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The verbal forms used to express the provisions in this specification are as follows:

- the term “shall” denotes a minimum requirement to conform to the standard;
- the term “should” denotes a recommendation or that which is advised but not required to conform to the standard;
- the term “may” is used to express permission or a provision that is optional;
- the term “can” is used to express possibility or capability.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001, [standards@api.org](mailto:standards@api.org).

## Precautions

**WARNING** — Fire testing of valves involves potential hazards. Depending on the design of the test valve and/or the nature of the fire test itself, the potential exists for a rupture of the pressure boundary components during testing. Protection for test personnel must be provided. Additionally, hazardous byproducts may be generated during the fire test as a result of decomposition of organic materials. Training of personnel on proper handling of any hazardous byproducts may be required.

**WARNING** — The system relief pressure must be low enough to preclude the rupture of the valve at the expected test temperatures.

**WARNING** — Elements, such as lead, tin, antimony, bismuth and cadmium that cause liquid metal embrittlement shall not be used in areas that are subjected to elevated temperatures.

**CAUTION** — A rupture of the pressure boundary components during the performance of a fire test may occur. The performance of a fire test may require additional safety precautions to be taken to minimize the likelihood of damage to surrounding equipment or the test environment.



## **Important Information Concerning Use of Asbestos or Alternative Materials**

Asbestos is specified or referenced for certain components of the equipment described in some API standards. It has been of extreme usefulness in minimizing fire hazards associated with petroleum processing. It has also been a universal sealing material, compatible with most refining fluid services.

Certain serious adverse health effects are associated with asbestos, among them the serious and often fatal diseases of lung cancer, asbestosis, and mesothelioma (a cancer of the chest and abdominal linings). The degree of exposure to asbestos varies with the product and the work practices involved.

Consult the most recent edition of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, Occupational Safety and Health Standard for Asbestos, Tremolite, Anthophyllite, and Actinolite, 29 Code of Federal Regulations Section 1910.1001 ; the U.S. Environmental Protection Agency, National Emission Standard for Asbestos, 40 Code of Federal Regulations Sections 61.140 through 61.156 ; and the U.S. Environmental Protection Agency (EPA) rule on labeling requirements and phased banning of asbestos products (Sections 763.160 –179).

There are currently in use and under development several substitute materials to replace asbestos in certain applications. Manufacturers and users are encouraged to develop and use effective substitute materials that can meet the specifications for, and operating requirements of, the equipment to which they would apply.

SAFETY AND HEALTH INFORMATION WITH RESPECT TO PARTICULAR PRODUCTS OR MATERIALS CAN BE OBTAINED FROM THE EMPLOYER, THE MANUFACTURER OR SUPPLIER OF THAT PRODUCT OR MATERIAL, OR THE MATERIAL SAFETY DATA SHEET.



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## **Introduction**

This standard is not intended to inhibit a manufacturer from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. When an alternative is offered, the manufacturer should identify any variation from this standard and provide details.

Informative Annexes are for informational purposes only and are not mandatory requirements.

Normative Annexes are indispensable and mandatory for the application of this document.

## **Changes from the 4<sup>th</sup> to the 5<sup>th</sup> Edition**

This standard is the result of updating the requirements from API Standard 6FA, Fourth Edition, to include requirements from API 6FD, Fire Test for Check Valves, in its entirety. With the publication of this document, the API 6FD document was withdrawn.

## **Units of Measurement**

In this standard, data are expressed in both U.S. customary (USC) and metric (SI) units.





# Standard for Fire Test of Valves

## 1 Scope

This standard establishes the requirements for testing and evaluating the pressure-containing performance of API 6A and API 6D valves when exposed to fire. The performance requirements of this standard establish qualification criteria for all sizes and pressure ratings. This standard may be applied to valves that do not meet the requirements of API 6A or API 6D at the user's discretion.

This standard applies to valves with one or more closure members.

This standard establishes acceptable levels for leakage through the test valve and external leakage after exposure to a fire for a 30-minute time period. The fire exposure test period has been established on the basis that it represents the maximum time required to extinguish most fires. Fires of greater duration are considered to be of a major magnitude, with consequences greater than those anticipated in this test.

This standard is not intended to address the qualification of valve actuators (including manually operated gearboxes). This standard does not cover pressure boundary penetration, external fittings, or end connections.

## 2 Normative References

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies, except that new editions may be used on issue and shall become mandatory upon the effective date specified by the publisher or six months from the date of the revision (where no effective date is specified).

API Specification 6A, *Specification for Wellhead and Tree Equipment*

API Specification 6D, *Specification for Pipeline Valves and Piping Valves*

ASTM D1414, *Standard Test Methods for Rubber O-Rings*

ASTM D1418, *Standard Practice for Rubber and Rubber Latices—Nomenclature*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension*

ASTM D4000, *Standard Classification System for Specifying Plastic Materials*

ASTM D4065, *Standard Practice for Plastics: Dynamic Mechanical Properties: Determination and Report of Procedures*

## 3 Terms, Definitions, Acronyms, Abbreviations, Symbols, and Units

### 3.1 Terms and Definitions

For the purposes of this standard, the definitions in API 6A and API 6D shall apply. When identical terms are defined in API 6A and API 6D and this standard, the following definitions shall apply.

#### 3.1.1

##### **class**

##### **pressure class**

Numerical pressure design class expressed in accordance with either the nominal pressure (PN) class or the ASME rating class.

**3.1.2****closure member**

Part(s) of a valve that is positioned in the flow stream to permit flow or to obstruct flow, depending on its position, such as a ball, disc, gate, or plug.

NOTE Closure member may be comprised of multiple parts.

**3.1.3****elastomer**

Amorphous material mechanically mixed with other constituents to form a compound, which is then shaped by flow into articles by means of the manufacturing processes of molding or extrusion, and then (invariably) chemically cured at elevated temperature to form an elastic insoluble material.

**3.1.4****nominal pipe size****NPS**

Alphanumeric designation of size that is common for components used in a piping system, used for reference purposes, comprising the letters NPS followed by a dimensionless number indirectly related to the physical size of the bore or outside diameter of the end connection, as appropriate.

NOTE The dimensionless number may be used as a valve size identifier without the prefix "NPS."

**3.1.5****nominal size****DN**

Numerical designation of size in millimeters that is common to components in piping systems.

NOTE Nominal size is designated by the abbreviation "DN" followed by a number.

**3.1.6****qualified person**

Individual with characteristics or abilities to perform a specific task, gained through training or experience, or both.

**3.2 Acronyms, Abbreviations, Symbols, and Units**

For the purposes of this standard, the following acronyms and abbreviations apply.

CRA	corrosion-resistant alloy
DN	nominal size
in.	inch
ml	milliliter
mm	millimeter
NPS	nominal pipe size
PEEK	polyetheretherketone
PTFE	polytetrafluoroethylene



## **4 Fire Test**

### **4.1 General**

#### **4.1.1 Procedures**

The supplier/manufacture shall develop procedures for conducting the fire test. These procedures shall be documented and included in the final report of the results. The procedures shall include pre- and post-test inspection activities and identify critical areas to be inspected. The supplier/manufacture shall document all test parameters and results of the evaluations that demonstrate conformance to this document.

Fire testing shall be discontinued if the product or system fails to perform within the limits specified, except when such failure is determined to be the result of a failure within the test facility or test fixture and that failure and its correction do not affect the validity of the test results.

#### **4.1.2 Personnel**

A qualified person shall conduct preparation, testing, and approval of results.

#### **4.1.3 Measuring and Monitoring Equipment**

Measuring and monitoring equipment used during the testing process shall be calibrated in accordance with the requirements of the supplier/manufacture or test facility. Measuring and monitoring equipment shall be used within its calibrated range.

All pressures are defined as gauge pressure unless otherwise specified and shall be recorded on time-based equipment.

Leakage rates shall be in milliliters per inch of nominal valve size per minute (milliliters per millimeter of nominal valve size per minute), averaged over the duration of the particular test period.

#### **4.1.4 Test Report**

A test report shall be prepared for each test. It shall be approved by a qualified person and retained as part of the design validation records for the product. The report shall include, at a minimum, the following information:

- validation test performed,
- description of the tested item, including size, type, model, unique identifier, and metallic and nonmetallic materials,
- data per Annex A, if applicable,
- test facility name, location, and person performing the testing,
- date of testing conducted,
- test schematic or photos,
- procedures used, records of results, and discussion of those results,
- results of specific pre- and post-test evaluations,
- summary of results, including a discussion of whether the test was successful,
- approvals and date of the report.

NOTE Records may be electronic or hardcopy.

#### **4.1.5 Previous Fire tests**

Fire testing that has been completed and documented in accordance with requirements of previous editions of API 6FA and 6FD during their validity shall be acceptable in meeting the requirements of this standard.

### **4.2 Test Valve**

#### **4.2.1 General**

The test valve shall conform to the applicable API product specification prior to the start of this fire test.

Except for check valves, the test valve shall include a port for the exclusive use of the relief valve (item 15 in Figure 1) to relieve the center cavity pressure to the atmosphere to protect against potential rupture of the valve.

For check valves, a bypass line shall be included (item 21 in Figure 1).

NOTE Any integral external pressure relief is in addition to the test port described above.

#### **4.2.2 Symmetry Limitation**

Valves with asymmetric seat or body sealing systems intended for bidirectional installation shall be qualified by testing in both directions.

NOTE The same valve may be refurbished and retested, or another, identical, valve may be tested in the other direction.

Asymmetric valves intended for single-direction installation shall be marked accordingly and shall be tested in the direction of recommended installation.

