

Methods of measurement of

Liquid flow in open channels —

Part 8: Current meters —

Part 8C: Calibration of rotating-element current-meters in straight open tanks

[ISO title: Liquid flow measurement in open channels —
Calibration of rotating-element current-meters in straight open tanks]

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Cooperating organizations

The Industrial-process Measurement and Control Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

- British Gas Corporation
- British Industrial Measuring and Control Apparatus Manufacturers' Association*
- British Steel Corporation
- CBMPE
- Control and Automation Manufacturers' Association (BEAMA)
- Department of Industry (Computers Systems and Electronics)
- Electrical, Electronic and Telecommunications Plumbing Union
- Electricity Supply Industry in England and Wales
- Electronic Engineering Association
- Engineering Equipment Users' Association
- Institute of Measurement and Control
- Institution of Electrical Engineers
- Institution of Gas Engineers
- Oil Companies Materials Association
- Post Office Engineering Union
- Scientific Instrument Manufacturers' Association*
- SIRA Institute

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

- Association of River Authorities
- Clyde River Purification Board
- Ministry of Development (Government of Northern Ireland)
- National Water Council
- Scottish Development Department
- Thames Water Authority Metropolitan Water Division

This British Standard, having been prepared under the direction of the Industrial-process Measurement and Control Standards Committee, was published under the authority of the Executive Board and comes into effect on 29 February 1980

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National foreword

This British Standard has been prepared under the direction of the Industrial-process Measurement and Control Standards Committee and is identical with ISO 3455:1976 “*Liquid flow measurement in open channels — Calibration of rotating-element current-meters in straight open tanks*” published by the International Organization for Standardization (ISO).

Terminology and conventions. The text of the International Standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards; attention is especially drawn to the following.

The comma has been used throughout as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker. Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

NOTE In 5.4.1 and 5.4.2 the unit symbol “rev/s” should be read as “r/s”.

Cross-reference

International Standard	Corresponding British Standard
ISO 772:1978	BS 3680 <i>Methods of measurement of liquid flow in open channels</i> Part 1:1979 <i>Vocabulary and symbols</i> (Technically equivalent)

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.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

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 and field of application

This International Standard specifies the procedure to be used for the calibration of current-meters, i.e. for the experimental determination of the relationship between liquid velocity and rate of revolution of the rotating element. It also specifies the type of tank and equipment to be used and the method of presenting the results.

The procedure does not take into account any possible difference existing between the behaviour of a current-meter moving in motionless water and that of a fixed current-meter in turbulent flow.

2 Definitions

For the purpose of this International Standard, the definitions given in ISO 772, *Liquid flow measurement in open channels — Vocabulary and symbols*, shall apply.

3 Principle of calibration procedure

The current-meter is drawn through still water contained in a straight tank of uniform cross-section at a number of steady velocities. Measurements are made of the speed of the towing carriage and of the rate of revolution of the rotor of the meter. The two sets of values are related by one or more equations of which the limits of application are stated.

4 Design criteria for calibration stations

4.1 Dimensions of calibration tank

The dimensions of the tank and the number and relative position of current-meters in the tank cross-section may affect the test results.

4.1.1 Length

The length of a calibration tank may be considered as comprising accelerating, stabilizing, measuring and braking sections.

The length of the accelerating and braking sections depends on the design of the carriage and on the maximum speed at which it is to be towed along the tank. The length required for the braking section must take account of safety requirements.

The length of the measuring section shall be such that the calibration error, which is composed of inaccuracies in the measurement of time, distance covered and rate of revolution, does not exceed the desired tolerance at any velocity. The required length will, therefore, depend on the type of current-meter being calibrated, the way the signals are produced and transmitted and the method of calibration.

For example, if measured times both for distance covered by the carriage and for the revolutions counted are accurate to 0,01 s in order to limit the error in time measurement to 0,1 % at the 95 % confidence level, the duration of the test shall be at least 10 s at maximum speed. If the maximum speed is 6 m/s, then the measuring section of the tank would be 60 m long. The total length of the tank would be about 100 m of which about 20 m would be for acceleration and stabilizing and 20 m for braking.

4.1.2 Depth and width

The depth of the tank may have an influence on the test results which cannot be regarded as negligible, more particularly when the towing speed coincides with the velocity of propagation of the surface wave. The dependence of this critical velocity v_c on tank depth is given by the equation.

$$v_c = \sqrt{gd}$$

where

g is the acceleration due to gravity;

d is the depth of water.

The wave crest produced by the current-meter and its means of suspension, which moves forward with the instrument, causes an increase in the height of the wetted cross-section and thus, in accordance with the continuity equation, a reduction of the relative velocity. This phenomenon, known as the Epper effect, may cause an error in calibration within a narrow band in the velocity range from $0,5 v_c$ to $1,5 v_c$. The magnitude of the Epper effect depends on the size of the current-meter(s) and suspension equipment, relative to the cross-sectional area of the tank. It may be negligible when a very small current-meter is calibrated.

The depth of the tank must therefore be chosen to suit the maximum velocity limits of the instruments to be calibrated. Care shall be taken to ensure either that the highest calibration velocities are attained before the interference or that they exceed it sufficiently for the critical zone to be bridged without extrapolation.

The width of the tank is of importance because the Epper effect is more pronounced in a narrower tank. The width also limits the number of instruments that can be calibrated simultaneously and has an effect on the stilling characteristics (time taken for the water to become reasonably still).