7.1](#). For these purposes, "cracking" includes disbondment or exposure of the base material due to extrusion or intrusion deformation, but does not include surface crazing.

16.2 Air oven exposure

16.2.1 Four specimens of combined coating material/base material, each measuring 4 by 4 in (102 by 102 mm), are to be used for this test. The thickness of the coating material and base material are to be equivalent to the thickness used in valve construction. The specimens are to be prepared in a manner that duplicates valve seat construction (surface roughness and application procedure).

16.2.2 The specimens are to be subjected to air-oven aging at 100 ± 1 °C (212 ± 2 °F), or at the temperature determined in [16.2.4](#), as appropriate, for 180 days.

16.2.3 Following the exposure, the test specimens are to be visually examined for any evidence of disbondment or blistering of the coating.

16.2.4 If a coating material does not withstand the temperature specified in [16.2.2](#) without excessive deterioration, an air-oven aging test at a lower temperature for a longer period of time shall be applied. If a coating material is capable of withstanding a higher temperature than that specified in [16.2.2](#) without excessive deterioration, an air-oven aging test at a higher temperature for a shorter period of time, but not less than 30 days, is permitted. The duration of exposure is to be calculated from the following equation:

$$D = (184,000)e^{-0.0693t}$$

in which:

D is the test duration in days, and

t is the test temperature in °C

16.3 Water immersion

16.3.1 Four specimens of combined coating material/base material, each measuring 4 in by 4 in (102 mm by 102 mm), are to be used for this test. The thickness of the coating material and base material are to be equivalent to the thickness used in valve construction. The specimens are to be prepared in a manner that duplicates valve seat construction (surface roughness and application procedure).

16.3.2 On each specimen an "X" measuring 3 ± 0.25 inch is to be scribed with a sharp instrument through the coating material to the base material surface. The scribed test specimens then are to be immersed in distilled water at a temperature of 70 ± 1 °C (158 ± 2 °F) for 90 days.

16.3.3 Following the exposure, the test specimens are to be visually examined for any evidence of disbondment or blistering of the coating or any corrosion of base metal outside of the scribed areas.

16.4 Sodium chloride immersion

16.4.1 Four specimens of combined coating material/base material, each measuring 4 in by 4 in (102 mm by 102 mm), are to be used for this test. The thickness of the coating material and base material are to be equivalent to the thickness used in valve construction. The specimens are to be prepared in a manner that duplicates valve seat construction (surface roughness and application procedure).

16.4.2 The test specimens are to be immersed in sodium chloride solution (2 % by weight) at a temperature of 70 ± 1 °C (158 ± 2 °F) for 90 days.

16.4.3 Following the exposure, the test specimens are to be visually examined for any evidence of disbondment or blistering of the coating.

16.5 Potassium biphthalate immersion

16.5.1 Four specimens of combined coating material/base material, each measuring 4 in by 4 in (102 mm by 102 mm), are to be used for this test. The thickness of the coating material and base material are to be equivalent to the thickness used in valve construction. The specimens are to be prepared in a manner that duplicates valve seat construction (surface roughness and application procedure).

16.5.2 The test specimens are to be immersed in potassium biphthalate solution (pH=4) at a temperature of 70 ± 1 °C (158 ± 2 °F) for 90 days.

16.5.3 Following the exposure, the test specimens are to be visually examined for any evidence of disbondment or blistering of the coating.

16.6 Sodium carbonate immersion

16.6.1 Four specimens of combined coating material/base material, each measuring 4 in by 4 in (102 mm by 102 mm), are to be used for this test. The thickness of the coating material and base material are to be equivalent to the thickness used in valve construction. The specimens are to be prepared in a manner that duplicates valve seat construction (surface roughness and application procedure).

16.6.2 The test specimens are to be immersed in sodium carbonate solution (pH=10) at a temperature of 70 ± 1 °C (158 ± 2 °F) for 90 days.

16.6.3 Following the exposure, the test specimens are to be visually examined for any evidence of disbondment or blistering of the coating.

16.7 Impact test

16.7.1 Three specimens of combined coating material/base material as described in [16.2.1](#), or three samples of the actual part from the valve, are to be tested. The impact apparatus described in the Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact), ASTM D2794, is to be used for this test. Each specimen is to be subjected to an impact using a hemispherical head having a diameter measuring 0.625 in (1.58 mm) having an impact value of 20 in-lbf (2.3 J).

