

Measurement of fluid flow in closed conduits — Weighing method

The European Standard EN 24185:1993 has the status of a
British Standard

UDC 532.575:531.753

Cooperating organizations

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

- British Gas Corporation*
- British Industrial Measuring and Control Apparatus Manufacturers' Association*
- British Steel Corporation
- Control and Automation Manufacturers' Association (BEAMA)
- Department of Industry
- Department of Industry (Computers, Systems and Electronics)
- Department of Industry (National Engineering Laboratory)*
- Department of the Environment (Water Engineering Division, Including Water Data Unit)
- Electrical, Electronic, Telecommunications and Plumbing Union
- Electricity Supply Industry in England and Wales*
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- Engineering Equipment Users' Association*
- Institute of Measurement and Control*
- 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 Technical Committee entrusted with the preparation of this British Standard:

- British Compressed Air Society
- Department of Energy (Gas Standards)
- Department of Trade (Metrology, Quality Assurance, Safety and Standards Division)
- Institute of Petroleum
- Institute of Trading Standards Administration
- National Water Council
- Society of Chemical Industry
- United Kingdom Atomic Energy Authority
- Individual expert

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 Board of BSI and comes into effect on 31 December 1981

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The following BSI references relate to the work on this standard:
Committee reference PCL/2
Draft for comment 78/28936 DC

ISBN 0 580 12474 6

Amendments issued since publication

Amd. No.	Date of issue	Comments
7979	October 1993	
8774	October 1995	Indicated by a sideline in the margin

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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 4185 “*Measurement of liquid flow in closed conduits — Weighing method*, including Technical Corrigendum 1” published in 1980 by the International Organization for Standardization (ISO).

In 1993 the European Committee for Standardization (CEN) accepted ISO 4185:1980 as European Standard EN 24185:1993. As a consequence of implementing the European Standard this British Standard is renumbered as BS EN 24185 and any reference to BS 6199-1:1981 should be read as a reference to BS EN 24185.

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

Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

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.

Cross-references

International Standard	Corresponding British Standard
ISO 4006:1977	BS 5857:1980 <i>Glossary of terms and symbols for measurement of fluid flow in closed conduits</i> (Identical)
ISO 5168:1978	BS 5844:1980 <i>Methods of measurement of fluid flow: estimation of uncertainty of a flow-rate measurement</i> (Identical)

OIML Recommendations Nos. 1, 2, 3, 20, 28 and 33, which are referred to in 3.4, are international recommendations of the International Organization of Legal Metrology (OIML).

In complying with this British Standard, implementation of these recommendations is not mandatory.

Copies of OIML Recommendations may be purchased from the following address.

The Director
International Bureau of Legal Metrology
11 rue Turgot
75009 Paris
France

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, the EN title page, pages 2 to 24, 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.

UDC 532.575:531.753

Descriptors: Flow measurement, liquid flow, pipe flow, measuring instruments, flowmeters, calibrating, weight measurement, error analysis

English version

Measurement of fluid flow in closed conduits — Weighing method

(ISO 4185:1980)

Mesure de débit des liquides dans conduites
fermées — Méthode par pesée
(ISO 4185:1980)

Durchflußmessung von Flüssigkeiten in
geschlossenen Leitungen — Wägevverfahren
(ISO 4185:1980)

This European Standard was approved by CEN on 1993-06-18. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

In 1991, ISO 4185:1980 *Measurement of fluid flow in closed conduits — Weighing method* was submitted to the CEN Primary Questionnaire procedure.

Following Resolution BT C 42/1992, ISO 4185:1980 was submitted to the formal vote; the result was positive.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 1993, and conflicting national standards shall be withdrawn at the latest by December 1993.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

NOTE The European references to international publications are given in Annex ZA (normative).

1 General

1.1 Scope and field of application

This International Standard specifies a method of liquid flow-rate measurement in closed conduits by measuring the mass of liquid delivered into a weighing tank in a known time interval. It deals in particular with the measuring apparatus, the procedure, the method for calculating the flow-rate and the uncertainties associated with the measurement.

The method described may be applied to any liquid provided that its vapour pressure is such that any escape of liquid from the weighing tank by vaporization is not sufficient to affect the required measurement accuracy. Closed weighing tanks and their application to the flow measurement of liquids of high vapour pressure are not considered in this International Standard.

This International Standard does not cover the cases of corrosive or toxic liquids.

Theoretically, there is no limit to the application of this method which is used generally in fixed laboratory installations only. However, for economic reasons, usual hydraulic laboratories using this method can produce flow-rates of 1.5 m³/s or less.

Owing to its high potential accuracy, this method is often used as a primary method for calibration of other methods or devices for mass flow-rate measurement or volume flow-rate measurement provided that the density of the liquid is known accurately. It must be ensured that the pipeline is running full with no air or vapour pockets present in the measuring section.

1.2 References

ISO 4006, *Measurement of fluid flow in closed conduits — Vocabulary and symbols*.

ISO 5168, *Measurement of fluid flow — Estimation of uncertainty of a flow-rate measurement*.

OIML, Recommendations Nos. 1, 2, 3, 20, 28, 33.

1.3 Definitions

Only terms which are used in a special sense or the meaning of which merits restatement are defined below.

1.3.1

static weighing

the method in which the net mass of liquid collected is deduced from tare and gross weighings made respectively before and after the liquid has been diverted for a measured time interval into the weighing tank

1.3.2

dynamic weighing

the method in which the net mass of liquid collected is deduced from weighings made while fluid flow is being delivered into the weighing tank. (A diverter is not required with this method.)

