International Standard 3454

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Liquid flow measurement in open channels — Direct depth sounding and suspension equipment

Mesure de débit des liquides dans les canaux découverts — Matériel de sondage et de suspension pour le mesurage direct de la profondeur

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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3454 was developed by Technical Committee ISO/TC 113, *Measurement of liquid flow in open channels*, and was circulated to the member bodies in April 1982.

It has been approved by the member bodies of the following countries :

Australia	Germany, F. R.	South Africa, Rep. of
Belgium	India	Switzerland
China	Italy	United Kingdom
Czechoslovakia	Korea, Dem. P. Rep. of	USA
Egypt, Arab Rep. of	Netherlands	USSR
France	Romania	

No member body expressed disapproval of the document.

This second edition cancels and replaces the first edition (i.e. ISO 3454-1975).

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0 Introduction

The object of sounding is to obtain the correct vertical depth of water from the surface to the bed, irrespective of the depth and velocity of flow. A sounding rod or a sounding cable and weight may be used for this purpose. The choice depends on the velocity and depth of flow.

1 Scope and field of application

This International Standard specifies functional requirements of sounding and suspension equipment used in the direct measurement of depth and velocity of flow in open channels, including the collection of sediment samples.

It applies to equipment used for sounding of water depth by the direct method and to equipment for suspending measuring or sampling instruments (for example current meter or sediment sampler) at the point of measurement. It does not apply to indirect methods such as echo sounding.

2 Units of measurement

The units of measurement used are SI units.

3 References

ISO 748, *Liquid flow measurement in open channels — Velocity-area methods.*

ISO 772, *Liquid flow measurement in open channels — Vocabulary and symbols.*

ISO 4375, *Measurement of liquid flow in open channels — Cableway system for stream gauging.*

4 Definitions, symbols and abbreviations

The definitions, symbols and abbreviations given in ISO 772 shall apply.

5 Sounding equipment

5.1 General

Sounding rods or cables may be used for suspending, measuring and sampling equipment. Requirements, limitations and corrections common to suspension and sounding are considered below.

5.2 Sounding rod

A sounding rod is rigid in construction. It may be hand-held and hand-operated or provided with a support and mechanically operated. A hand-held rod generally would not be used in depths exceeding 3 m and velocities exceeding 2 m/s. A supported, mechanically operated rod is generally suitable for depths up to 6 m and velocities up to 2 m/s. A wading rod may be used in shallow streams suitable for wading.

5.3 Sounding cable and weight

A sounding cable and weight may be used in situations where depths and velocities preclude the use of a sounding rod. In use, however, a sounding cable is subject to drag and a streamlined weight of sufficient mass should be attached to maintain the cable in a position as near to the vertical as possible. The sounding weight required will increase with water depth and velocity.

There is no precise rule for the choice of a suitable mass of sounding weight but general guidance is given in the annex.

6 Suspension equipment

6.1 General requirements

Suspension equipment should

a) be such that the suspended measuring or sampling device may be placed at a selected depth and position without causing undue disturbance to the device, irrespective of the depth and velocity;

b) maintain the measuring or sampling device stable at the selected depth and position during the period of observation.

6.2 Rod suspension equipment

This type of equipment has the merit that a measuring or sampling device can be placed at the desired depth and position, without the rod being subject to any appreciable deflection from the vertical plane through which the observations are being made. Rod suspension equipment may be hand-held and operated or provided with a support and operated mechanically. Hand-held rod suspension equipment should be simple to use in water of depths up to 3 m and velocities up to 2 m/s. A wading rod may be used in shallow streams suitable for wading. Supported, mechanically operated rod suspension equipment allows more accurate positioning of the measuring or sampling device at the required depth and position, but is heavier and requires careful installation and skilled handling. This equipment may be employed where the use of a hand-held rod becomes impracticable, but generally would not be used in depths exceeding 6 m and velocities exceeding 2 m/s.

6.3 Cable suspension equipment

Cable suspension may be used in situations where depths and velocities preclude the use of rod suspension. In use the cable is subject to drag and under most conditions it will be necessary to attach a streamlined weight of sufficient mass to maintain the cable in a position as near to the vertical as possible. The mass required will increase with water depth and velocity. Advice on selecting a suitable weight is given in the annex. Cable suspension may be hand-held and operated or dispensed from a winding reel. Hand-held suspension should be simple in design and should be capable of use with weights up to 15 kg. Where weights in excess of 15 kg are needed, it is recommended that a winding reel mounted on a suitable support for use from a cable-car, bridge, boat boom, crane or ice frame be used; this is appropriate under most conditions of flow.

7 Cable measurement corrections

A cable, whether used for suspension or sounding, will be deflected downstream by the flow. This results in the apparent measured depth being greater than the true depth. The magnitude of the deflection and the consequent need for correction will generally be a function of velocity and depth of immersion. Where the suspension cable exceeds an angle of 4° with the vertical, an unacceptable error may be introduced. The magnitude of such errors may be determined by reference to ISO 748.

