1.0 INTRODUCTION

This document provides instructions for preparing valves which will be fire tested using the procedures of the following specifications:

1. API Standard 607, 4th Edition, 1993
2. API Specification 6FA, 3rd Edition, 1999
3. BS 6755: Part 2: 1987, with Amendments 1 & 2, 1987

Please consult SwRI® for special preparation requirements for check valves, valves which do not have a straight-through bore (e.g., choke and angle valves), or for valves to be tested using procedures other than those given above. Wafer and lug style butterfly valves should be prepared as detailed in the following sections.

Some of the requirements of the above fire test standards are summarized below as they relate to the preparation of valves. However, this document may not contain all requirements and is not intended to be used as a substitute for the standard itself.

2.0 GENERAL ARRANGEMENT OF TEST FACILITY

Test valves are installed in the SwRI fire test facility as shown in Figure 1. A short length of pipe is installed on both the upstream and downstream ends of the valve to support the valve in the test stand and to allow for connection of supply, drain, and vent lines. The test fixture is pressurized with water from the upstream side during the test. The downstream pipe is connected to a drain and condenser system for collection of any through-valve leakage.

The test valve is placed in the test stand so that the valve stem is horizontal (i.e., parallel to the floor). The bore is slightly sloped toward the downstream end to ensure complete drainage of through-valve leakage. The upstream pipe is clamped in a pipe vise on top of a fixed pedestal. The downstream pipe rests in a pipe vise on top of a second pedestal. The downstream pipe is left unclamped to allow for thermal movement of the valve assembly during the test.

The test valve is surrounded on all four sides by portable screens designed to reduce heat loss and minimize the effect of wind gusts. Fire conditions are simulated using four natural gas burners located below the test valve. The area above the valve is partially closed by baffles that direct the burner flames to uniformly envelop the valve.

3.0 ACTUATOR REQUIREMENTS

A manual valve actuator (operating lever, handwheel, and/or gearbox) should be supplied for the test valve. Manual actuators will normally be left on the valve during the test. If possible, levers and handwheels should be installed so that they are oriented downward when the valve is installed in the test stand. Figure 1 shows the preferred orientation of operating levers and handwheels.

The specific requirements of the standards related to actuators are as follows:

- **API 6FA:** This specification contains no specific requirements. At the client's request, gearboxes will be removed during the test. The actuator will be reinstalled following the cooldown in order to cycle the valve as required by the test procedure. Gearboxes will only be removed if the client is present during the test to supervise their removal and re-installation.

- **API 607:** A valve must be tested with the manufacturer's standard manual actuating device (ref. Sect. 1.3.4).

- **BS 6755**: A valve that is normally supplied with a gearbox must be tested with the gearbox in place. For valves which can be supplied both with and without a gearbox, testing with the gearbox will qualify the valve without a gearbox, but not vice-versa (ref. Sect. 3.2).

Tests to BS 6755 require a measurement of the force required to open the valve following the cooldown. For these tests, the client should provide an adapter which will fit over the stem and/or handle and allow the valve to be operated with a torque wrench. SwRI will supply a ½" drive calibrated torque wrench to operate these valves. Please consult SwRI before the scheduled test date if opening torque is expected to exceed the capabilities of a ½" drive torque wrench.

4.0 BODY CAVITY VENT PORT

A port installed in the body cavity of double-seated valves for pressure monitoring and relief is a mandatory safety requirement of all fire test standards. During a test, steam trapped between the upstream and downstream seats can reach pressures that could cause the valve body to rupture. The body cavity port allows the internal pressure to be monitored during the test, and, if necessary, vented to prevent rupture of the valve body. The body cavity will be vented if the internal pressure reaches the maximum allowable value specified on the fire test application form. If the body cavity has to be vented during the test, the valve is considered to have failed the test. This port must be installed on all double-seated valves prior to shipping to SwRI for testing. **Please note that SwRI will not test any double-seated valve that does not have a body cavity port nor will the port be installed by SwRI once the valve is received.**

The body cavity vent port should consist of a threaded, female 1/4" NPT connection located in what will be the topmost point in the valve body when it is installed in the test stand. Refer to Figure 1 for the orientation of typical valves during a test. Drilling and tapping directly into the valve body is permissible provided that the body wall thickness is sufficient to permit full thread engagement. However, note that on smaller valves, the adapter fitting that is threaded into this port can interfere with valve internals once the fitting is completely tightened. If necessary, a threaded fitting (e.g., half-coupling or thread-o-let) may be welded to the valve body for use in connecting the pressure monitoring and relief system. Threaded fittings should have pressure ratings suitable for the full test pressure. These two methods for installing the body cavity port in a test valve are illustrated in Figure 2. Regardless of the method chosen for adding the body cavity vent port, it is the responsibility of the manufacturer to ensure that the modified valve (including the threaded fitting, if added) can safely withstand the test pressure.

