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Measurement of fluid flow in closed conduits — Methods of evaluating the performance of electromagnetic flow-meters for liquids

Mesure de débit des fluides dans les conduites fermées — Méthodes d'évaluation de la performance des débitmètres électromagnétiques utilisés pour les liquides

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Contents

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9104 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*.

Annex A of this International Standard is for information only.

Introduction

The methods of evaluation specified in this International Standard are intended for use by manufacturers to determine the performance of their products and by users or independent testing establishments to verify manufacturer's performance specifications and to demonstrate suitability of application.

The test conditions specified in this International Standard, for example the range of ambient temperatures and the power supply, represent those which commonly arise during use. Consequently, the values specified herein should be used where no other values are specified by the manufacturer.

The tests specified in this International Standard are not necessarily sufficient for instruments specifically designed for unusually arduous duties. Conversely, a restricted series of tests may be suitable for instruments designed to perform within a limited range of conditions.

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Measurement of fluid flow in closed conduits — Methods of evaluating the performance of electromagnetic flow-meters for liquids

1 Scope

1.1 This International Standard recommends methods of test for the evaluation of the performance of electromagnetic flow-meters for liquids flowing in closed conduits. It specifies a uniform procedure to verify the performance characteristics when the flow-meter is subjected to identified influence quantities and methods of representing the results of performance measurements.

NOTE 1 When a full evaluation in accordance with this International Standard is not required, those tests which are required should be performed and the results reported in accordance with those parts of this International Standard which are relevant.

1.2 This International Standard applies only to industrialized pipe-mounted electromagnetic flow-meters. It is not applicable to insertion-type flow-meters, liquid-metal flow-meters and medical flow-meters, although some of the tests described may be applied to such instruments if agreed to between the manufacturer and the user or evaluating body.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3966:1977, *Measurement of fluid flow in closed conduits — Velocity area method using Pitot static tubes.*

ISO 4006:1991, *Measurement of fluid flow in closed conduits — Vocabulary and symbols.*

ISO 4185:1980, *Measurement of liquid flow in closed conduits — Weighing method.*

ISO 5168:—[1], *Measurement of fluid flow — Evaluation of uncertainties.*

ISO 6817:—[2], *Measurement of conductive liquid flow in closed conduits — Method using electromagnetic flow-meters.*

ISO 7066-1:1989, *Assessment of uncertainty in the calibration and use of flow measurement devices — Part 1: Linear calibration relationships.*

ISO 7066-2:1988, *Assessment of uncertainty in the calibration and use of flow measurement devices — Part 2: Non-linear calibration relationships.*

ISO 8316:1987, *Measurement of liquid flow in closed conduits — Method by collection of the liquid in a volumetric tank.*

IEC 68-2-3:1969, *Basic environmental testing procedures — Test Ca: Damp heat, steady state.*

IEC 68-2-4:1960, *Basic environmental testing procedures — Test D: Accelerated damp heat.*

IEC 68-2-6:1982, *Basic environmental testing procedures — Test Fc and guidance: Vibration (sinusoidal).*

1) To be published. (Revision of ISO 5168:1978)

2) To be published. (Revision of ISO 6817:1980)

IEC 68-2-27:1972, *Basic environmental testing procedures — Test Ea: Shock.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 4006 apply. The following definitions are given only for terms used with a special meaning or for terms the meaning of which might be usefully recalled.

3.1 electromagnetic flow-meter: Flow-meter which creates a magnetic field perpendicular to the flow, so enabling the flow-rate to be deduced from induced electromotive force (e.m.f.) produced by the motion of a conducting fluid in the magnetic field. The electromagnetic flow-meter consists of a primary device and one or more secondary devices.

3.2 primary device: Device containing the following elements:

— an electrically insulating meter tube through which the conductive fluid to be metered flows,

— one or more pairs of electrodes, diametrically opposed, across which the signal generated in the fluid is measured, and

— an electromagnet for producing a magnetic field in the meter tube.

The primary device produces a signal proportional to the flow-rate and in some cases a reference signal.

3.3 secondary device: Equipment which contains the circuitry which extracts the flow signal from the electrode signal and converts it to a standard output signal directly proportional to the flow-rate. This equipment may be mounted on the primary device.

3.4 meter tube: Pipe section of the primary device through which the fluid to be measured flows; its inner surface is usually electrically insulating.

3.5 meter electrodes: One or more pairs of contacts or capacitor plates by means of which the induced voltage is detected.

3.6 lower range value: Lowest value of the measured variable that a device is adjusted to measure.

3.7 upper range value: Highest value of the measured variable that a device is adjusted to measure.

3.8 span: Algebraic difference between the upper and lower range values. For example, the span is equal to 16 mA when the range is 4 mA to 20 mA.

3.9 common mode voltage: Voltage which exists equally between each electrode and a reference potential.

3.10 reference signal: Signal which is proportional to the magnetic flux created in the primary device and which is compared in the secondary device with the flow signal.

3.11 output signal: Output from the secondary device which is a function of the flow-rate.

3.12 full-scale flow-rate: Flow-rate corresponding to the maximum output signal.

3.13 referee measurements: Measurements repeated under closely controlled atmospheric conditions when the correction factors to adjust parameters, sensitive to atmospheric conditions, to their standard atmosphere values are unknown and when measurements under the recommended range of ambient atmospheric conditions are unsatisfactory.

4 General testing procedure

Most evaluation tests for electromagnetic flow-meters are carried out with the liquid flowing through both the flow-meter and the standard calibration facility or reference flow-meter. Care shall be taken to ensure a mean steady flow in the test circuit, independently of the rapid fluctuations in local velocities due to turbulence which always occurs in the range of Reynolds numbers peculiar to industrial flow conditions. Furthermore, the measurement uncertainty of the reference flow-meter or calibration facility should be taken into account when estimating the measurement uncertainty of the electromagnetic flow-meter under test.

It will be appreciated that the closest communication should be maintained between the evaluating body and the manufacturer. Note shall be taken of the manufacturer's specifications for the instrument when the test programme is being decided, and the manufacturer should be invited to comment on both the test programmes and the results.

4.1 General requirements

4.1.1 The flow shall be steady.

4.1.2 At the inlet of the upstream straight pipe the flow should be axisymmetric and free from significant pulsation and swirl.