INTERNATIONAL STANDARD

ISO 11655

First edition
1995-06-01

Measurement of liquid flow in open channels — Method of specifying performance of hydrometric equipment

Mesure de débit des liquides dans les canaux découverts — Méthode de spécification des caractéristiques de fonctionnement des appareils hydrométriques

Reference number
ISO 11655:1995(E)

Contents

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

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 11655 was prepared by Technical Committee ISO/TC 113, *Hydrometric determinations*, Subcommittee SC 5, *Instruments, equipment and data management*.

Annex A of this International Standard is for information only.

Introduction

This International Standard contains recommendations for a method of specifying the performance of equipment used for the sensing, measuring and, as appropriate, recording of physical variables related to measurement of liquid flow in open channels.

The process of sensing, measuring and recording hydrological phenomena requires the conversion of a time-related physical event or state into a numerical expression in terms relative to a standard scale of measurement units. The steps in the conversion are the following:

a) adaptation or conversion (as the individual situation requires) of the naturally occurring phenomenon into a state where a representative determination can be made;

b) if necessary, identification of a surrogate parameter and the establishment of the relation between changes in that parameter value and changes in the phenomenon to be measured;

c) sensing, measurement and (if appropriate) recording of the physical phenomenon or its surrogate as it varies with the passage of time;

d) conversion of sampled data into numerical information.

The ultimate measure of equipment performance is the evaluation of the uncertainty with which the equipment converts the absolute value or level of the hydrological variable into a measured quantity, relative to another arbitrary or fixed reference datum. The suitability of a piece of equipment, however, may also be related to the particular method of measurement and to the measurement frequency.

The nature of the uncertainty is closely related to the physical method or principle employed in the process of conversion from the natural variable to the measured quantity. Different physical systems are affected to differing degrees by such factors as:

— intrinsic design of the equipment;

— calibration methods;

— natural environmental factors;

— man-made environmental factors;

— levels of care and maintenance;

— operator methods and skills.

The user should seek to identify the three fundamental factors which may affect the uncertainty; these, which should be objectively defined from study of the method of measurement, are:

a) the level of uncertainty of each individual measurement due to the principle of operation of the measurement equipment;

b) the range of factors, for example environmental conditions (expressed numerically) and other external forces which influence the performance of the measurement equipment;

c) the frequency with which the hydrological variable should be sampled by the equipment in order to achieve the required level of data uncertainty.

The previous information represents the minimum which must be made available to the manufacturer before he can recommend a product or commence design and manufacture.

Taken together these factors describe the customer specifications for the performance of the measurement equipment.

Once a design is selected for the equipment, the specifications for use are established through the relevant standards documentation on methods of measurement. Levels of care and maintenance are laid down by the manufacturer in the equipment handbook, and should be adhered to if the manufacturer's claims of performance levels are to be achieved and maintained.

If followed by the manufacturer, this method will provide the user with a basis for understanding the ability of a particular piece of equipment to meet the purpose intended. It further provides a framework within which the user may specify his requirements to the manufacturer and against which he may judge the usefulness of a product.

This page intentionally left blank

Measurement of liquid flow in open channels — Method of specifying performance of hydrometric equipment

1 Scope

This International Standard provides a method of specifying the performance of hydrometric equipment. It identifies, within a performance framework, the factors that affect the range of uncertainty within which the hydrological quantity is converted into a numerical quantity.

This International Standard applies to all equipment used for hydrological measurement, with the exception of equipment used for the determination of water quality. The sensor, the measurement system and the recorder are treated as a unit, whether operated in mechanical, electromechanical or electronic form, or using other physical principles. Because hydrological variables are frequently determined against time, the time measurement device is also considered to be an integral part of the measurement system.

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 31-1:1992, *Quantities and units — Part 1: Space and time.*

ISO 31-3:1992, *Quantities and units — Part 3: Mechanics.*

ISO 772:—[1], *Measurement of liquid flow in open channels — Vocabulary and symbols.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 772 and the following definitions apply.

3.1 influencing factor: Condition (environmental or otherwise), element, or activity external to the measuring equipment which may influence equipment performance.

3.2 performance measure: Degree to which the intended functions of the equipment are accomplished.

3.3 range: Span of values of the quantity being measured or of an influencing factor.

3.4 conditions of storage and transport: Those conditions specified by the manufacturer under which equipment may be stored and transported in an inoperative state and may be subjected to influences outside those experienced in use or operation.

Under these conditions the equipment may be specially packed or protected in whatever way considered appropriate by the manufacturer, in order that the equipment should not suffer damage or degradation

1) To be published. (Revision of ISO 772:1988)

of performance when subsequently operated within the applicable range of conditions.

3.5 conditions for normal operation: Those conditions within which the equipment is expected to measure the parameter under study in accordance with the appropriate criteria of performance.

