SLOVENSKI STANDARD
SIST EN ISO 6416:2018

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Nadomešča:
SIST EN ISO 6416:2005

Hidrometrija - Merjenje pretoka z ultrazvočno časovno prenosno metodo (čas letenja) (ISO 6416:2017)

Hydrometry - Measurement of discharge by the ultrasonic transit time (time of flight) method (ISO 6416:2017)

Hydrometrie - Messung des Durchflusses mit dem Ultraschall-Laufzeitverfahren (Transit-time-/Time-of-flight-Verfahren) (ISO 6416:2017)

Hydrométrie - Mesure du débit par le temps de transit ultrasonique (temps de vol) méthode (ISO 6416:2017)

Ta slovenski standard je istoveten z: **EN ISO 6416:2017**

ICS:

17.120.20 Pretok v odprtih kanalih Flow in open channels

SIST EN ISO 6416:2018 **en,fr,de**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 6416

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ICS 17.120.20

Supersedes EN ISO 6416:2005

English Version

Hydrometry - Measurement of discharge by the ultrasonic transit time (time of flight) method (ISO 6416:2017)

Hydrométrie - Mesure du débit par la méthode du temps de transit ultrasonique (temps de vol) (ISO 6416:2017)

Hydrometrie - Messung des Durchflusses mit dem Ultraschall-Laufzeitverfahren (Transit-time-/Time-of-flight-Verfahren) (ISO 6416:2017)

This European Standard was approved by CEN on 22 August 2017.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN ISO 6416:2017) has been prepared by Technical Committee ISO/TC 113 "Hydrometry" in collaboration with Technical Committee CEN/TC 318 "Hydrometry" the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by May 2018, and conflicting national standards shall be withdrawn at the latest by May 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 6416:2017 has been approved by CEN as EN ISO 6416:2017 without any modification.

INTERNATIONAL STANDARD

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Fourth edition
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Hydrometry — Measurement of discharge by the ultrasonic transit time (time of flight) method

Hydrométrie — Mesure du débit par la méthode du temps de transit ultrasonique (temps de vol)

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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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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 113, *Hydrometry*, Subcommittee SC 1, *Velocity area methods*.

This fourth edition cancels and replaces the third edition (ISO 6416:2004), which has been technically revised. The main changes from the previous edition are:

— the title has been changed;

— a new subclause (7.7) on wireless systems has been added;

— former subclauses 9.2 and 11.6 have been removed;

— Clause 10 on site selection has been revised;

— Annex A (*Principle of measurement uncertainty*) and Annex B (*Performance guide for hydrometric equipment for use in technical standards*) have been added.

Hydrometry — Measurement of discharge by the ultrasonic transit time (time of flight) method

1 Scope

This document describes the establishment and operation of an ultrasonic (transit-time) gauging station for the continuous measurement of discharge in a river, an open channel or a closed conduit. It also describes the basic principles on which the method is based, the operation and performance of associated instrumentation and procedures for commissioning.

It is limited to the "transit time of ultrasonic pulses" technique, and is not applicable to systems that make use of the "Doppler shift" or "correlation" or "level-to-flow" techniques.

This document is not applicable to measurement in rivers with ice.

NOTE This document focuses on open channel flow measurement. IEC 60041 covers the use of the technique for full pipe flow measurement.

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 4373, *Hydrometry — Water level measuring devices*

ISO/TS 25377, *Hydrometric uncertainty guidance (HUG)*

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 Applications

4.1 Types of applications

a) Open channels

b) Multiple channels

c) Closed conduits

This method does not need a man-made or natural control, as it does not rely upon the establishment of a unique relationship between water level and discharge.

4.2 Attributes and limitations

The following attributes and limitations shall be considered when deploying this measuring system.

Attributes	
1.	Potential for high accuracy
2.	Tolerant of back water effects
3.	Able to measure multiple channels and combine results to give total flow
4.	Capable of determining individual velocities at distinct heights within the water column
5.	Visually unobtrusive
6.	Fish friendly
7.	Mains power supply not essential
8.	Intrinsically safe systems available for use in explosive atmospheres
9.	No obstruction or head loss
10.	Suitable for large range of channel widths and depths
11.	Potential for built in redundancy
12.	Potential for relatively low operating costs

Limitations	
1.	A site with an unstable cross section needs to be avoided if possible
2.	Requires minimum depth of water to operate
3.	May require cables to both sides of channel
4.	Ragging of sensors by trash
5.	Potential attenuation of acoustic signal by
	suspended solids
	weeds
	entrained gasses
	temperature gradients
	salinity gradients

Detailed explanations of these attributes and limitations can be found in clauses throughout this document.

5 Method of measurement

5.1 Discharge

5.1.1 Discharge, as defined in ISO 772, is the volume of liquid flowing through a cross-section in a unit time. It is usually denoted by the symbol Q and expressed in cubic metres per second ($m^3 \cdot s^{-1}$). The definition of discharge is the product of the wetted cross-sectional area and the mean velocity vector perpendicular to it.

Thus:

$$Q = \bar{v} \times A \quad (1)$$

where

Q is the discharge, expressed in cubic metres per second ($m^3 \cdot s^{-1}$);

$\bar{v}$ is the mean velocity, expressed in metres per second ($m \cdot s^{-1}$);

A is the cross-sectional area, expressed in square metres (m^2).

The transit-time method is a velocity-area method using flow velocities which have been determined by the equipment, and which are averaged along one or more lines which are usually, but not necessarily, horizontal.

5.2 Calculation of discharge from the transit-time measurement

5.2.1 Discharge can be computed using the velocity-area method (see 5.1), provided that a relation can be established between the velocities determined by the transit time ultrasonic system and the mean cross-sectional velocity. If there are sufficient operational paths distributed sufficiently throughout the vertical to define the velocity profile, the resulting samples of flow velocity can be vertically integrated to provide an estimate of the mean cross-sectional velocity. Alternatively, if there are insufficient operational paths, a relationship between measured velocity (index velocity) and mean velocity can be established using a spot flow gauging technique, e.g. rotating element current meter or acoustic Doppler current profiler (ADCP).

5.2.2 The discharge calculation also requires the cross-sectional area of the water to be known. An ultrasonic transit-time system will, therefore, normally be capable not only of making sample measurements of velocity, but also of determining (or accepting a signal from some other device determining) water depth, and of storing details of the relation between water depth and cross-sectional area. It will also normally be capable of executing the mathematical functions necessary to compute flow from the relevant stored and directly determined data.

6 Flow velocity determination by the ultrasonic (transit time) method

6.1 Principle

6.1.1 An ultrasonic pulse travels in a downstream direction faster than a similar pulse travels upstream. The speed of a pulse of sound travelling diagonally across the flow in a downstream direction will be increased by the velocity component of the water. Conversely, the speed of a sound pulse moving in the opposite direction will be decreased. The difference in the transit time in the two directions can be used