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Hidrometrija - Naprave za merjenje višine gladine vode (ISO/DIS 4373:2021)

Hydrometry - Water level measuring devices (ISO/DIS 4373:2021)

Hydrometrie - Geräte zur Wasserstandsmessung (ISO/DIS 4373:2021)

Hydrométrie - Appareils de mesure du niveau de l'eau (ISO/DIS 4373:2021)

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Hydrometry — Water level measuring devices

Hydrométrie — Appareils de mesure du niveau de l'eau

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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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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 5, *Instruments, equipment and data management*.

This fourth edition cancels and replaces the third edition (ISO 4373:2008), which has been technically revised.

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

— Incorporation of improvements in water level measuring devices;

— The use of mercury has been removed from the standard;

— Splitting up the old Annex A into three new separate annexes A, B and C;

— In the new Annex A the nowadays more commonly used electronic techniques have been brought to the front in order to emphasize them more.

Introduction

Measuring the level of water surface is very important in hydrometry among other things for the purpose of determining flow rates. Information about water levels is also used in operational water management, for the design of dikes, for storm surge warning services and guidance of shipping. ISO 4373:2008 is now in revision because of numerous improvements in water level measuring devices since the standard was published in 2008.

Hydrometry — Water level measuring devices

1 Scope

This International Standard specifies the functional requirements of instrumentation for measuring the level of water surface (stage), primarily for the purpose of determining flow rates.

This International Standard is supplemented by an annex providing guidance on the types of water level measurement devices currently available and the measurement uncertainty associated with them (see Annex A).

This standard covers both contact and non-contact methods of measurement. The non-contact methods are not in direct material contact with the water surface but measure the height of the water level with ultrasonic or electromagnetic waves.

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*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas*

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 https://www.electropedia.org/

4 Instrument specification

4.1 Performance parameters

The performance parameters of a water level measuring device are uncertainty, measurement range, temperature range and relative humidity range. Thus, the overall performance of the equipment may be summarized by a few characterizing parameters.

4.2 Performance classification

Water level measuring devices shall be classified in accordance with the performance classes given in Table 1 that account for the resolution to be achieved and the limits of uncertainty required over specified measurement ranges. Measurement range is to be understood as the difference between the highest and the lowest water level that can be measured. When measuring short ranges with class 1 and 2 devices, the uncertainty is a few millimetres, and this is difficult to achieve.

It should be made clear whether these levels of attainment can only be achieved using special works, for example installation within a stilling well, also referred to as a gauge well.

Table 1 — Performance classes of water level measuring devices

Class	Resolution	Range	Nominal uncertainty
Performance class 1	≤ 1 mm ≤ 2 mm ≤ 10 mm	≤ 1,0 m ≤ 5,0 m ≤ 20 m	< ± 0,1 % of range
Performance class 2	≤ 2 mm ≤ 5 mm ≤ 20 mm	≤ 1,0 m ≤ 5,0 m ≤ 20 m	< ± 0,3 % of range
Performance class 3	≤ 10 mm ≤ 50 mm ≤ 200 mm	≤ 1,0 m ≤ 5,0 m ≤ 20 m	< ± 1 % of range

The manufacturer must state the physical principle of the measuring device to allow the user to judge the device's suitability for the proposed environment. In Table 2 the various physical principles of operational water level measuring devices, that are being used in the field, are listed against their characteristics. These different techniques are described in more detail in Annex A.

Table 2 — Characteristics of operational water level measuring devices

Device	Type	Suitable for continuous measurement	Typical measurement range	Typical resolution
Mechanical devices	Float	Yes	20 m	10 mm
	Peak level	No	15 m	10 - 20 mm
	Staff and ramp gauge	Yes	10 m	10 - 20 mm
Electrical devices	Bubbler	Yes	30 m	2 - 10 mm
	Pressure transducer	Yes	20 m	10 mm
	Capacitance	Yes	15 m	10 mm
	Resistance	–	15 m	10 mm
Non-contact devices	Radar/Laser	Yes	10 - 50 m	1 mm
	Ultrasonic (through air)	Yes	3 - 30 m	1 - 2 mm
	Ultrasonic (through water)	Yes	3 - 30 m	2 - 5 mm

