INTERNATIONAL STANDARD 3716

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Liquid flow measurement in open channels — Functional requirements and characteristics of suspended sediment load samplers

Mesure de débit des liquides dans les canaux découverts — Spécifications de fonctionnement et caractéristiques des appareils d'échantillonnage pour la détermination des charges sédimentaires en suspension

First edition — 1977-06-15

UDC 627.13 : 556.536 : 532.5.07 **Ref. No. ISO 3716-1977 (E)**

Descriptors : liquid flow, open channel flow, flow measurement, samplers, sediments, suspended matter, specifications, classification, performance evaluation.

Price based on 6 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (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 set up 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 3716 was developed by Technical Committee ISO/TC 113, *Measurement of liquid flow in open channels*, and was circulated to the member bodies in May 1975.

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

Austria	India	South Africa, Rep. of
Belgium	Ireland	Switzerland
Canada	Italy	Turkey
Czechoslovakia	Japan	United Kingdom
France	Norway	U.S.A.
Germany	Romania	U.S.S.R.

No member body expressed disapproval of the document.

Printed in Switzerland

Liquid flow measurement in open channels — Functional requirements and characteristics of suspended sediment load samplers

0 INTRODUCTION

Suspended sediment load samplers are classified according to their mode of operation into two general types : "instantaneous" and "time-integrating". A number of samplers that have been devised do not strictly qualify for either of these classifications on account of their design, sampling action, or method of operation. As the name implies, the "instantaneous" sampler is designed to trap a specimen of the water-sediment mixture passing the selected sampling point at a given point of time. The "time-integrating" sampler, on the other hand, takes the sample more slowly over an extended period of time to obtain a specimen in which the instantaneous or time-to-time fluctuations in the suspended load are averaged over the sampling period of time. The "time-integrating" samplers may be again divided into "point-integrating samplers" and "depth-integrating samplers". The "point-integrating" sampler is held stationary at the point in the sampling vertical during the time the sample is taken, and then moved, with the sampling action stopped, to a second point, and so on, the process being repeated. The "depth-integrating" sampler is lowered to the bottom of the stream and raised again to the surface at a uniform rate, sampling continuously during both periods of transit; or it is lowered only for sampling continuously from the surface to the stream bed, so that a mean sample from the vertical, with uniform weight accorded to the increments of the water-sediment mixture at various depths, is obtained. Some improved-type samplers enable operators, be means of a remote control, to take samples either over the whole, or only from a portion, of the vertical.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the functional requirements and characteristics of the different types of suspended sediment load samplers.

2 REQUIREMENTS OF SAMPLERS

In order that the samples taken by a sampler be truly representative of the sediment concentration of a stream at a point of sampling, the ideal sampler should fulfil the following technical requirements :

a) The sampler shall be streamlined so as to minimize disturbances to normal sediment flow.

b) The velocity of inflow at the mouth of the sampler or sampling tube shall be as close as possible to the velocity of the current of water at the sampling point, irrespective of what this velocity may be. This aspect is most important if large sampling errors are to be avoided.

c) The mouth of the sampler shall always face into the current and the water shall be taken parallel to the current direction at the sampling point.

d) The mouth of the sampler shall be outside the zone of the disturbances of the flow set up by the body of the sampler and its operating gear, and the flow lines shall be disturbed as little as possible, especially near the mouth.

e) Filling arrangements shall be smooth so that there is no sudden inrush or gulping; the air escaping from the sampler shall not hinder the entry of the sample; this necessitates a separate port for air exhaust.

f) The sampler shall be able to collect samples at the desired depth without the samples being disturbed or contaminated by the water-sediment mixture at other points while the sampler is being raised or lowered.

g) It shall be possible to take a sample exactly when and where it is required, in particular when sampling close to the stream bed.

h) The sampler shall be portable, yet sufficiently heavy to minimize deflection of the supporting cable from the vertical due to current drag.

i) The sampler shall be simple in design and robust in construction and shall require minimum care in maintenance and operation.

j) The removable-type container within the sampler shall be easily removed, readily capped and easily transported to a laboratory without loss of contents. Alternatively, if the container forms a part of the sampler, it shall be installed so as to secure complete drainage of the contents.

k) The volume of the sample collected by the sampler shall be sufficient for the determination of concentration and size analysis. The present practice is generally to use 0,5 l as a minimum.

l) Depth-integrating samplers should be lowered or raised at a uniform and slow speed, a fraction of the current velocity (for example, between 1/5 and 1/15 — see note).

