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Hydrometry — Suspended sediment in streams and canals — Determination of concentration by surrogate techniques

Hydrométrie — Sédiments en suspension dans les cours d'eau et dans les canaux — Détermination de la concentration par des techniques de substitution

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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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 113, *Hydrometry*, Subcommittee SC 6, *Sediment transport*.

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Introduction

Sedimentation and sediment transport in streams, rivers, reservoirs and estuaries are key parameters in many scientific, environmental, engineering, and agricultural problems. Success in managing and solving sedimentation problems requires comprehensive knowledge of sediment movement. This requires reliable methods of estimation of sediment load with high-quality data. The amount of sediment transport data being collected, however, has steadily declined in recent decades largely due to difficulty and costs associated with field methods used for data collection. High temporal resolution data of high quality are needed to better understand and more adequately describe many sedimentation processes.

The bed load and suspended load broadly constitute total sediment load. However, the scope of this International Standard is confined to the measurement of suspended sediment. Conventional methods for measurement of suspended sediment concentrations in streams rely on the principle of collecting samples of water-sediment mixture at various points in time and space using suitable sampling equipment and deployment methods and analysing the samples in laboratory for estimating the sediment concentration. These methods are labour intensive, expensive and can be hazardous. Moreover, the accuracy of these methods in estimating the sediment concentration of rivers and streams over a period of time may not be dependable due to the large spatial and temporal variability associated with the transport of suspended sediment.

Continuous and accurate estimation of suspended sediment concentration is essential in certain situations such as:

a) in hydropower projects for the safety of the turbines and other machinery, reservoir silting and flushing;

b) water-supply projects for monitoring water quality;

c) storm water run-off from urban areas;

d) silting of wetlands; and

e) long-term monitoring of sediment transport in rivers and streams, in order to obtain reliable base lines that can be used for decision making.

In such situations, automatic and cost-effective techniques are essential to collect high-quality data on suspended sediment concentrations and particle sizes.

Recent technological advances in the fields of optics and acoustics have provided new sediment-surrogate technologies and methods to determine suspended sediment fluxes and characteristics. Some of these methods can be used to measure suspended sediment concentration at higher resolution, with greater automation and potentially lower cost than traditional methods. These methods involve surrogate technologies that derive the suspended sediment concentration from measurements of optical backscatter, laser diffraction and acoustic backscatter.

The measurement of suspended sediment concentration (SSC) in the water samples can be carried out with the help of nephelometry, transmission, laser diffraction and acoustic back scatter techniques. The working principles, applications, advantages and disadvantages, limitations and usable instruments of the above techniques are elaborated in this International Standard. The optical backscatter technique is readily available and relatively inexpensive. Optical backscatter sensor sensitivity depends on grain size, colour and composition. The advantages are small size and small sample volume, linear and high frequency response, insensitive to ambient light, large measuring range and low cost. The laser diffraction (LD) technique is also readily available and cost effective. The acoustic backscatter is another technique for measurement of SSC in the aquatic ecosystems. Measurements are possible for a range of sediment sizes that is dependent on the acoustic frequency. The available maximum sampling depth will be limited at high concentrations.

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Hydrometry — Suspended sediment in streams and canals — Determination of concentration by surrogate techniques

1 Scope

This International Standard specifies methods for determination of the concentrations and particle-size distributions of suspended sediment in streams and canals by surrogate techniques. Methods based on bulk-optical principle of water such as transmission and nephelometry are the most commonly used surrogates for determining suspended sediment concentrations (SSC). Instruments and techniques based on acoustic attenuation and/or acoustic backscatter principles are also in use for measurement of suspended sediment concentration. Instrumentation based on the laser diffraction principle is also used for the measurement of particle size distribution. This International Standard covers brief description of the operating principle of each method and details of some of the instruments available.

The detailed method and principle of optical and acoustical transmission, nephelometry, and optical back scatter (OBS), laser diffraction technique (LD) and acoustic back scatter technique (ABS) with their limitations are described in Annex A, Annex B and Annex C respectively.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 4363, *Measurement of liquid flow in open channels — Methods for measurement of characteristics of suspended sediment*

ISO 13320, *Particle size analysis — Laser diffraction methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 772, ISO 4363 and ISO 13320 and the following apply.

3.1
surrogate technique
indirect method in which a substitute object or property is used for measurement in place of the original object or property

Note 1 to entry: Optical and acoustic properties of water-sediment mixture such as optical transmission, acoustic scattering and laser diffraction are some of the surrogates for measurement of suspended sediment concentration.

3.2
nephelometry
any method for estimating the concentration of particles in suspension by measuring the intensity of scattered light

Note 1 to entry: Light scattering depends upon number, size distribution, colour, composition (as manifested in the complex index of refraction) and shape characteristics of the particles.

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