5.0 ATTACHED PIPING

Valves to be tested at the SwRI fire test facility must have a short length of pipe installed on both the upstream and downstream ends of the valve to support the valve in the test stand and to allow for connection of supply, drain, and vent lines. Examples of various types of valves prepared for fire testing are shown in Figure 4.

For valves requiring welded assembly (see Section 5.2 below), clients are urged to consider supplying valves complete with the attached piping per the requirements of the following subsections. By doing so, the client can inspect all materials and assembly and verify the integrity of the seats and seals prior to shipping the valve to SwRI for testing. Otherwise, SwRI can supply the materials and labor to prepare the valve. While precautions will be taken to minimize heating of the test valve during welding, SwRI will not be responsible for any damage or dimensional changes resulting from the welding process. An additional fee will be charged for the fabrication and installation of the attached piping.

All welded assemblies prepared by a client must be hydrostatically tested to 150% of design pressure to ensure their integrity before shipping to SwRI.

SwRI has flanged pipe available in several common sizes for tests in which the attached piping is not welded directly to the valve. The available assemblies are constructed of carbon steel pipe with ANSI carbon steel flanges. If available pipe an flanges are used, SwRI will assemble the test fixture with spiral-wound gaskets, A-193 stud bolts, and A-194 nuts at no additional cost. Flange bolts will be tightened with a calibrated torque wrench to standard torque values. If other materials are required, please consult SwRI.

5.1 Pipe Size and Material

Unless there is a specific requirement to the contrary in the relevant standard (see below), it is usually most convenient to make the upstream and downstream pipes the same size as the test valve. However, the SwRI fire test facility is designed to accommodate a maximum 4-inch nominal pipe size, as both a practical clamping limit and to minimize the volume of steam generated during a test. Valves larger than 4-inch must be fitted with reducers so that 4-inch or smaller pipe can be used. When reducers are required, eccentric reducers are required in order to have effective air purging and ensure complete drainage of through-valve leakage. Eccentric reducers should be oriented as shown in Figure 4(B). For large valves, it may be necessary to use two eccentric reducers at each end.

The specific requirements of the standards related to attached pipe size are as follows:

- **API 6FA:** This specification contains no specific requirements.
- **API 607:** The downstream pipe must be at least ½" NPS (ref. Sect. 2.3).
- **BS 6755:** The downstream piping must be 15 mm - 25 mm nominal size, regardless of test valve size. This effectively limits the downstream pipe size to either ½" , ¾" or 1" NPS (ref. sect. A.2.1).

The pipe and any reducers used on both the upstream and downstream sides will be subjected to the full test pressure and may experience surface temperatures as high as 1400-1500°F during a test. Pipe and reducers should be carefully chosen to contain the test pressure and

provide support for the weight of the test valve. All pipe should be at least Schedule 80 (XH), A106 Grade B. In some cases, wall thicknesses greater than Schedule 80 will be required by the test pressure.

5.2 Attachment to Test Valve

Although the fire test procedures do not evaluate the end connections where the pipe is attached to the valve, it is important that this joint not leak during the test. If leakage occurs at either end connection, the amount of external leakage attributable to the test valve cannot be determined. All of the fire test standards allow the valve end connections to be modified as needed to eliminate leakage at these connections during the test.

If available, butt-weld or socketweld ends are the most convenient configuration for a test valve as they allow the attached piping to be directly welded to the valve. For valves with threaded end connections, it is recommended that the threaded pipe connections be backwelded after assembly to prevent leakage.

Leakage frequently occurs when bolted, flanged connections are used for the attached piping. When testing valves with flanged ends, it is preferable to weld the upstream and downstream pipes (or eccentric reducers) directly to the flange faces to prevent leakage at these connections during the test. Welding methods should be suitable for the expected test pressure.

