White Paper for the design of Tailored of Plunger Valves.

Dr. Raúl Trujillo Álvarez

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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 Control Valve Flow Characteristics.

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1 Scope

The flow characteristics the relationship between flow coefficient and valve stroke have been a subject of misunderstandings and endless debate with the operators of water transport and distribution systems. Many valve types, such as butterfly, eccentric disk, and ball valves, have inherent characteristics that cannot be changed. The flow characteristics of plunger control valves can be determined by the shape of the cylinder.

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 characteristics of the system. "Installed characteristics" include both the valve and pipeline effects.

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]. K_v can be substituted for C_v, were $K_v = 0.85 \cdot C_v$ [4].
- **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
  - Equal percentage
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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.