

# Seat Tightness of Pressure Relief Valves

API STANDARD 527  
THIRD EDITION, JULY 1991

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**American Petroleum Institute**  
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**Refining Department**

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**American  
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## FOREWORD

This standard describes tests to determine the seat tightness of metal- and soft-seated pressure relief valves. Valves of conventional, bellows, and pilot-operated designs are covered. Acceptable leakage rates are defined. Tests with air, steam, and water are described.

This standard requires the purchaser to specify certain details and features. Although it is recognized that the purchaser may desire to modify, delete, or amplify sections of this standard, it is strongly recommended that such modifications, deletions, and amplifications be made by supplementing this standard, rather than by rewriting or incorporating sections thereof into another complete standard.

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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, published at 54 *Federal Register* 29460 (July 12, 1989).

There are currently in use and under development a number of 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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# Seat Tightness of Pressure Relief Valves

## SECTION 1—SCOPE

This standard describes methods of determining the seat tightness of metal- and soft-seated pressure relief valves, including those of conventional, bellows, and pilot-operated designs.

The maximum acceptable leakage rates are defined for pressure relief valves with set pressures from 15 pounds per square inch gauge (103 kilopascals gauge) to 6,000 pounds per square inch gauge (41,379 kilopascals gauge). If greater seat tightness is required, the purchaser shall specify it in the purchase order.

The test medium for determining the seat tightness—air, steam, or water—shall be the same as that used for determining the set pressure of the valve.

For dual-service valves, the test medium—air, steam, or water—shall be the same as the primary relieving medium.

To ensure safety, the procedures outlined in this standard shall be performed by persons experienced in the use and functions of pressure relief valves.

## SECTION 2—TESTING WITH AIR

### 2.1 Test Apparatus

A test arrangement for determining seat tightness with air is shown in Figure 1. Leakage shall be measured using a tube with an outside diameter of  $\frac{5}{16}$  inch (7.9 millimeters) and a wall thickness of 0.035 inch (0.89 millimeter). The tube end shall be cut square and smooth. The tube opening shall be  $\frac{1}{2}$  inch (12.7 millimeters) below the surface of the water. The tube shall be perpendicular to the surface of the water.

Arrangement shall be made to safely relieve or contain body pressure in case the valve accidentally pops (see Figure 2).

### 2.2 Procedure

#### 2.2.1 TEST MEDIUM

The test medium shall be air (or nitrogen) near ambient temperature.

#### 2.2.2 TEST CONFIGURATION

The valve shall be vertically mounted on the test stand, and the test apparatus shall be attached to the valve outlet, as shown in Figure 1. All openings—including but not limited to caps, drain holes, vents, and outlets—shall be closed.

#### 2.2.3 TEST PRESSURE

For a valve whose set pressure is greater than 50 pounds per square inch gauge (345 kilopascals gauge), the leakage

rate in bubbles per minute shall be determined with the test pressure at the valve inlet held at 90 percent of the set pressure. For a valve set at 50 pounds per square inch gauge (345 kilopascals gauge) or less, the test pressure shall be held at 5 pounds per square inch (34.5 kilopascals) less than the set pressure.

#### 2.2.4 LEAKAGE TEST

Before the leakage test, the set pressure shall be demonstrated, and all valve body joints and fittings should be checked with a suitable solution to ensure that all joints are tight.

Before the bubble count, the test pressure shall be applied for at least 1 minute for a valve whose nominal pipe size is 2 inches (50 millimeters) or smaller; 2 minutes for a valve whose nominal pipe size is 2½, 3, or 4 inches (65, 80, or 100 millimeters); and 5 minutes for a valve whose nominal pipe size is 6 inches (150 millimeters) or larger. The valve shall then be observed for leakage for at least 1 minute.

### 2.3 Acceptance Criteria

For a valve with a metal seat, the leakage rate in bubbles per minute shall not exceed the appropriate value in Table 1. For a soft-seated valve, there shall be no leakage for 1 minute (0 bubbles per minute).