The specific recommendations of SwRI for flanged-end valves are as follows:

- **30 psi test pressure*:** For valves 4" NPS and larger, the attached piping or reducers must be welded to the flanges. Although flanged connections on valves smaller than 4" are less prone to leakage, the client is urged to consider welding the attached piping on these valves as well.

- **Test pressures above 30 psi:** For all valve sizes, the attached piping or reducers must be welded directly to the flanges.

5.3 Dimensional Requirements

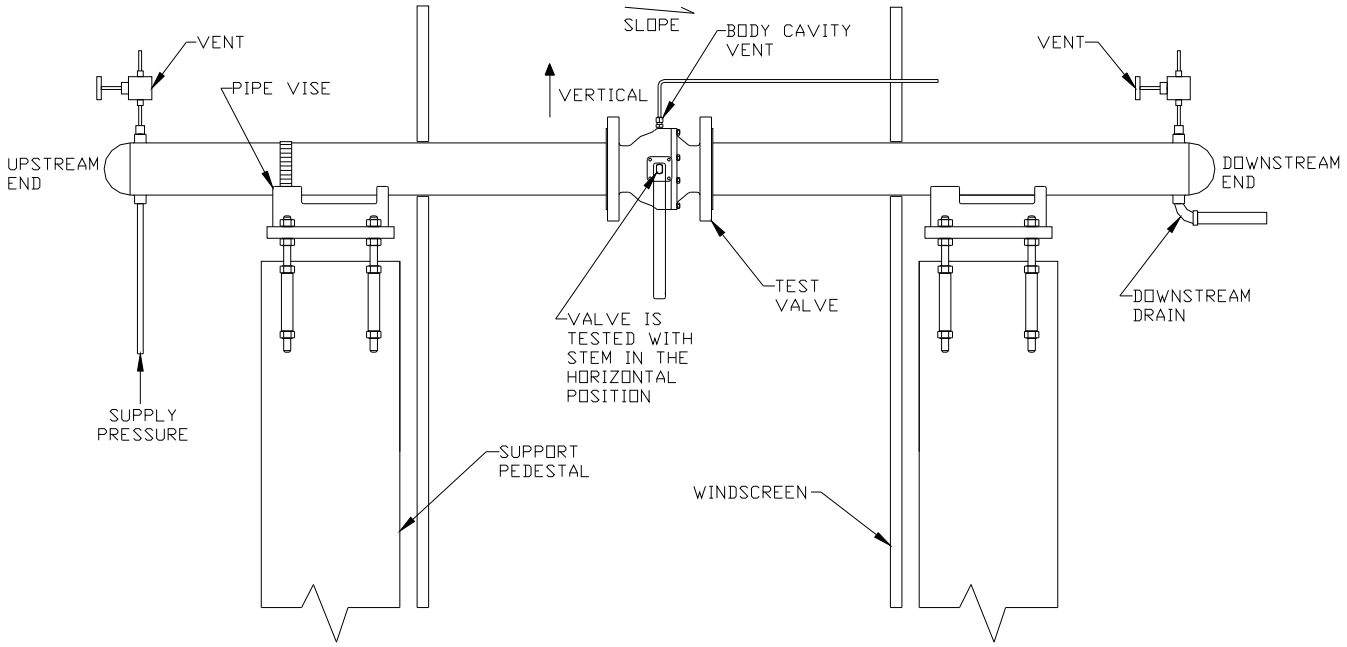
Dimensional requirements for the piping are shown in Figure 4. Regardless of preparation, finished end-to-end length should be approximately 90 inches as shown in Figure 4.

5.4 Pipe End Preparation

Figure 3 shows the recommended preparation for the ends of the attached pipe. For pipe sizes larger than 1" NPS, the ends should be capped and ported as shown in Figure 3(A). Note that when the valve stem and bore centerlines are both in a horizontal plane, the threaded ports at the pipe ends must lie in a vertical plane. Weld caps and threaded fittings used on both the upstream and downstream ends will be subjected to the full test pressure. Material, wall thicknesses, pressure ratings, and welding methods should be appropriate for the expected test pressure. For pipe sizes 1" NPS and smaller, the ends may be provided with an NPT thread as shown in Figure 3(B). The upstream and downstream ends are identical.

* The 30 psi test pressure is used for API 607 tests on the following valves: (a) Upstream-sealing, dual seated valves from Classes 150 and 300, and (b) other valves from Classes 150, 300, and 600.

