

CONFIRMED
APRIL 1998

Measurement of liquid flow in open channels —

Part 3: Stream flow measurement —

**Part 3M: Guide to the methods of
measuring high discharges in rivers**

UDC 532.543:53.08:532.543.4

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Committees responsible for this British Standard

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 and 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 subcommittees and panels:

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

This British Standard, having been prepared under the direction of the Industrial-process Measurement and Control Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 29 June 1990

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The following BSI references relate to the work on this standard:
Committee reference PCL/3
Draft for comment 88/20271 DC

ISBN 0 580 18382 3

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 Definitions	1
3 Effect of high discharges on rivers	1
4 Methods of gauging high discharges	1
5 Site selection and survey	5
Appendix A List of parts of BS 3680	8
Figure 1 — Flood gauging in main channel and across embankments	6
Publications referred to	Inside back cover

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.

1 Scope

This British Standard gives guidance on the applicability and extension of existing methods of discharge measurement under conditions of high discharge. Site selection under these conditions is also considered.

NOTE 1 A list of other Parts of BS 3680 which may be used in conjunction with this guide is given in Appendix A.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

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

3 Effect of high discharges on rivers

3.1 River behaviour

3.1.1 High discharges in incised rivers raise water levels, increase flow velocities, generate turbulence and surface waves, and increase loads of suspended and bed sediment. Bed scour is often severe with debris in the form of stones, boulders, trees and animals being moved downstream. On the recession, scour holes fill and no evidence of the depth of scour remains [see **3.2 h**].

3.1.2 High discharges may be contained within the main channel (incised rivers in the steeper parts of a catchment) or they may overtop the banks of the main channel and spread across a wide flood plain (alluvial rivers in the less steep parts of a catchment). In the latter case the difficulties of flow measurement are increased. To determine the total discharge measurements need to be made both in the main channel where flow is deep and fast and separately in the flood plains where flow is relatively shallow and slow.

3.2 Discharge measurement

High discharges may affect the techniques of measuring flow in the following ways.

- a) Increased water levels and velocities may prevent gauging by wading even in very small rivers.
- b) High velocities, turbulence and waves make the use of boats dangerous. Larger boats and engines are necessary, and boat crews with experience and skill are essential.
- c) Surface debris adds to the danger of using boats; attention to upstream conditions is necessary and mooring a launch by anchor or to a cableway is often unwise.

d) High velocities and surface waves demand that heavier suspension weights are used to sink current meters.

e) Rising water levels drown weirs so that stage discharge and all (slope) stage discharge relations are no longer valid.

f) Sediment may accumulate upstream of weirs thereby affecting approach conditions.

g) Heavy sediment loads and changing conditions on rising and falling floods affect stage discharge relations.

h) Substantial bed scour may occur, increasing depths of flow more than would appear from the rise in water level.

i) Discharges change with time; in small catchments the changes are rapid leaving little time for staff to reach a site for gauging, making it necessary to use gauging methods which are less accurate but can be completed quickly.

j) Overbank spill may make access to gauging sites difficult, if not impossible.

k) When overbank spill occurs the discharges both in the channel and over the flood plain have to be measured, greatly increasing the amount of work.

l) Depths of flow on flood plains may be too shallow for practical measurement.

m) Velocities of flow over flood plains may be too low for practical measurement.

n) The width of the flow path across a flood plain and variations of flow velocity and depth may make measurements impracticable.

o) Vegetation may affect flow velocities and cause significant changes in flow across the plain.

4 Methods of gauging high discharges

4.1 General

High discharges or high stages render some of the usual methods of flow gauging impracticable and increase the difficulties of others. A number of methods can however be used to measure high discharges, although the accuracy of measurement may be reduced. Since observations at high discharges are made infrequently, more expensive labour intensive methods may be considered provided that many rivers do not have to be gauged simultaneously and that there are sufficient trained staff available.