For valves with more than one closure member, if all seals and closure members are of the same design, testing of the pressurized side of the closure member in a single direction shall qualify all closure members in both directions.

#### **4.2.3 Thermal Protection Limitation**

Valves shall not be protected with insulation material or heat shield of any form during testing, except where such insulation/heat shield is part of the design.

#### **4.2.4 Bolt Coating**

Coating and thread compound elements that cause liquid metal embrittlement shall not be used.

NOTE Lead, tin, antimony, bismuth, cadmium are examples of elements known to cause liquid metal embrittlement.

### **4.3 Test Facility**

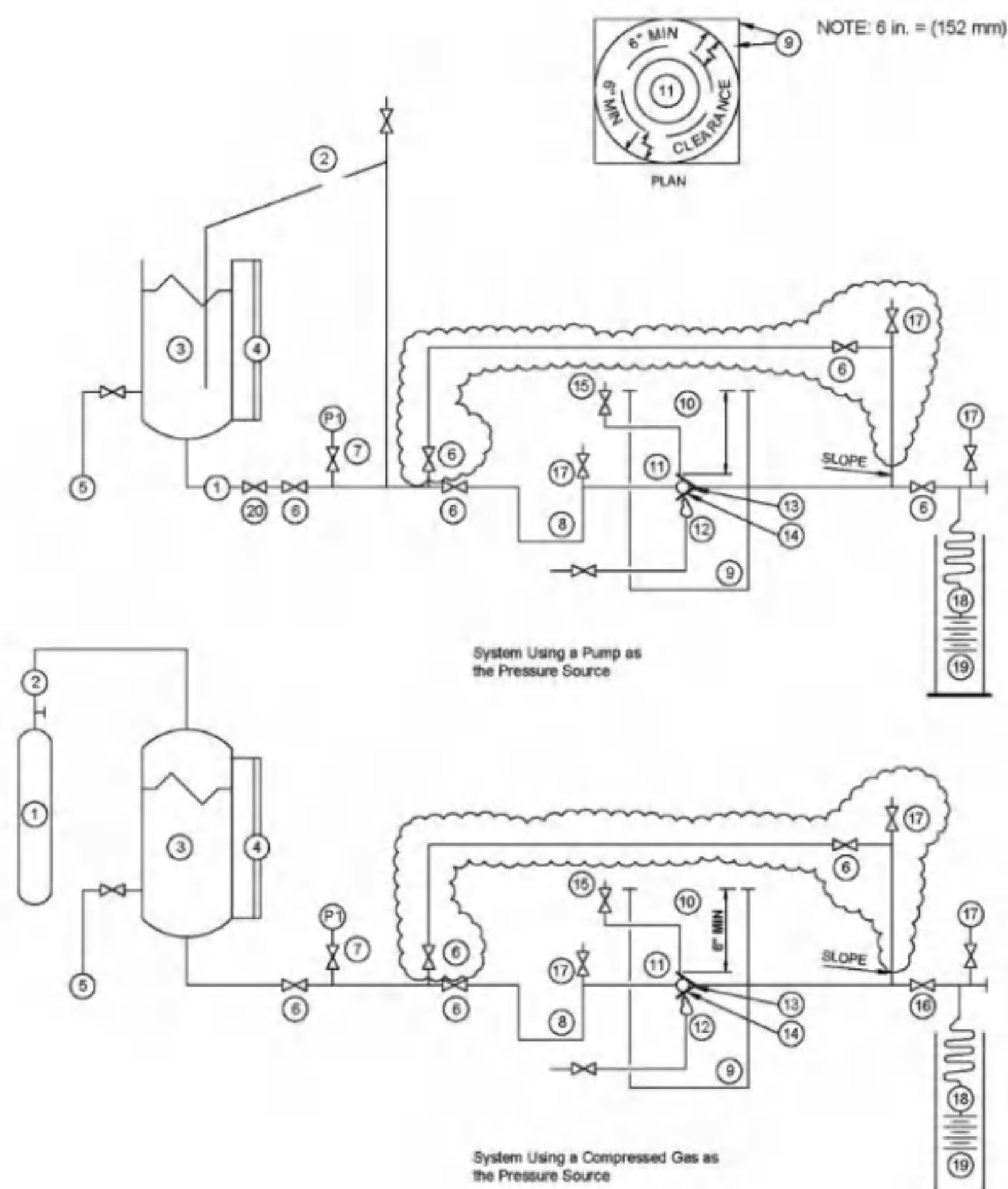
#### **4.3.1 General**

The test facility shall be designed to permit the validation tests to be performed as detailed in Figure 1. The minimum requirements for the test facility shall be:

- pressure source (item 1)
- pressure regulator and relief with a pressure as determined by the valve manufacturer (item 2)
- water vessel and associated measuring device (item 3 and item 4),

- 
- shut off valve, if required (item 6),
  - pressure gauge (item 7),
  - piping arranged to provide vapor trap (item 8),
  - enclosure for test:
    - 6 in. (152 mm) minimum horizontal clearance between any part of the valve and the closure,
    - 6 in. (152 mm) minimum height above the top of the valve,
  - fuel supply to burners (item 12),
  - pressure gauge and relief valve connected to the center cavity of the valve (for valves without a closed cavity connect vent valve to body on the pressurized side of the body closure member) (item 15),
  - vent valve (item 17),
  - condenser and associated measuring device (item 18 and item 19),
  - check valve, if required (item 20),
  - bypass, if required (item 21).





### Key

- |    |   |    |  |
|----|---|----|--|
| 1  | pressure source   | 11 | test valve mounted horizontally with stem in horizontal position |
| 2  | pressure regulator and relief   | 12 | fuel supply to burners (see 4.4.1)                               |
| 3  | vessel for water  | 13 | calorimeter—1½ in. cubes (see 4.4.1)                             |
| 4  | calibrated sight gauge or equivalent  | 14 | flame temperature thermocouple (see 4.4.1)                       |
| 5  | water supply  | 15 | pressure gauge and relief valve (see precautions)                |
| 6  | shut off valve  | 16 | shut off valve   |
| 7  | pressure gauge  | 17 | vent valve   |
| 8  | piping arranged to provide vapor trap   | 18 | condenser  |
| 9  | flame envelope for test—horizontal clearance between any part of the valve and the closure shall be a minimum of 6 in. (152 mm) | 19 | calibrated container   |
| 10 | minimum height of flame envelope shall be 6 in. (152 mm) above the top of the valve   | 20 | check valve  |
|    |   | 21 | bypass line (items within shaded area)                           |

**Figure 1—Schematic of Suggested Systems for Fire Test for Valves**

### 4.3.2 Test Instrumentation

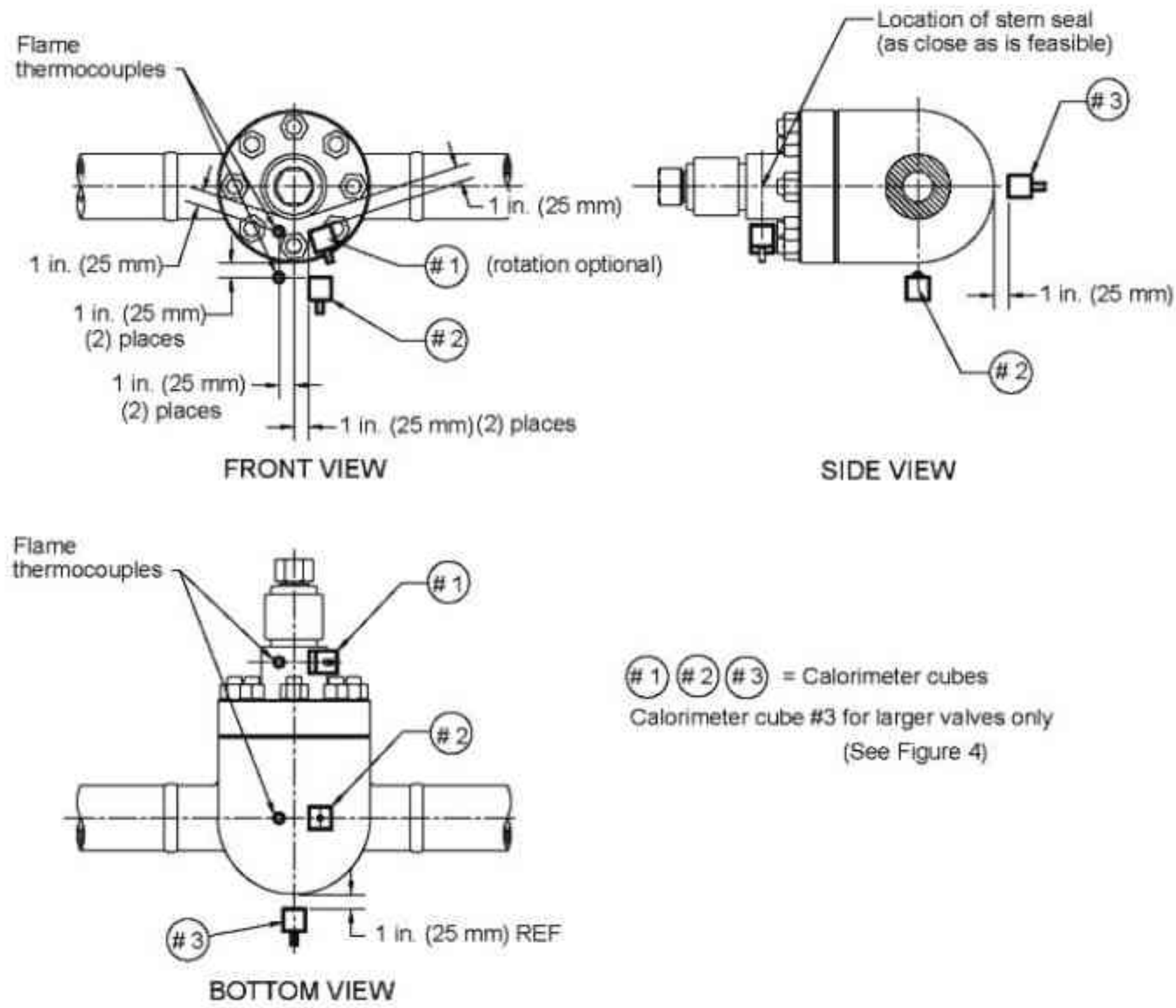
The test valve shall be equipped with thermocouples.