The range of operational conditions shall be defined by the user.

3.6 extreme conditions of equipment use: Those conditions which exceptionally lie outside the range normally applicable to equipment operation, and against which the equipment is provided with no special protection.

The equipment is expected to resume required performance levels as soon as the influencing factors return to within the range applicable to the operation mode. The limits of these conditions should be specified by the manufacturer.

3.7 hazardous area: Area in which exist hazardous conditions potentially capable of endangering safety by whatever means.

The danger may arise through physical location or through exposure to a potentially explosive atmosphere, for example in sewers.

3.8 overall performance level: Statement of expected performance of the equipment, relative to the true values of the measured hydrological variable.

3.9 timing performance: Statement of expected performance of any timing element of the equipment employed to control the sampling rate or frequency.

4 Units of measurement

The units of measurement used in this International Standard are SI units, in accordance with ISO 31-1 and ISO 31-3.

5 Objectives

The purposes of this International Standard are

— to specify the terminology and definitions related to the functional performance of equipment used for the determination of hydrological data and information,

— to specify the requirements for statements by manufacturers, and

— to recommend the criteria to be identified by users/customers at the time of ordering/acquiring equipment for hydrological measurement purposes.

6 Equipment performance

6.1 Influencing factors

Before choosing equipment for measurement purposes, the user should ascertain that the equipment will provide the required operational performance relative to the chosen method of measurement under the range of factors which may influence that performance. These influencing factors are as follows.

6.1.1 Atmospheric conditions

a) Ambient temperature;

b) atmospheric humidity;

c) atmospheric pressure;

d) atmospheric quality (for example atmospheric contaminants);

e) atmospheric precipitation;

f) solar radiation;

g) wind speed;

h) environmental electrical discharges (natural and man-made);

i) electromagnetic interference.

6.1.2 Aquatic conditions

a) Water temperature;

b) water pressure;

c) water quality (for example pH, suspended solids, conductivity, visible oil).

6.1.3 Mechanical factors

a) Operating position;

b) vibration;

c) mechanical shock.

6.1.4 Other factors

a) Nature of energy source;

b) level of biological activity;

c) electrical interference through ground or water;

d) operator skill;

e) standards of operational maintenance.

6.2 Range of values of influencing factors

Manufacturers supplying equipment for hydrometric measurement purposes, either as complete measurement systems or as elements of such systems, shall provide statements of the limiting ranges of values for each of the influencing factors listed in annex A, A.1 to A.3.

Annex A presents three equipment situations for which ranges of influencing factors shall be provided:

a) equipment storage and transport, when the equipment is in an inoperative state;

b) equipment use when required to produce a functional signal only;

c) equipment operation when required to produce data within the performance limits declared by the manufacturer and in accordance with the requirements of clause 7.

Equipment operating in accordance with this International Standard shall show no permanent damage or degradation of performance when, whether inoperative or in use, it is subjected to conditions where one or more of the influencing factors assumes a value within the limiting values of any of the ranges assigned for the equipment during a specified time. If no time limit is specified, it should be assumed that such conditions apply for an indefinite time. On re-establishment of conditions in which values of the influencing factors lie within the operating range, the equipment is expected to operate within the stated performance limits.

It is recommended that the user and the manufacturer use the checklist form in annex A, in order to clearly identify all environmental and other influencing factors which may affect equipment performance.

It is further recommended that there be discussion between the manufacturer and the user in order to identify any combination of factors that may result in abnormal effects.

7 Overall equipment performance

7.1 General

The user shall state the allowable tolerance on any single parameter/measurement which lies within the operational range, subject to all influencing factor values lying within the range of operational use. The allowable tolerance may vary from one part of the range to another, in which case the user shall state both allowable tolerance values and the subdivision of the operational range over which any specific tolerance value applies.

The manufacturer shall state the performance characteristics of the equipment over the full operational range required by the user.

7.2 Resolution

The resolution of a device is its ability to define the value of a parameter, as qualified by the degree of discrimination possible. (Resolution may be specified in either absolute terms or relative terms; for example ± 10 mm, ± 0,5 % of full scale, 1 ppm.)

7.3 Repeatability

The repeatability is the ability of a device to provide the same measurement response when sensing the same absolute parameter values on different occasions, and when operating under identical influence factor conditions.

7.4 Response time

Response time is the time taken by the device to react to changes in the value of the parameter to be measured. (Response time may be given in terms of seconds to register a specified proportion of change in the parameter value.)

7.5 Uncertainty

The uncertainty is an estimate characterizing the range of values within which the true value of the parameter being measured lies when operating within the operational range of influencing factors. The value of uncertainty applies only when operating under steady-state conditions, and may be indicated in absolute or relative terms.