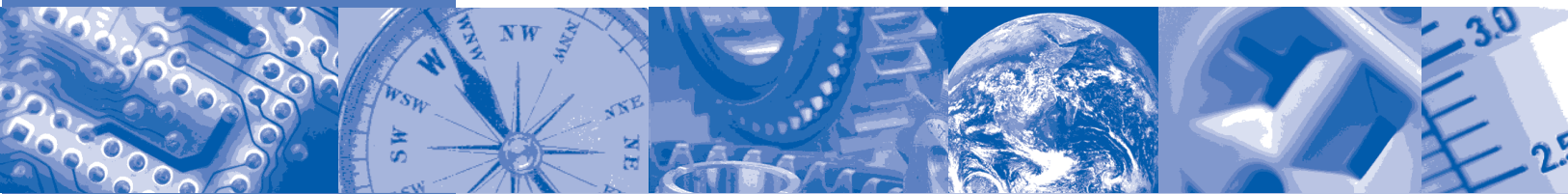


ANSI/ISA-75.11.01-1985 (R2002)

Formerly ISA-75.11-1985 (R1997)



Inherent Flow Characteristic and Rangeability of Control Valves



**ISA—The Instrumentation,
Systems, and
Automation Society**

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Inherent Flow Characteristic and Rangeability of Control Valves

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1 Scope

The scope of this standard is to define the statement of typical control valve inherent flow characteristics and inherent rangeabilities, and to establish criteria for adherence to manufacturer-specified flow characteristics.

2 Basic definitions

2.1 Terminology

Basic terminology used herein is based on definitions stated in "Control Valve Terminology" ANSI/ISA-75.05.01-2000.

2.1.1 flow coefficient:

a constant (C_v), related to the geometry of a valve, for a given valve opening, that can be used to predict flow rate. See ANSI/ISA-75.01-1985 (R1995), "Flow Equations for Sizing Control Valves" and ANSI/ISA-75.02-1996, "Control Valve Capacity Test Procedures."

2.1.3 inherent flow characteristic:

the relationship between the flow rate through a valve and the travel of the closure member as the closure member is moved from the closed position to rated travel with constant pressure drop across the valve.

2.1.4 inherent rangeability:

the ratio of the largest flow coefficient (C_v) to the smallest flow coefficient (C_v) within which the deviation from the specified inherent flow characteristic does not exceed the limits stated in Clause 4.

2.1.5 relative flow coefficient (ϕ):

the ratio of the flow coefficient (C_v) at a stated travel to the flow coefficient (C_v) at rated travel.

2.1.6 relative travel (h):

The ratio of the travel at a given opening to the rated travel.

3 Typical inherent flow characteristics

3.1 The typical inherent flow characteristic for a specific size, type, and trim configuration of a control valve shall be specified by the manufacturers either graphically or in tabular form.

3.2 When tabulated, specific flow coefficients shall be stated for the following travel positions: at 5%, 10%, 20%, and every subsequent 10% of rated travel up to and including 100%.

3.3 The manufacturer may publish flow coefficients in addition to those at the above-stated travel positions.

3.4 In addition, the manufacturer is encouraged to specify the generic name of a specific flow characteristic such as "Linear," "Equal-Percentage," etc., if applicable, following the definitions in ANSI/ISA-75.05.01-2000.

3.5 The manufacturer shall state the largest flow coefficient that meets the criteria of Clause 4 if it is less than the rated flow coefficient. (See Figure 2.)

