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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

