

TECHNICAL REPORT

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Measurement of liquid flow in open channels — Determination of the wetline correction

*Mesure de débit des liquides dans les canaux découverts — Détermination de la
correction de câble immergé*



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Foreword

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ISO/TR 9209, which is a technical report of type 2, was prepared by Technical Committee ISO/TC 113, *Measurement of liquid flow in open channels*.

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International Organization for Standardization

Case postale 56 • CH-1211 Genève 20 • Switzerland

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Introduction

When the need arises for correction to the wetline sounding obtained during a discharge measurement, the recommended procedure is to consult airline and wetline correction tables, using the observed angle of entry of the wetline and the observed depth.

Hitherto, the recommended tables to be consulted have been those based on the work of F.C. Shenehon (see [1] and [2]). This Technical Report presents the theory and procedures for the use of an alternative set of tables based on the work of the Ministry of Water Resources and Electric Power of the People's Republic of China. This alternative procedure requires further technical studies after which it will be included in a future edition of ISO 748. This Technical Report should be treated as an acceptable basis for such further studies.

Shenehon's work, carried out prior to 1900, is reported in [1]. The full tables and a synopsis of the methodology and thinking behind the tables are contained in [2]. The tables given in ISO 748 are an abbreviated version only.

Since a future edition of ISO 748 will contain both sets of tables to enable the user to decide which set is more appropriate to the case in hand, a short description of the Shenehon method is given before presentation of the more recent alternative methodology of the People's Republic of China.

The principle of Shenehon's method is as follows.

"The method depends on an elementary principle of mechanics: if a known horizontal force is applied to a weight suspended on a cord, the cord takes a position of rest at some angle with the vertical, and the tangent of the vertical angle of the cord is equal to the horizontal force divided by the vertical force due to the weight. If several additional horizontal and vertical forces are applied to the cord, the tangent of the angle of the cord above any point is equal to a summation of the horizontal forces below that point, divided by a summation of the vertical forces below the point.

In applying the above principle to conditions of measurements of depths of flowing water it is assumed that with a properly designed sounding weight the horizontal pressure on the weight in the comparatively still water near the bottom can be neglected. The distribution of total horizontal water pressure along the sounding line is made in accordance with the variation of velocity from surface to bottom. The excess in length of the curved line over the vertical depth is the sum of the products of each tenth of depth and the exsecants of the corresponding angles derived for each tenth of depth by means of the tangent relation of the forces acting below any point."

Advice to the user of this method is also given in [2]:

"The following points concerning the method for determining the vertical depth of water from the wet-line depth and vertical angle of the line at or above the surface should be kept in mind by users of the method: —

1. The weight and line are such that the weight will go to the bottom despite the force of the water.

2. The sounding is made when the weight is at the bottom but entirely supported by the line.
3. Horizontal pressure on the weight when in the sounding position is neglected.
4. The table is general, not for any particular line or wire or sounding weight, provided they are designed so as to offer little resistance to the current, as the vertical angle is a function of the resistance offered by the line and weight."

The approach in the method of the People's Republic of China outlined below differs in a number of respects from that of the Shenhon method, notably in the following ways.

- a) The contention that the horizontal pressure on the sounding weight at rest on the river bed is negligible and can be ignored is disputed. The pressure can be quite considerable, particularly in shallow swift-flowing streams. The Chinese method takes such horizontal pressure on the sounding weight into consideration.
- b) The tables are specific in allowing for different weights.
- c) The effects of horizontal pressure on the current meter, sounding line and any accompanying signal cable are allowed for.
- d) The tables are specific in that they allow for different diameters of sounding lines in use.

References

- [1] LYDECKER, G.J. Survey of northern and northwestern lakes, *Ann. Rep. Chief of Engineers*, US Army, pt. 8, Appendix III, 1900: pp. 5329-5330.
- [2] CORBETT, D.M. *et al.* Stream-gauging procedure, *Geological Survey Water Supply Paper 888*, US Dept. of Interior, 1945: pp. 44-51.