



SLOVENSKI STANDARD
SIST ISO 3455:2021

01-oktober-2021

Nadomešča:
SIST ISO 3455:2013

Hidrometrija - Kalibracija merilnikov tokov v ravnih odprtih cisternah

Hydrometry - Calibration of current-meters in straight open tanks

iTeh STANDARD PREVIEW
Hydrométrie - Étalonnage des moulinets en bassins découverts rectilignes
(standards.iteh.ai)

Ta slovenski standard je istoveten z: ISO 3455:2021

<https://standards.iteh.ai/catalog/standards/sist/8785d8d9-04ad-47ee-93c6-844b7567fa1/sist-iso-3455-2021>

ICS:

17.120.20 Pretok v odprtih kanalih Flow in open channels

SIST ISO 3455:2021

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST ISO 3455:2021

<https://standards.iteh.ai/catalog/standards/sist/8785d8d9-04ad-47ee-93c6-844b75fe7fa1/sist-iso-3455-2021>

INTERNATIONAL
STANDARD

ISO
3455

Third edition
2021-01

**Hydrometry — Calibration of current-
meters in straight open tanks**

*Hydrométrie — Étalonnage des moulinets en bassins découverts
rectilignes*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST ISO 3455:2021](https://standards.iteh.ai/catalog/standards/sist/8785d8d9-04ad-47ee-93c6-844b75fe7fa1/sist-iso-3455-2021)

<https://standards.iteh.ai/catalog/standards/sist/8785d8d9-04ad-47ee-93c6-844b75fe7fa1/sist-iso-3455-2021>



Reference number
ISO 3455:2021(E)

© ISO 2021

iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST ISO 3455:2021

<https://standards.iteh.ai/catalog/standards/sist/8785d8d9-04ad-47ee-93c6-844b75fe7fa1/sist-iso-3455-2021>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principle of calibration	1
4.1 Statement of the principle.....	1
4.2 Accuracy of the method.....	2
4.2.1 Overall uncertainty on the velocity measurement.....	2
4.2.2 Requirements for accurate measurements.....	2
5 Infrastructure	2
5.1 Dimensions of the towing tank.....	2
5.1.1 General.....	2
5.1.2 Length.....	2
5.1.3 Depth and width.....	2
5.2 Towing cart.....	3
5.2.1 General.....	3
5.2.2 Cart track system.....	3
5.2.3 Types of towing carts.....	3
5.2.4 Cart operation.....	3
5.2.5 Cart control.....	4
5.3 Measuring equipment.....	4
5.3.1 General.....	4
5.3.2 Distance measurement.....	4
5.3.3 Time measurement.....	4
5.3.4 Current-meter velocity measurement.....	4
5.3.5 Sources of error related to infrastructure.....	5
5.4 Data acquisition.....	6
5.5 Data processing.....	6
5.6 Other requirements.....	6
6 Calculation of uncertainty	6
7 Calibration procedure	7
7.1 Calibration of rotating element current-meters.....	7
7.1.1 Suspension of the current-meter.....	7
7.1.2 Performance of calibration.....	7
7.1.3 Data analysis.....	8
7.1.4 Presentation of results.....	9
7.2 Calibration of electromagnetic current-meters.....	10
7.2.1 Instructions for calibration.....	10
7.2.2 Mounting the electromagnetic current-meter.....	10
7.2.3 Number of calibration points.....	10
7.2.4 Performance of calibration.....	11
7.2.5 Data analysis.....	11
7.2.6 Presentation of results.....	11
7.3 Calibration of acoustic current-meters for point velocity measurement.....	11
7.3.1 Instructions for calibration.....	11
7.3.2 Mounting the acoustic current-meter.....	12
7.3.3 Performance of calibration.....	12
7.3.4 Data analysis.....	12
7.3.5 Presentation of results.....	12
Bibliography	13

ISO 3455:2021(E)

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.

This document was prepared by Technical Committee ISO/TC 113, *Hydrometry*, Subcommittee SC 5, *Instruments, equipment and data management*. [SIST ISO 3455:2021](https://standards.iteh.ai/catalog/standards/sist/8785d8d9-04ad-47ee-93c6-8448-75576)

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.

ISO 3455:2021(E)

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 \(1\)](#):

$$v_c = \sqrt{gd} \quad (1)$$

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.

The depth and width of the tank shall therefore be chosen to suit the size and the maximum velocity limits of the current-meters to be calibrated. Care shall be taken to ensure that either high calibration velocities are attained before the interference or that they exceed it sufficiently for the critical zone to be bridged without extrapolation.