A)



B)

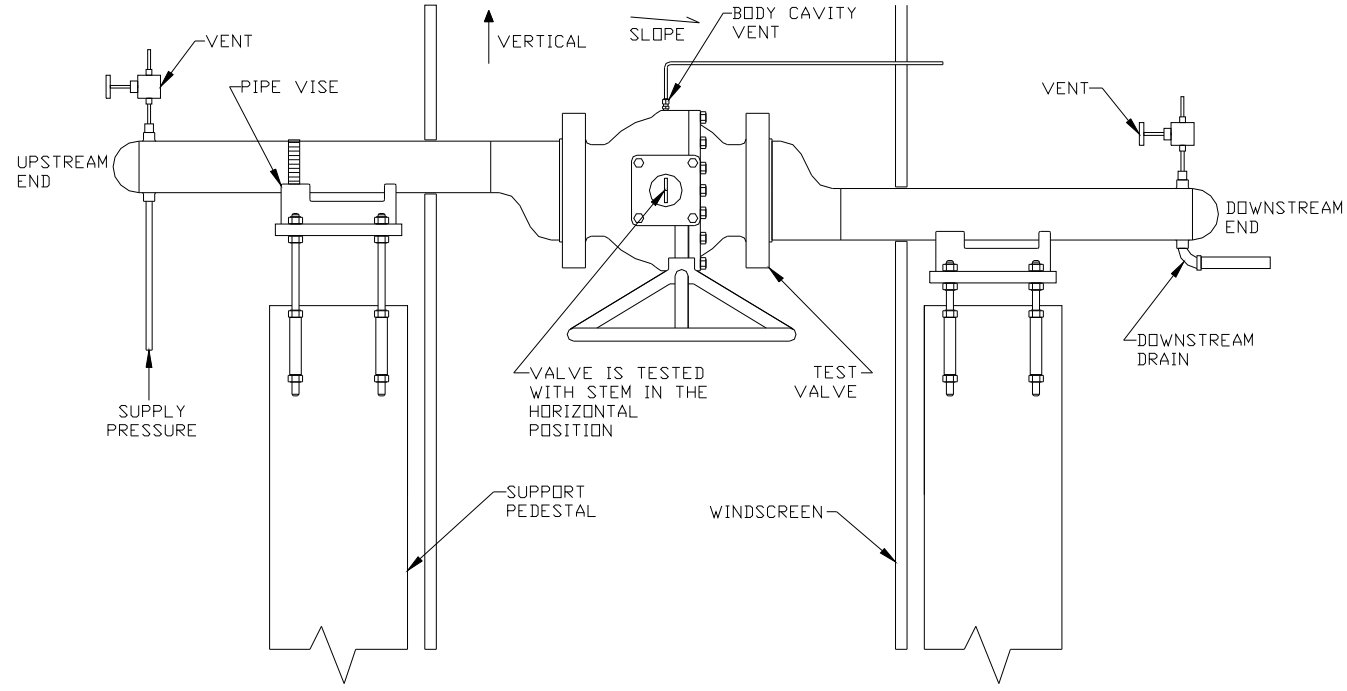


FIGURE 1. Schematic of the fire test facility showing valves installed for testing. **(A)** Valve with handle operator, and **(B)** valve with gear operator.

