भारतीय मानक

Indian Standard

IS 9119 : 2024

जेट विशेषताओं द्वारा प्रवाह अनुमान की पद्धति (अनुमानित पद्धतियाँ)

(पहला पुनरीक्षण)

Method of Flow Estimation by Jet Characteristics (Approximate Methods)

(First Revision)

ICS 93.025

भारतीय मानक ब्यूरो
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October 2024 **Price Group 5**

Hydrometry Sectional Committee, WRD 01

FOREWORD

The Indian Standard (First Revision) was adopted by the Bureau of Indian Standards after the draft was finalized by the Hydrometry Sectional Committee and had been approved by the Water Resources Division Council.

This method may be applied for approximately estimating the rate of flow through a horizontal pipe discharging freely into the atmosphere, such as discharge from a pump installed at a tube-well or any other lift pumps.

This standard was first published in 1979. This revision has been brought out to bring the standard in latest style and update with respect to the latest field practices. In revision of this standard, the following changes have been incorporated:

a) The formula for computation of error in discharge has been added in **4.2.1**; and

b) List of standards related to fluid flow measurement given in Annex B for information has been updated.

The composition of the Committee responsible for formulation of this standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 2022 ‘Rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METHOD OF FLOW ESTIMATION BY JET CHARACTERISTICS (APPROXIMATE METHODS)

(First Revision)

1 SCOPE

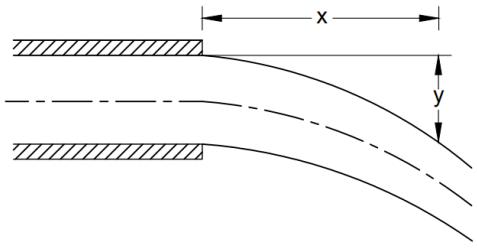
1.1 This standard lays down the procedures for estimation of flow in closed circular horizontal conduits flowing full and freely discharging into atmosphere as a free jet. The characteristics of this free jet are expressed in terms of the vertical drop of the jet over a certain horizontal distance from the free end of the pipe.

1.2 This method should not be used where there is a heavy tendency of jet to disintegrate and when the jet fluctuates violently.

2 PRINCIPLE OF METHOD

2.1 Neglecting the friction due to air, the jet issuing from the pipe takes a parabolic trajectory under the influence of the constant forward momentum flux and the gravitational field. Under these conditions (*see* Fig. 1 the discharge, Q in litre/min bears the following relationship with the diameter of the pipe d, horizontal distance from the exit end of the pipe x, and the drop of the jet, y (all dimensions in millimeters):

$$\frac{Q}{d^2.\sqrt{g}} = K\sqrt{\frac{x^2}{y}} \qquad \ldots(1)$$



NOTE — It is preferable to avoid any fitting (like flange, coupling) near the end of the pipe; otherwise due correction should be made.

FIG. 1 DEFINITION SKETCH

3 GENERAL REQUIREMRNTS FOR MEASUREMENTS

3.1 The pipe shall be flowing full at all times during the measurement and shall discharge freely and steadily into atmosphere.

3.2 The discharge pipe shall be level and shall consist of preferably a straight length of 40 d, subject to a minimum of 10 d , upstream of the exit end.

3.3 The internal surface of the pipe shall be clean, free from pitting and deposits and not encrusted.

3.4 The exit end of the pipe shall be in flush with the inner surface of the pipe and its plane parallel to a normal cross-section of the free jet.

3.5 The co-ordinates x and y shall be measured upstream of the disintegrating region of the jet. Keeping the horizontal distance x constant, at least six readings of y should be taken at the crest of the jet and the average value should be used to ensure that the deviation in the measurement of discharge to be within ± 3 percent.