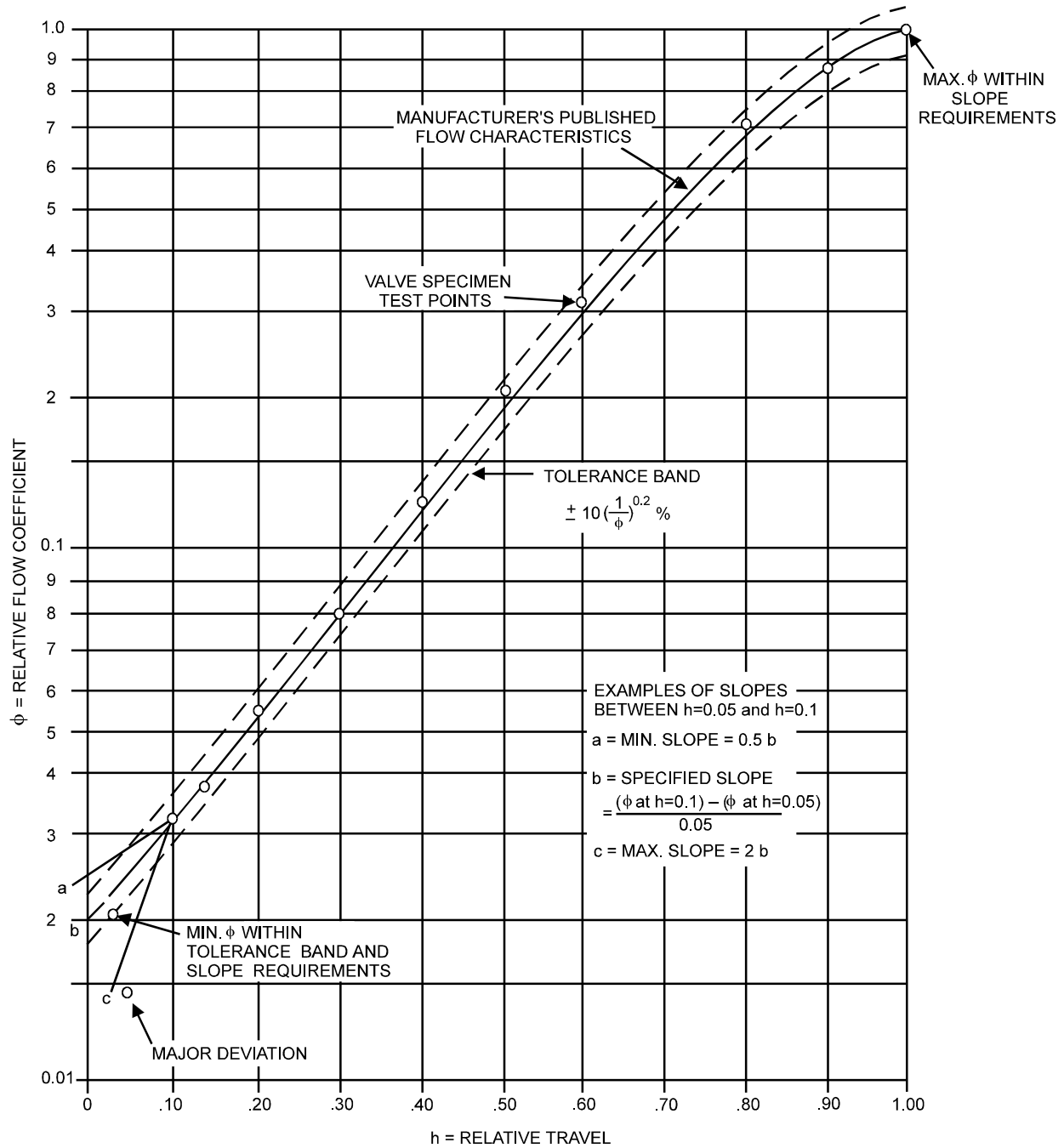
4 Permissible deviations between actual and manufacturer-stated inherent flow characteristics

4.1 When subjected to a flow test per ANSI/ISA-75.02-1996, the individual test C_v values may not deviate by more than $\pm 10 \{1/\phi\}^{0.2}$ percent from those values specified in the flow characteristic published by the manufacturer. Exceptions of this are C_v s at given travel positions falling below a C_v value of 5, or above a C_v value of $30d^2$. In the above relationships, d is the nominal valve size in inches, and ϕ is the relative flow coefficient based on published C_v s. Allowable deviations calculated by the above equation are listed in Table 1.

Table 1 — Permissible deviations between actual and manufacturer-stated inherent flow characteristics

% C_v Rated	ϕ	Permitted +/- Deviation (%)	ϕ Range	
			High	Low
5	0.05	18.2	0.0591	0.0409
10	0.1	15.8	0.116	0.0842
20	0.2	13.8	0.227	0.172
30	0.3	12.7	0.338	0.262
40	0.4	12.0	0.448	0.352
50	0.5	11.5	0.557	0.443
60	0.6	11.1	0.667	0.533
70	0.7	10.7	0.775	0.625
80	0.8	10.4	0.883	0.717
90	0.9	10.2	0.992	0.808
100	1.0	10.0	1.100	0.900