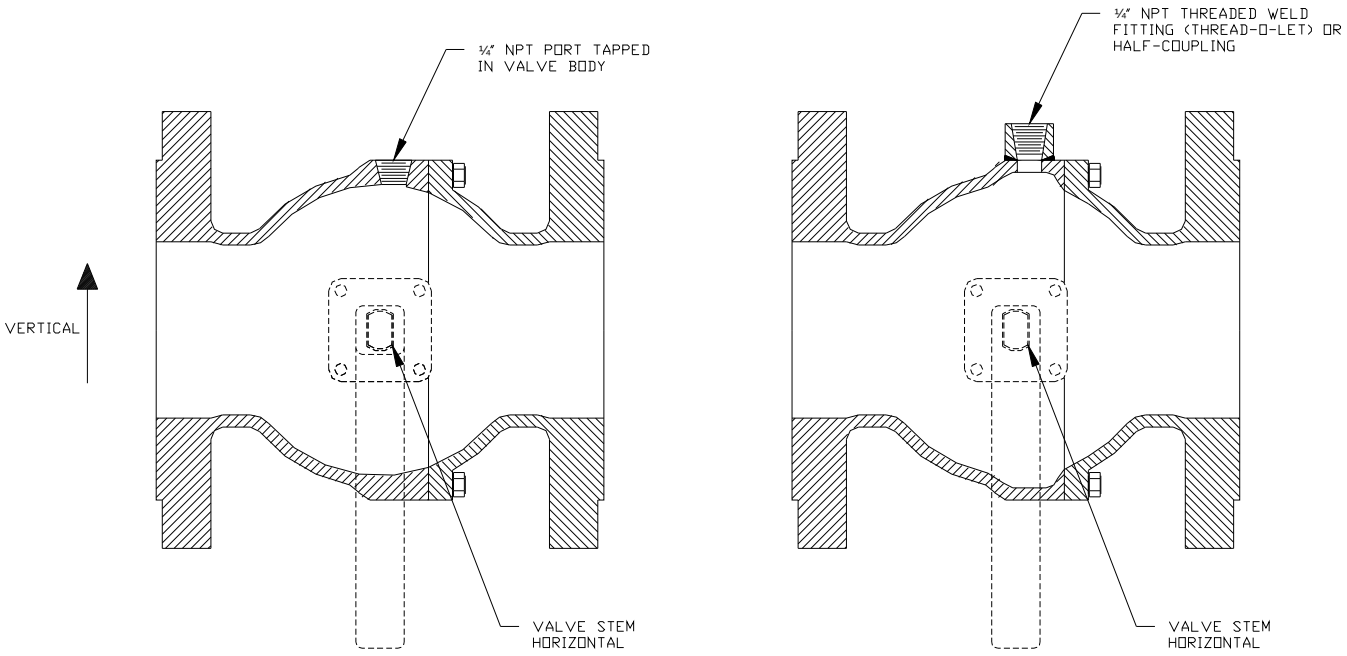
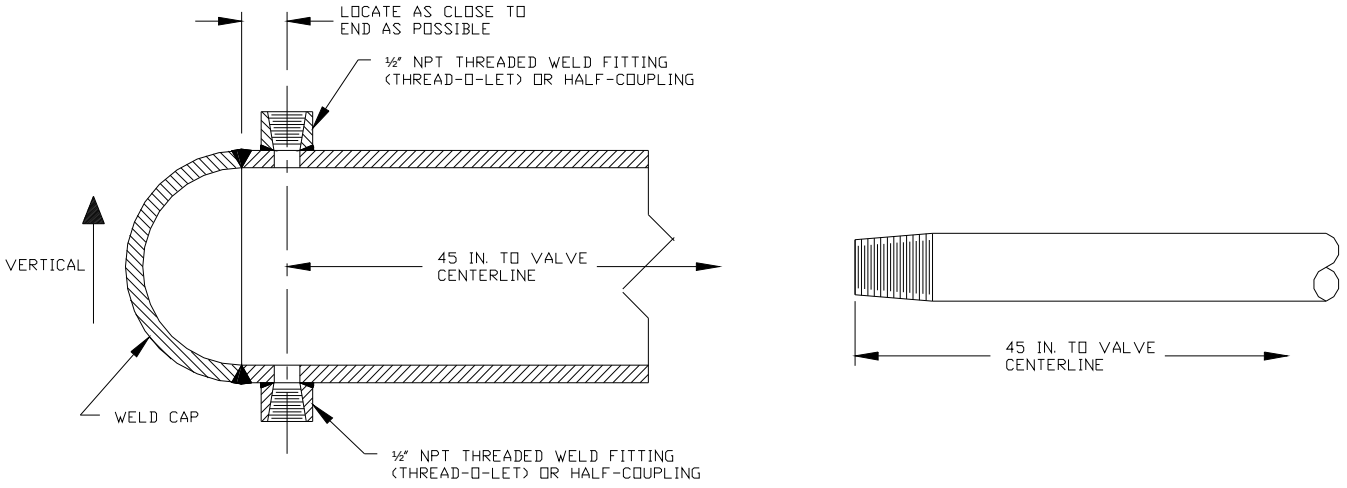


FIGURE 2. Two methods for installing the body cavity vent port in a test valve.



