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Industrial-process control valves —

Part 1: Control valve terminology and general considerations

The European Standard EN 60534-1:2005 has the status of a British Standard

ICS 23.060.40; 25.040.40

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 60534-1:2005. It is identical with IEC 60534-1:2005. It supersedes BS EN 60534-1:1993, which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/2, Elements of systems, which has the responsibility to:

— aid enquirers to understand the text;

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English version

Industrial-process control valves
Part 1: Control valve terminology and general considerations
(IEC 60534-1:2005)

Vannes de régulation des processus industriels
Partie 1: Terminologie des vannes de régulation et considérations générales
(CEI 60534-1:2005)

Stellventile für die Prozessregelung
Teil 1: Begriffe und allgemeine Betrachtungen
(IEC 60534-1:2005)

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Foreword

The text of document 65B/543/FDIS, future edition 3 of IEC 60534-1, prepared by SC 65B, Devices, of IEC TC 65, Industrial-process measurement and control, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60534-1 on 2005-02-01.

This European Standard supersedes EN 60534-1:1993.

The main changes with respect to EN 60534-1:1993 are an update of the definitions given in EN 60534-1 in order to harmonize them with current terminology.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2005-11-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-02-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60534-1:2005 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

ISO 6708	NOTE	Harmonized as EN ISO 6708:1995 (not modified).

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CONTENTS

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 part establishes a partial basic terminology list and provides guidance on the use of all other parts of IEC 60534.

2 Normative references

The following referenced documents are indispensable for the application 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 Component terminology

3.1
control valve
power-operated device which changes the fluid flow rate in a process control system. It 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
control valve with a linear motion closure member

3.1.1.1
diaphragm valve
valve in which a flexible closure member isolates the line fluid from the actuating mechanism and provides a seal to the atmosphere

3.1.1.2
gate valve
valve whose closure member is a flat gate that moves in a direction parallel to the plane of the seat

3.1.1.3
globe (angle) valve
valve in which the closure member moves in a direction perpendicular to the plane of the seat(s)

3.1.2
control valve with a rotary motion closure member

3.1.2.1
ball valve
valve with a closure member that is a sphere with an internal passage. The centre of the spherical surface is coincident with the axis of the shaft.

3.1.2.2
segmented ball valve
valve with a closure member that is a segment of a sphere. The centre of the spherical surface is coincident with the axis of the shaft

3.1.2.3
butterfly valve
valve with a circular body and a rotary motion disk closure member, pivotally supported by its shaft. The shaft and/or closure member may be centred or offset

3.1.2.4
plug valve
valve with a closure member that is cylindrical or conical, with an internal passage

3.1.2.5
eccentric plug valve
valve with an eccentric closure member that may be in the shape of a spherical or conical segment

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

3.2.2
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

3.2.3
end connection
valve body configuration provided to make a pressure tight joint to the pipe carrying the fluid to be controlled

3.2.3.1
flanged ends
end connections incorporating flanges which allow pressure seals by mating with corresponding flanges on the piping

3.2.3.2
flangeless ends
end connections where no flanges are incorporated on the valve body. 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

3.2.3.3
threaded ends
end connections incorporating threads, either male or female

3.2.3.4
welded ends
end connections where valve body ends have been prepared for welding to the line pipe or other fittings. Such connections may be of the butt-weld or socket-weld types

3.2.4
valve trim
functional components of the valve, excluding the body, bonnet and blind head (if present), which are in contact with the fluid

3.2.4.1
valve seats
corresponding sealing surfaces within a control valve which make full contact when the control valve is in the closed position

3.2.4.2
seat ring
part assembled in the valve body to provide a removable valve seat

3.2.4.3
closure member
movable part of the valve which is positioned in the flow path to restrict the flow through the valve. A closure member may be a plug, ball, disk, vane, gate, diaphragm, etc.

3.2.4.4
valve stem (or shaft)
component extending through the bonnet which connects the actuator to, and positions, the closure member. For rotary valves, the word shaft should be used in place of stem

3.3
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. The signal or energizing force may be pneumatic, electric, hydraulic, or any combination thereof

3.3.1
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

3.3.2
yoke
structure which rigidly connects the actuator power unit to the valve. It can be an integral part of the bonnet or actuator

3.3.3
actuator stem
component which transmits motion from the actuator power unit to the valve stem (or shaft)

3.4
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

4 Functional terminology

4.1
nominal size
DN
alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises 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 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 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 The definition of nominal size is in accordance with ISO 6708.

4.2
nominal pressure
PN
numerical designation which is a convenient rounded number for reference purposes. All equipment of the same nominal size (DN) designated by the same PN number shall have compatible mating dimensions

NOTE 1 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 2 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).

NOTE 3 The definition of nominal pressure is in accordance with ISO 7268.

4.3
NPS
numeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters NPS followed by a dimensionless number. NPS is 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 For NPS greater than 4, the equivalence is DN = 25 times NPS.

4.4
class
convenient round number used to designate pressure-temperature ratings

NOTE It is designated by the word Class followed by the appropriate reference number from the following series: 125; 150; 250; 300; 600; 900; 1 500; 2 500.