Except for check valves, two thermocouples shall be directly exposed to the flame source at the locations specified in Figure 2. For check valves, thermocouples shall be located as specified in Figure 2, Figure 3, and Figure 4.

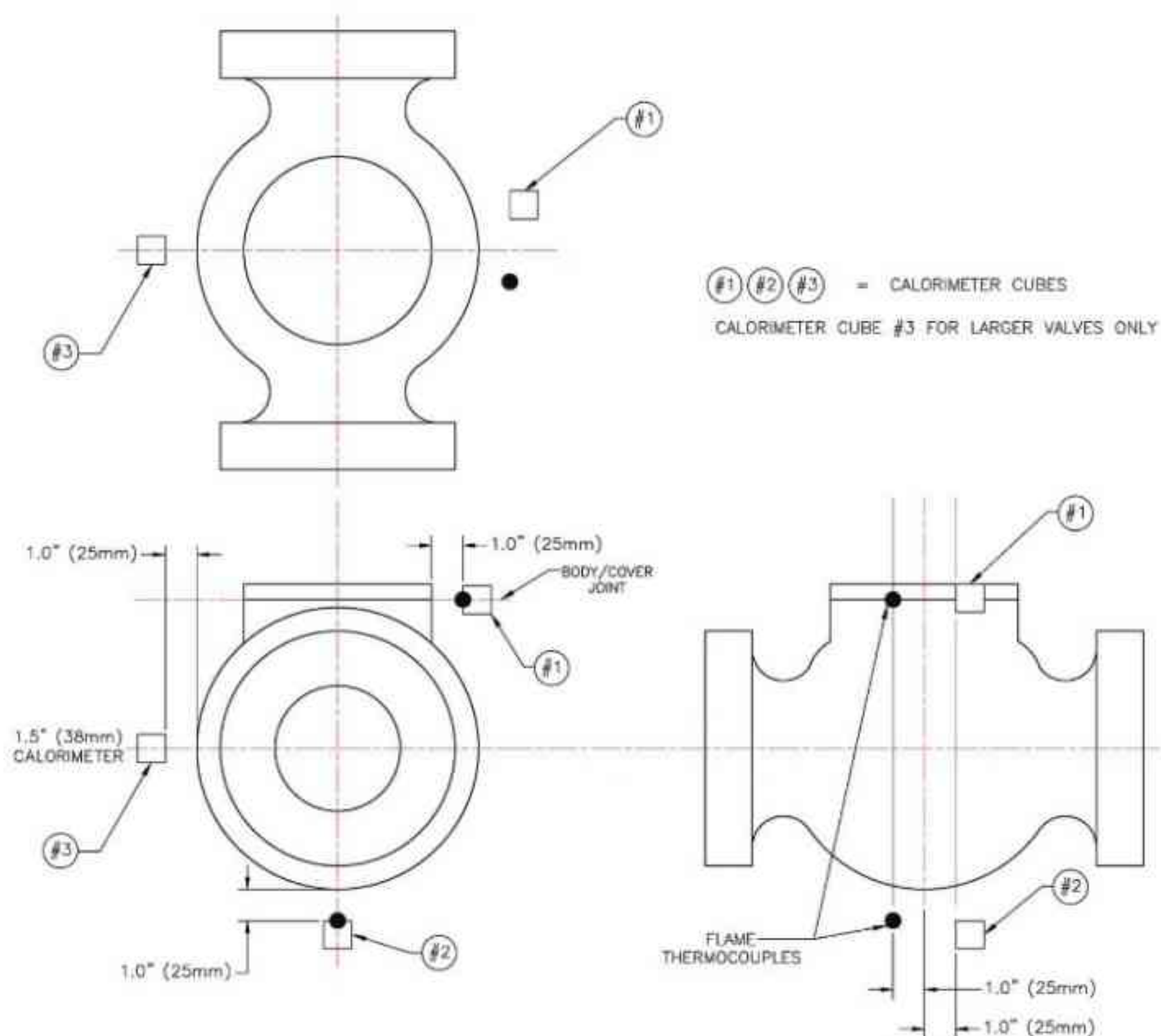
For API 6A valves size  $7\frac{1}{16}$  in. and smaller and API 6D valves NPS 6 and smaller, two calorimeter cubes shall be located as shown in Figure 2, Figure 3, or Figure 4 for check valves.

For larger sized valves, three calorimeter cubes shall be used. Thermocouples shall be located inside calorimeter cubes. The calorimeter cubes shall be made of carbon steel and conform to the dimensions specified in Figure 5.

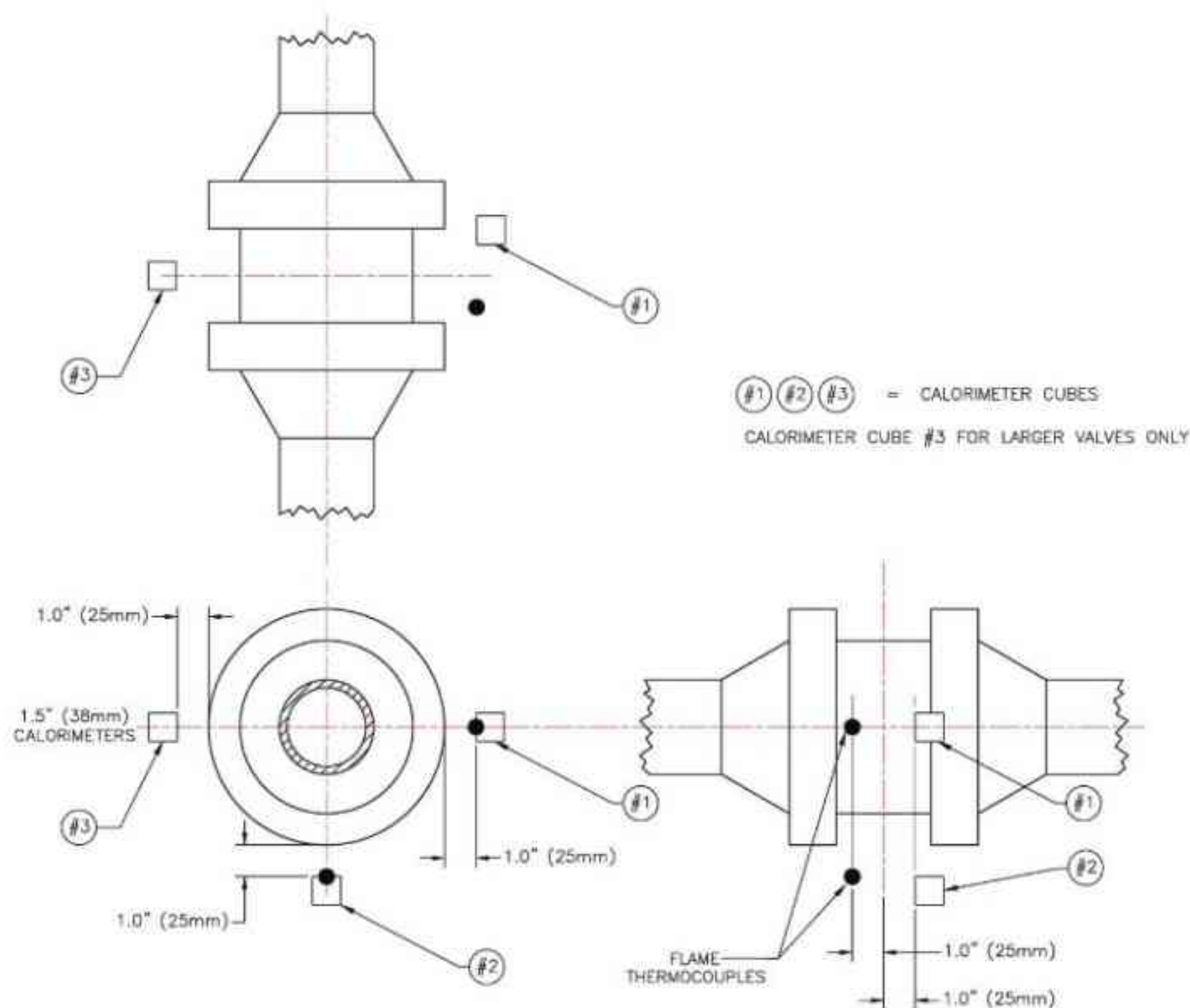
**NOTE** Dimensions shown in Figure 2, Figure 3 and Figure 4 may be taken from the valve or thermal protection device when the latter is part of the design.