NOTE — *Depth integration* (with uniform vertical motion — see figure)

$A \cdot v \cdot t = V$ . . . (1)

$i = k \cdot v$ . . . (2)

$h = i \cdot t$ . . . (3)

where

A is the area of the mouth or tube;

v is the current velocity;

t is the maximum duration of sampling;

V is the sample volume to be taken;

i is the uniform rate for sampler movement;

h is the maximum vertical distance for sampling.

From equations (1), (2) and (3),

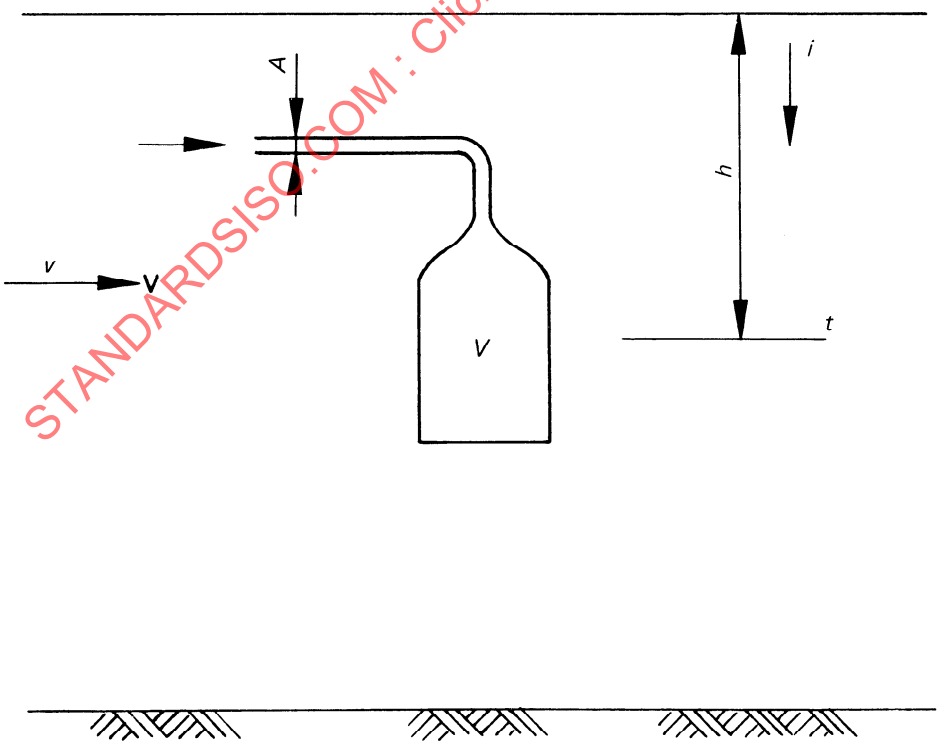
$$h = k \frac{V}{A}$$

For example, with $A = 28{,}3\ mm^2$ (ϕ 6 mm), $k = 1/10$, and $V = 0{,}51$, the maximum depth of sampling is 1,76 m only. If the flow depth is larger, sampling should be effected from two or more sections.

3 CHARACTERISTICS OF SUSPENDED SEDIMENT LOAD SAMPLERS

3.1 Since the sampling conditions encountered in streams vary widely, a single sampler for all the conditions cannot be recommended. Factors such as cost, availability, and specific requirements of the sampling also influence the choice of the sampler to a great extent. Therefore, the table summarizing the characteristics of most samplers in use will help in the selection of the sampler in given conditions. For general use, the point-integrating samplers are recommended. A depth-integrating sampler is, however, called for under special conditions.

3.2 As the data obtained are affected by the sampling action and the mechanism of the sampler, any change in the sampler would itself introduce a variable. Therefore, the result obtained from different samplers might not be comparable to one another.



