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INTERNATIONAL STANDARD

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Industrial-process control valves – Part 2-4: Flow capacity – Inherent flow characteristics and rangeability

Vannes de régulation des processus industriels – Partie 2-4: Capacité d'écoulement – Caractéristiques intrinsèques de débit et coefficient intrinsèque de réglage

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IEC 60534-2-4:2009

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INDUSTRIAL-PROCESS CONTROL VALVES –

Part 2-4: Flow capacity – Inherent flow characteristics and rangeability

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International Standard IEC 60534-2-4 has been prepared by subcommittee 65B: Devices and process analysis, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 1989. This edition constitutes a technical revision. The main changes with respect to the previous edition are listed below.

This standard has been revised to:

a) update the normative references;
b) delete the terminology included in IEC 60534-1;
c) transform the previous Note 1 in Clause 6;
d) redraw the graphics;
e) delete the previous Figure 3.

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

FDIS	Report on voting
65B/704/FDIS	65B/713/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 parts of 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 maintenance result 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- withdrawn;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.

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INDUSTRIAL-PROCESS CONTROL VALVES –

Part 2-4: Flow capacity – Inherent flow characteristics and rangeability

1 Scope

This part of IEC 60534 applies to all types of industrial-process control valves. It defines how to state typical control valve inherent flow characteristics and inherent rangeabilities. It also defines how to establish criteria for adherence to manufacturer-stated flow characteristics.

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 or the referenced document (including any amendments) applies.

IEC 60534-1:2005, *Industrial-process control valves – Part 1: Control valve terminology and general considerations*

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IEC 60534-2-3, *Industrial-process control valves – Part 2-3: Flow capacity – Test procedures*

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3 Terms and definitions

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For the purposes of this document, the terms and definitions given in IEC 60534-1 and the following apply.

3.1
flow coefficient
(see IEC 60534-1, 4.6)

3.2
rated flow coefficient
(see IEC 60534-1, 4.6.3)

3.3
relative flow coefficient (Φ)
Φ_0 is the relative flow coefficient at 0 % relative travel

[IEC 60534-1, 4.9 modified]

3.4
travel
(see IEC 60534-1, 4.5.2)

3.5
rated travel
(see IEC 60534-1, 4.5.3)

3.6
relative travel (h)
(see IEC 60534-1, 4.5.4)

3.7
nominal slope
slope of the best fit line

for an ideal inherent linear flow characteristic, the nominal slope is: m

with $m = \frac{\Phi - \Phi_0}{h}$

for an ideal inherent equal percentage flow characteristic, the nominal slope is: n

with $n = \log\left(\frac{1}{\Phi_0}\right)$

3.8
inherent flow characteristic
(see IEC 60534-1, 4.9)

3.8.1
ideal inherent linear flow characteristic
(see IEC 60534-1, 4.9.1)

3.8.2
ideal inherent equal percentage flow characteristic
(see IEC 60534-1, 4.9.2)

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3.9
inherent rangeability
ratio of the largest flow coefficient (Φ_{max}) to the smallest flow coefficient (Φ_{min}) within which the deviation from the stated inherent flow characteristic does not exceed the allowable deviation stated in Clause 7
[IEC 60534-1, 4.11 modified]

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4 Symbols

Table 1 gives an overview of the symbols used in this standard.

Table 1 – Symbols

Symbol	Description	Unit
Φ	Relative flow coefficient	Dimensionless
C	Flow coefficient (K_v, C_v)	Various (see IEC 60534-1)
C_R	Flow coefficient (K_v and C_v) at rated travel	Various (see IEC 60534-1)
d	Nominal valve diameter	mm
h	Relative travel	Dimensionless

5 Typical inherent flow characteristics

The typical inherent flow characteristics and the values of n, m and Φ_0 for a specific size, type and trim configuration of a control valve shall be stated by the manufacturer either graphically or in tabular form.

When tabulated, specific flow coefficients shall be stated for the following travel positions: at 5 %, 10 %, 20 %, and every subsequent 10 % of rated travel up to and including 100 % (see Figures 1 and 2).

The manufacturer may publish flow coefficients in addition to those at the above stated travel positions.

In addition, the manufacturer is encouraged to specify the generic name of a specific flow characteristic, such as "linear" or "equal percentage", if applicable, following the terms and definitions of IEC 60534-1.

The manufacturer shall state the largest flow coefficient that meets the criteria of Clause 7, if it is less than the rated flow coefficient (see Figures 1 and 2).