**Figure 2—Location of Calorimeters**

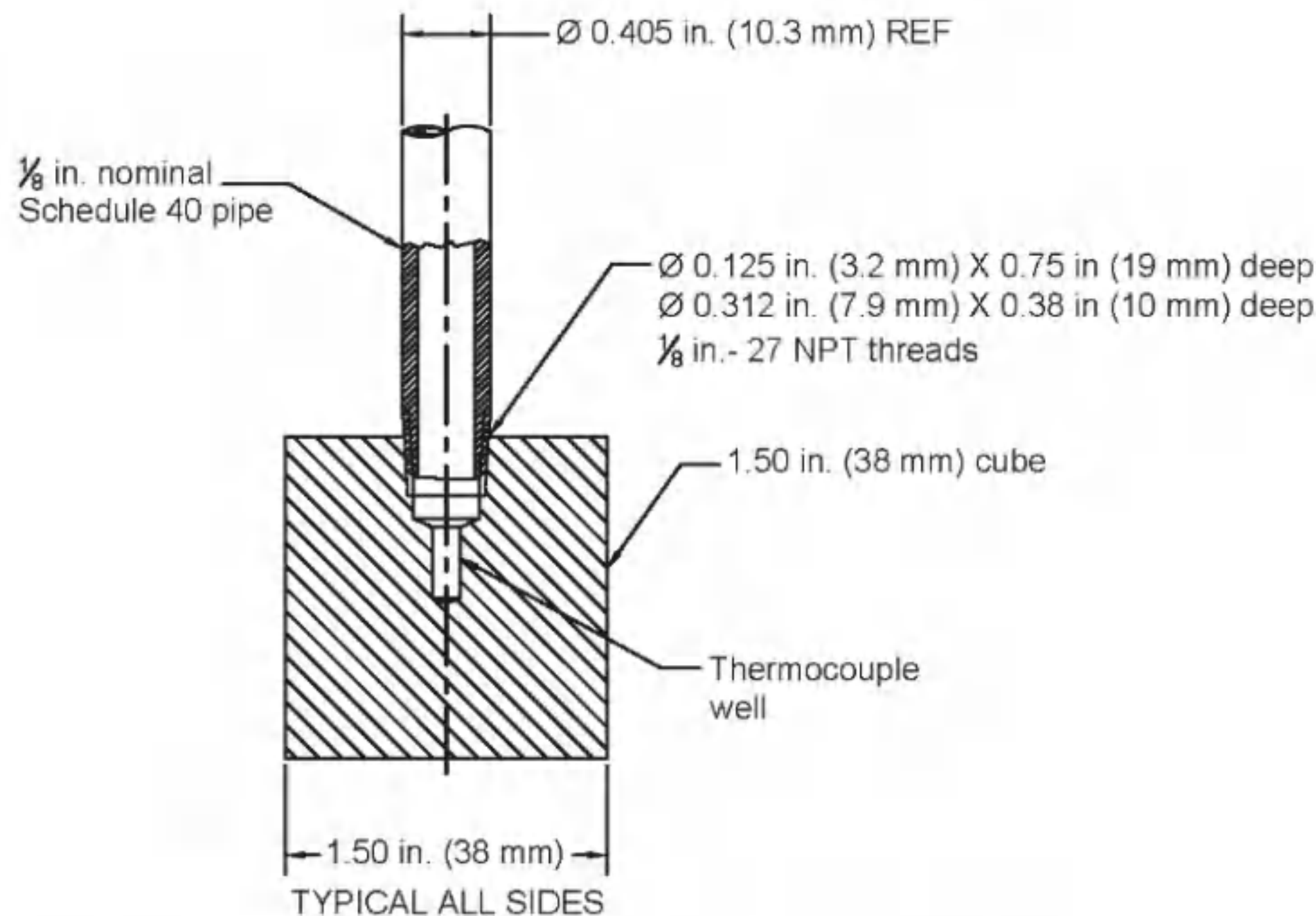


**Figure 3—Location of Calorimeters—Flanged Check Valves**



**Figure 4—Location of Calorimeters—Wafer Type Check Valves**





**Figure 5—Calorimeter Cube Design**

## 4.4 Test Procedure

### 4.4.1 General

The valve shall be tested with water, with the closure member in the closed position. Except for check valves, the stem and bore shall be in the horizontal position. For check valves, the valve shall be tested in its horizontal flow orientation.

For valves with two or more closure members, the upstream closure member shall be in the closed position, and the other closure member in the open position.

For valves with more than one closure member, the flame thermocouples and calorimeter cubes shall be located on the body of the upstream closure member with that closure member in the closed position.

NOTE 1 Thermocouples and calorimeter cubes are not required on the downstream closure member.

NOTE 2 The end connection piping-to-valve joint leakage (flanged, threaded, or welded) is not considered a part of this test and is not included in the allowable external leakage in 4.4.2.2 and 4.4.3.2 for the test. It may be necessary to modify this joint to eliminate leakage.

The valve shall be enveloped in flame having an average temperature from two flame thermocouples between 1400 °F and 1800 °F (761 °C to 980 °C), located as shown in Figure 2, Figure 3, or Figure 4. No single flame thermocouple reading shall be below 1300 °F (704 °C).

Piping upstream of the test valve shall not be larger than the test valve nominal size and not be smaller than NPS 1 or one half of nominal pipe size of the test valve whichever smaller for a distance of at least 6 in. (152 mm) as shown in Figure 1.

The piping on the pressurized side of the closure member shall be enveloped in flame for a distance of at least 6 in. (152 mm) as shown in Figure 1.

Diameter of the piping outside of the flame envelope shall be sized to ensure delivery of a flow rate in excess of the maximum allowable leak rate for the size of the valve being tested.

The piping on the non-pressurized side of the closure member shall be inclined so it fully drains.

The test setup shall include 1 1/2 in. (38 mm) cube calorimeter cubes made of carbon steel, with a thermocouple located in the center of each cube (see Figure 4 for calorimeter cube configuration).

For all sizes, the fire exposure period shall be a minimum of 30 minutes from ignition.

If the test valve design includes an integral pressure relief provision to atmosphere or to downstream side of the valve, and it activates during the test, the test shall continue and any leakage through this device shall be counted as external or seat leakage, respectively.

If the maximum allowable cavity pressure as defined by the valve manufacturer is exceeded at any time during the test, the test shall end, and the valve shall have failed the requirements of the fire test.

Acceptance criteria for leakage rate shall be the average over the duration of the specified test period in milliliters per inch of nominal valve size per minute (milliliters per millimeter of nominal valve size per minute).

#### 4.4.2 High Pressure Test

##### 4.4.2.1 Procedure

The test procedure shall be performed as follows (the specified item numbers are identified in Figure 1):

**NOTE** The test system, excluding the test valve, may be adjusted during the test period to keep the test within the limits specified herein.

- 1) Open the valve (item 5 and item 6) at the water source, and any necessary vent valves (item 17) to flood the system and purge the air.

**NOTE** The test valve may have to be placed in the partially open position to completely flood the valve body.

- 2) Close the water supply valve (item 5) and test valve (item 11), then close vent valves (item 17). The piping system upstream of the test valve shall be filled completely with water and the system downstream shall be drained.
- 3) Pressurize the system to the appropriate high test pressure from Table 1 or Table 2. Tolerance on all test pressures shall be  $\pm 10\%$ . Maintain this pressure during the fire exposure and cool-down period. Momentary pressure losses greater than the tolerance shall be permissible, provided their cumulative recovery time is less than two minutes. The reading from the calibrated sight gauge or equivalent (item 4) shall be recorded. Empty the graduated container (item 19).
- 4) Open fuel supply—Establish a fire and monitor the flame temperature. The average of two flame thermocouples (item 14) shall reach 1400 °F (761 °C) within two minutes. The average temperature shall be maintained between 1400 °F (761 °C) and 1800 °F (980 °C), with no single flame thermocouple reading less than 1300 °F (704 °C) for the remainder of the fire exposure period.
- 5) The average temperature of the calorimeters (item 13) shall reach 1200 °F (650 °C) within 15 minutes of fire ignition. For the remainder of the burn period, the calorimeters shall maintain a minimum average temperature of 1200 °F (650 °C), and none of the calorimeters shall have a temperature less than 1050 °F (565 °C).
- 6) Drops in indicated temperatures shall be noted in the test report.



NOTE Impingement of water or steam from external leakage onto flame thermocouples or calorimeters can result in a substantial drop in the indicated temperature of the affected sensor, even if no actual drop in flame temperature has occurred. The test may continue with no downward adjustment of the burner controls provided that at least one flame thermocouple and one calorimeter are functioning.

- 7) Record Instrument readings (items 7, 13, 14, and 15) at least every 30 seconds during the fire exposure period.
- 8) At the end of the fire exposure period (30 minutes), shut off the fuel.
- 9) Immediately determine the amount of water collected in the calibrated container (item 19) to establish total through valve seat leakage. Continue collecting water in the calibrated container (item 19) for use in establishing the external leakage rate. If the test valve is of the upstream sealing type, the volume of water that is trapped between the upstream seat seal and the downstream seat seal when the valve is closed shall be determined before the test is started and identified in the test report. Since the trapped volume has not actually leaked past the upstream seat seal, it shall be deducted from the total volume measured in the calibrated container when determining the through valve leakage. If the total volume collected downstream during the fire exposure and/or cool-down period is less than the body cavity volume, the through leakage shall be defined as zero.
- 10) Within 15 minutes of extinguishing the fire, force-cooling the test valve with water shall commence so that its external surface temperature remains below 212 °F (100 °C). The time for force-cooling shall not exceed 30 minutes. The time taken to force-cool the external surface of the valve to below 212 °F (100 °C) shall be recorded.

CAUTION — After cooling, the internal parts of the valve can remain at significantly higher temperatures than the external surface of the valve.

