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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Industrial-process control valves –
Part 1: Control valve terminology and general considerations

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FOREWORD

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

This fourth edition cancels and replaces the third edition published in 2005. This edition constitutes a technical revision.

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

a) update of the definitions given in IEC 60534-1 in order to harmonize them with current terminology;
b) addition of terms common to individual standards in the 60534 series; and
c) further clarification in existing definitions.

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

Draft	Report on voting
65B/1228/FDIS	65B/1235/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

IEC 60534 consists of the following parts, under the general title *Industrial-process control valves*:

Part 1: *Control valve terminology and general considerations*
Part 2-1: *Flow capacity – Sizing equations for fluid flow under installed conditions*
Part 2-3: *Flow capacity – Test procedures*
Part 2-4: *Flow capacity – Section Four: Inherent flow characteristics and rangeability*
Part 3-1: *Dimensions – Face-to-face dimensions for flanged, two-way, globe-type, straight pattern and centre-to-face dimensions for flanged, two-way, globe-type, angle pattern control valves*
Part 3-2: *Dimensions – Face-to-face dimensions for rotary control valves except butterfly valves*
Part 3-3: *Dimensions – End-to-end dimensions for buttweld, two-way, globe-type, straight pattern control valves*
Part 4: *Inspection and routine testing*
Part 5: *Marking*
Part 6-1: *Mounting details for attachment of positioners to control valves – Section 1: Positioner mounting on linear actuators*
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Part 7: *Control valve data sheet*
Part 8-1: *Noise considerations – Section One: Laboratory measurement of noise generated by aerodynamic flow through control valves*

Part 8-2: *Noise considerations – Section 2: Laboratory measurement of noise generated by hydrodynamic flow through control valves*

Part 8-3: *Noise considerations – Control valve aerodynamic noise prediction method*

Part 8-4: *Noise considerations – Section 4: Prediction of noise generated by hydrodynamic flow*

Part 9: *Test procedure for response measurements from step inputs*

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

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INDUSTRIAL-PROCESS CONTROL VALVES –

Part 1: Control valve terminology and general considerations

1 Scope

This part of IEC 60534 applies to all types of industrial-process control valves (hereinafter referred to as control valves). This document establishes a partial basic terminology list and provides guidance on the use of all other parts of IEC 60534.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60534 (all parts), *Industrial-process control valves*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Component terminology

3.1.1
control valve
power-operated device that changes the fluid flow rate in a process control system

Note 1 to entry: ~~It~~ The device assembly consists of a valve connected to an actuator that is capable of changing the position of a closure member in the valve in response to a signal from the controlling system.

3.1.1.1
control valve with a linear motion closure member
valve that contains a closure member that moves in a line perpendicular to the seating plane

3.1.1.1.1
diaphragm valve
valve in which a flexible closure member isolates the line fluid from the actuating mechanism and provides a seal to the atmosphere

3.1.1.1.2
gate valve
valve whose closure member is a flat gate that moves in a direction parallel to the plane of the seat

3.1.1.1.3
globe ~~(angle)~~ valve
valve in which the closure member moves in a direction perpendicular to the plane of the seat(s)

Note 1 to entry: This definition is applicable to both straight and angle pattern control valves.

3.1.1.2
control valve with a rotary motion closure member
valve that contains a closure member that is rotated into or away from a seat to modulate flow

3.1.1.2.1
ball valve
valve with a closure member that is a sphere with an internal passage wherein the centre of the spherical surface is coincident with the axis of the shaft

3.1.1.2.2
segmented ball valve
valve with a closure member that is a segment of a sphere wherein the centre of the spherical surface is coincident with the axis of the shaft

3.1.1.2.3
butterfly valve
valve with a circular body and a rotary motion disk closure member, pivotally supported by its shaft

Note 1 to entry: The shaft and/or closure member may be centred or offset.

3.1.1.2.3.1
fluted vane butterfly valve
butterfly valve which has flutes (grooves) on the face(s) of the disk

Note 1 to entry: These flutes are intended to shape the flow stream without altering the seating line or seating surface.

3.1.1.2.4
plug valve
valve with a closure member that is cylindrical or conical, with an internal passage

3.1.1.2.5
eccentric plug valve
valve with an eccentric closure member that may be in the shape of a spherical or conical segment

Note 1 to entry: Not every control valve can be exclusively categorized as linear or rotary as defined above.

