

Specification for

Turbine meters used for the measurement of gas flow in closed conduits

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee CPL/30, Measurement of fluid flow in closed circuits, upon which the following bodies were represented:

- British Compressed Air Society
- British Gas plc
- Department of Energy (Gas and Oil Measurement Branch)
- Department of Trade and Industry (National Engineering Laboratory)
- Electricity Industry in United Kingdom
- Energy Industries Council
- GAMBICA (BEAMA Ltd.)
- Institute of Measurement and Control
- Institute of Petroleum
- Institute of Trading Standards Administration
- Institution of Gas Engineers
- Institution of Mechanical Engineers
- Society of British Gas Industries
- Water Services Association of England and Wales

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National foreword

This British Stanard has been prepared by Technical Committee CPL/30 and is identical with ISO 9951:1993 *Measurement of gas flow in closed conduits — Turbine meters*, published by the International Organization for Standardization (ISO). This is a new British Standard and no other standard has been superseded or withdrawn.

This standard does not apply to turbine meters which are used for the measurement of fuel gas for fiscal purposes. Such meters are covered by different international and British Standards.

Cross-references

International standard	Corresponding British Standard
ISO 3:1973	BS 2045:1965 <i>Preferred numbers</i> (Technically equivalent)
ISO 4006:1991	BS EN 24006:1993 <i>Measurement of fluid flow in closed conduits. Vocabulary and symbols</i> (Identical)
ISO 5167-1:1991	BS 1042 <i>Measurement of fluid flow in closed conduits</i> Part 1 <i>Pressure differential devices</i> Section 1.1:1992 <i>Specification for square-edged orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full</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)
IEC 79 (series)	BS 5501 (series) <i>Electrical apparatus for potentially explosive atmospheres</i>
VIM:1993	PD 6461 <i>Vocabulary of metrology</i> Part 1:1995 <i>Basic and general terms (international)</i> (Identical)

A related British Standard to ISO 5208:1993 is BS 6755-1:1986 *Specification for production pressure testing requirements*. There is no British Standard corresponding to ISO 6708.

Copies of OIML Recommendations may be purchased from:

BIML, 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, pages 1 to 14, 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

This International Standard specifies dimensions, ranges, construction, performance, calibration and output characteristics of turbine meters for gas flow measurement.

It also deals with installation conditions, leakage testing and pressure testing and provides a series of informative Annex A to Annex E including recommendations for use, field checks and perturbations of the fluid flowing.

In many countries, some or all of the items covered by this International Standard are subject to mandatory regulations imposed by the laws of these countries. In cases where conflict exists between such mandatory regulations and this International Standard, the former shall prevail.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. ISO 3:1973, *Preferred numbers — Series of preferred numbers*.

ISO 4006:1991, *Measurement of fluid flow in closed conduits — Vocabulary and symbols*.

ISO 5167-1:1991, *Measurement of fluid flow by means of pressure differential devices — Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full*.

ISO 5168:1978, *Measurement of fluid flow — Estimation of uncertainty of a flow-rate measurement*.

ISO 5208:1993, *Industrial valves — Pressure testing of valves*.

ISO 6708:1980, *Pipe components — Definition of nominal size*.

IEC 79:—, *Electrical apparatus for explosive gas atmospheres*.

OIML R 6:1989, *General provisions for gas meters*.

OIML R 32:1989, *Rotary piston gas meters and turbine gas meters*.

VIM:1984, *International vocabulary of basic and general terms in metrology* (BIPM, IEC, ISO, OIML).

3 Definitions and symbols

3.1 Definitions

For the purposes of this International Standard, the definitions given in ISO 4006 and the International vocabulary of basic and general terms in metrology apply. The following definitions are given only for terms used in some special sense or for terms whose meaning it seems useful to recall.

3.1.1

flowrate

actual volume of flow per unit of time

3.1.2

working range

range of flowrates of gas limited by the maximum flowrate $q_{\max}$ and the minimum flowrate $q_{\min}$, for which the meter error lies within specified limits (sometimes also called “rangeability”)

3.1.3

metering pressure

gas pressure in a meter to which the indicated volume of gas is related

3.1.4

average velocity

volume flowrate per unit of cross-sectional area

3.1.5

shell

pressure-containing structure of the meter

3.1.6

metering conditions

conditions, at the point of measurement, of the gas whose volume is to be measured (for example gas temperature and pressure)

3.1.7

base conditions

conditions to which the measured volume of the gas is converted (for example base temperature and base pressure)

3.1.8

specified conditions

conditions of the gas at which performance specifications of the meter are given

NOTE 1 Metering and base conditions relate only to the volume of the gas to be measured or indicated, and should not be confused with “rated operating conditions” or “reference conditions” (VIM 5.05 and 5.07), which refer to influence quantities (VIM 2.10).

3.2 Symbols and subscripts

The symbols and subscripts used in this International Standard are given in Table 1.

Table 1 — Symbols and subscripts

Symbol	Quantity	Dimensions ^a	SI unit
c	Pressure loss coefficient depending on meter type	L^{-4}	m^{-4}
d	Relative density of the gas ($d_{\text{air}} = 1$)	Dimensionless	—
D	Inside diameter meter outlet/inlet	L	m
D_1	Inside diameter pipe	L	m
DN	Nominal size meter outlet/inlet	Dimensionless	—
DN ₁	Nominal size pipe	Dimensionless	—
H	Height of strut	L	m
L	Length of the strut	L	m
m	Mass	M	kg
M	Molar mass	M	kg/mol
N	Number of moles of gas		mol
p	Absolute pressure	$ML^{-1} T^{-2}$	Pa
p_m	Metering pressure	$ML^{-1} T^{-2}$	Pa
q	Flowrate	$L^3 T^{-1}$	m^3/s
R	Molar gas constant	$ML^2 T^{-2} \Theta^{-1}$	$J/(mol \cdot K)$
S	Chord distance between adjacent struts measured at the tip	L	m
t	Time	T	s
T	Absolute temperature of the gas	Θ	K
V	Volume	L^3	m^3
Z	Compressibility factor (deviation from ideal gas laws)	Dimensionless	—
ρ	Density of the gas	ML^{-3}	kg/m^3
ψ	Working range $q_{\text{max}}/q_{\text{min}}$	Dimensionless	—
Subscripts			
b	Base conditions for volume or rate calculations		
m	Metering conditions of the gas		
s	Specified conditions for volume or rate		

^a M = mass; L = length; T = time; Θ = temperature.

4 Principle of the method of measurement

The turbine meter is a fluid measuring device in which the dynamic forces of the flowing fluid cause the turbine wheel to rotate with a speed approximately proportional to the rate of volume flow. The number of revolutions of the turbine wheel is the basis for the indication of the volume passed through the meter.

5 Flowrates

The maximum and minimum flowrates shall be specified for the gas densities for which the meter will operate within the specifications of meter performance defined in clause 8. The maximum flowrate in cubic metres per hour (m^3/h) of the meter should preferably be a number in the set R5 of preferred numbers specified in ISO 3 (the value 63 has been rounded to 65). The unit of cubic metres per hour (m^3/h) is preferred.