FIGURE

TABLE — **Characteristics of suspended sediment load samplers**

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sampler No.	**Type**	**Description**	**Disturbance to flow characteristics**	**Intermixing of sample with water**	**Sampling action**	**Field handling**	**Adaptability to various field conditions**
A1	Can or pail	Ordinary can or pail	Considerable	Considerable	Instantaneous	Not necessary to transfer the contents	Offers considerable resistance to current. Only surface sampels are taken
A2	Vertical pipe	With a vertical cylinder or pipe forming the container. When the sampler is lowered to the desired depth, water sediment mixture flows upward through the container. Valves at either end close and trap the sample	Considerable	None	Instantaneous. Samples are not weighted according to velocity distribution	Necessary to transfer into another container	Offers considerable resistance to current. Not satisfactory when close to stream bed. Effective in still water or at very low velocities
A3	Instantaneous vertical	A vertical sampler with arrangement to open the sampler for the instantaneous (rapid) intake of samples at the desired time and depth	Effect not evaluated	None	Instantaneous	Necessary to transfer into another container	Not satisfactorily streamlined or adapted for use near stream bed. Effective in still water or at very low velocities
A4	Vertical	A vertical sampler with opening arrangement for slow intake of samples at the desired time and depth	Effect not evaluated	None	Slow filling, no initial inrush	Necessary to transfer into another container	Allows sampling very close to stream bed. Effective in still water or at very low velocities
A5	Bottle	Consisting of a standard container held in a case with a device for lowering and opening at the sampling point. The mouth is kept open for the minimum time required to fill the bottle	Considerable	Considerable, if not opened and closed at the sampling point	Bubbling or slow filling after initial inrush	Container with sample removable	Not capable of sampling close to stream bed. Has high efficiency in trapping fine grade sediment and the efficiency is less with the increase in grade
A6	Bottle (modified)	Consisting of a 1 l capacity container fitted in a case with a device for lowering or raising and opening at the sampling point. Provided also with separate water intake and air exhaust device for equalizing pressure inside and outside the container	Considerable	Considerable, if not opened and closed at the sampling point	Slow filling, no initial inrush present	Container with sample detachable	Not capable of sampling close to stream bed

TABLE (*continued*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sampler No.	**Type**	**Description**	**Disturbance to flow characteristics**	**Intermixing of sample with water**	**Sampling action**	**Field handling**	**Adaptability to various field conditions**
A7	Single-stage suspended sediment sampler (automatic)	Used for automatic collection of samples from flashy, intermittent streams at remote sites. The sampling unit consists of a bottle with an intake and an exhaust tube, each tube bent to an appropriate shape. Several sampling units are mounted one above another on a vertical support. As the water surface rises in the stream, it also rises in the intake tube of the sampler. When water reaches the crown of the intake, flow starts and the bottle fills. The sampling ceases when the water level in the bottle reaches the inner end of the air exhaust which is kept at a lower level than the inner end of the intake	Inconsider-able	Inconsider-able	Slow-filling, no initial inrush	Container with sample removable	Not capable of sampling close to stream bed. Samples are usually obtained near the edge of the stream. No samples are taken during the falling stages. There are two types of intake, namely vertical and horizontal. Vertical type is used for sediments finer than 62 μm and the horizontal intake is used for sediments coarser than 62 μm
B1	Instantaneous horizontal	With a horizontal cylinder equipped with end valves which can be closed suddenly to trap instantaneous samples at any desired time and depth	Inconsider-able	Inconsider-able	Instantaneous	Necessary to transfer into another container	Allows sampling very close to stream bed. Adaptable to any stream or depth
B2	Point-integrating	A streamlined body with tail vanes, containing a sampling bottle designed to fill continuously at a given point over an interval of time. Therefore, it is provided with an opening and closing mechanism and also with a pressure equalizer to minimize the initial inrush of water. Many of these samplers are capable of being used as depth-integrating samplers also	Inconsider-able	Inconsider-able	Smooth-filling, minimum initial inrush	Container with sample removable	