Industrial-process control valves - Part 8-3: Noise considerations - Control valve aerodynamic noise prediction method

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EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
Käesolev Eesti standard EVS-EN 60534-8-3:2011 sisaldab Euroopa standardi EN 60534-8-3:2011 ingliskeelset teksti.	This Estonian standard EVS-EN 60534-8-3:2011 consists of the English text of the European standard EN 60534-8-3:2011.
Standard on kinnitatud Eesti Standardikeskuse 28.02.2011 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.	This standard is ratified with the order of Estonian Centre for Standardisation dated 28.02.2011 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.
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ICS 17.140.20, 23.060.40, 25.040.40

EUROPEAN STANDARD

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EN 60534-8-3

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ICS 17.140.20; 23.060.40; 25.040.40

Supersedes EN 60534-8-3:2000

English version

Industrial-process control valves -
Part 8-3: Noise considerations -
Control valve aerodynamic noise prediction method
(IEC 60534-8-3:2010)

Vannes de régulation des processus industriels -
Partie 8-3: Considérations sur le bruit -
Méthode de prédiction du bruit aérodynamique des vannes de régulation
(CEI 60534-8-3:2010)

Stellventile für die Prozessregelung -
Teil 8-3: Geräuschbetrachtungen -
Berechnungsverfahren zur Vorhersage der aerodynamischen Geräusche von Stellventilen
(IEC 60534-8-3:2010)

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

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

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Foreword

The text of document 65B/765/FDIS, future edition 3 of IEC 60534-8-3, prepared by IEC/SC 65B, Devices & process analysis, of IEC TC 65, Industrial-process measurement, control and automation, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60534-8-3 on 2011-01-01.

This European Standard supersedes EN 60534-8-3:2000.

The significant technical changes with respect to EN 60534-8-3:2000 are as follows:

– predicting noise as a function of frequency;

– using laboratory data to determine the acoustical efficiency factor.

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

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)	2011-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-01-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60534-8-3:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

[1] IEC 60534-2-1 NOTE Harmonized as EN 60534-2-1.

[2] IEC 60534-8-1 NOTE Harmonized as EN 60534-8-1.

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 When 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
IEC 60534-1	-	Industrial-process control valves - Part 1: Control valve terminology and general considerations	EN 60534-1	-

CONTENTS

INTRODUCTION

The mechanical stream power as well as acoustical efficiency factors are calculated for various flow regimes. These acoustical efficiency factors give the proportion of the mechanical stream power which is converted into internal sound power.

This method also provides for the calculation of the internal sound pressure and the peak frequency for this sound pressure, which is of special importance in the calculation of the pipe transmission loss.

At present, a common requirement by valve users is the knowledge of the sound pressure level outside the pipe, typically 1 m downstream of the valve or expander and 1 m from the pipe wall. This standard offers a method to establish this value.

The equations in this standard make use of the valve sizing factors as used in IEC 60534-1 and IEC 60534-2-1.

In the usual control valve, little noise travels through the wall of the valve. The noise of interest is only that which travels downstream of the valve and inside of the pipe and then escapes through the wall of the pipe to be measured typically at 1 m downstream of the valve body and 1 m away from the outer pipe wall.

Secondary noise sources may be created where the gas exits the valve outlet at higher Mach numbers. This method allows for the estimation of these additional sound levels which can then be added logarithmically to the sound levels created within the valve.

Although this prediction method cannot guarantee actual results in the field, it yields calculated predictions within 5 dB(A) for the majority of noise data from tests under laboratory conditions (see IEC 60534-8-1). The current edition has increased the level of confidence of the calculation. In some cases the results of the previous editions were more conservative.

The bulk of the test data used to validate the method was generated using air at moderate pressures and temperatures. However, it is believed that the method is generally applicable to other gases and vapours and at higher pressures. Uncertainties become greater as the fluid behaves less perfectly for extreme temperatures and for downstream pressures far different from atmospheric, or near the critical point. The equations include terms which account for fluid density and the ratio of specific heat.

NOTE Laboratory air tests conducted with up to 1 830 kPa (18,3 bar) upstream pressure and up to 1 600 kPa (16,0 bar) downstream pressure and steam tests up to 225 °C showed good agreement with the calculated values.

A rigorous analysis of the transmission loss equations is beyond the scope of this standard. The method considers the interaction between the sound waves existing in the pipe fluid and the first coincidence frequency in the pipe wall. In addition, the wide tolerances in pipe wall thickness allowed in commercial pipe severely limit the value of the very complicated mathematical approach required for a rigorous analysis. Therefore, a simplified method is used.

Examples of calculations are given in Annex A.

This method is based on the IEC standards listed in Clause 2 and the references given in the Bibliography.

INDUSTRIAL-PROCESS CONTROL VALVES –

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

1 Scope

This part of IEC 60534 establishes a theoretical method to predict the external sound-pressure level generated in a control valve and within adjacent pipe expanders by the flow of compressible fluids.

This method considers only single-phase dry gases and vapours and is based on the perfect gas laws.

This standard addresses only the noise generated by aerodynamic processes in valves and in the connected piping. It does not consider any noise generated by reflections from external surfaces or internally by pipe fittings, mechanical vibrations, unstable flow patterns and other unpredictable behaviour.

It is assumed that the downstream piping is straight for a length of at least 2 m from the point where the noise measurement is made.

This method is valid only for steel and steel alloy pipes (see Equations (21) and (23) in 5.5).

The method is applicable to the following single-stage valves: globe (straight pattern and angle pattern), butterfly, rotary plug (eccentric, spherical), ball, and valves with cage trims. Specifically excluded are the full bore ball valves where the product F_pC exceeds 50 % of the rated flow coefficient.

For limitations on special low noise trims not covered by this standard, see Clause 8. When the Mach number in the valve outlet exceeds 0,3 for standard trim or 0,2 for low noise trim, the procedure in Clause 7 is used

The Mach number limits in this standard are as follows:

Mach number location	Mach number limit		
	Clause 5 Standard trim	**Clause 6 Noise-reducing trim**	**Clause 7 High Mach number applications**
Freely expanded jet M_j	No limit	No limit	No limit
Valve outlet M_o	0,3	0,2	1,0
Downstream reducer inlet M_r	Not applicable	Not applicable	1,0
Downstream pipe M_2	0,3	0,2	0,8

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*

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

3 Terms and definitions

For the purposes of this document, all of the terms and definitions given in the IEC 60534 series and the following apply:

3.1
acoustical efficiency
η
ratio of the stream power converted into sound power propagating downstream to the stream power of the mass flow

3.2
external coincidence frequency
f_g
frequency at which the external acoustic wavespeed is equal to the bending wavespeed in a plate of equal thickness to the pipe wall

3.3
internal coincidence frequency
f_o
lowest frequency at which the internal acoustic and structural axial wave numbers are equal for a given circumferential mode, thus resulting in the minimum transmission loss

3.4
fluted vane butterfly valve
butterfly valve which has flutes (grooves) on the face(s) of the disk. These flutes are intended to shape the flow stream without altering the seating line or seating surface

3.5
independent flow passage
flow passage where the exiting flow is not affected by the exiting flow from adjacent flow passages

3.6
peak frequency
f_p
frequency at which the internal sound pressure is maximum

3.7
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