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1 Scope

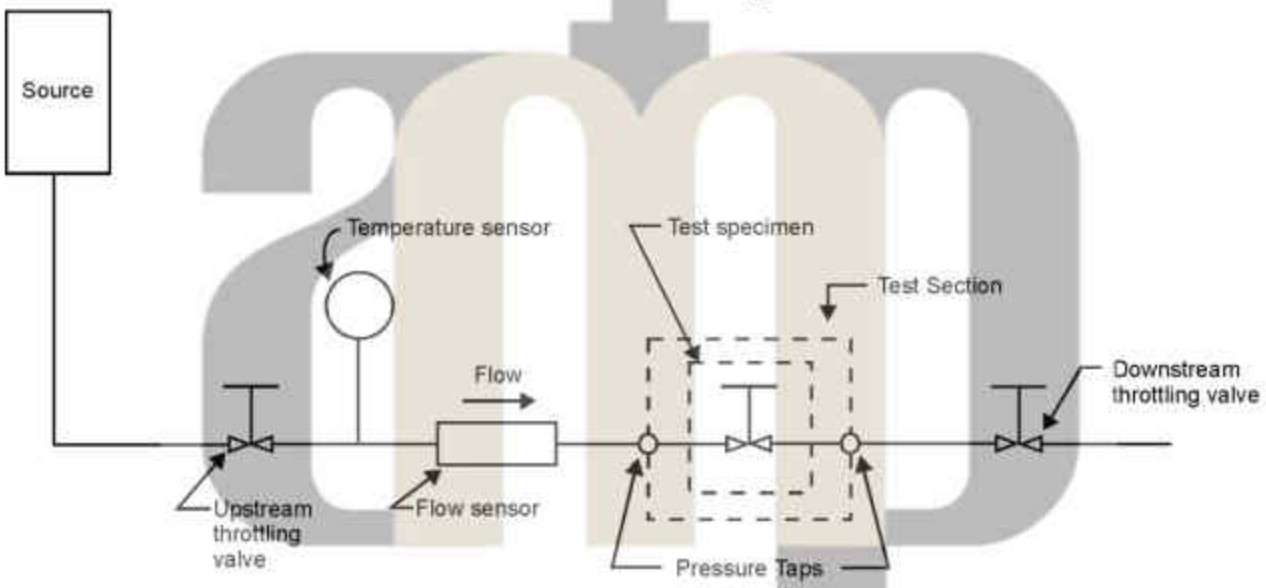
This test standard utilizes the mathematical equations outlined in ANSI/ISA-S75.01, Flow Equations for Sizing Control Valves, in providing a test procedure for obtaining the following Cv.

The purpose of this standard is to provide a procedure for testing control valve capacity and **related flow coefficients** for incompressible fluids.

2 Test system

2.1 General description: A basic flow test system as shown in Figure 1

Figure 1



2.2 Test specimen: The test specimen is any valve or combination of valve, pipe reducer, and expander or other devices attached to the valve body for which test data are required. Modeling of valves to a smaller scale is an acceptable practice in this standard, although testing of full-size valves or models is preferable. Good practice in modeling requires attention to significant relationships such as Reynolds Number, the Mach number where compressibility is important, and geometric similarity.

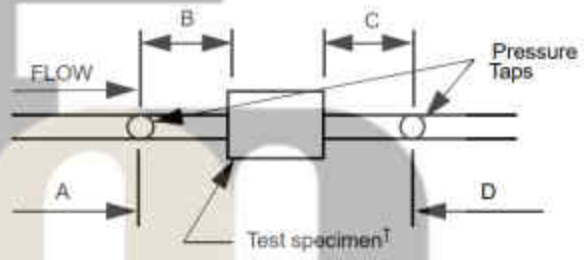
2.3 Test section: The upstream and downstream piping adjacent to the test specimen shall conform to the nominal size of the test specimen connection and to the length requirements of Table 1. The piping on both sides of the test specimen shall be Schedule 40 pipe for valves through 250-mm (10-in.) size having a pressure rating up to and including ANSI Class 600. Pipe having 10-mm (0.375-in.) wall may be used for 300-mm (12-in.) through 600-mm (24-in.) sizes. An effort should be made to match the inside diameter at the inlet and outlet of the test specimen with the inside diameter of the adjacent piping for valves outside the above limits. The inside surfaces shall be reasonably free of flaking rust or mill scale and without irregularities that could cause excessive fluid frictional losses.