3.2
valve
assembly forming a pressure retaining envelope containing a closure member for changing the flow rate of the process fluid

3.2.1.1
valve body
part of the valve which is the main pressure retaining boundary and provides the fluid-flow passageways and the pipe-connecting ends

3.2.1.2
bonnet
portion of the valve which closes an opening in the body and through which passes the stem connecting the closure member to the actuator

3.2.1.3
end connection
valve body configuration provided to make a pressure tight joint to the pipe carrying the fluid to be controlled

3.2.1.3.1
flanged ends
end connections incorporating flanges which allow pressure seals by mating with corresponding flanges on the piping

3.2.1.3.2
flangeless ends
end connections where no flanges are incorporated on the valve body and installation is accomplished by clamping the valve between the pipe flanges

Note 1 to entry: Valve body ends incorporate facings which mate with corresponding facings on flanges attached to the connecting piping. ~~Installation is accomplished by clamping the valve between the pipe flanges~~

3.2.1.3.3
threaded ends
end connections incorporating threads, either male or female

3.2.1.3.4
welded ends
end connections where valve body ends have been prepared for welding to the line pipe or other fittings

Note 1 to entry: Such connections may be of the butt-weld or socket-weld types

3.2.1.4
valve trim
functional components of the valve, excluding the body, bonnet and blind head (if present), which are in contact with the fluid

3.2.1.4.1
independent flow passage
flow passage where the exiting flow is not affected by the exiting flow from adjacent flow passages

3.2.1.4.2
valve seats
corresponding sealing surfaces within a control valve which make full contact when the control valve is in the closed position

3.2.1.4.3
seat ring
part assembled in the valve body to provide a removable valve seat

3.2.1.4.4
closure member
movable part of the valve which is positioned in the flow path to restrict the flow through the valve

Note 1 to entry: A closure member may be a plug, ball, disk, vane, gate, diaphragm, etc.

3.2.1.4.5
valve stem (or shaft)
component extending through the bonnet which connects the actuator to, and positions, the closure member

Note 1 to entry: For rotary valves, the word shaft should be used in place of stem.

3.2.2
actuator
device or mechanism which transforms a signal into a corresponding movement controlling the position of the internal regulating mechanism (closure member) of the control valve

Note 1 to entry: The signal or energizing force may be pneumatic, electric, hydraulic, or any combination thereof.

3.2.2.1
actuator power unit
that part of the actuator which coverts fluid, electrical, thermal or mechanical energy into actuator stem motion to develop thrust or torque

3.2.2.2
yoke
structure which rigidly connects the actuator power unit to the valve. It can be an integral part of the bonnet or actuator

3.2.2.3
actuator stem
component which transmits motion from the actuator power unit to the valve stem (or shaft)

3.2.3
fitting
any device such as a reducer, expander, elbow, T-piece, or bend which is either close-coupled or attached direct to an end connection of a control valve

3.3 Functional terminology

3.3.1
nominal size
DN
alphanumeric designation of size for components of a pipework system, which is used for reference purposes~~. It comprises~~, comprised of the letters DN followed by a dimensionless whole number which is related direct to physical size, in millimetres, of the bore or outside diameter of the end connections

Note 1 to entry: It is designated by the letters DN followed by a number from the following series: 10; 15; 20; 25; 32; 40; 50; 65; 80; 100; 125; 150; 200; 250; 300; 350; 400; etc.

Note 2 to entry: The number following the letters DN does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

Note 3 to entry: The definition of nominal size is in accordance with ISO 6708.

3.3.2
nominal pressure
PN
alphanumerical designation of pressure which is a convenient rounded number for reference purposes

Note 1 to entry: All equipment of the same nominal size (DN) designated by the same PN number shall have compatible mating dimensions

Note 2 to entry: The maximum allowable pressure depends upon materials, design and working temperatures and should be selected from the pressure/temperature rating tables in the appropriate standards.

Note 3 to entry: It is designated by the letters PN followed by the appropriate reference number from the following series: 2,5; 6; 10; 16; 20; 25; 40; 50; etc. (see ISO 7268 and EN ~~61333~~ 1333).

Note 4 to entry: The definition of nominal pressure is in accordance with ISO 7268.

3.3.3
NPS
numeric designation of size for components of a pipework system, which is used for reference purposes~~. It comprises~~, comprised of the letters NPS followed by a dimensionless number and related to nominal size DN as follows:

DN	10	15	20	25	32	40	50	65	80	100
NPS	3/8	½	¾	1	1 ¼	1 ½	2	2 ½	3	4

Note 1 to entry: For NPS greater than 4, the equivalence is DN = 25 times NPS.

3.3.4
class
convenient round number used to designate pressure-temperature ratings according to appropriate standards

Note 1 to entry: It is designated by the word Class followed by the appropriate reference number from the following series: 125; 150; 250; 300; 600; 900; 1500; 2500.

3.3.5
closure member position

3.3.5.1
closed position
position of the closure member when a continuous surface or line of contact is established with the valve seat

Note 1 to entry: For non-seating valves, the closed position is obtained when the flow passageway is minimum.

3.3.5.2
travel
displacement of the closure member from the closed position

3.3.5.3
rated travel
displacement of the closure member from the closed position to the designated full open position

3.3.5.4
relative travel, *h*
ratio of the travel at a given opening to the rated travel

3.3.5.5
over-travel
displacement of the actuator stem, or shaft, beyond the closed position

Note 1 to entry: For some valve designs, over-travel may occur as the closure member moves to a mechanical stop position after full exposure of the flow restricting orifice(s).

