

White Paper for the design of Tailored of Plunger Valves.

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Abstract

The scope of this With paper is to provide guidelines for designing the Inherent Control Valve Flow Characteristics in such a way as to allow linear Installed Flow Characteristics.

Contents

1	Scope	1
2	Basic definitions	1
3	Exempla A	2
	Reference	2

1 Scope

The inherent and installed flow characteristic, the relationship between flow coefficient and valve stroke, has been a subject of misunderstandings and endless debate with water transport and distribution systems operators.

The control valves must be analyzed from the perspective of their *inherent characteristics* and their system behavior (*Installed characteristics*). The “*inherent flow characteristic*” is 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 a constant pressure drop across the valve. *The Inherent flow characteristics* are determined under laboratory conditions. But, what interests hydraulic design engineers, control engineers, and automation engineers are *the installed flow characteristics*. “*The Installed flow characteristics*” include both the valve and pipeline effects. In other words, One crucial requirement in selecting the proper control valve is ensuring that the valve has the properly *installed flow characteristic*. *The installed flow characteristic* usually differs from the inherent due to changes in pressure drop: as flow increases, there is less pressure drop available across the valve. It’s generally desirable to have a linear installed characteristic.

2 Basic definitions

Basic terminology used herein is based on definitions stated in “Control Valve Terminology” [2] or applicable IEC standards.

- **Flow coefficient:** Flow coefficient is a constant (K_v) related to the geometry of a valve plus cylinder (obturator) for a given valve opening that can be used to predict flow rate; see ANSI/ISA-75.01.01 (IEC 60534-2-1 Mod)-2007, “Flow Equations for Sizing Control Valves,” [1] and ANSI/ISA-75.02.01-2008, “Control Valve Capacity Test Procedures” [3].
- **Inherent flow characteristic:** The Inherent flow characteristic is 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 a constant pressure drop across the valve [4]. The Inherent flow characteristics are determined under laboratory conditions by testing the valve flow versus valve position or travel using a constant differential pressure drop across the valve through the test. Manufacturers publish the inherent flow characteristics for each control valve plus the cylinder. The Inherent flow characteristics are standardized for a fixed pressure drop as defined using the valve flow coefficient value K_v .
- **Inherent flow characteristic curves:** Control valves can be mounted with different cylinders in such a way as to present different performance curves for the percentage of rated $K_{v_{max}}$ versus the percent of rated travel of the cylinder. There are three basic characteristics: Quick opening; Linear and Equal percentage.
- **Relative flow coefficient (ϕ):** The relative flow coefficient is the flow coefficient ($K_{v_{max}}$) ratio at a stated full open to the flow coefficient (K_v) at rated travel [4].

3 Exempla A

A reservoir supplies water to a system in which a control valve is used to maintain the downstream elevation at 5 meter.

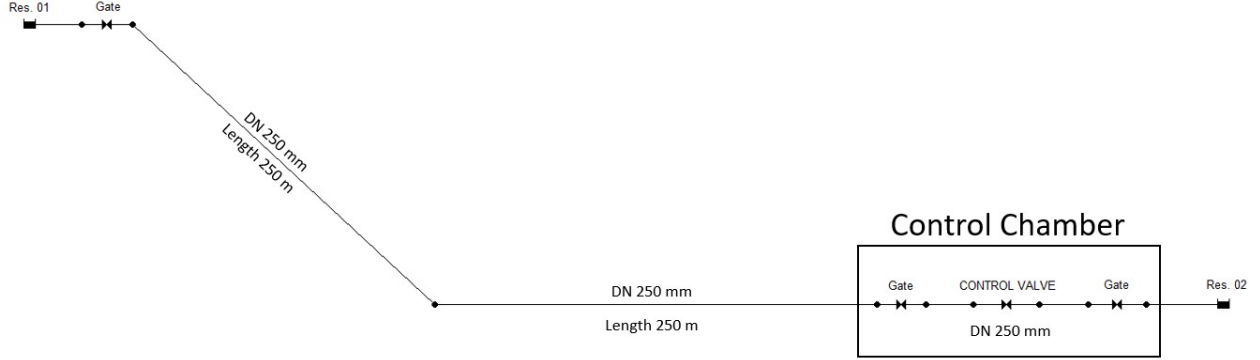


Figure 1: Flow Schematic

Reference

- [1] AMERICAN NATIONAL STANDARDS INSTITUTE ; INTERNATIONAL SOCIETY OF AUTOMATION: ANSI/ISA-75.01.01-2007, Flow equations for sizing control valves.
- [2] AMERICAN NATIONAL STANDARDS INSTITUTE ; ISA–THE INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY ; INSTRUMENT SOCIETY OF AMERICA: ANSI/ISA-75.05.01-2000 (R2005), Control Valve Terminology.
- [3] INTERNATIONAL SOCIETY OF AUTOMATION ; AMERICAN NATIONAL STANDARDS INSTITUTE: ANSI/ISA-75.02.01-2008, Control valve capacity test procedures.

- [4] INTERNATIONAL SOCIETY OF AUTOMATION ; AMERICAN NATIONAL STANDARDS INSTITUTE: ISA-75.11-2013 (2013), Inherent flow characteristic and rangeability of control valves.