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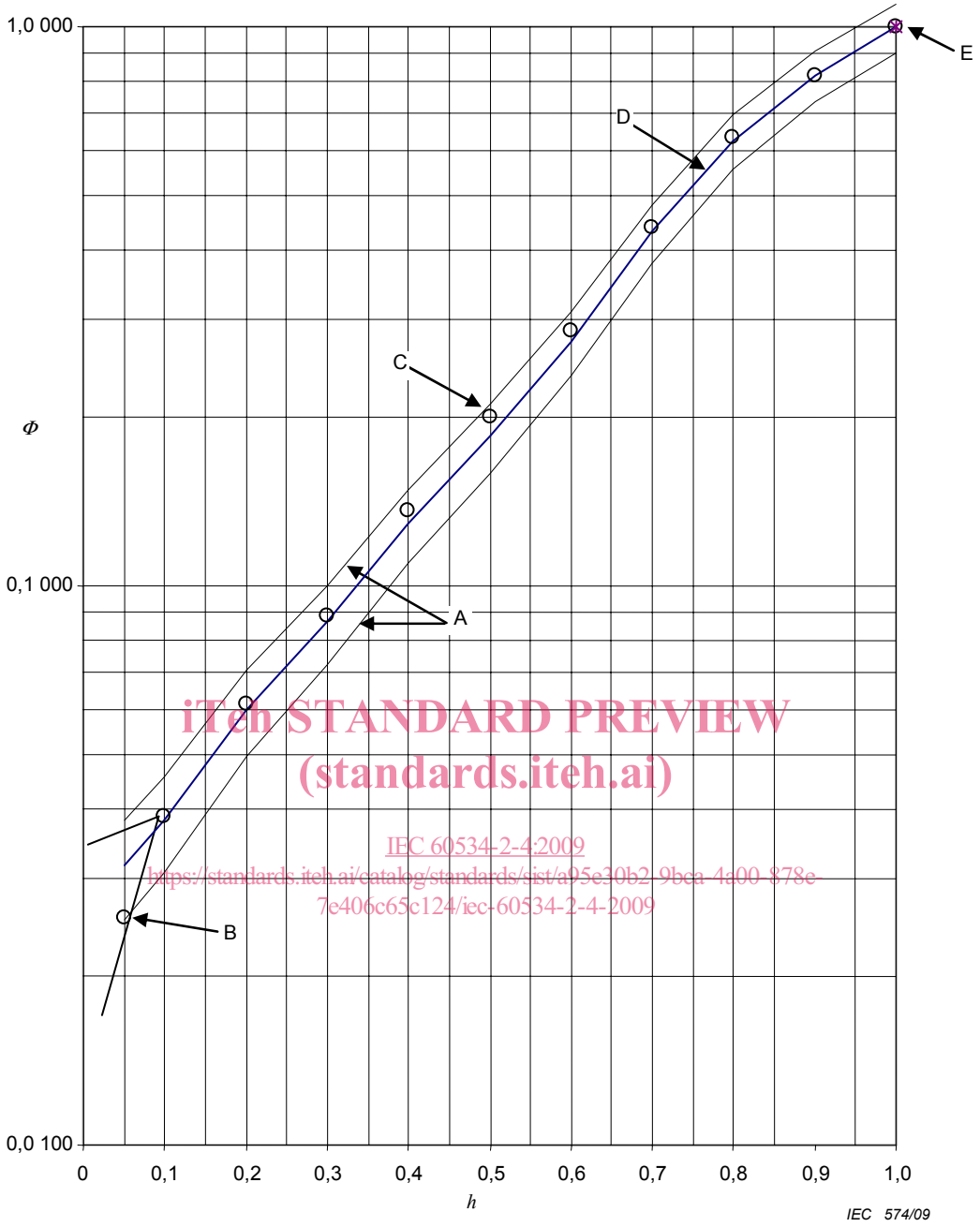

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Key

A tolerance band

B minimum Φ within tolerance band and slope requirements (0,025 3)