(A) **(B)**

FIGURE 3. Preparation details for the ends of the attached pipes. The upstream and downstream pipes are identical. For pipe sizes larger than 1" NPS, the ends should be capped and ported as shown in **(A)**. For pipe 1" NPS and below, the ends may be provided with an NPT thread as shown in **(B)**.

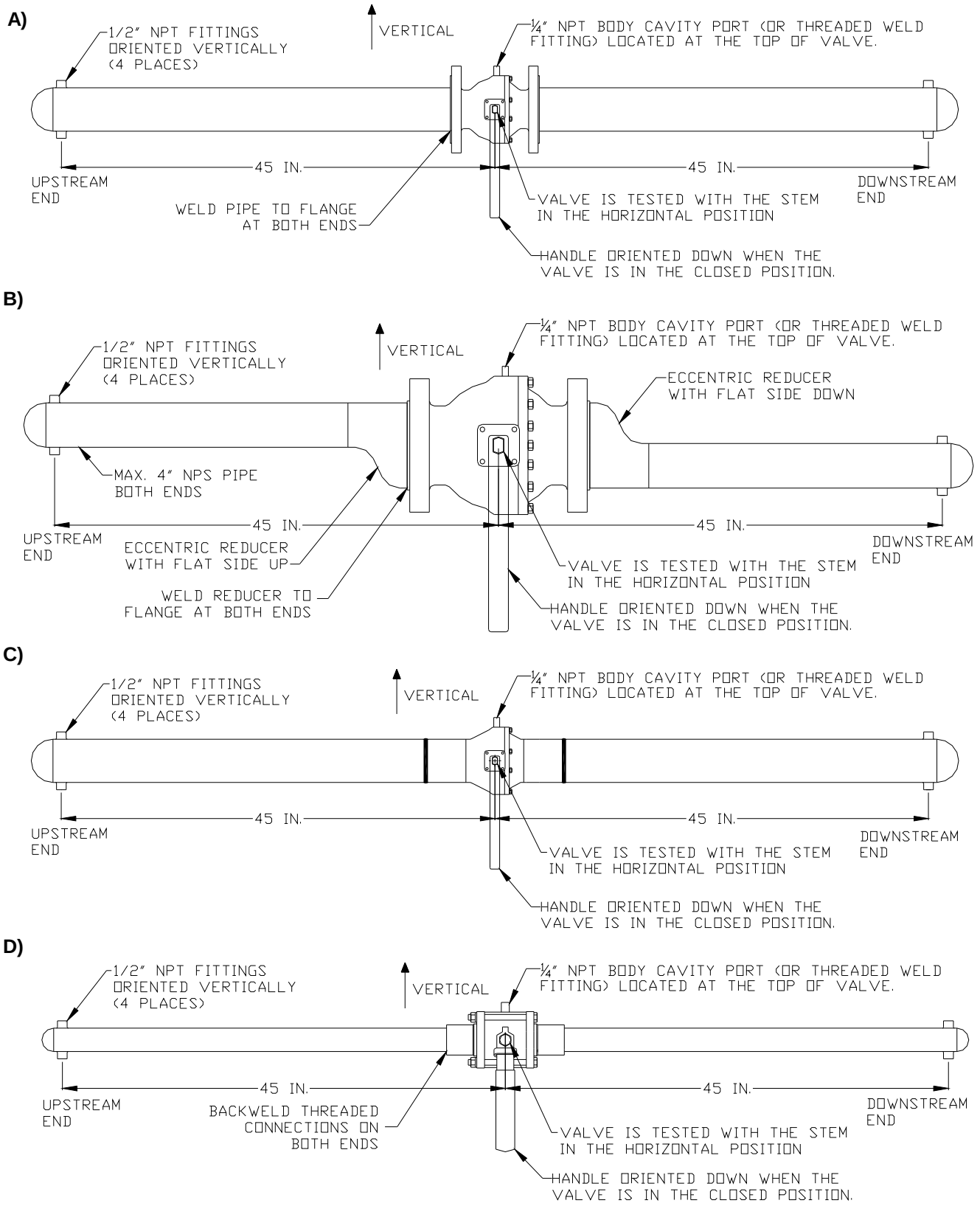


FIGURE 4. Various types of valves prepared for fire testing: **(A)** Flanged-4" NPS and smaller, **(B)** flanged-larger than 4" NPS, **(C)** buttweld or socketweld, and **(D)** threaded.