1.3.3

diverter

a device which diverts the flow either to the weighing tank or to its by-pass without changing the flow-rate during the measurement interval

1.3.4

flow stabilizer

a structure forming part of the measuring system, ensuring a stable flow-rate in the conduit being supplied with liquid; for example, a constant level head tank, the level of liquid in which is controlled by a weir of sufficient length

1.3.5

buoyancy correction

the correction to be made to the readings of a weighing machine to take account of the difference between the upward thrust exerted by the atmosphere, on the liquid being weighed and on the reference weights used during the calibration of the weighing machine

1.4 Units

The units used in this International Standard are the SI units, metre, kilogram, and second; the degree Celsius is used for convenience instead of the kelvin.

1.5 Notation

Symbol	Designation	Dimension	SI Units
q_m	Mass flow-rate	MT^{-1}	kg/s
q_V	Volume flow-rate	L^3T^{-1}	m ³ /s
m	Mass	M	kg
V	Volume	L^3	m ³
t	Time	T	s
ρ	Density of liquid	ML^{-3}	kg/m ³
ρ_a	Density of air	ML^{-3}	kg/m ³
ρ_p	Density of standard weights	ML^{-3}	kg/m ³
s_x	Estimated standard deviation		
σ_x	Standard deviation of variable x		
e	Uncertainty of measurement		
e_s	Systematic uncertainty		
E_s	Percentage systematic uncertainty		
e_R	Random uncertainty		
E_R	Percentage random uncertainty		

1.6 Certification

If the installations for flow-rate measurement by the weighing method are used for purposes of legal metrology, they should be certified and registered by the national metrology service. Such installations are then subject to periodical inspection at stated intervals. If a national metrology service does not exist, a certified record of the basic measurement standards (weight and time), and error analysis in accordance with this International Standard and ISO 5168, shall also constitute certification for legal metrology purposes.

2 Principle

2.1 Statement of the principle

2.1.1 Static weighing

The principle of the flow-rate measurement method by static weighing (for schematic diagrams of typical installations, see Figure 1A, Figure 1B, Figure 1C) is:

- to determine the initial mass of the tank plus any residual liquid;
- to divert the flow into the weighing tank (until it is considered to contain a sufficient quantity to attain the desired accuracy) by operation of the diverter, which actuates a timer to measure the filling time;
- to determine the final mass of the tank plus the liquid collected in it.

The flow-rate is then derived from the mass collected, the collection time and other data as discussed in clause 5 and Annex A.

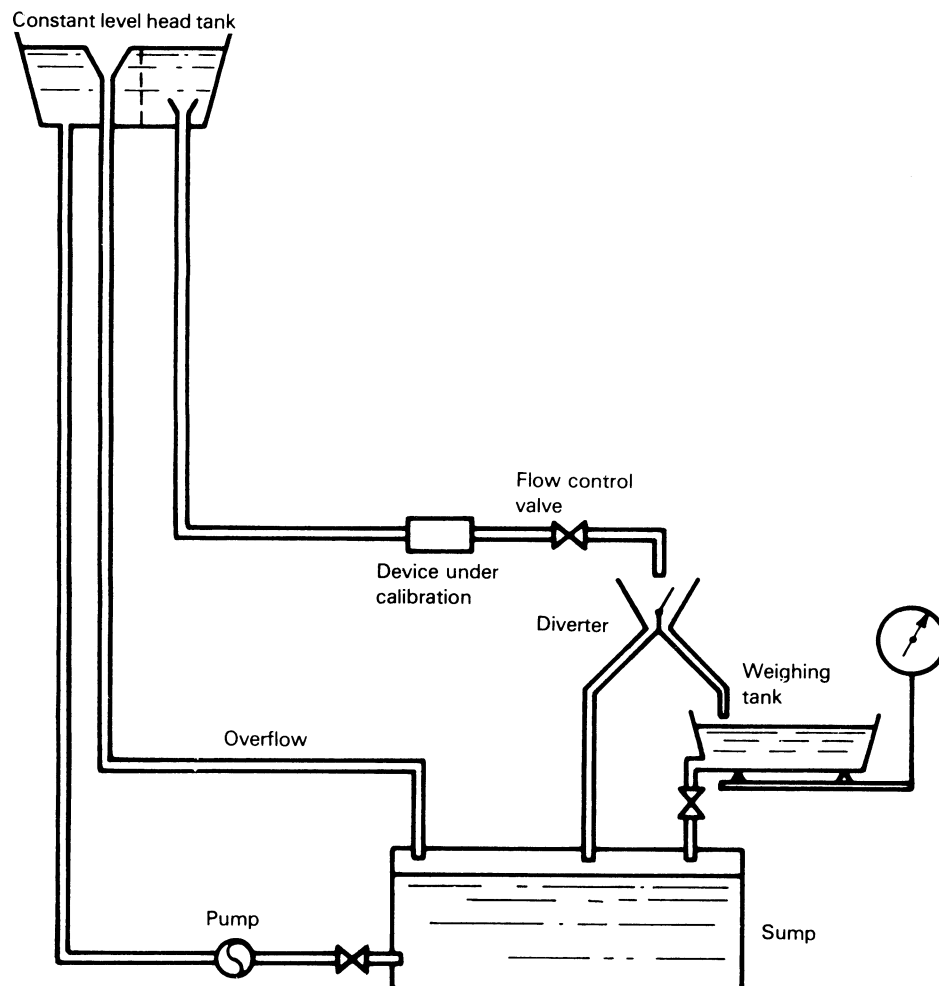


Figure 1A — Diagram of an installation for calibration by weighing (static method, supply by a constant level head tank)