16.7.2 Following the impact the specimens are to be visually examined, without magnification, for any evidence of coating cracking. If there is visual evidence of cracking, the samples shall be further subjected to the Holiday Test as described in the Standard Test Methods for Holiday Detection in Pipeline Coatings, ASTM G62 to identify gross faults of the coating material.

16.7.3 The Holiday Test is to be conducted as described in ASTM G62, Method A (Potential of 100 volts or less).

17 Nonmetallic Materials Test

17.1 Plastic or other nonmetallic parts (excluding rubber, synthetic elastomers and coatings)

17.1.1 Air oven aging

17.1.1.1 After air-oven aging for 180 days at 121 ± 1 °C (250 ± 2 °F), or at the temperature determined in [17.1.1.2](#), as appropriate, there shall be no warping, creeping, cracking, or other evidence of deterioration of a plastic component which may impair the intended operation of the valve. Additionally, a valve with aged plastic (or other like material) components shall comply with the applicable requirements in the Leakage Test, Hydrostatic Test, and the Cycling Test Sections [18](#), [19](#), and [24](#), respectively.

17.1.1.2 If a material cannot withstand the temperature specified in [17.1.1.1](#) without excessive softening, distortion, or deterioration, an air-oven aging test at a lower temperature for a longer period of time shall be applied. If a material is capable of withstanding a higher temperature than that specified in [17.1.1.1](#) without excessive softening, distortion, or deterioration, an air-oven aging test at a higher temperature for a shorter period of time, but not less than 30 days, shall be permitted. The duration of exposure is to be calculated from the following equation:

$$D = (790000)e^{-0.0693t}$$

in which:

D is the test duration in days, and

t is the test temperature in °C

17.1.1.3 A complete valve assembly including plastic (or other like) parts, and sample plastic (or other like) components to be aged, are to be supported in a full draft, circulating air oven that has been preheated at full draft to 121 ± 1 °C (250 ± 2 °F). Elastomeric seats or "O" rings may be included or excluded at the manufacturer's option. Samples are to be supported so that they do not touch one another or the sides of the oven. The samples are to be aged for 180 days, at full draft, and then allowed to cool in air at 23 ± 2 °C (73 ± 4 °F) for at least 24 h before any test or dimensional check is conducted. Prior to any tests, elastomeric parts complying with the requirements in [17.2.1](#) are to be installed in the valve, if they are not included in the aging test. As used in this test, the term "full draft" refers to the air flow over the samples in the oven with air inlet and outlet full open. The oven used for accelerated aging is to be Type

IIA as specified in the Standard Specification for Gravity-Convection and Forced-Ventilation Ovens, ASTM E145.

17.1.2 Water aging

17.1.2.1 After immersion in distilled water at 87 ± 2 °C (188 ± 4 °F) for 180 days, or at the temperature determined in [17.1.2.2](#), as appropriate, there shall be no warping, creeping, cracking or other signs of deterioration of a plastic (or other like) component which may impair the intended operation of the valve. Additionally, a valve with aged components shall comply with the requirements in the Leakage Test, Hydrostatic Test, and the Cycling Test Sections [18](#), [19](#), and [24](#), respectively.

17.1.2.2 If a material cannot withstand the temperature specified in [17.1.2.1](#) without excessive softening, distortion, or deterioration, a water aging test at a lower temperature for a longer period of time shall be applied. The duration of exposure is to be calculated from the following formula:

$$D = (74800)e^{-0.0693t}$$

in which:

D is the test duration in days, and

t is the test temperature in °C

17.2 Elastomeric parts (except gaskets)

17.2.1 An elastomeric part used to provide a seal shall have the following properties when tested as specified in the Standard for Gaskets and Seals, UL 157:

- a) For silicone rubber (having poly-organo-siloxane as its constituent characteristic), a minimum tensile strength of 500 psi (3.4 MPa) and a minimum ultimate elongation of 100 %.
- b) For natural rubber and synthetic rubber other than silicone rubber, a minimum tensile strength of 1500 psi (10.3 MPa) and minimum ultimate elongation of 150 %; or a minimum tensile strength of 2200 psi (15.2 MPa) and a minimum ultimate elongation of 100 %.
- c) Those properties relating to maximum tensile set; minimum tensile strength and elongation after oven aging; and hardness after oven aging, all as specified in UL 157. The maximum service temperature used to determine the oven time and temperature for oven aging is considered to be 60 °C (140 °F).