4 COMPUTATION — QUANTITIES TO BE MEASURED

4.1 Equation

Equation of the type given in **2.1** is considered for finding the volume rate of flow. The constant K in equation (1) has been experimentally observed to be 0.573 as against a theoretical value of 0.555 and the equation shall read as:

$$\frac{Q}{d^2.\sqrt{g}} = 0.573\sqrt{\frac{x^2}{y}}$$

4.2 Example for the calculation of rate of flow.

4.2.1 Method of application of the equation in **4.1** will be as follows:

d, Diameter of the pipe = 50 mm
x, Horizontal distance = 400 mm
y, Vertical drop of jet = 170 mm
g, Gravitational constant = 9 800 mm/s^2

Therefore, volumetric discharge = 0.573

$$d^2.\sqrt{g}.\sqrt{\frac{x^2}{y}} \times 60 \times 10^{-6} \text{ litres/min} = 264 \text{ litres/min}$$

The error in computation of discharges Q arising out of error in measurement of *x* and *y* can be calculated using the following formula.

$$\frac{\Delta Q}{Q} = \sqrt{\left(\frac{\Delta x}{x}\right)^2 + \left(\frac{\Delta y}{2y}\right)^2}$$

Where, Δx and Δy are the measurement errors in *x* and *y* respectively while ΔQ is the computed error in discharge Q.

An error of 5 mm in the measurement of y yields an error of 1.5 percent in the discharge for the specified diameter from 25 mm to 200 mm and discharges specified from 75 litres/min to 10 000 litres/min. For other values larger errors will be involved.

4.3 Alternately, the nomograph given in Annex A may be used for y from 2 mm to 200 mm and x from 10 mm to 1 000 mm with pipe diameter from 20 mm to 200 mm.

ANNEX A

(*Clause* 4.3)

