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Industrial-Process Control Valves - Part 2-1: Flow capacity - Sizing equations for fluid flow under installed conditions

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Industrial-Process Control Valves – Part 2-1: Flow capacity – Sizing equations for fluid flow under installed conditions

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL-PROCESS CONTROL VALVES –

Part 2-1: Flow capacity – Sizing equations for fluid flow under installed conditions

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International Standard IEC 60534-2-1 has been prepared by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 1998. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- the same fundamental flow model, but changes the equation framework to simplify the use of the standard by introducing the notion of ΔP_{sizing};
- changes to the non-turbulent flow corrections and means of computing results;

- multi-stage sizing as an Annex.

The text of this standard is based on the following documents:

FDIS	Report on voting
65B/783/FDIS	65B/786/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts of the IEC 60534 series, under the general title *Industrial-process control valves*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INDUSTRIAL-PROCESS CONTROL VALVES –

Part 2-1: Flow capacity – Sizing equations for fluid flow under installed conditions

1 Scope

This standard includes equations for predicting the flow of compressible and incompressible fluids through control valves.

The equations for incompressible flow are based on standard hydrodynamic equations for Newtonian incompressible fluids. They are not intended for use when non-Newtonian fluids, fluid mixtures, slurries or liquid-solid conveyance systems are encountered. The equations for incompressible flow may be used with caution for non-vaporizing multi-component liquid mixtures. Refer to Clause 6 for additional information.

At very low ratios of pressure differential to absolute inlet pressure ($\Delta P/P_1$), compressible fluids behave similarly to incompressible fluids. Under such conditions, the sizing equations for compressible flow can be traced to the standard hydrodynamic equations for Newtonian incompressible fluids. However, increasing values of $\Delta P/P_1$ result in compressibility effects which require that the basic equations be modified by appropriate correction factors. The equations for compressible fluids are for use with ideal gas or vapor and are not intended for use with multiphase streams such as gas-liquid, vapor-liquid or gas-solid mixtures. Reasonable accuracy can only be maintained when the specific heat ratio, γ, is restricted to the range $1.08 < \gamma < 1.65$. Refer to Clause 7.2 for more information.

For compressible fluid applications, this standard is valid for valves with $x_T \leq 0.84$ (see Table D.2). For valves with $x_T > 0.84$ (e.g. some multistage valves), greater inaccuracy of flow prediction can be expected.

Reasonable accuracy can only be maintained for control valves if:

$$\frac{C}{N_{18}d^2} < 0.047$$

Note that while the equation structure utilized in this document departs radically from previous versions of the standard, the basic technology is relatively unchanged. The revised equation format was adopted to simplify presentation of the various equations and improve readability of the document.

The accuracy of results computed with the equations in this standard will be governed by the accuracy of the constituent coefficients and the process data supplied. Methods of evaluating the coefficients used in the equations presented herein are given in IEC 60534-2-1. The stated accuracy associated with the coefficients in that document is ±5% when $C_v/d^2 < 0.047\ N_{18}$. Reasonable accuracy can only be maintained for control valves if $C_v/d^2 < 0.047\ N_{18}$.