INTERNATIONAL STANDARD

ISO 1070

Third edition
2018-11

Hydrometry — Slope-area method

Hydrometrie — Methode de la pente de la ligne d'eau

Reference number
ISO 1070:2018(E)

© ISO 2018



COPYRIGHT PROTECTED DOCUMENT

© ISO 2018

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2018 – All rights reserved

Contents

Page

Foreword ..... **v**

Introduction ..... **vi**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Principle of the method of measurement **1**

5 Selection and demarcation of site **3**
5.1 Initial survey of site 3
5.2 Selection of site 3
5.3 Demarcation of site 4

6 Measurement of slope **4**
6.1 High-water marks 4
6.2 Crest-stage gauges 4
6.3 Pressure transmitters 4
6.4 Reference gauge 4

7 Determination of slope **5**

8 Cross sections of a stream **5**
8.1 Number and location of cross sections 5
8.2 Measurement of cross-sectional profiles 5

9 Computation of discharge **5**
9.1 General 5
9.2 Uniform cross sections 6
9.2.1 General 6
9.2.2 Determination of the mean cross-sectional area and mean wetted perimeter of the reach 6
9.2.3 Determination of hydraulic radius 6
9.2.4 Determination of the mean velocity in the reach 7
9.3 Non-uniform cross sections (2-cross-section formulation) 8
9.3.1 General 8
9.3.2 Computation of conveyance 8
9.3.3 Evaluation of the friction slope 9
9.4 Composite cross sections 11
9.5 Computation of discharge using three or more cross sections 12
9.6 State of flow 13

10 Alternative methods to estimate conveyance **14**
10.1 General 14
10.2 Divided channel method 14
10.3 Conveyance estimation system 14

11 Uncertainty in flow measurement **14**
11.1 Definition of uncertainty 14
11.2 Sources of uncertainty for a uniform reach 15
11.2.1 General considerations 15
11.2.2 Uncertainty of the mean cross-sectional area 15
11.2.3 Uncertainty in the calculation of the mean wetted perimeter 15
11.2.4 Uncertainties in determination of the friction slope 16
11.2.5 Uncertainty due to the choice of the rugosity coefficient 16
11.2.6 Overall uncertainty in the measurement of discharge 16

Annex A (informative) **Approximate value of coefficients *n* and *C* for open channels** **17**

Annex B (informative) **Approximate value of Strickler-coefficients k_{St} for natural streams** **20**

© ISO 2018 – All rights reserved

Annex C (informative) **US Soil Conservation Service method of estimating Manning's *n*** **22**
Annex D (informative) **Conveyance estimation system** **24**
Bibliography **26**

© ISO 2018 – All rights reserved

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 113, *Hydrometry*.

This third edition cancels and replaces the second edition (ISO 1070:1992), which has been technically revised. It also incorporates the amendment ISO 1070:1992/Amd.1:1997. The main changes compared to the previous edition are as follows:

— the document has been reorganized to first present two-section computations followed by multiple reach computations;

— a third governing formula has been added;

— three annexes have been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2018 – All rights reserved

Introduction

The slope–area method is an indirect method of determining discharge in open channels when direct measurement of the flow is not possible because of the timing of the flow or because the site is too hazardous for direct measurement techniques. The method is usually used to document the discharge of a flood and to extend the stage–discharge rating of a stream flow gauging station above direct measurements of discharge. The method can also be used at locations where bridge, cableway or boat measurements are not possible. Water discharge is computed using flow resistance formulae based on channel characteristics, water-surface profiles, and a roughness or friction coefficient.

© ISO 2018 – All rights reserved

Hydrometry — Slope-area method

1 Scope

This document specifies a method of determining discharge in open channels from observations of the surface slope and cross-sectional area of the channel.

It is applicable to use under special conditions when direct measurement of discharge by typically more accurate methods, such as the velocity-area method, is not possible. Generally, the method can be used to determine discharge

a) for a peak flow that left high-water marks along the stream banks,

b) for a peak flow that left marks on a series of water-level gauges or where peak stages were recorded by that series of gauges, and

c) for flow observed at the time of determining gauge heights from a series of gauges.

The method is commonly used to undertake the extension of stage–discharge relationships above the highest gauged flows.

It does not apply to determining discharges in tidal reaches.

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*

ISO 4373, *Hydrometry — Water level measuring devices*

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 http://www.electropedia.org/

4 Principle of the method of measurement

A measuring reach is chosen for which the mean area of the stream or river cross section is determined, and the surface slope of the flowing water in that reach is measured. The mean velocity is then established using known empirical formulae that relate the velocity to the hydraulic radius. The surface slope is corrected to account for the kinetic energy of the flowing water and the characteristics of the bed and bed material. The discharge is computed as the product of the mean velocity and the mean area of the stream cross section.

Hydraulic assumptions of the method limit its suitability for use in very large channels with very flat surface slopes, steep mountainous channels where free fall over riffles and boulders occurs, or channels

© ISO 2018 – All rights reserved