2.4 Throttling valves: The upstream and downstream throttling valves are used to control the pressure differential across the test section pressure taps and to maintain a specific downstream pressure. There are no restrictions as to style of these valves. However, the downstream valve should be of sufficient capacity to ensure that choked flow can be achieved at the test specimen for both compressible and incompressible flow. Vaporization at the upstream valve must be avoided when testing with liquids.

2.5 Flow measurement: The flow-measuring instrument may be any device that meets specified accuracy. This instrument will be used to determine the true time average flow rate within an error not exceeding ± 2 percent of the actual value. The resolution and repeatability of the instrument shall be within ± 0.5 percent. The measuring instrument shall be calibrated as frequently as necessary to maintain specified accuracy.

2.6 Pressure measurement: All pressure and pressure differential measurements shall be made to an error not exceeding ± 2 percent of actual value. Pressure-measuring devices shall be calibrated as frequently as necessary to maintain specified accuracy. Pressure differential instruments are required in the measurement of the pressure differential across the test specimen to avoid additional inaccuracies resulting from taking the difference of two measurements. Exceptions to this are the procedures in Sections 6.2 and 8.2 in ISA 7502 for determining maximum flow rates for incompressible and compressible flow, respectively.

Table 1

A*,**	B	C	D	Standard Test Section Configuration
At least 18 nominal pipe diameters of straight pipe	2 nominal pipe diameters of straight pipe	6 nominal pipe diameter of straight pipe	At least 1 nominal pipe diameter of straight pipe	

* Dimension "A" may be reduced to 8 nominal diameters if straightening vanes are used.
Information concerning the design of straightening vanes can be found in ASME Performance Test Code PTC 19.5-1972, "Applications."
** If an upstream flow disturbance consists of two ells in series and they are in different planes, dimension "A" must exceed 18 nominal pipe diameters unless straightening vanes are used.
†See Section 2.2 for definition of the test specimen

2.7 Temperature measurement: The fluid temperature shall be measured to an error not exceeding ±1°C (± 2°F) of actual value. The inlet fluid temperature shall remain constant within ±3°C (±5°F) during the test run to record data for each specific test point.

2.8 Accuracy of test: Valves having an N3 Cv / 2 ratio of less than 30 will have a calculated flow coefficient, Cv, of the test specimen within a tolerance of ± 5 percent.

3 Test procedure for water

The procedures for data evaluation of these tests follow in ISA 75.02 Section 7.

3.1 Cv Test procedure

The following test procedure is required to obtain test data for the calculation of the flow coefficient Cv. The data evaluation procedure is provided in ISA 75.02 Section 7.1.

3.1.1 Install the test specimen without reducers or other attached devices in accordance with piping requirements in Table 1.

3.1.2 Flow tests shall include flow measurements at three widely spaced pressure differentials
within the turbulent, non-vaporizing region. The suggested differential pressures are:

a) just below the onset of cavitation or the maximum available in the test facility, whichever is less;

b) about 50% of the pressure differential of (a); and
c) about 10% of the pressure differential of (a) and shall be measured across the test section pressure taps with the valve at the rated travel.
The line velocity should not exceed 13.7 m/s (45 ft/s).
A minimum valve Reynolds Number, Rev, of 105 is recommended. Deviations from standard requirements shall be recorded.
For large valves where flow source limitations are reached, lower pressure differentials may be used optionally as long as turbulent flow is maintained. Deviations from standard requirements shall be recorded.

3.1.3 The valve flow test shall be performed at 100 percent of rated valve travel. Optional tests may be performed at each 10 percent of rated valve travel or any other points to more fully determine the inherent characteristic of the specimen.

3.1.4 The following data shall be recorded:
a) Valve travel (measurement error not exceeding ±0.5 percent of rated travel)
b) Upstream pressure (p_1) (measurement error not exceeding ±2 percent of actual value)
c) Pressure differential (Δp) across test section pressure taps (measurement error not exceeding±2 percent of actual value)
d) Volumetric flow rate (q) (measurement error not exceeding ±2 percent of actual value)
e) Fluid inlet temperature (T_1) (measurement error not exceeding ±1°C[±2°F])
f) Barometric pressure (measurement error not exceeding ±2 percent of actual value).
g) Physical description of test specimen (i.e., type of valve, flow direction, etc.)
h) Physical description of test system and test fluid.