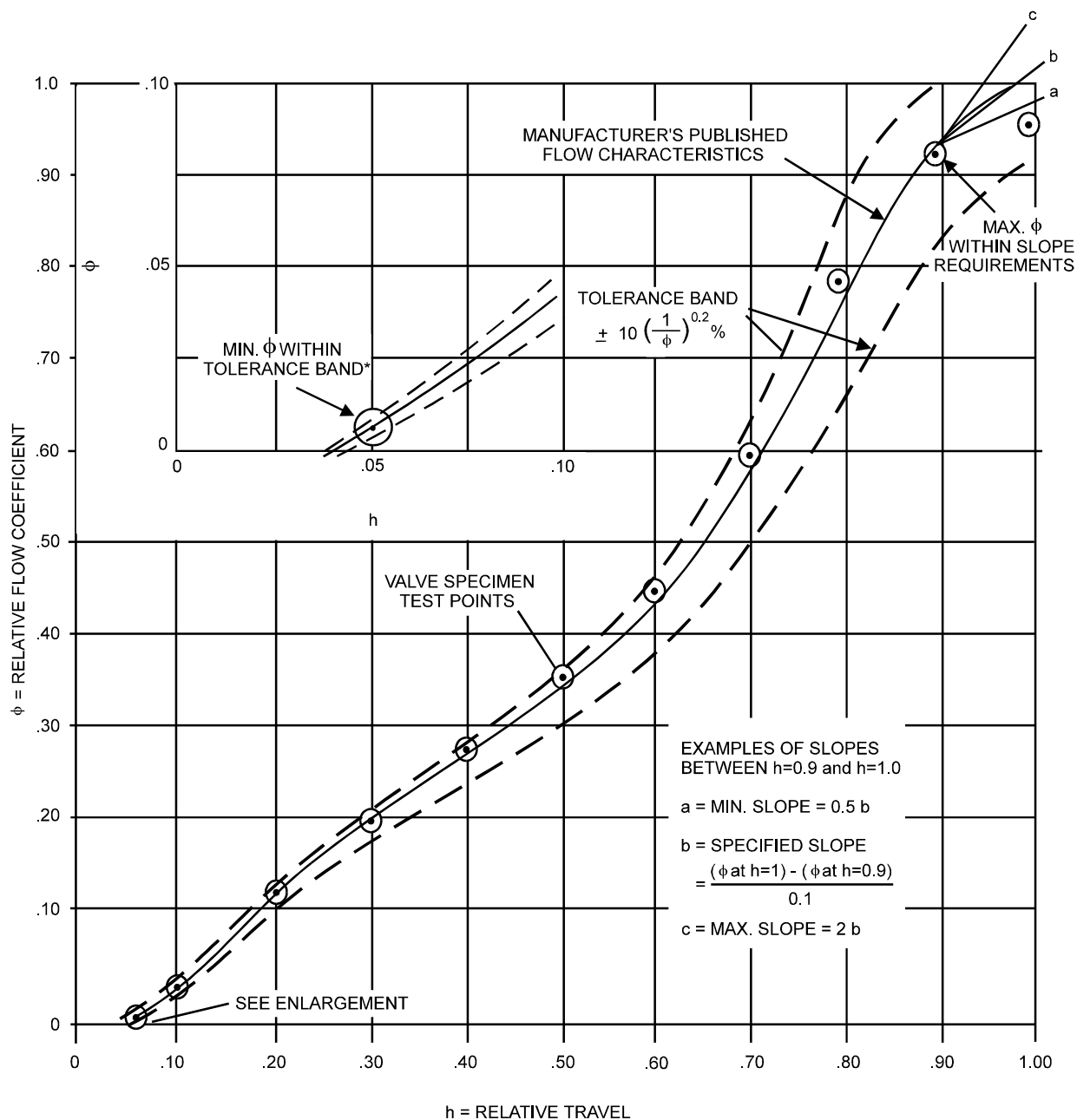
4.2 The inherent flow characteristic of a control valve, when plotted from test data at the stated increments of travel, shall show no major deviations in slope. By definition, a major deviation is when the slope of the line connecting two adjacent test points varies by more than 2 to 1 or 0.5 to 1 from the slope of a line drawn between flow coefficients specified by the manufacturer for the same travel positions. (See Figure 1.)



INHERENT RANGEABILITY OF TEST SPECIMEN (per Section 2.4):
 $\frac{\phi_{\text{MAX.}}}{\phi_{\text{MIN.}}} = \frac{\phi_{1.000}}{\phi_{0.021}} = 47.6$

The maximum flow coefficient φ meeting the requirement of Section 4 is 1.000; the minimum φ is 0.021.

Figure 1 — Example of globe valve specimen compared to manufacturer-specified flow characteristic



INHERENT RANGEABILITY OF TEST SPECIMEN (per Section 2.4):

$$\frac{\phi \text{ MAX.}}{\phi \text{ MIN.}} = \frac{\phi \text{ 0.91}}{\phi \text{ 0.01}} = 91$$

The maximum flow coefficient ϕ meeting the requirements of Section 4 is 0.91; the minimum ϕ is 0.01.

*Tolerance band for $\phi = 0.01$ is $10 \left\{ \frac{1}{0.01} \right\}^{0.2} = \pm 25\%$ of $\phi = 0.01$.

Figure 2 — Example of butterfly valve specimen compared to manufacturer-specified flow characteristic

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