17.2.2 The Standard for Gaskets and Seals, UL 157, provides for the testing of either finished elastomeric parts or sheet or slab material. Sheet or slab material is to be tested when the elastomeric parts are O-rings having diameters of less than 1 in (25.4 mm). The material tested is to be the same as that used in the product, regardless of whether finished elastomeric parts or sheet or slab material is tested.

18 Leakage Test

18.1 A valve shall withstand, without leakage at the valve seat or seal provided for the stem, either an internal hydrostatic pressure of two times the rated working pressure of the valve applied for 1 min, or an aerostatic pressure of 1.1 times the rated working pressure of the valve applied for 1 min.

18.2 The pressure is to be applied between one end of the valve and the closed disc, and with both ends closed and the disc opened.

19 Hydrostatic Test

19.1 A valve shall withstand for 1 min, without rupture, a test pressure equal to a multiple of the rated working pressure as shown in [Table 19.1](#). Pressure is to be applied to the body with the disc partially open so that the entire valve is subjected to the hydrostatic test pressure.

Table 19.1
Hydrostatic Test Pressures with Partially Open Disc

Valve size NPS	Multiple of rated working pressure
Up to 6	5
Greater than 6 to 10	4
Greater than 10 to 29	3
Greater than 29	2

19.2 The hydrostatic test then is to be repeated on the valve with the disc closed and pressure applied to one side of the disc for 1 s. For this test, the valve may include special provisions to prevent leakage past the seat. The test pressure is to be three times the rated working pressure. Following this exposure, the valve is to be opened and resealed, and there shall be no leakage, as demonstrated by the valve complying with the Leakage Test, Section [18](#).

20 Torque Tests

20.1 All valves

20.1.1 A valve shall sustain a torque equal to three times the operating torque for 1 min. This torque is to be applied to the top of the valve shaft.

20.1.2 In determining compliance with the requirements in [20.1.1](#), the operating torque is defined as the maximum torque, applied at the top of the valve shaft, required to open and close the valve when the valve is tested as specified in [21.2](#) – [21.6](#). Operating torque shall be measured using calibrated torque wrench, strain gage, or other equivalent method.

20.1.3 A torque equal to three times the operating torque determined in [20.1.2](#) is to be applied to the top of the valve shaft while the disc is blocked in the open position. The valve assembly, including the shaft-to-disc connection, shall remain operable as intended.

20.2 Valves with integral indicating and operating arrangements

20.2.1 An integral actuator and valve shall withstand the effects of a 200-pound (890-N) closing and opening force without damage, without sticking or jamming of the operating mechanism, and without the disc being blocked open. The force is to be applied to the gripping portion (outside diameter) of the handwheel or to the extreme end of the crank intended for use with the valve.

20.2.2 Initial torque failure (see [20.2.3](#)) of a completely assembled valve shall be at a point that is external to both the valve and the enclosed portion of the actuator. This test is to be conducted against the opening stop and the closing stop and the force is to be applied as a continuation of the force application in [20.2.1](#).

20.2.3 With reference to the requirements in [20.2.2](#), the initial torque failure is defined as the point at which the handwheel or crank can no longer be used to control the disc orientation.

20.3 Valve with wrench nut actuator

20.3.1 A wrench nut actuator and valve shall withstand the effects of an input torque of 300 lbf-ft (407 N·m) applied to the wrench nut without damage to the valve or actuator. The torque is to be applied against the opening and closing stops.

21 Operation Tests

21.1 A valve that incorporates a wrench nut actuator shall fully open and close without exceeding a maximum torque of 80 lbf-ft (108 N·m) applied at the wrench nut when tested as specified in [21.2](#) – [21.6](#). A valve that incorporates an integral indicating and operating arrangement shall fully open and close without exceeding a force of 80 pounds-force (356 N) applied to the gripping portion of the handwheel or crank when tested as specified in [21.2](#) – [21.6](#). Following each test, the valve shall comply with the requirements in Leakage Test, Section [18](#).