4.5
closure member position

4.5.1
closed position
position of the closure member when a continuous surface or line of contact is established with the valve seat. For non-seating valves, the closed position is obtained when the flow passageway is minimum

4.5.2
travel
displacement of the closure member from the closed position

4.5.3
rated travel
displacement of the closure member from the closed position to the designated full open position

4.5.4
relative travel
h
ratio of the travel at a given opening to the rated travel

4.5.5
overtravel
displacement of the actuator stem, or shaft, beyond the closed position. For some valve designs, overtravel may occur as the closure member moves to a mechanical stop position after full exposure of the flow restricting orifice(s)

4.6
flow coefficient
basic coefficient used to state the flow capacity of a control valve under specified conditions. Flow coefficients in current use are K_v and C_v depending upon the system of units

NOTE 1 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 2 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.

4.6.1
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 ºC to 40 ºC),

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

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

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

where

Q is the measured volumetric flow rate in m^3/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/m^3;

ρ_w is the density of water (see above) in kg/m^3 (1 000 kg/m^3).

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

4.6.2
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 ºF to 100 ºF, 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:

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

where

Q is the measured volumetric flow rate in US gallons per minute (1 US gallon per minute = 6,309 × 10^{-5} m^3/s);

ρ is the density of the flowing fluid in pounds per cubic foot (1 lb/ft^3 = 16,018 kg/m^3);

ρ_w is the density of water within a temperature range of 40 ºF to 100 ºF (4 ºC to 38 ºC) 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

4.6.3
rated flow coefficient
value of the flow coefficient at the rated travel

4.6.4
relative flow coefficient
Φ
ratio of the flow coefficient at a relative travel to the rated flow coefficient

4.7
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

4.8
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)

4.9
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)

4.9.1
ideal inherent linear flow characteristic
characteristic n which equal increments of relative travel, h, yield equal increments of relative flow coefficient, Φ

Mathematically

$$\Phi = \Phi_0 + mh \quad (4)$$

where

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

m is the slope of the straight line.

4.9.2
ideal inherent equal percentage flow characteristic
characteristic which equal increments of relative travel, h, yield equal percentage increments of the relative flow coefficient, Φ.

Mathematically

$$\Phi = \Phi_0 \, e^{nh} \quad (5)$$

where

Φ_0 is the relative flow coefficient corresponding to $h = 0$;

n is the slope of the inherent equal percentage flow characteristic when $\log_e \Phi$ is plotted against h. Thus when $\Phi = 1$, $h = 1$ and $n = \log_e (1/\Phi_0)$.

4.10
installed flow characteristic
relationship between the flow rate and the closure member travel as it is moved from the closed position to rated travel as the pressure drop across the valve is influenced by the varying process conditions

4.11
inherent rangeability
ratio of the largest flow coefficient to the smallest flow coefficient within specified deviations (see IEC 60534-2-4)

4.12
installed rangeability
ratio beween maximum and minimum flow passing through a control valve under actual operating conditions and where the slope of the installed flow characteristic stays within limits specified by the user

4.13
choked flow
limiting, or maximum, flow condition which either incompressible or compressible fluids can reach in passing through control valves. With either type of fluid and with fixed inlet (upstream) conditions, choked flow is evidenced by the failure of increasing pressure differentials to produce further increases in the flow rate

4.14
critical differential pressure ratio
maximum ratio of differential pressure to inlet absolute pressure that is effective in all valve sizing equations for compressible fluids. Choked flow as defined in 4.13 occurs when this maximum ratio has been reached

5 Testing requirements

5.1 Production testing

Minimum requirements for production test routines are given in IEC 60534-4 which also delineates a basis for inspecting control valves at a manufacturer's premises. Additional requirements shall be subject to normal negotiation depending upon the severity of the hazards expected, the service duty involved, and the design of the control valve to be used.

5.2 Type testing

5.2.1 Flow-capacity testing

For the purpose of evaluating control valve capacity, testing shall follow the procedures given in IEC 60534-2-3. These tests provide the information necessary for the determination of flow coefficients and related factors for both compressible and incompressible fluids which, in turn, permit prediction of gas, vapour or liquid flow rates under installed conditions.

5.2.2 Laboratory noise testing

Laboratory testing for the purpose of determining sound pressure levels shall follow the procedures given in IEC 60534-8-1 for gases and IEC 60534-8-2 for liquids.

6 Prediction methods

6.1 Valve sizing

The determination of a control valve size, required for a given flow rate under specified pressure and temperature conditions, shall be carried out in accordance with IEC 60534-2-1. The prediction of the flow rate achievable for a specific size and style of control valve under specified pressure and temperature conditions shall be carried out by the corresponding procedures in this standard.

6.2 Noise levels

The sound pressure level to be expected at a point adjacent to an individual control valve when operating under specified conditions of pressure and temperature shall be determined using the procedure given in IEC 60534-8-3 for compressible fluids and IEC 60534-8-4 for incompressible fluids.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60534	Series	Industrial-process control valves	EN 60534	Series

Bibliography

ISO 6708:1995, *Pipework components – Definition and selection of DN (nominal size).*

ISO 7268:1983, *Pipe components – Definition of nominal pressure*
Amendment 1 (1984)

EN 61333:1998, *Marking on U and E ferrite cores*

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