5.2 Towing cart

5.2.1 General

During calibration, the current-meter is suspended below the cart and immersed in the water at a specified depth and the cart travels along the length of the tank at known and accurate speeds in the measuring section.

5.2.2 Cart track system

The cart may run on two parallel rails which shall be accurately aligned with both the length of the tank and the surface of the water in the tank. It is essential that the rails are straight and that both the rails and the wheels of the cart are free of irregularities in order to avoid irregular motions of the cart. The material and hardness of the rails and the driving wheels should be chosen so that there shall not be undue wear and tear of the wheels. In the case of rubber tire wheels, provision shall be made to lift the wheels above the rail surface when not in use for a long time.

5.2.3 Types of towing carts

The following types of towing carts are in common usage.

- a) The towed cart which is moved along the track by a cable driven from a constant speed motor standing apart from the moving cart. The towed cart may be lighter in construction with the consequent advantage of high acceleration and quick braking, but the elasticity of the towing cable can cause irregularities in the running of the cart thereby affecting the accuracy of current-meter calibration.
- b) The self-propelled cart which is moved along the track by internally mounted electric motor(s). The power to the cart may be fed by a trailing wire track system, by an overhead conductor system or other systems specially designed for the purpose. The self-propelled cart is heavier in construction as it carries the driving motors. This results in greater inertia of the cart and assists in smoothing out the running irregularities of the cart.

5.2.4 Cart operation

The cart shall travel smoothly and at constant speed in the measuring section of the towing tank ensuring that oscillatory motion is not transmitted to the current-meters under calibration.

The cart shall have smooth operational capability. Vibration of the tow cart should be avoided.

The cart shall remain stable during acceleration, deceleration and braking. There shall not be any forward/backward or sideways rocking, or slippage during peak acceleration/deceleration and during normal operation at any speed in specified range.

During calibration, the measuring equipment, sensors and other instruments shall not be affected by noise and spurious signals induced by the main power supply or cart drive and control system or otherwise by electrical equipment installed in the rating tank building and vicinity.

In addition to normal braking, an alternate brake system shall also be provided on the cart which would automatically activate during an emergency.

ISO 3455:2021(E)**5.2.5 Cart control**

The cart may be manned or unmanned. In the case of a manned cart, an operator on-board controls various functions of the cart.

The unmanned cart is operated remotely without any operator on board.

5.3 Measuring equipment**5.3.1 General**

The calibration of a current-meter calls for the simultaneous recording of the following three parameters:

- a) distance covered by the cart;
- b) time; and
- c) signal (pulses) delivered by the current-meter or velocity processed by the meter control unit.

The towing speed is calculated from the simultaneous measurement of distance and time. In case of a rotating-element current-meter, the rate of current-meter revolutions (rotations) is obtained by the simultaneous measurement of the number of signals (pulses) and the time.

5.3.2 Distance measurement

Different methods are available for measurement of distance to the specified measurement uncertainty (see 5.3.5). Two of the most common methods are as follows:

- a) the establishment of light barriers (markers) at regular intervals along the length of the tank which actuate mechanical or optical pulse transmitters fitted to the cart;
- b) the use of measuring wheels with mechanical or photoelectric pulse transmitters/optical encoders which are drawn along the track by the cart.

In the case of using a measuring wheel, it shall be ensured that there is no slippage during travel. An additional method of precise speed measurement shall also be provided to check the accuracy of the measuring wheel on a regular basis.

5.3.3 Time measurement

The time of travel of the cart is normally measured by an electronic counter with an in-built accurate time reference, for example a quartz crystal. A period can thus be read to 1 ms or better. This equipment should be checked periodically against a reference device traceable to a national time standard.

5.3.4 Current-meter velocity measurement

The cart shall be provided with a suitable recording device for the measurement of current-meter signals.

In the case of rotating-element current-meters, the sensor of the current-meter shall generate a clear and positive signal corresponding to the rotor revolutions. Normally, as per the design of the system, the signals are generated once per revolution, twice per revolution, or in some cases, once for five revolutions or even once for 10 revolutions. The signals received from the current-meter(s) may be counted using the counting device of the current-meter. In measuring the number of current-meter revolutions in a given time, it is important to measure between identical points on the current-meter signal. It shall be ensured that none of the signals are missed.

In the case of an electromagnetic or acoustic current-meter, the electrical signals from its sensor are processed by its control unit.