**Table 1—API 6A Valve Test Pressure during Fire Test**

	Valve Rating			High Test Pressure			Low Test Pressure		
	psi	Bar	MPa	psi	Bar	MPa	psi	Bar	MPa
API 6A Valves	2000	138	13.8	1500	103.4	10.3	—	—	—
	3000	207	20.7	2250	155.1	15.5	—	—	—
	5000	345	34.5	3750	258.6	25.9	—	—	—
	10,000	690	69.0	7500	517.1	51.7	—	—	—
	15,000	1035	103.5	11,250	775.7	77.6	—	—	—
	20,000	1380	138.0	15,000	1035	103.5	—	—	—

**Table 2—API 6D Valve Test Pressure during Fire Test**

	Valve Rating	High Test Pressure			Low Test Pressure		
	Class	psi	Bar	MPa	psi	Bar	MPa
API 6D Valves	150	210	14.5	1.5	30	2.0	0.2
	300	540	37.2	3.7	50	3.4	0.34
	600	1080	74.5	7.5	105	7.2	0.72
	900	1620	111.7	11.2	—	—	—
	1500	2700	186.2	18.6	—	—	—
	2500	4500	310.3	31.0	—	—	—



#### 4.4.2.2 Acceptance Criteria

The maximum through-seat leakage for the stated fire exposure period shall not be greater than the following (see 4.4.2.1, Step 8):

- fire exposure period: 30 minutes minimum,
- rate: 400 ml/in./min (15.7 ml/mm/min).

The maximum external leakage for the fire exposure period and the cool-down period for the stated test duration shall not be greater than the following (see 4.4.2.1, Step 8 and Step 9):

- test duration: 30 minutes plus time to cool down to 212 °F (100 °C),
- rate: 100 ml/in./min (3.9 ml/mm/min).

#### 4.4.3 Low Pressure Test for 6D Valves of Class 600 or Lower

##### 4.4.3.1 Procedure

The following additional testing shall be performed on API 6D valves with ratings of class 600 and lower.

- 1) Decrease the test pressure to the lower test pressure value shown in Table 2. Measure the leakage through the valve's seat and external leakage over a 5-minute period.
- 2) Increase pressure on the test valve to the high test pressure value in Table 2.
- 3) Measure and record the maximum through-seat leakage and external leakage for a 5-minute period.

##### 4.4.3.2 Acceptance Criteria

The maximum through-seat leakage for the stated test duration shall not be greater than the following:

- test duration: 5 minutes,
- rate: 40 ml/in./min (1.6 ml/mm/min).

The maximum external leakage for the stated test duration shall not be greater than the following:

- test duration: 5 minutes,
- rate: 20 ml/in./min (0.8 ml/mm/min).

#### 4.4.4 Valve Operation Test

##### 4.4.4.1 Operation of Test Valve after the Fire Test

Except for check valves, the valve shall be capable of being unseated from the closed position against high differential test pressure in accordance with Table 1 or Table 2.

- 1) Close the shutoff valve (item 16). Open the test valve against the high differential test pressure to the partly open (approximately half-way) position. Vent the piping and test valve body cavity to remove air or steam. Venting can be accomplished through the pressure regulator and relief (item 2), shutoff valve (item 16), the vent valves (item 17), or any combination of these items.
- 2) Open the valve to the partially open position and reapply high test pressure.

- 3) Measure and record external leakage for a 5-minute period.

#### **4.4.4.2 Operation of Test Valve after the Fire Test for Check Valve**

For check valves, the valve shall be capable of being unseated from the closed position one time, and the following shall apply:

- 1) Vent the test pressure to atmosphere.
- 2) Reverse the water flow using the bypass line to pressurize the non-pressurized side of the closure member.
- 3) Apply pressure to demonstrate flow but not to exceed 75 % of rated working pressure.
- 4) Measure and record the external leakage over a 5-minute period while at the high test pressure.

#### **4.4.4.3 Acceptance Criteria**

With the test valve in the partially open position, or the check valve unseated, the external leakage as determined in 4.4.4.1, Step 3 or 4.4.4.2, Step 4 shall not be greater than 200 ml/in./min (8 ml/mm/min).

### **4.5 Marking of Tested Products**

The manufacturer shall have a documented method for the marking of valves that satisfies the requirements of this standard. The procedure shall identify where and how the valve shall be marked.

When required by the purchaser, or at the option of the manufacturer, valves that have been qualified in accordance with the requirements of this standard shall be permanently marked with the designation "6FA".

When required by the purchaser, or at the option of the manufacturer, valves that have been qualified in accordance with the requirements of Annex A of this standard shall be permanently marked with the designation "6FA-EXT".

## **5 Scaling**

### **5.1 Validation Testing Based on Other Designs**

Scaling shall be documented and approved by a qualified person.

NOTE 1 Scaling may be used to validate a variation of a validated product in accordance with the limitations of this section.

Testing of a valve shall qualify valves within the same basic design as follows:

- The geometric relationships between parts, including tolerance criteria of valve bore sealing mechanisms, are the same.
- The sealing system, geometry of seals or components that house the seals are the same.
- The design principles of physical configuration and functional operation are the same.
- The valve family includes designs that are based on the same design specifications or standards.
- Valves with more than one closure member are qualified by the testing of a valve with a single closure member.

NOTE 2 As noted in the scope of this standard, testing of end connections, pressure boundary penetration, and external fittings do not apply to this standard.



## 5.2 Allowances of Scaling by Size

One successfully tested valve shall qualify valves larger than the test valve, up to twice the size of the tested valve in accordance with Table 3 and Table 4. An NPS 8 (DN 200) valve shall qualify all larger sizes.

**Table 3—Qualification by Valve Size from Test of 6A Valve**

Size of Test Valve <sup>a</sup>	Other Valve Sizes Qualified	
Nominal Size	Nominal Size/NPS <sup>c</sup>	DN <sup>b</sup>
$1\frac{13}{16}$ , $2\frac{1}{16}$	API 6A $1\frac{13}{16}$ , $2\frac{1}{16}$ , $2\frac{9}{16}$ , $3\frac{1}{16}$ , $3\frac{1}{8}$ , $4\frac{1}{16}$	—
	API 6D 2, $2\frac{1}{2}$ , 3, 4	50, 65, 80, 100
$2\frac{9}{16}$	API 6A $2\frac{9}{16}$ , $3\frac{1}{16}$ , $3\frac{1}{8}$ , $4\frac{1}{16}$ , $5\frac{1}{8}$	—
	API 6D $2\frac{1}{2}$ , 3, 4	65, 80, 100, 125
$3\frac{1}{16}$ , $3\frac{1}{8}$	API 6A $3\frac{1}{16}$ , $3\frac{1}{8}$ , $4\frac{1}{16}$ , $5\frac{1}{8}$ , $7\frac{1}{16}$	—
	API 6D 3, 4, 6	80, 100, 125, 150
$4\frac{1}{16}$	API 6A $4\frac{1}{16}$ , $5\frac{1}{8}$ , $7\frac{1}{16}$	—
	API 6D 4, 6, 8	100, 125, 150, 200
$5\frac{1}{8}$	API 6A $5\frac{1}{8}$ , $7\frac{1}{16}$ , 9	—
	API 6D 6, 8, 10	125, 150, 200, 250
$7\frac{1}{16}$	API 6A $7\frac{1}{16}$ , 9, 11	—
	API 6D 6, 8, 10, 12	150, 200, 250, 300
9	API 6A 9, 11	—
	API 6D 8 and larger	200 and larger

<sup>a</sup> Larger valve sizes may be fire tested by agreement.

<sup>b</sup> DN is the size designation used for API 6D valves only and does not apply to API 6A valves.

<sup>c</sup> For API 6A valve sizes, the nominal size includes all listed bore diameters.

**Table 4—Qualification by Valve Size from Test of 6D Valve**

Size of Test Valve <sup>a</sup>		Other Valve Sizes Qualified	
NPS	DN <sup>b</sup>	Nominal Size/NPS <sup>c</sup>	DN <sup>b</sup>
$\frac{1}{2}$	15	API 6D $\frac{1}{2}$ , $\frac{3}{4}$ , 1	15, 20
1	25	API 6D $1\frac{1}{4}$ , $1\frac{1}{2}$ , 2	25, 32, 40
	—	API 6A $1\frac{13}{16}$ , $2\frac{1}{16}$	—
2	50	API 6D 2, $2\frac{1}{2}$ , 3, 4	50, 65, 80, 100
	—	API 6A $1\frac{13}{16}$ , $2\frac{1}{16}$ , $2\frac{9}{16}$ , $3\frac{1}{8}$ , $4\frac{1}{16}$	—
$2\frac{1}{2}$	65	API 6D $2\frac{1}{2}$ , 3, 4	65, 80, 100, 125
	—	API 6A $2\frac{9}{16}$ , $3\frac{1}{8}$ , $4\frac{1}{16}$ , $5\frac{1}{8}$	—
3	80	API 6D 3, 4, 6	80, 100, 125, 150
	—	API 6A $3\frac{1}{8}$ , $4\frac{1}{16}$ , $5\frac{1}{8}$ , $7\frac{1}{16}$	—
4	100	API 6D 4, 6, 8	100, 125, 150, 200
	—	API 6A $4\frac{1}{16}$ , $5\frac{1}{8}$ , $7\frac{1}{16}$	—
6	150	API 6D 6, 8, 10, 12	150, 200, 250, 300
	—	API 6A $7\frac{1}{16}$ , 9, 11	—
8	200	API 6D 8 and larger	200 and larger
	—	API 6A 9, 11	—

<sup>a</sup> Larger valve sizes may be fire tested by agreement.

