

Leakage Classifications of Control Valves

Classification of seat leakage through control valves

Control valves are designed to throttle and not necessary to close 100%.

A control valve's ability to shut off has to do with many factors as the type of valves for instance. A double seated control valve have very poor shut off capability. The guiding, seat material, actuator thrust, pressure drop, and the type of fluid can all play a part in how well a particular control valve shuts off.

Seat Leakage Classifications

There are actually six different seat leakage classifications as defined by [ANSI/FCI 70-2 1976\(R1982\)](#).

The most common used are

- CLASS IV
- CLASS VI

CLASS IV is also known as **metal to metal**. It is the kind of leakage rate you can expect from a valve with a metal plug and metal seat.

CLASS VI is known as a **soft seat** classification. Soft Seat Valves are those where either the plug or seat or both are made from some kind of composition material such as Teflon or similar.

Valve Leakage Classifications

Class I - Valve Leakage Classifications

Identical to Class II, III, and IV in construction and design intent, but no actual shop test is made. Class I is also known as dust tight and can refer to metal or resilient seated valves.

Class II - Valve Leakage Classifications

Intended for double port or balanced single port valves with a metal piston ring seal and metal to metal seats.

- 0.5% leakage of full open valve capacity.
- Service dP or 50 psid (3.4 bar differential), whichever is lower at 50 to 125°F.
- Test medium air at 45 to 60 psig is the test fluid.

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Typical constructions:

- Balanced, single port, single graphite piston ring, metal seat, low seat load
- Balanced, double port, metal seats, high seat load

Class III - Valve Leakage Classifications

Intended for the same types of valves as in Class II.

- 0.1% leakage of full open valve capacity.
- Service dP or 50 psid (3.4 bar differential), whichever is lower at 50 to 125°F.
- Test medium air at 45 to 60 psig is the test fluid.

Typical constructions:

- Balanced, double port, soft seats, low seat load
- Balanced, single port, single graphite piston ring, lapped metal seats, medium seat load

Class IV - Valve Leakage Classifications

Intended for single port and balanced single port valves with extra tight piston seals and metal to-metal seats.

- 0.01% leakage of full open valve capacity.
- Service dP or 50 psid (3.4 bar differential), whichever is lower at 50 to 125°F.
- Test medium air at 45 to 60 psig is the test fluid.

Typical constructions:

- Balanced, single port, Teflon piston ring, lapped metal seats, medium seat load
- Balanced, single port, multiple graphite piston rings, lapped metal seats
- Unbalanced, single port, lapped metal seats, medium seat load
- Class IV is also known as metal to metal

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Class V - Valve Leakage Classifications

Intended for the same types of valves as Class IV.

- The test fluid is water at 100 psig or operating pressure.
- Leakage allowed is limited to 5 x 10 ml per minute per inch of orifice diameter per psi differential.
- Service dP at 50 to 125 °F.

Typical constructions:

- Unbalanced, single port, lapped metal seats, high seat load
- Balanced, single port, Teflon piston rings, soft seats, low seat load
- Unbalanced, single port, soft metal seats, high seat load

Class VI - Valve Leakage Classifications

Class VI is known as a soft seat classification. Soft Seat Valves are those where the seat or shut-off disc or both are made from some kind of resilient material such as Teflon. Intended for resilient seating valves.

- The test fluid is air or nitrogen.
- Pressure is the lesser of 50 psig or operating pressure.
- The leakage limit depends on valve size and ranges from 0.15 to 6.75 ml per minute for valve sizes 1 through 8 inches.

Port Diameter		Bubbles per minute	ml per minute
inches	Millimeters		
1	25	1	0.15
1 1/2	38	2	0.30
2	51	3	0.45
2 1/2	64	4	0.60
3	76	6	0.90
4	102	11	1.70
6	152	27	4.00
8	203	45	6.75
10	254	63	9
12	305	81	11.5

Typical constructions:

- Unbalanced, single port, soft seats, low load

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Control Valve Leakage Classification - Overview

Leakage Class Designation	Maximum Leakage Allowable	Test Medium	Test Pressure	Testing Procedures Required for Establishing Rating
I	x	x	x	No test required
II	0.5% of rated capacity	Air or water at 50 - 125° F (10 - 52°C)	45 - 60 psig or maximum operating differential whichever is lower	45 - 60 psig or maximum operating differential whichever is lower
III	0.1% of rated capacity	As above	As above	As above
IV	0.01% of rated capacity	As above	As above	As above
V	0.0005 ml per minute of water per inch of port diameter per psi differential	Water at 50 to 125°F (10 to 52°C)	Maximum service pressure drop across valve plug not to exceed ANSI body rating	Maximum service pressure drop across valve plug not to exceed ANSI body rating
VI	Not to exceed amounts shown in the table above	Air or nitrogen at 50 to 125° F (10 to 52°C)	50 psig or max rated differential pressure across valve plug whichever is lower	Actuator should be adjusted to operating conditions specified with full normal closing thrust applied to valve plug seat