

This document is a review generated by EVS

Industrial-process control valves - Part 2-3: Flow capacity - Test procedures

## ESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 60534-2-3:2016 sisaldb Euroopa standardi EN 60534-2-3:2016 ingliskeelset teksti.	This Estonian standard EVS-EN 60534-2-3:2016 consists of the English text of the European standard EN 60534-2-3:2016.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 08.04.2016.	Date of Availability of the European standard is 08.04.2016.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 23.060.40, 25.040.40

Standardite reproduutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:  
Aru 10, 10317 Tallinn, Eesti; koduleht [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Aru 10, 10317 Tallinn, Estonia; homepage [www.evs.ee](http://www.evs.ee); phone +372 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

April 2016

ICS 23.060.40; 25.040.40

Supersedes EN 60534-2-3:1998

English Version

Industrial-process control valves -  
Part 2-3: Flow capacity - Test procedures  
(IEC 60534-2-3:2015)

Vannes de régulation des processus industriels -  
Partie 2-3: Capacité d'écoulement - Procédures d'essais  
(IEC 60534-2-3:2015)

Stellventile für die Prozessregelung -  
Teil 2-3: Durchflusskapazität - Prüfverfahren  
(IEC 60534-2-3:2015)

This European Standard was approved by CENELEC on 2016-01-20. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

## European foreword

The text of document 65B/1025/FDIS, future edition 3 of IEC 60534-2-3, prepared by SC 65B "Measurement and control devices" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60534-2-3:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-10-20
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-01-20

This document supersedes EN 60534-2-3:1998.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

## Endorsement notice

The text of the International Standard IEC 60534-2-3:2015 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:

IEC 60751:2008 NOTE Harmonized as EN 60751:2008 (not modified).

## Annex ZA (normative)

### **Normative references to international publications with their corresponding European publications**

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60534-1	-	Industrial-process control valves - Part 1: Control valve terminology and general considerations	EN 60534-1	-
IEC 60534-2-1	2011	Industrial-process control valves - Part 2-1: Flow capacity - Sizing equations for fluid flow under installed conditions	EN 60534-2-1	2011
IEC 60534-8-2	-	Industrial-process control valves - Part 8-2: Noise considerations - Laboratory measurement of noise generated by hydrodynamic flow through control valves	EN 60534-8-2	-
IEC 61298-1	-	Process measurement and control devices - General methods and procedures for evaluating performance - Part 1: General considerations	EN 61298-1	-
IEC 61298-2	-	Process measurement and control devices - General methods and procedures for evaluating performance - Part 2: Tests under reference conditions	EN 61298-2	-

## CONTENTS

FOREWORD .....	4
1 Scope .....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 Symbols .....	7
5 Test system .....	8
5.1 Test specimen .....	8
5.2 Test section .....	8
5.3 Throttling valves .....	9
5.4 Flow measurement.....	10
5.5 Pressure taps .....	10
5.6 Pressure measurement .....	10
5.7 Temperature measurement .....	10
5.8 Valve travel.....	11
5.9 Installation of test specimen.....	11
6 Accuracy of tests .....	12
7 Test fluids.....	12
7.1 Incompressible fluids .....	12
7.2 Compressible fluids .....	12
8 Test procedure for incompressible fluids .....	12
8.1 Test procedure for flow coefficient C .....	12
8.2 Test procedure for liquid pressure recovery factor $F_L$ and combined liquid pressure recovery factor and piping geometry factor $F_{LP}$ .....	14
8.3 Test procedure for piping geometry factor $F_p$ .....	15
8.4 Test procedure for liquid critical pressure ratio factor $F_F$ .....	15
8.5 Test procedure for Reynolds number factor $F_R$ for incompressible flow .....	15
8.6 Test procedure for valve style modifier $F_d$ .....	15
9 Data evaluation procedure for incompressible fluids .....	16
9.1 Non-choked flow .....	16
9.2 Choked flow .....	16
9.3 Calculation of flow coefficient C .....	17
9.4 Calculation of liquid pressure recovery factor $F_L$ and the combined liquid pressure recovery factor and piping geometry factor $F_{LP}$ .....	17
9.5 Calculation of piping geometry factor $F_p$ .....	18
9.6 Calculation of liquid critical pressure ratio factor $F_F$ .....	18
9.7 Calculation of Reynolds number factor $F_R$ .....	18
9.8 Calculation of valve style modifier $F_d$ .....	18
10 Test procedure for compressible fluids .....	19
10.1 Test procedure for flow coefficient C .....	19
10.2 Test procedure for pressure differential ratio factors $x_T$ and $x_{TP}$ .....	20
10.3 Test procedure for piping geometry factor $F_p$ .....	21
10.4 Test procedure for Reynolds number factor $F_R$ .....	22
10.5 Test procedure for valve style modifier $F_d$ .....	22
10.6 Test procedure for small flow trim .....	22
11 Data evaluation procedure for compressible fluids .....	23

11.1	Flow equation .....	23
11.2	Calculation of flow coefficient C .....	23
11.3	Calculation of pressure differential ratio factor $x_T$ .....	23
11.4	Calculation of pressure differential ratio factor $x_{TP}$ .....	24
11.5	Calculation of piping geometry factor $F_p$ .....	24
11.6	Calculation of Reynolds number factor $F_R$ for compressible fluids .....	24
11.7	Calculation of valve style modifier $F_d$ .....	24
11.8	Calculation of flow coefficient C for small flow trim .....	24
Annex A (normative)	Typical examples of test specimens showing appropriate pressure tap locations .....	26
Annex B (informative)	Engineering data .....	28
Annex C (informative)	Derivation of the valve style modifier, $F_d$ .....	31
Annex D (informative)	Laminar flow test discussion .....	35
Annex E (informative)	Long form $F_L$ test procedure .....	36
E.1	General .....	36
E.2	Test procedure .....	36
E.3	Graphical data reduction .....	36
Annex F (informative)	Calculation of $F_p$ to help determine if pipe/valve port diameters are adequately matched .....	39
Bibliography .....	41	
Figure 1 – Basic flow test system .....	8	
Figure 2 – Test section piping requirements .....	9	
Figure 3 – Recommended pressure tap connection .....	11	
Figure A.1 – Typical examples of test specimens showing appropriate pressure tap locations .....	27	
Figure B.1 – Dynamic viscosity of water .....	28	
Figure C.1 – Single seated, parabolic plug (flow tending to open) .....	34	
Figure C.2 – Swing-through butterfly valve .....	34	
Figure E.1 – Typical flow results .....	37	
Table 1 – Test specimen alignment .....	11	
Table 2 – Minimum inlet absolute test pressure in kPa (bar) as related to $F_L$ and $\Delta p$ .....	13	
Table 3 – Numerical constants $N$ .....	25	
Table B.1 – Properties for water .....	28	
Table B.2 – Properties of air .....	29	
Table B.3 – Test section piping .....	30	
Table C.1 – Numerical constant, $N$ .....	34	
Table F.1 – Tabulated values of $F_p$ if upstream and downstream pipe the same size .....	40	
Table F.2 – Tabulated values of $F_p$ if downstream pipe larger than valve .....	40	