8 Specific requirements

8.1 Rods for sounding and suspension

8.1.1 Hand-held rods

This equipment should satisfy the following requirements :

a) Its mass should be as low as possible.

b) It should be straight and have sufficient strength to withstand the force due to flowing water without significant deflection or vibration. It may be sectional to allow it to be dismantled. The sectional connection should not interfere with positioning or operation of the current meter.

c) Construction should be of corrosion resistant material.

d) It should not cause significant heading-up of water due to its own obstruction.

e) The interval between graduations should permit observation to within 10 mm; graduation increments of 0,1 m, 0,5 m and 1 m should be clearly identified. Graduations should remain visible when the rod is wet and should be wear-resistant. They should be visible from all angles.

f) It should incorporate a foot plate to prevent penetration into the bed of the channel.

g) It should incorporate a movable mounting for equipment and a means of conveying an electrical signal to the top of the rod.

h) Provision may be made for a secondary rod which allows the setting of the meter from the top of the rod.

j) It should be easy to hold, especially when wet or cold.

8.1.2 Mechanically operated rods

In addition to the requirements of 8.1.1, mechanically operated rod equipment (see 6.2) should have the following features :

a) A locking arrangement such as pawl and ratchet to hold the rod in the desired position.

b) A mechanical arrangement to raise and lower the rod easily.

c) An arrangement for securing it safely to the gauging platform or structure.

d) Sufficient counter-balancing to ensure stability.

e) A means for easily determining the rod position.

8.2 Cable sounding and suspension equipment

8.2.1 Cable

The cable itself used with sounding and suspension equipment should

a) be corrosion-resistant, preformed and reverse-laid to inhibit spinning;

b) be equipped with a suitable attachment for suspending the measuring equipment and weights;

c) incorporate insulated conductors suitable for the transmission of signals from the instrument;

d) be constructed so that in normal use it will not sustain any permanent bends or twists, which would affect its utility and length;

e) have sufficient strength to support the current meter and sounding weight safely. A breaking load of not less than five times the maximum sounding weight provides a suitable safety margin to allow for the loading effects of drag and the live load. Its elongation under load should not exceed 0,5 %.

In addition, where it is to be used as a hand line, the portion of the cable to be handled should be of suitable material and dimensions (for example, 10 mm diameter, with a polyvinyl chloride or rubber cover) to avoid discomfort or injury to the operator. The wet-line portion should have a diameter as small as possible (consistent with the conditions stated above) in order to minimize drag.

8.2.2 Winding reels

Winding reels used to dispense and measure suspension cable should satisfy the following requirements :

a) The radii of drums, pulleys and cable guides should not be less than the minimum cable bending radius recommended by the manufacturer.

b) There should be a device to measure the amount of cable paid out. It may be driven by the drum when the cable can be accommodated in a single layer, otherwise it should be driven directly by the cable.

c) There should be an arrangement to ensure that the cable is wound evenly on to the drum; the end of the cable shall be securely fastened to the drum.

d) There should be a locking arrangement to hold the drum at any desired position.

e) There should be provision for an electrical connection between the recording equipment and the suspended instrument.

f) The design of the reel should be such that hand operation is easy; the drum may be provided with a power drive unit for raising and lowering the measuring equipment and attached weight : the method of attachment to the supporting device should be simple and safe.

8.2.3 Supports and mounting structures for winding reels

Supports and mounting structures to be used on or attached to bases indicated in 6.3 should

a) be of adequate strength to support the winding reel together with the measuring or sampling equipment and any attached weight plus debris which might catch on the equipment;

b) enable the measuring or sampling equipment to be lowered or raised in a vertical plane giving adequate clearance from the support structure;

c) incorporate adequate counter-balancing to ensure its stability at all times;

d) should be easily transportable. To this end it may be collapsible.

In addition, such supports and mounting structures may

a) incorporate a protractor to measure the deviation of the cable from the vertical;

b) have provision for attaching a power drive unit.

8.3 Sounding weights

Sounding weights should be constructed of a dense material to minimize volume, streamlined to minimize drag and fitted with fins to provide directional stability. The location of the weight with respect to the measuring instrument should be such as to minimize its effect on the operating characteristics of the instrument. The anchorage point for the attachment of the suspension cable should be made as small as possible or incorporated in the body of the weight.

In addition, the weight may

a) be equipped with a device to detect and signal contact with the bed;

b) have other hydrometric equipment attached directly to it;

c) be part of an assembly having an overhanging support for securing hydrometric equipment.

Attaching two or more weights to the sounding or suspension cable is not recommended.

Annex

Estimation of sounding weight mass to suit velocity and depth

(This annex forms part of the standard.)

To maintain sounding and suspension cables as near to the vertical as possible, a streamlined sounding weight may be required. An estimate of the mass required can be found using the formula

$$m = 5\,\bar{v}D$$

where

m is the mass of the weight in kilograms;

$\bar{v}$ is the mean velocity of flow in metres per second;

D is the depth in metres.

The shape and size of the weight assembly have an effect on the local flow conditions in the channel and so should be streamlined to minimize that effect. However, physical conditions may determine the practical shape and size of sounding weight assemblies, for example, when sounding through holes drilled in ice cover.