3.3.6
flow coefficient
basic coefficient used to state the flow capacity of a control valve under specified conditions

Note 1 to entry: Flow coefficients in current use are K_v and C_v depending upon the system of units

Note 2 to entry: It will be noted that the dimensions and units on each of the following defined flow coefficients are different. However, it is possible to relate these flow coefficients numerically. This relationship is as follows:

$$\frac{K_v}{C_v} = 0{,}865 \qquad (1)$$

Note 3 to entry: The flow coefficient definitions for K_v and C_v include some units, nomenclature, and temperature values which are not consistent with other parts of IEC 60534. These inconsistencies are limited to this subclause and are only used to show the unique relationships traditionally used in the control valve industry. These inconsistencies do not affect the other parts of IEC 60534.

3.3.6.1
flow coefficient, K_v
~~flow coefficient K_v in cubic metres per hour is a~~ special volumetric flow rate in cubic metres per hour (capacity) through a valve at a specified travel and in the following conditions:

– the static pressure loss (Δp_{K_v}) across the valve is 10^5 Pa (1 bar),

– the fluid is water within a temperature range of 278 K to 313 K (5 °C to 40 °C),

– the unit of the volumetric flow rate is the cubic metre per hour

Note 1 to entry: More information can be found in IEC 60534-2-1.

~~The value of K_v can be obtained from test results with the help of the following equation:~~

$$K_v = Q\sqrt{\left(\frac{\Delta p_{K_v}}{\Delta p}\right)\left(\frac{\rho}{\rho_w}\right)} \quad (2)$$

~~where~~

~~Q is the measured volumetric flow rate in m³/h;~~

~~Δp_{K_v} is the static pressure loss of 10^5 Pa (see above);~~

~~Δp is the measured static pressure loss across the valve in Pa;~~

~~ρ is the density of the fluid in kg/m³;~~

~~ρ_w is the density of water (see above) in kg/m³ (1 000 kg/m³).~~

~~Equation (2) is valid when the flow is turbulent, no cavitation or flashing occurs, and the DN (NPS) of the valve is equal to the DN (NPS) of the pipe~~

3.3.6.2
flow coefficient, C_v
~~the flow coefficient C_v is a non-SI control valve coefficient which is in widespread use worldwide. Numerically, C_v is represented as the number of US gallons of water, within a temperature range of 40 °F to 100 °F, that will flow through a valve in 1 min when a pressure drop of 1 psi exists. For conditions other than these, C_v can be obtained using the following equation:~~

$$C_v = Q\sqrt{\left(\frac{\Delta p_{C_v}}{\Delta p}\right)\left(\frac{\rho}{\rho_w}\right)} \quad (3)$$

~~where~~

~~Q is the measured volumetric flow rate in US gallons per minute (1 US gallon per minute = $6{,}309 \times 10^{-5}$ m³/s);~~

~~ρ is the density of the flowing fluid in pounds per cubic foot (1 lb/ft³ = 16,018 kg/m³);~~

~~ρ_w is the density of water within a temperature range of 40 °F to 100 °F (4 °C to 38 °C) in pounds per cubic foot;~~

~~Δp is the measured static pressure loss across the valve in psi (1 psi = 6894,8 Pa);~~

~~Δp_{Cv} = 1 psi.~~

~~Equation (3) is valid when the flow is turbulent and no cavitation or flashing occurs~~

non-SI control valve coefficient which is in widespread use worldwide, represented numerically as the number of US gallons of water, that will flow through a valve in 1 min under the following conditions:

- The static pressure loss (Δp_{C_v}) across the valve is 1 psi (0,0689 bar),
- the fluid is water within a temperature range of 40 ºF to 100 ºF (4 °C to 38 °C),
- the unit of the volumetric flow rate is US gallons per minute

Note 1 to entry: More information can be found in IEC 60534-2-1.

3.6.3
rated flow coefficient
value of the flow coefficient at the rated travel

3.3.6.4
relative flow coefficient, Φ
ratio of the flow coefficient at a relative travel to the rated flow coefficient

3.3.7
rated valve capacity
rate of flow of a fluid (compressible or incompressible) that will pass through a valve at the rated travel under stated conditions

3.3.8
valve style modifier, F_d
ratio of the hydraulic diameter of a single flow passage to the diameter of a circular orifice, the area of which is equivalent to the sum of areas of all identical flow passages at a given travel

3.3.9
seat leakage
rate of flow of a fluid (compressible or incompressible) passing through an assembled valve in the closed position under specified test conditions (specifications for seat leakage classifications are contained in IEC 60534-4)

3.3.10
inherent flow characteristic
relationship between the relative flow coefficient, Φ, and the corresponding relative travel, h, independent of the means of actuation (see IEC 60534-2-4)

3.3.10.1
ideal inherent linear flow characteristic
characteristic in which equal increments of relative travel, h, yield equal increments of relative flow coefficient, Φ

Mathematically

$$\Phi = \Phi_0 + mh \tag{2}$$

where

Φ_0 is the relative flow coefficient corresponding to h = 0,

m is the slope of the straight line.