4.3 Maximum rate of change

As water levels may rise and fall rapidly in some applications, to provide guidance on suitability, for mechanical devices the manufacturer shall state on the equipment specification sheet and in the instruction manual:

a) the maximum rate of change which the instrument can follow without damage;

b) the maximum rate of change which the instrument can tolerate without suffering in change in calibration;

c) the response time of the instrument. The response time is the time interval between the instant when the level sensor is subjected to an abrupt change in liquid level and the instant when the readings cross the limits of (and remain inside) a band defined by the 90 % and the 110 % of the difference between the initial and final value of the abrupt change. The response time should be short enough for the instrument to follow even the fastest relevant changes in water level, e.g. tides and flood waves. The response time should not be too short. Therefore, in many electronic devices, it is possible to enlarge the response time through the setting of certain parameters within the instrument. This can be useful, for example, to damp out the rapid excursions caused by short waves. Such rapid disturbances are due to local hydraulic phenomena and are thus not representative for the water level over a large section of the water course. The locally excited disturbances are thus to be discarded as much as possible.

4.4 Environment

4.4.1 General

Water level measuring devices shall operate within the ranges of temperature in 4.4.2 and the ranges of relative humidity in 4.4.3.

4.4.2 Temperature

Water level measuring devices shall operate within the following ambient air temperature classes:

Temperature class 1: - 30 °C to + 55 °C;

Temperature class 2: - 10 °C to + 50 °C;

Temperature class 3: 0 °C to + 50 °C.

4.4.3 Relative humidity

Water level measuring devices shall operate within the following relative humidity classes:

Relative humidity class 1: 5 % to 95 % including condensation;

Relative humidity class 2: 10 % to 90 % including condensation;

Relative humidity class 3: 20 % to 80 % including condensation;

4.5 Timing

4.5.1 General

Where timing, either analogue or digital, is part of the instrument specification, the timing method used shall be clearly stated on the instrument and in the instruction manual.

NOTE It is recognized that digital timing is potentially more accurate than analogue timing.

Moreover, when several raw data samples are assembled together in order to arrive at a time averaged measurement value, it should clearly be stated to which moment in time the final result applies. It is preferred to have this time label at exactly the middle of the averaging time window, because this moment is the most representative. However, many commercially available loggers add time and data stamps at the beginning or at the end of the averaging time window.

4.5.2 Digital

The uncertainty of digital timing devices used in water level measuring devices shall be within ± 60 s at the end of a period of 30 days, within the range of environmental conditions defined in 4.4.

4.5.3 Analogue

The uncertainty of analogue timing devices used in water level measuring devices shall be within ± 5 min at the end of a period of 30 days, within the range of environmental conditions defined in 4.4.

5 Recording

5.1 Chart recorders

Where a chart recorder is to be used as the primary source of data, the resolution and uncertainty parameters shall take account of changes in the dimensions of the recording medium due to atmospheric variables.

NOTE Chart recorders have been superseded to a large extent by data logging services. However, they are still used as back-up units or to provide rapid visual assessment of flow changes on site.

5.2 Data loggers

A data logger shall be able to store at least the measured value and a timestamp. The data logger shall be able to store at least the equivalent of four digits per measurement and at least the equivalent of nine digits for the timestamp.

NOTE The above mentioned statement of nine digits for the timestamp is based on the format DDDYYHHMM (day, year, hour, minute).

Where a data logger includes the interface electronics, the resolution and uncertainty shall relate to the stored value.

6 Enclosure

The performance of the enclosure shall be stated in terms of the IP classification system in accordance with IEC 60529. It shall be stated whether or not any parts in contact with water are suitable for contact with water. National regulations and by-laws relating to materials in contact with water shall be obeyed. It shall be stated whether or not the equipment may be used in a potentially explosive environment in accordance with IEC 60079-10.

7 Installation

The manufacturer shall provide clear instructions for the installation of water level measuring devices.

The water level measuring device must have a clearly visible reference mark, which can be used for tying the device to the local gauge datum.

If a float measuring system is equipped with a stilling well, the diameter of the horizontal inlet pipe or orifice to the stilling well should be about ten times smaller than the diameter of the stilling well itself in order to sufficiently reduce any disturbances originating from the wavy water in the main channel.

Furthermore, the vertical cylindrical pipes, in which the float can move up and down should be at least 10 cm wider than the float diameter and shall be erected exactly along the local vertical in order to ensure free movement of the float over the entire range.

Ensure that a non-contact sensor is set up with its beam perpendicular to the water surface. Non-contact sensors shall be installed on rigid and well secured brackets to prevent movement of the sensor that could introduce errors in the measurement. There should be a clear path from the sensor face to the water surface, free from obstacles that might give false reflections. Many non-contact instruments include signal diagnostics that help the user when commissioning the instrument.

