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Merjenje pretoka plina na podlagi kritičnega toka v Venturijeve 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)

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

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kritischer Strömung (ISO 9300:2022)

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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of an identical text or by endorsement, at the latest by December 2022, and conflicting national standards shall be withdrawn at the latest by December 2022.

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**ISO
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Third edition
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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).

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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;

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- 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.

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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

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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)