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Hydrometry — Calibration of current-meters in straight open tanks

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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).

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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.

This document was prepared by Technical Committee ISO/TC 113, *Hydrometry*, Subcommittee SC 5, *Instruments, equipment and data management*.

This third edition cancels and replaces the second edition (ISO 3455:2007), which has been technically revised.

The main changes compared to the previous editions are as follows:

— a subclause for calibration of acoustic current-meters for point velocity measurement has been added;

— clauses referring to outdated tracking systems like track systems using tooth belts have been removed;

— clauses referring to outdated technique for data acquisition like strip chart recorder or magnetic tapes have been removed;

— the clause for computerized data acquisition and processing system has been removed;

— the clause discussing the Epper effect has been removed.

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.

Hydrometry — Calibration of current-meters in straight open tanks

1 Scope

This document specifies a calibration method for mechanical type, electromagnetic type and acoustic type hydrometric current-meters used for point velocity measurement of flowing water. The method requires towing the instrument through still water in a straight open tank. It includes measuring apparatus, the calibration procedure, the method of presenting the results and the uncertainties associated with the method.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 772, *Hydrometry — Vocabulary and symbols*

ISO 2537, *Hydrometry — Rotating-element current-meters*

ISO/IEC Guide 98-3*Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 772 apply.

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

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

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

4 Principle of calibration

4.1 Statement of the principle

Calibration of a current-meter means experimental determination of the relationship between water velocity and either the rate of revolution of the rotating element or the velocity directly indicated by the current-meter. For this purpose, the current-meter is mounted on a towing cart and drawn through still water contained in a straight tank with a uniform cross section at a number of steady speeds of the towing cart. Simultaneous measurements of the speed of the towing cart and the rate of revolution of the rotating element or the velocity indicated by the current-meter are made. In the case of rotating-element current-meters, the two parameters are related by one or more formula(e), the limits of validity of which are stated. In the case of stationary-sensor type current-meters, containing no rotating elements, the velocity indicated by its display unit is compared with the corresponding cart speed to know the error in measurement.

4.2 Accuracy of the method

4.2.1 Overall uncertainty on the velocity measurement

The towing method gives an absolute measurement of water speed, which in principle only requires position and time measurements. This method can be considered as very accurate if the precautions listed in 4.2.2 are taken.

4.2.2 Requirements for accurate measurements

The towing method gives an accurate measurement of water speed provided that:

a) the position, the timing and means for starting and stopping it achieve the necessary accuracy;

b) residual currents in the water are small.

5 Infrastructure

5.1 Dimensions of the towing tank

5.1.1 General

The dimensions of the tank and the number and relative position of current-meters in the tank cross section shall be chosen so that their effects on the test result are minimized.

5.1.2 Length

The length of a rating tank comprises of accelerating, stabilizing, measuring and braking sections.

The length of the accelerating and braking sections depend on the design of the cart, the maximum acceleration and deceleration achievable at maximum payload, and the maximum speed at which the payload is to be towed along the tank. Safety requirements of the cart should be taken into account while working out the length of the braking section. The length of the measuring section shall be such that the calibration error, which is composed of inaccuracies in the measurement of time, distance covered and rate of revolution, does not exceed the desired tolerance at any velocity. The required length, therefore, depends on the type of current-meter being calibrated, type of cart and the way the signals are produced and transmitted.

5.1.3 Depth and width

The depth of the tank can have an influence on the test results which cannot be regarded as negligible, more particularly when the towing speed coincides with the velocity of propagation of the surface wave. The dependence of this critical velocity, v_c, on tank depth is given by the Formula (1):

$$v_c = \sqrt{gd} \tag{1}$$

where

g is the acceleration due to gravity;

d is the depth of water.

Depending on the size of the current-meter(s) and the cross section of the suspension equipment relative to the cross-sectional area of the tank, the wave crest produced by the current-meter and its means of suspension may cause an error in calibration within a narrow band in the velocity range from 0,5 v_c to 1,5 v_c. It is a systematic and not a random error.