<sup>b</sup> DN is the size designation used for API 6D valves only and does not apply to API 6A valves.

<sup>c</sup> For API 6A valve sizes, the nominal size includes all listed bore diameters.



The nominal size of the test valve shall be determined by the size of the end connections.

### 5.3 Allowances of Scaling by Pressure Rating

One successfully tested valve shall qualify valves with higher-pressure ratings no greater than twice the pressure rating of the tested valve (see Table 5 and Table 6).

**Table 5—Qualification by Pressure Rating from Test of 6A Valve**

Rating of Test Valve			Other Valve Ratings Qualified		
psi	MPa	Bar	Rating or Class	MPa	Bar
2000	13.8	138	API 6A 2,000 psi; 3000 psi	13.8, 20.7	138, 207
			API 6D class 900; class 1500	—	—
3000	20.7	207	API 6A 3000 psi; 5000 psi	20.7, 34.5	207, 345
—	—	—	API 6D class 1500; class 2500	—	—
5000	34.5	345	API 6A 5000 psi; 10,000 psi	34.5, 69.0	345, 690
—	—	—	API 6D class 2500	—	—
10,000	69.0	690	API 6A 10,000 psi; 15,000 psi; 20,000 psi	69.0, 103.5, 138.0	690, 1035, 1380
15,000	103.5	1035	API 6A 15,000 psi; 20,000 psi	103.5, 138.0	1035, 1380
20,000	138.0	1380	API 6A 20,000 psi	138.0	1380

**Table 6—Qualification by Pressure Rating from Test of 6D Valve**

Rating of Test Valve		Other Valve Ratings Qualified	
Class	Rating or Class	MPa	Bar
150	API 6D class 150; class 300	—	—
300	API 6D class 300; class 600	—	—
600	API 6D class 600; class 900	—	—
—	API 6A 2000 psi; 3000 psi	13.8, 20.7	138, 207
900	API 6D class 900; class 1500	—	—
—	API 6A 3000 psi	20.7	207
1500	API 6D class 1500; class 2500	—	—
—	API 6A 5000 psi	34.5	345
2500	API 6D class 2500	—	—
—	API 6A 10,000 psi	69.0	690

### 5.4 Allowances of Scaling for Nonmetallic Materials

Any change in qualified nonmetallic material with respect to the seat-to-closure member seal, seat-to-body seal, stem seal, and body joint seal shall require additional qualification.

**NOTE** By agreement between the manufacturer and purchaser, the extended nonmetallic material qualification in Annex A may be used to validate a change in nonmetallic materials.

If the primary pressure sealing mechanism used in a qualified valve is unchanged, adding additional seals shall not require new qualification.

A change in the design or density or loading to a graphite or carbon fiber seal shall require additional qualification. Successful test of the smallest valve of a previously qualified range, with the new seal, shall extend the previous qualified range to include the new material.

## 5.5 Allowances of Scaling for Metallic Materials

### 5.5.1 Pressure-containing Parts

Qualification of valves by metallic materials shall be determined by the materials of construction of the pressure-containing parts other than the stem. The material of the test valve qualifies other valves made of alloys that are in the same material group. The five metallic material groups are as follows:

- 1) low alloy and carbon steel
- 2) martensitic stainless steel
- 3) austenitic stainless steel
- 4) duplex stainless steel
- 5) nickel-alloy steel

Testing of a valve without CRA overlay material shall qualify a valve with CRA overlay.

Successful qualification of a range of valves shall qualify materials of lower thermal conductivity, provided one valve of the lower thermal conductivity material group is successfully tested. The one valve tested shall qualify valves of equal and larger size and equal and higher-pressure class/rating.

Thermal conductivity comparison values shall be at the same temperature.

EXAMPLE Low alloy and carbon steel qualifies duplex stainless steel.

NOTE For example, if gate valves of the same basic design are qualified by the testing of "low alloy" or "carbon steel" materials, a successful test of a Size 4 class 300 gate valve in duplex material will qualify all gate valves of the same basic design that are Size 4 and larger in pressure classes 300 and higher. Gate valves in duplex material that are less than Size 4 and all those in class 150 are not qualified by the additional test.

Materials of construction of the pressure-containing parts not covered in above material groups shall require full testing of representative sizes and pressure classes/ratings as specified in Table 5 and Table 6.

### 5.5.2 Metallic Seal

Any change in qualified metallic seal material with respect to the seat-to-closure member seal, seat-to-body seal, stem seal, and body joint seal shall not require additional qualification.

### 5.5.3 Closure Bolting

Valves qualified with low alloy steel closure bolting shall also qualify valves with other low alloy steel bolting, stainless-steel bolting (austenitic, ferritic-austenitic, martensitic, precipitation-hardened), and nickel-alloy bolting, provided the thermal conductivity is less than or equal to that of alloy steel bolting. Otherwise, testing of one valve with specific closure bolting material shall qualify only that bolting material for all sizes and pressure classes/ratings.

Valves qualified with austenitic stainless-steel closure bolting (e.g. B8, B8M) shall also qualify valves with other austenitic stainless-steel and nickel-alloy bolting, provided the thermal conductivity is less than or equal to that of qualified austenitic stainless-steel bolting. Otherwise, testing of one valve with specific closure bolting material shall qualify only that bolting material for all sizes and pressure classes/ratings.

## 6 Certificate of Conformance

When requested by the user/purchaser, the supplier/manufacture shall furnish a certificate of conformance. The certificate shall include, at a minimum, the following:

- test number
- test date
- valve unique identifier
- statement of conformance to this standard

Records of the size, pressure class/rating, and materials of the qualification shall be maintained by the valve manufacturer for 10 years from the date of the last manufacture.



## **Annex A**

### **(informative)**

## **Extended Nonmetallic Material Qualification**

### **A.1 General**

The intent of this annex is to extend existing fire test certifications to additional nonmetallic materials in the same class designation or family.

To apply the rules of this annex, it is necessary to start with a valve (or range of valves) design that has been successfully tested in accordance with the requirements in the main body of this document.

The manufacturer shall determine the class designation (per ASTM D1418 for elastomers) or family (per ASTM D4000 for plastics) for the tested valve.

Elastomer materials shall be subjected to a test for modulus of elasticity at 100 % elongation, at ambient temperature in accordance with methods described in ASTM D412 or ASTM D1414.

Plastic materials shall be subjected to a dynamic mechanical analysis (DMA) in accordance with ASTM D4065. The valve manufacturer shall select the "forced constant amplitude; fixed or variable frequency-torsional oscillation mode" of analysis (ASTM D4065, Table 1, Figure 8) for all materials to be qualified. A minimum of three DMA test temperatures shall be specified by the valve manufacturer and shall be above the maximum operating temperature of the test valve. Results of the elastic component values (i.e. modulus of elasticity) at each test temperature shall be recorded. Data sets collected using different methods of analysis shall not be used for grouping and qualification.

Valves that are designed for the seat-to-closure member seal to degrade, decompose, or extrude to allow metal-to-metal sealing during the fire test shall not be eligible to extend qualification by this annex.

Annex A shall not apply to seal configurations comprised of multiple materials (e.g. a stem seal stack with both PEEK and PTFE rings).

See Figure A.1 and Figure A.2.

### **A.2 Elastomers**

Comparison of modulus of elasticity data shall qualify additional elastomer materials of the same class designation as identified in ASTM D1418.

The steps listed below shall be followed, in the sequence shown, to extend fire test qualification to additional elastomer materials. See Figure A.1.

- 1) Select a valve with API 6FA qualification.
- 2) Determine the class designation and modulus of elasticity of the elastomer in the original test valve.
- 3) Select a second elastomer from the same class designation as the original test valve and document the modulus of elasticity.
- 4) The modulus of elasticity for the second elastomeric seal (material) shall be compared and shown to have a modulus of elasticity greater than or equal to the elastomeric seal (material) used in the previously qualified valve.

- 5) Install the second elastomer into the second valve for testing.
- 6) The second valve shall be tested in accordance with the main body of this document.
- 7) A successful test shall qualify all elastomers in that class designation, with equal or higher modulus than the original elastomer tested, and according to clause A.4.

