

Measurement of liquid flow in open channels —

Part 3: Stream flow measurement —

Part 3J: Guide to the measurement of
discharge using three verticals

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The preparation of this British Standard was entrusted by the Industrial-process Measurement and Control Standards Policy Committee (PCL/-) to Technical Committee PCL/3, upon which the following bodies were represented:

- Clyde River Purification Board
- Department of the Environment
- Department of the Environment for Northern Ireland
- Institute of Measurement and Control
- Institution of Civil Engineers
- Institution of Water & Environmental Management (IWEM)
- Ministry of Agriculture, Fisheries and Food
- Water Authorities' Association
- Welsh Office

The following bodies were also represented in the drafting of the standard, through sub-committees and panels:

- Institute of Hydrology
- North West Water Authority
- Severn Trent Water Authority
- Southern Water Authority
- Thames Water Authority
- Water Research Centre
- Yorkshire Water Authority

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Foreword

This Part of BS 3680 has been prepared under the direction of the Industrial-process Measurement and Control Standards Policy Committee.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

Measurement of discharge by the velocity-area method is a laborious and costly procedure. Hence, there is a great temptation to use fewer verticals for the measurement than is recommended in BS 3680-3A. However, the use of such short-cut methods can lead to considerable loss of accuracy if undertaken without due consideration for the outcome.

This guide has been prepared on the basis of detailed analyses of the behavioural patterns of the three elements involved in the velocity-area method of discharge measurement, namely, width, depth and velocity at 14 gauging sites on 12 rivers for a total of 66 discharge measurements. These measurements cover a wide range of climatic and flow conditions throughout the world. However, it is realised that such a relatively small sample can in no way be considered universal, but nevertheless it is felt that there is sufficient similarity exhibited in the study cases to warrant the publication of this guide. Probably, many thousands of such analyses should be conducted to ensure that the applicability of the method outlined in this guide is in fact universal.

NOTE The reproduction of the large amount of measurement data obtained is not considered appropriate in this British Standard. However, a copy of it may be examined by reference to the Librarian of the Institution of Civil Engineers, Great George Street, London SW1, under the title: "Tables, derived from a series of discharge measurements at 77 locations with the computation of results" by Dr. R. J. Williams.

1 Scope

This Part of BS 3680 provides guidance on a method that enables a measurement of discharge to be performed using three verticals only, without significant loss of accuracy, and advises when such a short-cut method may be used.

It is stressed that the method outlined in this guide is not an alternative for normal use to those recommended in BS 3680-3A. The methods proposed in that standard are those recommended for accurate results, whilst the method proposed in this Part has limited application and should be used only in special circumstances (see clause 5).

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions and symbols

2.1

for the purposes of this Part of BS 3680 the definitions given in BS 3680-1 apply

2.2

the following symbols are used in this Part of BS 3680 with the corresponding units of measurement. The convention has been adopted that upper case letters refer to values based on the total discharge measurement, whilst lower case letters refer to values relating to some portion less than the total

Symbol		Units of measurement
A	Area of cross section	m^2
B	Width of channel at water surface	m
b	Equal width of the n segments	non-dimensional
C	Value derived from $C = Q/D^{3/2} \times B$	non-dimensional
c	Value derived at measured vertical from $c = \bar{v}/\sqrt{d}$	non-dimensional
$\bar{c}$	Arithmetic mean of c values for discharge measurement	non-dimensional
$\bar{D}$	Mean depth, derived from $\bar{D} = A/B$	m
d	Measured depth at vertical	m
H	Stage, as read at gauge	m
Q	Total discharge	m^3/s
q	Unit width discharge	m^3/s
$\bar{v}$	Mean velocity at the vertical	m/s

3 Principle

The discharge per unit width, q in m^3/s , may be assumed as:

$$q = c d^{3/2}$$

Then

$$c = q/d^{3/2} = \bar{v}/\sqrt{d} = \bar{v}/\sqrt{d}$$

and

$$C = Q/\bar{D}^{3/2} \times B$$

where the symbols are as in 2.2.