21.2 Representative valve samples are to be connected to a piezometer to which a pressure gauge has been attached, and to a water supply capable of providing:

- a) The valve's maximum rated working pressure when the valve disc is within 10° of the closed position; and
- b) A flowing velocity of 16 ft/s (4.9 m/s).

21.3 The flow at 16 ft/s (4.9 m/s) is to be based upon the open area in Schedule 40 steel pipe of the same nominal pipe size as the valve.

21.4 The valve is to be closed and the inlet pressure at the piezometer is to be increased to the maximum rated working pressure. The valve then is to be opened to the open position until a flowing velocity of 16 ft/s (4.9 m/s) is achieved. The valve then is to be closed. The inlet pressure is to be maintained at the maximum rated working pressure while the disc position is within 10° of the closed position. See [21.5](#).

21.5 Test measurements are to be made of the operating torque required to close the valve to the point only where flow is stopped, to fully close it, to open it to the point where leakage begins, and to fully open it.

21.6 For a specific valve construction, this test may be conducted on smaller size valves and the data generated may be used to calculate the operating torque values for larger size valves that are otherwise equivalently constructed. See Annex [A](#) for Guidelines for Conducting Operating Torque Value Calculations for Butterfly Valves.

22 Hydraulic Friction Loss Test

22.1 A valve shall have a friction loss not exceeding 1.5 psi (10.3 kPa) while flowing water at a velocity of 15 ft/s (4.6 m/s).

22.2 The flow at 15 ft/s (4.6 m/s) is to be based upon the open area in Schedule 40 steel pipe of the same nominal pipe size as the valve.

22.3 The sample valve is to be installed in its intended position in a test piping system. The test line is to be equipped with a calibrated flow measuring device and a means by which selected rates of flow can be established. A differential gauge is to be connected to piezometer fittings located upstream and downstream from the test valve by means of which the loss-of-head between the two piezometer fittings is

to be measured. Selected flow rates are to be established and the loss-of-head over the valve plus that over the piping between piezometers for each rate of flow shall be determined.

22.4 The sample valve then is to be removed from the test piping and the loss-of-head for test piping located between the piezometer fittings is to be determined for the same rates of flow. The loss-of-head for the valve then is to be determined by subtracting the losses over the piping alone from the losses over the piping and valve.

23 10-Day Moist Ammonia Air Stress Cracking Test

23.1 After being subjected to the conditions described in [23.2](#) – [23.4](#), a brass part containing more than 15 % zinc when examined using 25X magnification shall:

- a) Show no evidence of cracking; or
- b) Comply with the Leakage Test, Section [18](#) and the Operation Test, in Section [21](#), if there is evidence of cracking.

23.2 Each test sample is to be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses are to be applied to the sample prior to and maintained during the test. Samples with threads, intended to be used for installing the product in the field, are to have the threads engaged and tightened to the torque specified in [Table 23.1](#). Teflon tape or pipe compound are not to be used on the threads.

Table 23.1
Torque Requirements for Threaded Connections

Nominal thread size		Torque	
in	(mm)	lbf-in	(N·m)
1	(25.4)	1200	(136)
1-1/4	(31.75)	1450	(164)
1-1/2	(38.1)	1550	(175)
2	(50.8)	1650	(186)
2-1/2	(63.5)	1750	(198)
3	(76.2)	1800	(203)
4	(102)	1900	(215)

23.3 Three samples without any plating or coatings are to be degreased and then continuously exposed in a set position for ten days to a moist ammonia-air mixture maintained in a sealed glass chamber having a glass cover.

23.4 A sufficient amount of aqueous ammonia to cover the bottom of the chamber having a specific gravity of 0.94 shall be maintained during the test. The samples are to be positioned 1-1/2 in (38.1 mm) above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber is to be maintained at atmospheric pressure and at a temperature of $93 \pm 2^\circ\text{F}$ ($34 \pm 1^\circ\text{C}$).

23.5 After the exposure period, the test samples shall be examined, with a microscope having a magnification of 25X, for any cracking, delamination, or other degradation as a result of the test exposure.