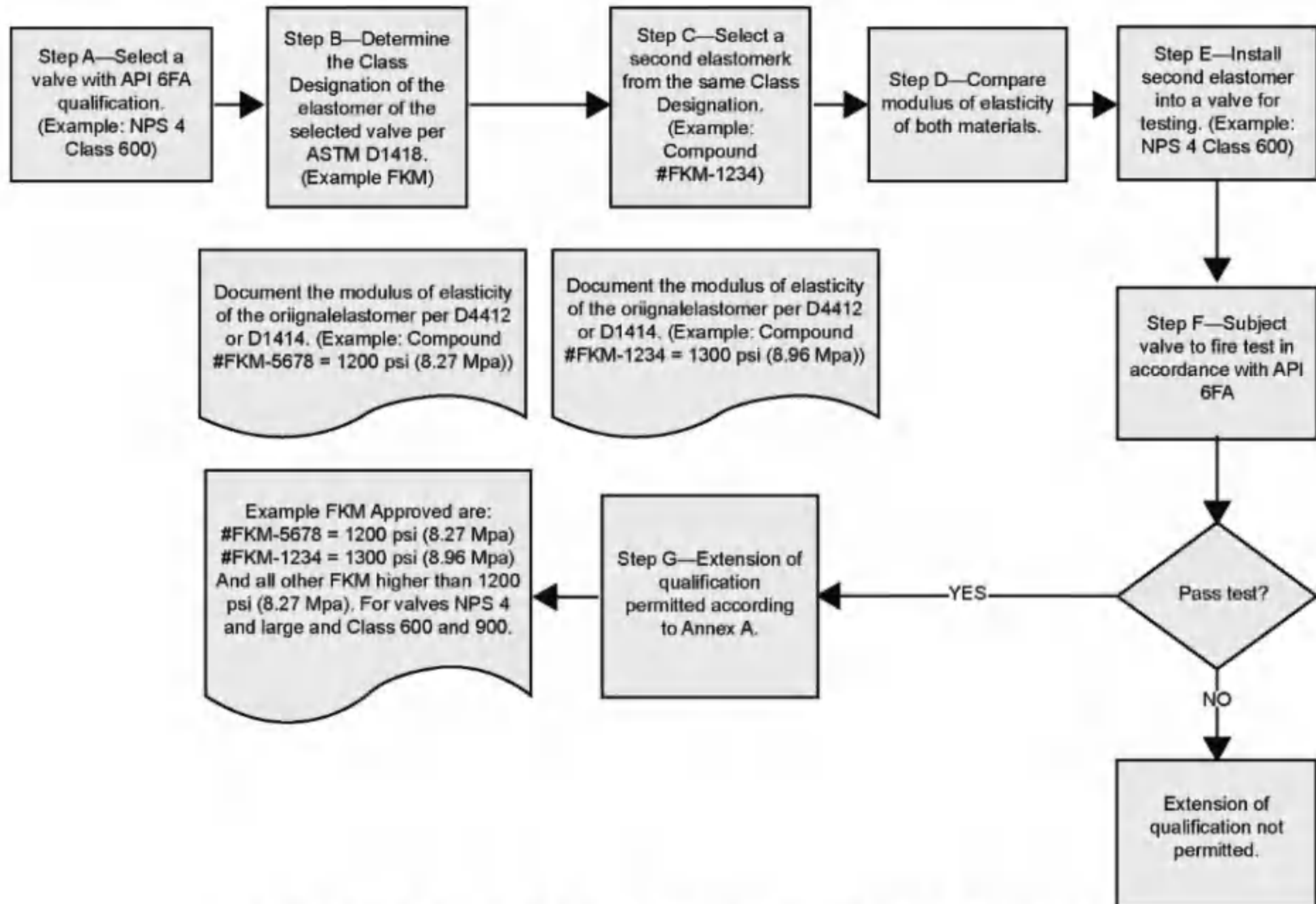


Figure A.1—Steps for Qualifying Elastomers, Including Examples

### A.3 Plastics

Comparison of dynamic mechanical analysis (DMA) data shall qualify additional plastic materials of the same family as identified in ASTM D4000.

The steps listed below shall be followed, in the sequence shown, to extend fire test qualification to additional plastic materials. See Figure A.2.

- 1) Select a valve with API 6FA qualification.
- 2) Determine the family and DMA data table of the plastic in the original test valve.
- 3) Select a second plastic from the same family as the original test valve and document the DMA data table.
- 4) The DMA data table of the second plastic shall be compared with the material in the original test valve. The modulus of elasticity for the second plastic seal (material) shall be compared and shown to have a modulus of elasticity greater than or equal to the plastic seal (material) used in the previously qualified valve.
- 5) Install the second plastic into a second valve for testing.



- 6) The second valve shall be tested in accordance with the main body of this document.
- 7) A successful test shall qualify all plastics in that family with modulus of elasticity results greater than or equal to the modulus of elasticity results at the same temperature of the original material and according to clause A.4.

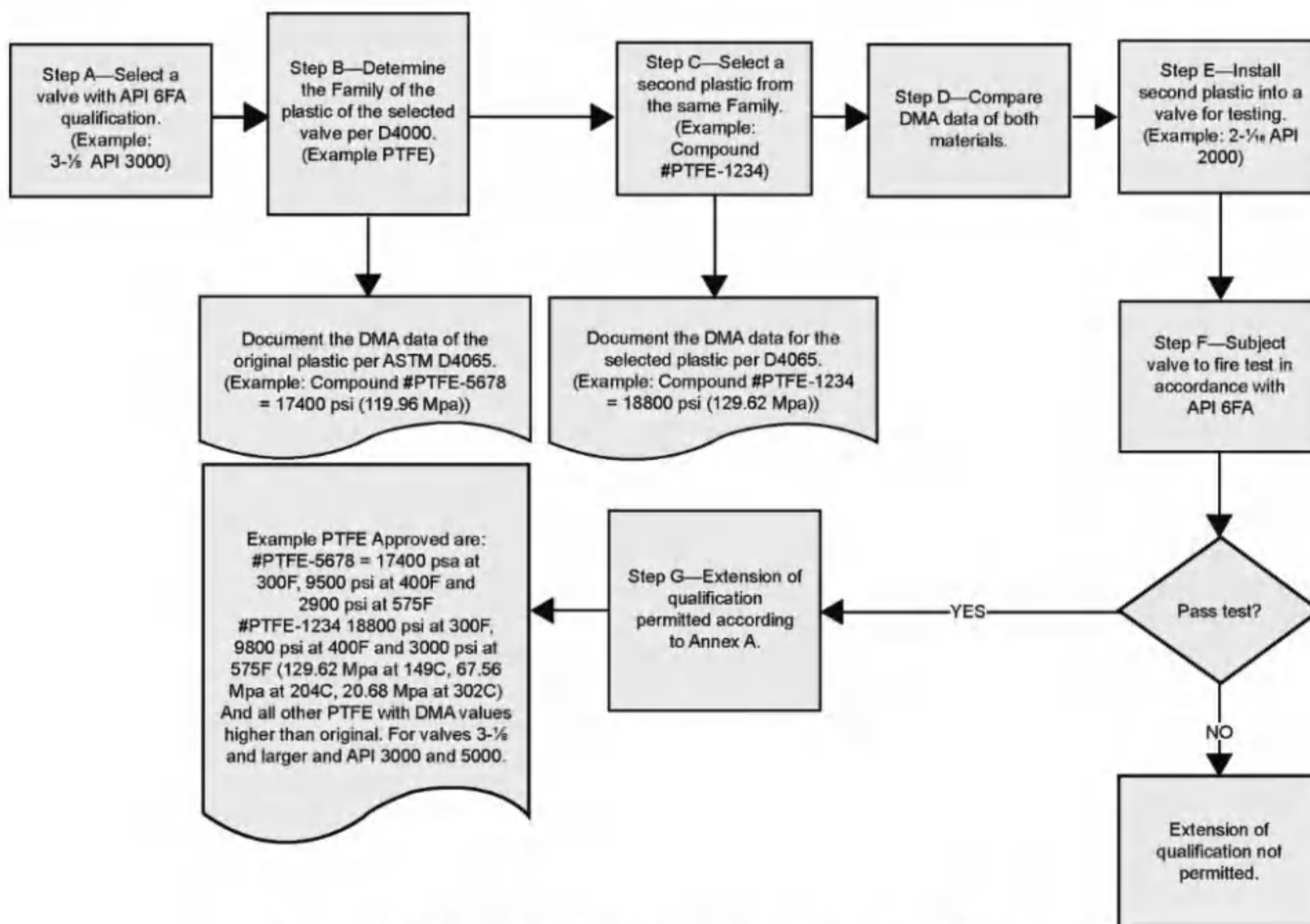


Figure A.2—Steps for Qualifying Plastics, Including Examples

## A.4 Qualification

One test valve shall qualify valves equal to and larger than the test valve (see Table A.1 and Table A.2).

The nominal size of the valve shall be determined by the size of the end connections.

One test valve shall qualify valves with equal and higher-pressure ratings, but no greater than twice the pressure rating of the test valve (see Table A.3 and Table A.4).

Table A.1—Qualification by Valve Size from Test of 6A Valve

Size of Test Valve <sup>a</sup>	Other Valve Sizes Qualified	
	Size/NPS	DN <sup>b</sup>
1 <sup>13</sup> / <sub>16</sub> , 2 <sup>1</sup> / <sub>16</sub>	API 6A 1 <sup>13</sup> / <sub>16</sub> , 2 <sup>1</sup> / <sub>16</sub> , 2 <sup>9</sup> / <sub>16</sub> , 3 <sup>1</sup> / <sub>16</sub> , 3 <sup>1</sup> / <sub>8</sub> , 4 <sup>1</sup> / <sub>16</sub> , 5 <sup>1</sup> / <sub>8</sub> , 7 <sup>1</sup> / <sub>16</sub> , 9, 11	—
	API 6D NPS 2 and larger	50 and larger
2 <sup>9</sup> / <sub>16</sub>	API 6A 2 <sup>9</sup> / <sub>16</sub> , 3 <sup>1</sup> / <sub>16</sub> , 3 <sup>1</sup> / <sub>8</sub> , 4 <sup>1</sup> / <sub>16</sub> , 5 <sup>1</sup> / <sub>8</sub> , 7 <sup>1</sup> / <sub>16</sub> , 9, 11	—
	API 6D NPS 2 <sup>1</sup> / <sub>2</sub> and larger	65 and larger



Table A.1—Qualification by Valve Size from Test of 6A Valve (Continued)

Size of Test Valve <sup>a</sup>	Other Valve Sizes Qualified	
	Size/NPS	DN <sup>b</sup>
3 <sup>1</sup> / <sub>16</sub> , 3 <sup>1</sup> / <sub>8</sub>	API 6A 3 <sup>1</sup> / <sub>16</sub> , 3 <sup>1</sup> / <sub>8</sub> , 4 <sup>1</sup> / <sub>16</sub> , 5 <sup>1</sup> / <sub>8</sub> , 7 <sup>1</sup> / <sub>16</sub> , 9, 11	—
	API 6D NPS 3 and larger	80 and larger
4 <sup>1</sup> / <sub>16</sub>	API 6A 4 <sup>1</sup> / <sub>16</sub> , 5 <sup>1</sup> / <sub>8</sub> , 7 <sup>1</sup> / <sub>16</sub> , 9, 11	—
	API 6D NPS 4 and larger	100 and larger
5 <sup>1</sup> / <sub>8</sub>	API 6A 5 <sup>1</sup> / <sub>8</sub> , 7 <sup>1</sup> / <sub>16</sub> , 9, 11	—
	API 6D NPS 6 and larger	150 and larger
7 <sup>1</sup> / <sub>16</sub>	API 6A 7 <sup>1</sup> / <sub>16</sub> , 9, 11	—
	API 6D NPS 8 and larger	200 and larger
9	API 6A 9, 11	—
	API 6D NPS 8 and larger	200 and larger
<sup>a</sup> Larger valve sizes may be fire tested by agreement.		
<sup>b</sup> DN is the size designation used for API 6D valves only and does not apply to API 6A valves.		

