STANDARDS FOR CONTROL VALVE SEAT LEAKAGE

1. PURPOSE

1.1 This standard establishes a series of seat leakage classes for control valves and defines the test procedures.

2. SCOPE & LIMITATIONS

2.1 Selection of a leakage class is not restricted as to valve design but acceptable values for various commercially available designs are suggested for each class under Section 4.

2.2 The standard cannot be used as a basis for predicting leakage at conditions other than those specified.

2.3 The standard does not apply to control valves with a rated Cv less than 0.1.

3. DEFINITIONS

3.1 Control Valve

3.1.1 A valve with a power positioning actuator for moving closure member to any position relative to valve port or ports in response to and in proportion to an external signal. The energy for a control valve actuator is derived from an independent source.

3.1.2 Control valve body subassemblies on which an actuator is to be mounted at some later date are within the intent of this definition.

3.2 Cv

- An experimentally determined valve sizing coefficient. (Ref. ISA S39.1,2,3 and 4).

3.3 Rated Valve Capacity

- The quantity of test fluid (air or water) that would pass through the valve at rated travel under the stated pressure conditions as determined by the appropriate equations and manufacturer's ratings.

3.4 Rated Travel

- The valve travel at which the manufacturer's rating is established.

3.5 Seat Leakage

- The quantity of test fluid passing through an assembled valve in the closed position under the test conditions as defined.

4. LEAKAGE SPECIFICATIONS & CLASSES

4.1 The maximum allowable seat leakage as specified for each class shall not exceed the seat leakage in Table 1 using the test procedure as defined in Section 5. For Classes II through VI each and every valve shall be tested.

4.2 Leakage Classes

4.2.1 CLASS I

- A modification of any Class II, III, or IV valve where design intent is the same as the basic class, but by agreement between user and supplier, no test is required.

4.2.2 CLASS II

- This class establishes the maximum permissible leakage generally associated with commercial double-port, double-seat control valves or balanced single-port control valves with a piston ring seal and metal-to-metal seats. Use test procedure Type A.

4.2.3 CLASS III

- This class establishes the maximum permissible leakage generally associated with Class II (4.2.2), but with a higher degree of seat and seal tightness. Use test procedure Type A.

4.2.4 CLASS IV

- This class establishes the maximum permissible leakage generally associated with commercial unbalanced single-port, single-seat control valves and balanced single-port control valves with extra tight piston rings or other sealing means and metal-to-metal seats. Use test procedure Type A.

4.2.5 CLASS V

- This class is usually specified for critical applications where the control valve may be required to be closed, without a blocking valve, for long periods of time with high differential pressure across the seating surfaces. It requires special manufacturing assembly and testing techniques. This class is generally associated with metal seat, unbalanced single-port, single seat control valves or balanced single port designs with exceptional seat and seal tightness. Use test procedure Type B using water at the maximum operating differential pressure.

4.2.6 CLASS VI

–This class establishes the maximum permissible seat leakage generally associated with resilient seating control valves either unbalanced or balanced single port with "O" rings or similar gapless seals. Use test procedure Type C.

TABLE 1

Leakage Class	Maximum Seat Leakage	Test Procedure
Class I (See 4.2.1)	See paragraph 4.2.1	None
Class II (See 4.2.2)	0.5% of rated valve capacity	Type A (See 5.1)
Class III (See 4.2.3)	0.1% of rated valve capacity	Type A (See 5.1)
Class IV (See 4.2.4)	0.01% of rated valve capacity	Type A (See 5.1)
Class V (See 4.2.5)	5×10^{-4} ml per minute of water per inch of orifice diameter per psi differential (5×10^{-12} m^3 per second of water per mm of orifice diameter per bar differential)	Type B (See 5.2)
Class VI (See 4.2.6)	Leakage per paragraph 5.3.4 as expressed in ml per minute versus port diameter	Type C (See 5.3)

5. TEST PROCEDURES

5.1 Test Procedure Type A

5.1.1 Test medium shall be clean air or water at 10-52 deg C (50-125 deg F).

5.1.2 Pressure of test medium shall be 3-4 bar (45-60 psig) or the maximum operating differential pressure whichever is less.

