

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1088

COLLECTION OF DATA FOR DETERMINATION OF ERRORS
IN MEASUREMENT OF LIQUID FLOW BY VELOCITY AREA METHODS

1st EDITION
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BRIEF HISTORY

The ISO Recommendation R 1088, *Collection of data for determination of errors in measurement of liquid flow by velocity area methods*, was drawn up by Technical Committee ISO/TC 113, *Measurement of liquid flow in open channels*, the Secretariat of which is held by the Indian Standards Institution (ISI).

Work on this question led to the adoption of a Draft ISO Recommendation.

In November 1966, this Draft ISO Recommendation (No. 995) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	India	Romania
Belgium	Ireland	South Africa, Rep. of
Brazil	Israel	Switzerland
Bulgaria	Italy	U.A.R.
Chile	Japan	United Kingdom
France	Netherlands	U.S.A.
Germany	Portugal	

One Member Body opposed the approval of the Draft :

Canada

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in June 1969, to accept it as an ISO RECOMMENDATION.

FOREWORD

While ISO Recommendation R 748, *Liquid flow measurement in open channels by velocity area methods*, was in course of preparation, it was felt that there was a need for systematic collection of data for the determination of the magnitude of error involved in such measurements. This led to the drawing up of the present ISO Recommendation which is intended to serve as a basis for collection of data which supplement and improve the values given in section 9 of ISO Recommendation R 748.

For efficient processing of data, the instructions given in this ISO Recommendation should be strictly followed wherever possible.

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COLLECTION OF DATA FOR DETERMINATION OF ERRORS IN MEASUREMENT OF LIQUID FLOW BY VELOCITY AREA METHODS

1. SCOPE

This ISO Recommendation is intended chiefly to provide a standard basis for the collection of data for the determination of individual components of the total error in the measurement of liquid flow in open channels by velocity area methods.

2. GENERALITIES

2.1 Calculation of discharge by the velocity area method

The generalized equation for calculating the discharge is as follows :

$$Q = \sum_{i=1}^m b_i d_i \bar{v}_i \quad (\text{equation 1})$$

where

- Q is the total discharge;
- b_i is the width of the i th segment;
- d_i is the depth of the i th vertical;
- $\bar{v}_i$ is the mean velocity of the i th vertical;
- m is the number of verticals.

2.2 Individual components of the error

The symbols used are those given in the table below :

Quantity	Percentage standard error*	
	random	systematic**
width	X'_{b_i}	X''_b
depth	X'_{d_i}	X''_d
mean velocity	$X'_{\bar{v}_i}$	$X''_{\bar{v}}$

* All the standard errors used in this ISO Recommendation are in terms of percentages.

** These systematic errors are those of instruments and they vary randomly from instrument to instrument. They are not the systematic errors inherent in the types of instruments or measurements which cannot be eliminated or reduced by repeated measurements by the same instrument.

The major source of the error in the velocity will arise from errors in the calibration of the current meters.

When $\bar{v}_i$ has been derived from a one-point, two-point, multiple-point or velocity distribution method, the single velocity v at an individual point should be considered in the determination of the accuracy of $\bar{v}_i$.

In practice it is found that the standard error X_f in v is increased when measurements are taken approaching the bed of the channel. As an approximation, if, during the actual measurement of the discharge, the average number of point measurements in the vertical is p , then the contribution of the standard error $X_{\bar{v}_i}$ of the mean velocity in the vertical from this source may be calculated from the formula :

$$X_{\bar{v}_i} = \pm \sqrt{\frac{X_f^2}{p}} \quad (\text{equation 2})$$

2.3 Overall error in discharge

The overall standard error X_Q in the discharge Q is the resultant of the component errors. Also the shape of the cross-section of the channel and the horizontal velocity distribution affect the accuracy of discharge measurement. The random error from this effect X_m decreases with an increase in the number of verticals.

The overall random standard error is as follows :

$$X'_Q = \pm \sqrt{X_m^2 + \frac{\sum_1^m (b_i d_i \bar{v}_i)^2 (X_{b_i}'^2 + X_{d_i}'^2 + X_{\bar{v}_i}'^2)}{\left(\sum_1^m b_i d_i \bar{v}_i\right)^2}} \quad (\text{equation 3})$$

The overall systematic standard error is as follows :

$$X''_Q = \pm \sqrt{X''_b{}^2 + X''_d{}^2 + X''_{\bar{v}}{}^2} \quad (\text{equation 4})$$

NOTE. — Equation 4 is only applicable if the number of instruments used is such as to allow the expectation that the resultant of the systematic errors they introduce will be zero. If this is not the case, there will be a systematic deviation.

The overall standard error in the discharge may be taken from the following formula :

$$X_Q = \pm \sqrt{X'_Q{}^2 + X''_Q{}^2} \quad (\text{equation 5})$$

2.4 Evaluation of the error in the individual components

The evaluation of the error in the individual components of the total error can be obtained by a statistical analysis of a large number of observations for a particular component under operating conditions. To incorporate this procedure in the normal routine measurement is not feasible, and therefore centralized processing of collected data according to standardized programmes, as indicated in this ISO Recommendation, is recommended with a view to providing a general standard on the errors of the components within the practical range of measurements.