Table A.2—Qualification by Valve Size from Test of 6D Valve

Size of Test Valve <sup>a</sup>		Other Valve Sizes Qualified	
NPS	DN <sup>b</sup>	NPS/Size	DN <sup>b</sup>
1/2	15	API 6D NPS 1/2 and larger	15 and larger
		API 6A 1 <sup>13</sup> / <sub>16</sub> and larger	—
3/4	20	API 6D NPS 3/4 and larger	20 and larger
		API 6A 1 <sup>13</sup> / <sub>16</sub> and larger	—
1	25	API 6D NPS 1 and larger	25 and larger
		API 6A 1 <sup>13</sup> / <sub>16</sub> and larger	—
1 1/4	32	API 6D NPS 1 1/4 and larger	32 and larger
		API 6A 1 <sup>13</sup> / <sub>16</sub> and larger	—
1 1/2	40	API 6D NPS 1 1/2 and larger	40 and larger
		API 6A 1 <sup>13</sup> / <sub>16</sub> and larger	—
2	50	API 6D NPS 2 and larger	50 and larger
		API 6A 2 <sup>1</sup> / <sub>16</sub> and larger	—
2 1/2	65	API 6D NPS 2 1/2 and larger	65 and larger
		API 6A 2 <sup>9</sup> / <sub>16</sub> and larger	—
3	80	API 6D NPS 3 and larger	80 and larger
		API 6A 3 <sup>1</sup> / <sub>16</sub> and larger	—
4	100	API 6D NPS 4 and larger	100 and larger
		API 6A 4 <sup>1</sup> / <sub>16</sub> and larger	—
6	150	API 6D NPS 6 and larger	150 and larger
		API 6A 5 <sup>1</sup> / <sub>8</sub> and larger	—
8	200	API 6D NPS 8 and larger	200 and larger
		API 6A 7 <sup>1</sup> / <sub>16</sub> and larger	—
<sup>a</sup> Larger valve sizes may be fire tested by agreement.			
<sup>b</sup> DN is the size designation used for API 6D valves only and does not apply to API 6A valves.			

**Table A.3—Qualification by Pressure Rating from Test of 6A Valve**

Rating of Test Valve			Other Valve Ratings Qualified		
psi	MPa	Bar	Rating or Class	MPa	Bar
2000	13.8	138	API 6A 2000 psi; 3000 psi	13.8, 20.7	138, 207
—	—	—	API 6D class 900; class 1500	—	—
3000	20.7	207	API 6A 3000 psi; 5000 psi	20.7, 34.5	207, 345
—	—	—	API 6D class 1500; class 2500	—	—
5000	34.5	345	API 6A 5000 psi; 10,000 psi	34.5, 69.0	345, 690
—	—	—	API 6D class 2500	—	—
10,000	69.0	690	API 6A 10,000 psi; 15,000 psi; 20,000 psi	69.0, 103.5, 138.0	690, 1035, 1380
15,000	103.5	1035	API 6A 15,000 psi; 20,000 psi	103.5, 138.0	1035, 1380
20,000	138.0	1380	API 6A 20,000 psi	138.0	1380

**Table A.4—Qualification by Pressure Rating from Test of 6D Valve**

Rating of Test Valve		Other Valve Ratings Qualified	
Class	Rating or Class	MPa	Bar
150	API 6D class 150; class 300	—	—
300	API 6D class 300; class 600	—	—
600	API 6D class 600; class 900	—	—
—	API 6A 2000 psi; 3000 psi	13.8, 20.7	138, 207
900	API 6D class 900; class 1500	—	—
—	API 6A 3000 psi	20.7	207
1500	API 6D class 1500; class 2500	—	—
—	API 6A 5000 psi	34.5	345
2500	API 6D class 2500	—	—
—	API 6A 10,000 psi	69.0	690

## A.5 Certification

All valves that are qualified under the rules of Annex A shall receive a certificate that shall include the words "QUALIFIED BY API 6FA ANNEX A."

**NOTE** When subjecting a valve to fire test for the purposes of extending the range of nonmetallic materials, the valve under test (and its corresponding range) is eligible for standard certification under the rules of this standard.

## A.6 Examples

### A.6.1 Elastomers

This example follows the steps of clause A.2.

- 1) Select an NPS 4, class 600 gate valve from a range of valves with existing API 6FA coverage that had an FKM elastomer installed. The elastomer in the existing qualified range is in accordance with manufacturer specification #FKM-5678 and has known modulus of elasticity records.



- 2) The elastomer from the selected valve is in the class designation "FKM" as defined by ASTM D1418, and has modulus of elasticity at 50 % elongation of 1200 psi (8.27 MPa) at ambient temperature. These data have been recorded in accordance with ASTM D412 or ASTM D1414.
- 3) The second material selected is a different grade but is an FKM as defined by ASTM D1418. The elastomer is in accordance with manufacturer specification #FKM-1234 and has modulus of elasticity at 50 % elongation of 1300 psi (8.96 MPa) at ambient temperature. These data have been recorded in accordance with ASTM D412 or ASTM D1414.
- 4) Comparing the modulus of elasticity records, the second FKM has modulus of elasticity results greater than that of the original test valve, and as such, conforms with the requirements of Annex A.
- 5) The second test valve is assembled using #FKM-1234 elastomer seals.
- 6) The second test valve is subjected to fire test in accordance with API 6FA and passes the test.
- 7) With a successful test of the second test valve, all FKM elastomers with modulus of elasticity equal to or greater than 1200 psi (8.27 MPa) are now approved, by extension, for valves NPS 4 and larger, class 600, and class 900. Valves smaller than NPS 4 are not covered by this extension test. Valves in class 150, class 300, class 1500, and class 2500 are not covered by this extension test.

### A.6.2 Plastics

This example follows the steps of clause A.3.

- 1) Select a 3 $\frac{1}{8}$ -in. API 3000 psi gate valve. This valve has a PTFE plastic installed, has a maximum operating temperature of 180 °F (82 °C), and has successfully completed fire testing in accordance with API 6FA. The plastic is in accordance with manufacturer specification #PTFE-5678 and has known modulus of elasticity records.
- 2) The plastic is in the family "PTFE" as defined by ASTM D4000, and has modulus of elasticity of 17,400 psi at 300 °F (119.96 MPa at 149 °C), 9500 psi at 400 °F (65.5 MPa at 204 °C), and 2900 psi at 575 °F (20 MPa at 302 °C). These data have been recorded in accordance with ASTM D4065.
- 3) The second material selected is a different grade, but is PTFE as defined by ASTM D4000. The plastic is in accordance with manufacturer specification #PTFE-1234 and has modulus of elasticity of 18,800 psi at 300 °F (129.62 MPa at 149 °C), 9800 psi at 400 °F (67.56 MPa at 204 °C), and 3000 psi at 575 °F (20.68 MPa at 302 °C). These data have been recorded in accordance with ASTM D4065.
- 4) Comparing the modulus of elasticity records, the second PTFE has modulus of elasticity results greater than that of the original test valve at each test temperature, and as such, conforms with the requirements of Annex A.
- 5) The second test valve is assembled using #PTFE-1234 plastic seals.
- 6) The second test valve is subjected to fire test in accordance with API 6FA and passes the test.
- 7) With a successful test of the second test valve, all PTFE plastics with modulus of elasticity results at the same temperature, greater than or equal to those of the original test valve, are now approved by extension, for valves 3 $\frac{1}{8}$ -in. and larger, API 3000 psi, and API 5000 psi. Valves smaller than 3 $\frac{1}{8}$  in. are not covered by this extension test. API 2000 psi, API 10,000 psi, API 15,000 psi, and API 20,000 psi are not covered by this extension test.



### A.6.3 DMA Data Table

Table A.5 and Table A.6 are sample DMA data tables.

**Table A.5—Example DMA Table for Plastic Material in Original Test Valve**

PTFE per #PTFE-5678	Test Temperature		
	300 °F (149 °C)	400 °F (204 °C)	575 °F (302 °C)
Modulus of Elasticity	17,400 psi	9500 psi	2900 psi
	119.96 MPa	65.5 MPa	20 MPa

**Table A.6—Example DMA Table for Plastic Material in Second Test Valve**

PTFE per #PTFE-1234	Test Temperature		
	300 °F (149 °C)	400 °F (204 °C)	575 °F (302 °C)
Modulus of Elasticity	18,800 psi	9800 psi	3000 psi
	129.62 MPa	67.56 MPa	20.68 MPa





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