## SECTION 3—TESTING WITH STEAM

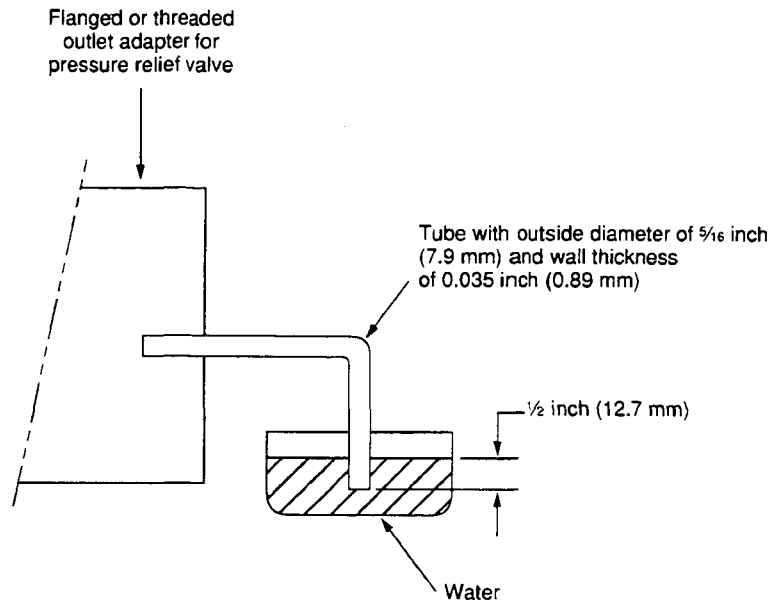
### 3.1 Procedure

#### 3.1.1 TEST MEDIUM

The test medium shall be saturated steam.

#### 3.1.2 TEST CONFIGURATION

The valve shall be vertically mounted on the steam test stand.



Note: See Figure 2 for an example of a device to relieve body pressure in case the valve accidentally pops.

Figure 1—Apparatus to Test Seat Tightness With Air

**3.1.3 TEST PRESSURE**

For a valve whose set pressure is greater than 50 pounds per square inch gauge (345 kilopascals gauge), the seat tightness shall be determined with the test pressure at the valve inlet held at 90 percent of the set pressure. For a valve set at 50 pounds per square inch gauge (345 kilopascals gauge) or

less, the test pressure shall be held at 5 pounds per square inch (34.5 kilopascals) less than the set pressure.

**3.1.4 LEAKAGE TEST**

Before starting the seat tightness test, the set pressure shall be demonstrated, and the test pressure

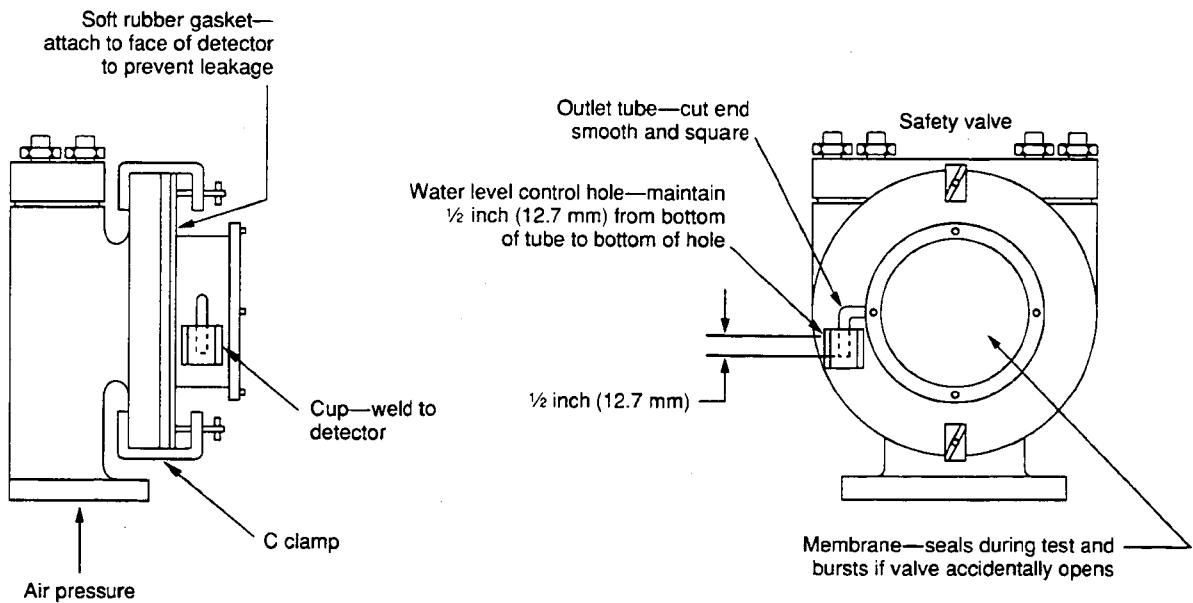


Figure 2—Device to Relieve Body Pressure Caused by Accidental Popping of the Valve



