SLOVENSKI STANDARD
SIST EN ISO 9300:2022

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SIST EN ISO 9300:2005

Merjenje pretoka plina na podlagi kritičnega toka v Venturijevi šobi (ISO 9300:2022)

Measurement of gas flow by means of critical flow nozzles (ISO 9300:2022)

Durchflussmessung von Gasen mit Venturidüsen bei kritischer Strömung (ISO 9300:2022)

Mesurage de débit de gaz au moyen de tuyères en régime critique (ISO 9300:2022)

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Measurement of gas flow by means of critical flow nozzles (ISO 9300:2022)

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This European Standard was approved by CEN on 17 June 2022.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN ISO 9300:2022) has been prepared by Technical Committee ISO/TC 30 "Measurement of fluid flow in closed conduits" in collaboration with CCMC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2022, and conflicting national standards shall be withdrawn at the latest by December 2022.

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

This document supersedes EN ISO 9300:2005.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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Endorsement notice

The text of ISO 9300:2022 has been approved by CEN as EN ISO 9300:2022 without any modification.

INTERNATIONAL STANDARD

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Measurement of gas flow by means of critical flow nozzles

Mesurage de débit de gaz au moyen de tuyères en régime critique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

ISO 9300 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 2, *Pressure differential devices*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/SS F05, *Measuring instruments*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 9300:2005), which has been technically revised.

The main changes are as follows:

— the discharge coefficient curve is given by a single equation each for the toroidal- and cylindrical-throat critical flow nozzles (CFNs) that covers both the laminar and turbulent boundary layer regimes;

— the discharge coefficient curve of the cylindrical-throat CFN is updated based on the recent experimental and theoretical data;

— the quadrant CFN and detachable diffuser are introduced;

— the basic equations used to measure the discharge coefficient are listed;

— the premature unchoking phenomenon is explained to give attention to the unpredictable unchoking at low Reynolds numbers;

— REFPROP is introduced for the calculations of critical flow function and viscosity as well as their fitted curves are given for some pure gases and air;

— the diameter correction method is introduced to fit the experimental discharge coefficient data to a reference curve;

— the detailed method to match the discharge coefficient curve on an experimental data set is described;

— the background of the specifications is given.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Measurement of gas flow by means of critical flow nozzles

1 Scope

This document specifies the geometry and method of use (installation in a system and operating conditions) of critical flow nozzles (CFNs) used to determine the mass flow rate of a gas flowing through a system basically without the need to calibrate the CFN. It also gives the information necessary for calculating the flow rate and its associated uncertainty.

This document is applicable to nozzles in which the gas flow accelerates to the critical velocity at the minimum flowing section, and only where there is steady flow of single-phase gas. When the critical velocity is attained in the nozzle, the mass flow rate of the gas flowing through the nozzle is the maximum possible for the existing inlet condition, while the CFN can only be used within specified limits, e.g. the CFN throat to inlet diameter ratio and Reynolds number. This document deals with the toroidal- and cylindrical-throat CFNs for which direct calibration experiments have been made in sufficient number to enable the resulting coefficients to be used with certain predictable limits of uncertainty.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Pressure

3.1.1
static pressure
pressure of the flowing gas (see Annex J)

Note 1 to entry: The static pressure is measured through a *wall pressure tapping* (3.1.3).

3.1.2
stagnation pressure
pressure which would exist in a flowing gas stream if the stream were brought to rest by an isentropic process

3.1.3
wall pressure tapping
hole drilled in the wall of a conduit to measure the *static pressure* (3.1.1) of the flowing gas in the conduit

3.2 Temperature

3.2.1
static temperature
temperature of the flowing gas (see Annex J)

Note 1 to entry: The static temperature cannot be measured exactly by a temperature sensor fixed in the conduit .

3.2.2
stagnation temperature
temperature which would exist in a flowing gas stream if the stream were brought to rest by an isentropic process (see Annex J).

3.2.3
recovery temperature (wall temperature, measured temperature)
temperature of the gas touching the wall (see Annex J)

Note 1 to entry: The temperature sensor fixed on a conduit measures the recovery temperature.

3.3 Nozzle

3.3.1
contraction
portion of the *nozzle* (3.3.5) upstream of the *throat* (3.3.2) intended to accelerate the flow and attain the supposed flow field at the *critical point* (3.4.4)

3.3.2
throat
portion of the *nozzle* (3.3.5) where the cross section is minimum

Note 1 to entry: This document deals with nozzles with toroidal- and cylindrical-throats.

3.3.3
diffuser
divergent portion of the *nozzle* (3.3.5) behind the *throat* (3.3.2) intended to recover the pressure

3.3.4
traditional diffuser
frustum *diffuser* (3.3.3) machined as one piece

3.3.5
nozzle
device inserted in a system intended to use for measurement of the flow rate through system, which consists of *contraction* (3.3.1) and *throat* (3.3.2), or *contraction* (3.3.1), *throat* (3.3.2), and *diffuser* (3.3.3)

3.3.6
critical flow nozzle
CFN
nozzle (3.3.5) that attains the *critical flow* (3.4.2)

3.3.7
normal precision nozzle
NPN
nozzle (3.3.5) machined by a lathe, with the surface polished to achieve the desired roughness

3.3.8
high precision nozzle
HPN
nozzle (3.3.5) machined by a lathe that can achieve mirror finish without polishing the surface, thus it has the form exactly as designed

3.4 Flow

3.4.1
isentropic flow
theoretical flow along which the thermodynamic process is adiabatic and reversible (see Annex J)

3.4.2
critical flow
flow in a *nozzle* (3.3.5) that has attained the maximum flow rate of the *nozzle* (3.3.5) for a given set of inlet conditions (see Annex J)

3.4.3
choke
attaining the *critical flow* (3.4.2) in a *nozzle* (3.3.5) (see Annex J)

3.4.4
critical point
location in the *CFN* (3.3.6) where the flow attains the *critical velocity* (3.4.11)

3.4.5
critical pressure
p^*
static pressure (3.1.1) at the *critical point* (3.4.4) (see Annex J)

3.4.6
critical pressure of perfect gas
p^*_P
theoretical *static pressure* (3.1.1) at the *critical point* (3.4.4) assuming the *isentropic flow* (3.4.1) of *perfect gas* (3.6.1)

3.4.7
critical temperature
T^*
static temperature (3.2.1) at the *critical point* (3.4.4)

3.4.8
critical temperature of perfect gas
T^*_P
theoretical *static temperature* (3.2.1) at the *critical point* (3.4.4) assuming the *isentropic flow* (3.4.1) of *perfect gas* (3.6.1)