NOMOGRAPH FOR SOLUTION ON JET CHARACTERISTICS OF FLOW

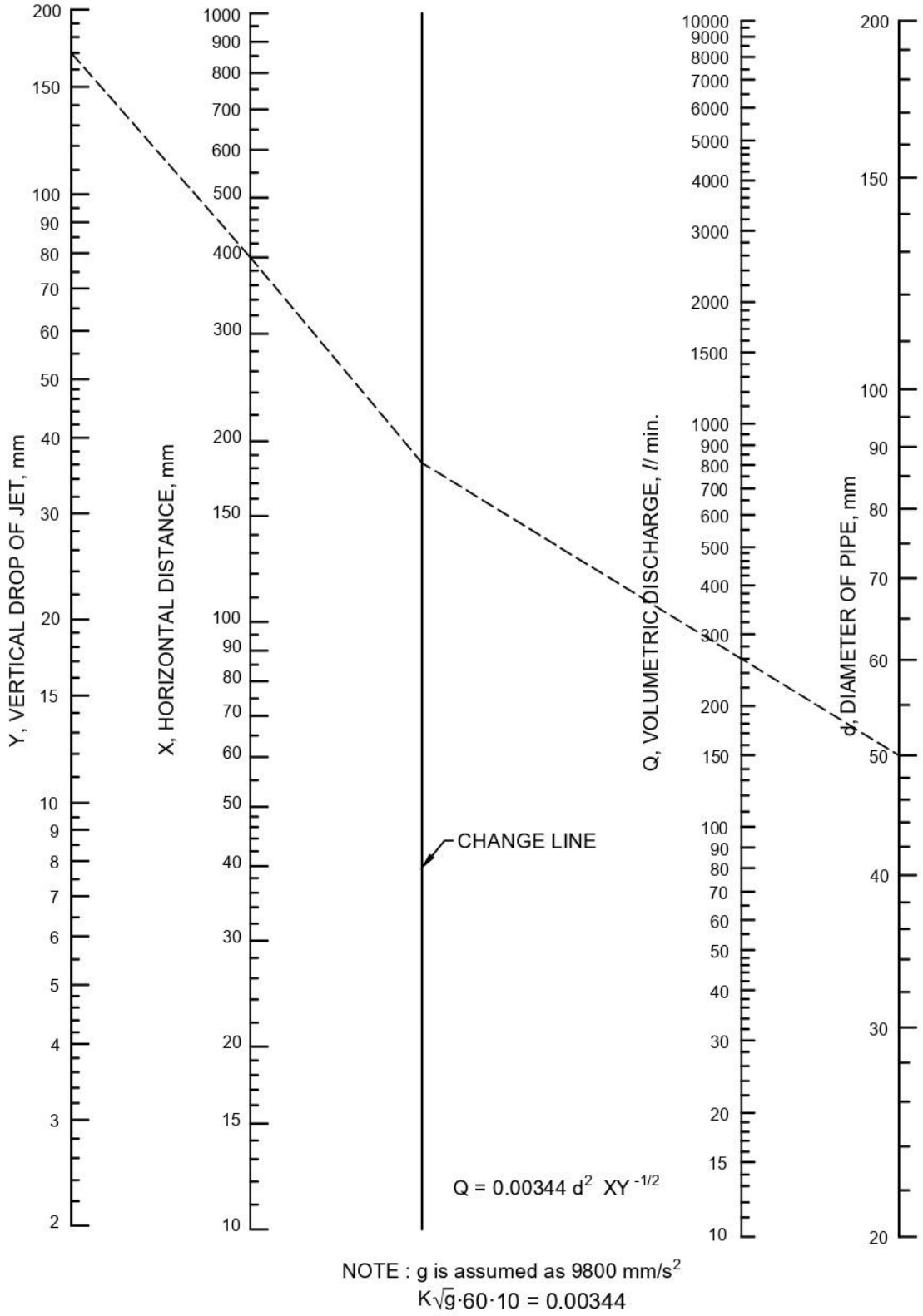


FIG. 2 NOMOGRAPH FOR SOLUTION ON JET CHARACTERISTICS OF FLOW

ANNEX B

(*Foreword*)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 1192 : 2024/ ISO 748 : 2021	Hydrometry — measurement of liquid flow in open channels — velocity area methods using point velocity measurements (*third revision*)
IS 1194 : 1960	Forms for recording measurement of flow of water in open channels
IS 2912 : 2022 ISO 1070 : 2018	Liquid flow measurement in open channels — Slope — Area method (*second revision*)
IS 2951	Recommendation for estimation of flow of liquids in closed conduits:
(Part 1) : 1965	Head loss in straight pipes due to frictional resistance
(Part 2) : 1965	Head loss in valves and fittings
IS 3910 : 2013/ ISO 2537 : 2007	Hydrometry — Rotating-element current-meters (*second revision*)
IS 3911 : 1994	Surface floats — Functional requirements (*first revision*)
IS 3912 : 2013/ ISO 3454 : 2008	Hydrometry — Direct depth sounding and suspension equipment (*second revision*)
IS 3913 : 2014	Hydrometry — Functional requirements and characteristics of suspended-sediment samplers (*second revision*)
IS 3917 : 2003	Scoop type bed material samplers — Specification (*first revision*)
IS 3918 : 1966	Code of practice for use of current meter (cup type) for water flow measurement
IS 4073 : 1967	Specification for fish weights
IS 4080 : 1994	Vertical staff gauges — Functional requirements (*first revision*)
IS 4477 (Part 2) : 1975	Method of measurement of fluid flow by means of venturi meters: Part II Compressible fluids
IS 4858 : 1968	Specification for velocity rods
IS 4890 : 1968	Methods for measurement of suspended sediment in open channels
IS 6062 : 1971	Method of measurement of flow of water in open channels using standing wave flume-fall
IS 6063 : 1971	Method of measurement of flow of water in open channels using standing wave flume
IS 6064 : 1971	Specification for sounding and suspension equipment
IS 6339 : 2013	Hydrometry — Sediment in streams and canals — Determination of concentration, particle size distribution and relative density (*first revision*)
IS 9119 : 2024	Method of flow estimation by jet characteristics (approximate method)

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Hydrometry Sectional Committee, WRD 01

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Bhabha Atomic Research Centre, Radiochemistry and Isotope Group, Mumbai	SHRI H. J. PANT SHRI V. K. SHARMA (*Alternate*)
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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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