Table 1—Maximum Seat Leakage Rates for Metal-Seated Pressure Relief Valves

Set Pressure at 60°F (15.6°C)		Effective Orifice Sizes 0.307 Inch and Smaller			Effective Orifice Sizes Larger Than 0.307 Inch		
		Leakage Rate (bubbles per minute)	Approximate Leakage per 24 Hours		Leakage Rate (bubbles per minute)	Approximate Leakage per 24 Hours	
Pounds per Square Inch Gauge	Mega- pascals		Standard Cubic Feet	Standard Cubic Meters		Standard Cubic Feet	Standard Cubic Meters
15–1000	0.103–6.896	40	0.60	0.017	20	0.30	0.0085
1500	10.3	60	0.90	0.026	30	0.45	0.013
2000	13.0	80	1.20	0.034	40	0.60	0.017
2500	17.2	100	1.50	0.043	50	0.75	0.021
3000	20.7	100	1.50	0.043	60	0.90	0.026
4000	27.6	100	1.50	0.043	80	1.20	0.034
5000	38.5	100	1.50	0.043	100	1.50	0.043
6000	41.4	100	1.50	0.043	100	1.50	0.043

shall be held for at least 3 minutes. Any condensate in the body bowl shall be removed before the seat tightness test. Air (or nitrogen) may be used to dry condensate.

After any condensate has been removed, the inlet pressure shall be increased to the test pressure. Tightness shall then be checked visually using a black background.

The valve shall then be observed for leakage for at least 1 minute.

### 3.2 Acceptance Criteria

For both metal- and soft-seated valves, there shall be no audible or visible leakage for 1 minute.

## SECTION 4—TESTING WITH WATER

### 4.1 Procedure

#### 4.1.1 TEST MEDIUM

The test medium shall be water near ambient temperature.

#### 4.1.2 TEST CONFIGURATION

The valve shall be vertically mounted on the water test stand.

#### 4.1.3 TEST PRESSURE

For a valve whose set pressure is greater than 50 pounds per square inch gauge (345 kilopascals gauge), the seat tightness shall be determined with the test pressure at the valve inlet held at 90 percent of the set pressure. For a valve set at 50 pounds per square inch gauge (345 kilopascals gauge) or less, the test pressure shall be held at 5 pounds per square inch (34.5 kilopascals) less than the set pressure.

#### 4.1.4 LEAKAGE TEST

Before starting the seat tightness test, the set pressure shall be demonstrated, and the outlet body bowl shall be filled with water, which shall be allowed to stabilize with no visible flow from the valve outlet. The inlet pressure shall then be increased to the test pressure. The valve shall then be observed for 1 minute at the test pressure.

### 4.2 Acceptance Criteria

For a metal-seated valve whose inlet has a nominal pipe size of 1 inch or larger, the leakage rate shall not exceed 10 cubic centimeters per hour per inch of nominal inlet size. For a metal-seated valve whose inlet has a nominal pipe size of less than 1 inch, the leakage rate shall not exceed 10 cubic centimeters per hour. For soft-seated valves, there shall be no leakage for 1 minute.

## SECTION 5—TESTING WITH AIR—ANOTHER METHOD

### 5.1 Type of Valve to be Tested

Valves with open bonnets—bonnets that cannot be readily sealed, as specified in 2.2.2—may be tested in accordance with this section instead of Section 2.

This alternative method shall not be used to test valves in which air bubbles can travel to the open bonnet through any passageway inside the valve guide without being observed at the valve outlet.

## 5.2 Procedure

### 5.2.1 TEST MEDIUM

The test medium shall be air (or nitrogen) near ambient temperature.

### 5.2.2 TEST CONFIGURATION

The valve shall be vertically mounted on the air test stand. The valve outlet shall be partially sealed with water to about  $\frac{1}{2}$  inch (12.7 millimeters) above the nozzle's seating surface.

### 5.2.3 TEST PRESSURE

For a valve whose set pressure is greater than 50 pounds per square inch gauge (345 kilopascals gauge), the leakage rate in bubbles per minute shall be determined with the test pressure at the valve inlet held at 90 percent of the set pressure. For a valve set at 50 pounds per square inch gauge (345 kilopascals gauge) or less, the test pressure shall be

held at 5 pounds per square inch (34.5 kilopascals) less than the set pressure.

### 5.2.4 LEAKAGE TEST

Before starting the seat tightness test, the set pressure shall be demonstrated, and the outlet body bowl shall be filled with water to the level of the partial seal. The inlet pressure shall then be increased to the test pressure and held at this pressure for 1 minute before the bubble count. The valve shall then be observed for leakage for at least 1 minute.

*CAUTION:* When looking for leakage, the observer shall use a mirror or some other indirect means of observation so that the observer's face is not in line with the outlet of the valve, in case the valve accidentally pops.

## 5.3 Acceptance Criteria

For a valve with a metal seat, the leakage rate in bubbles per minute shall not exceed 50 percent of the appropriate value in Table 1. For a soft-seated valve, there shall be no leakage for 1 minute (0 bubbles per minute).

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