C valve specimen test points

D manufacturer stated characteristic

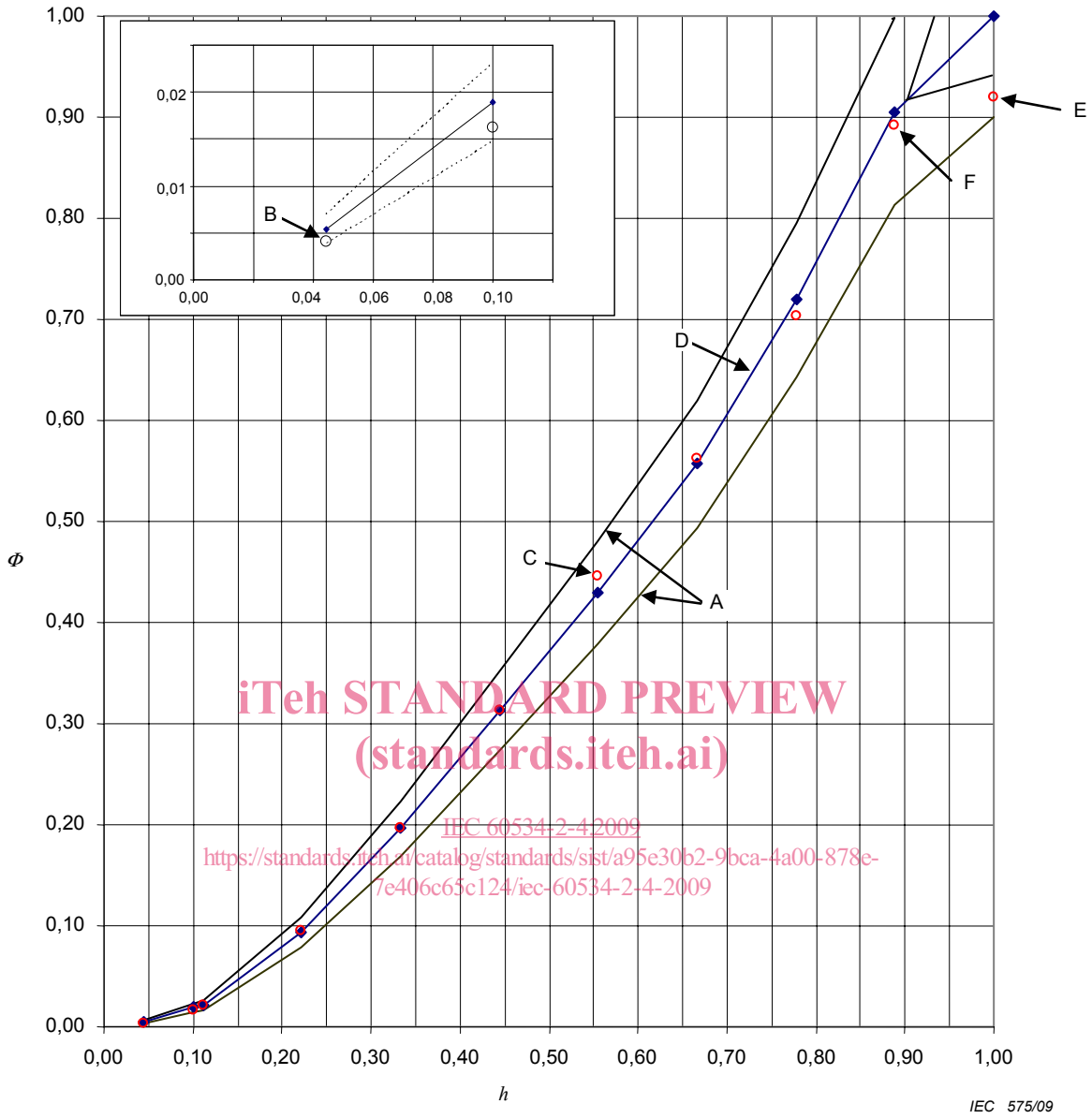
E maximum Φ within slope requirements (1,0)

h relative travel

Φ relative flow

Inherent rangeability of test specimen: $\frac{\Phi\text{max}}{\Phi\text{min}} = \frac{1{,}000}{0{,}025\ 3} = 39{,}5$

Figure 1 – Example of an equal percentage characteristic valve specimen compared to manufacturer-stated flow characteristic



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Key

A tolerance band
B minimum Φ within tolerance band (0,004 1)
C valve specimen test points
D manufacturer stated characteristic
E major deviation
F maximum Φ within slope requirements (0,89)
h relative travel
Φ relative flow

Inherent rangeability of test specimen: $\dfrac{\Phi\text{max}}{\Phi\text{min}} = \dfrac{0{,}89}{0{,}004\ 1} = 217$

Figure 2 – Example of linear characteristic valve specimen compared to manufacturer-stated flow characteristic

6 Inherent rangeability

The stated inherent rangeability of a specific control valve is related solely to the interaction between the closure member and the flow control orifice of a valve. This given value may not be applicable when the control valve is installed. Other factors such as the positioning accuracy of the actuator or the effects of hydraulic flow resistance of associated piping should be considered when deriving the installed rangeability for a specific application.

Within the range of limiting flow coefficients given in Table 2, both the flow coefficient deviation and the slope deviation are applicable in determining the inherent rangeability. Outside this range (see Table 2) only the slope deviation is applicable.

7 Permissible deviations between actual and manufacturer-stated inherent flow characteristics

7.1 Flow coefficient deviations

When subjected to a flow test per IEC 60534-2-3, the individual test flow coefficient shall not deviate by more than $\pm$ 10 $(1/\Phi)^{0,2}$ % from those values stated in the flow characteristic by the manufacturer.

The above relationship may be used to calculate allowable deviations for relative flow coefficients from zero to 1,0. For convenience, some allowable deviations calculated from this relationship are listed in Table 3.

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This deviation is not applicable to flow coefficients at given travel positions when the manufacturer stated flow coefficient at the same travel positions fail below the lower limits or above the upper limits given in Table 2.

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Table 2 – Limiting values of flow coefficients

Flow coefficient	Lower limit	Upper limit
K_v	4,3	$(4,0 \times 10^{-2})d^2$
C_v	5	$(4,7 \times 10^{-2})d^2$
NOTE d = valve size in mm (numerically equivalent to DN for calculation purposes).		