5.1.3 Leakage flow and pressure data shall be accurate to ± 10 percent of reading.

5.1.4 The test fluid shall be applied to the normal or specified valve body inlet. The valve body outlet may be open to atmosphere or connected to a low headloss measuring device.

5.1.5 The actuator shall be adjusted to meet the operating conditions specified. The full normal closing thrust as applied by air pressure, a spring or other means shall then be applied. No allowance or adjustment shall be made to compensate for any increase in seat load obtained when the test differential is less than the maximum valve operating differential pressure.

5.1.6 On valve body assemblies made for stock, tested without the actuator, a test fixture should be utilised which applies a net seat load not exceeding the manufacturer's normal expected load under maximum service conditions.

5.1.7 On water test, care shall be taken to eliminate air pockets in the valve body and piping.

5.1.8 The leakage rate thus obtained can then be compared to the calculated values for Classes II, III and IV, Table 1.

5.2 Test Procedure Type B

5.2.1 Test fluid shall be clean water at 10-52 deg C (50-125 deg F).

5.2.2 The water test differential pressure shall be the maximum service pressure drop across the valve plug, not exceeding the maximum operating pressure at room temperature as determined by ANSI B16.1. B16.5, or B16.34, or some lesser pressure by individual agreement (7 bar (100 psi) pressure drop minimum). Pressure measurement accuracy is to be in accordance with Paragraph 5.1.3.

5.2.3 Test fluid shall be applied to the normal or specified inlet of the valve body. The valve plug shall be opened and the valve body assembly filled completely with water, including outlet portion and any downstream connecting piping, and then stroked closed.

5.2.4 The water test differential pressure as specified in 5.2.2 is then applied with the actuator adjusted to meet the operating conditions specified. The net actuator thrust shall be the specified maximum. Net actuator thrust above the specified maximum is not to be used.

5.2.5 When leakage flow is stabilised, the quantity should be observed over a period of time sufficient to obtain the accuracy under Paragraph 5.1.3.

5.2.6 The leakage rate thus obtained shall not be greater than the value calculated from the definition of maximum seat leakage for Class V as shown in Table 1. The orifice diameter is understood to be the diameter at the point of seating contact to the nearest 2 millimeters (1/16 inch).

5.3 Test Procedure Type C - Class VI

5.3.1 Test medium shall be air or nitrogen gas at 10-52 deg C (50-125 deg F).

5.3.2 Pressure of the test medium shall be the maximum rated differential pressure across the valve plug or 3.5 bar (50 psi) whichever is the least.

5.3.3 The test fluid shall be applied to the normal or specified valve body inlet, and the outlet connected to a suitable measuring device.

5.3.4 With the control valve adjusted to meet the operating conditions specified (See Paragraphs 5.1.5 and 5.1.6) and with sufficient time allowance for stabilising flow, the leak rate shall not exceed the values in Table 2.

TABLE 2

Nominal Port Diameter			
Millimeters	Inches	ml per Minute	Bubbles per Minute*
25	1	0.15	1
38	$1^1/_2$	0.30	2
51	2	0.45	3
64	$2^1/_2$	0.60	4
76	3	0.90	6
102	4	1.70	11
152	6	4.00	27
203	8	6.75	45

* Bubbles per minute as tabulated are a suggested alternative based on a suitable calibrated measuring device, in this case a 1/4 inch (6.3mm) O.D. x 0.032 inch (0.8mm) wall tube submerged in water to a depth of from 1/8 to 1/4 inch (3 to 6mm). The tube end shall be cut square and smooth with no chamfers or burrs and the tube axis shall be perpendicular to the surface of the water. Other apparatus may be constructed and the number of bubbles per minute may differ from those shown as long as they correctly indicate the flow in ml per minute.

Note: Provisions should be made to avoid overpressuring of measuring devices resulting from inadvertent opening of the valve plug.