
**Measurement of water flow in closed
conduits — Meters for hot water —**

**Part 1:
Specifications**

*Mesurage de débit d'eau dans les conduites fermées — Compteurs d'eau
chaude —*

Partie 1: Spécifications

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Contents

	Page
Foreword.....	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Technical characteristics	4
4.1 Meter size and overall dimensions, meter designation and permanent flowrate	4
4.2 Indicating device	7
4.3 Verification devices — Control element and verification scale interval	9
4.4 Adjustment device	10
4.5 Accelerating device	10
4.6 Remote output systems	11
4.7 Materials	11
4.8 Strainers	11
4.9 Behaviour in case of flow reversal.....	11
4.10 Sealing	11
5 Metrological characteristics	12
5.1 Maximum permissible errors.....	12
5.2 Metrological classes.....	12
6 Pressure loss	12
7 Marking	12
Bibliography	14

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 10385 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10385-1 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 7, *Volume methods including water meters*.

ISO 10385 consists of the following parts, under the general title *Measurement of water flow in closed conduits — Meters for hot water*:

— *Part 1: Specifications*

Installation conditions as well as test methods and equipment will be the subjects of future parts to ISO 10385.

Measurement of water flow in closed conduits — Meters for hot water —

Part 1: Specifications

1 Scope

This part of ISO 10385 specifies the technical characteristics, metrological characteristics, pressure loss and marking of meters for hot water.

This part of ISO 10385 applies to water meters which are self-contained integrating measuring instruments which continuously determine the volume of water flowing through them, employing a direct mechanical process involving the use of volumetric chambers with mobile walls ("volumetric" meters) or the action of the velocity of the water on a moving part ("velocity" meters). A magnetic coupling is considered as a direct mechanical process.

It applies to hot-water meters having permanent flowrates which lie within the range 0,6 m³/h to 400 m³/h at maximum admissible working pressures (MAP) of 10 bar¹⁾ to 40 bar and at maximum admissible temperatures (MAT) corresponding to one of the following values: 70 °C, 90 °C, 130 °C and 180 °C.

Legal requirements take precedence over the specifications of this part of ISO 10385.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10385. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10385 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 7005-1:1992, *Metallic flanges — Part 1: Steel flanges.*

ISO 7005-2:1988, *Metallic flanges — Part 2: Cast iron flanges.*

ISO 7005-3:1988, *Metallic flanges — Part 3: Copper alloy and composite flanges.*

IEC 60529, *Degrees of protection provided by enclosures (IP Code).*

1) 1 bar = 10⁵ Pa = 0,1 MPa

3 Terms and definitions

For the purposes of this part of ISO 10385, the following terms and definitions apply.

3.1

volumetric meter

device, fitted into a closed conduit, which consists of chambers of known volume and a mechanism driven by the flow, whereby these chambers are successively filled with water and then emptied

NOTE By counting the number of these volumes passing through the device, the indicating device totalizes the volume of water passed.

3.2

velocity meter

device, fitted into a closed conduit, which consists of a moving element deriving its motion directly from the velocity of the water flow

NOTE The movement of the moving element is transmitted by mechanical or other means to the indicating device which totalizes the volume of water passed.

3.2.1

Woltman meter

velocity meter comprising a rotor with helical blades which rotates about the axis of the flow within the meter

3.2.2

single-jet meter

velocity meter comprising a turbine rotor which rotates about an axis perpendicular to the axis of the flow within the meter

NOTE The jet impinges at a single place on the periphery of the rotor.

3.2.3

multi-jet meter

velocity meter comprising a turbine rotor which rotates about an axis perpendicular to the axis of the flow within the meter

NOTE The jets impinge at several points around the periphery of the rotor.

3.3

flowrate

quotient of the volume of water passing through the water meter, and the time taken for this volume to pass through the water meter

3.4

overload flowrate

q_s

flowrate at which the water meter is required to operate in a satisfactory manner (see 3.6) for a short period of time without deteriorating; its value being twice the value of q_p

NOTE It is expressed in cubic metres per hour.

3.5

minimum flowrate

q_{min}

lowest flowrate at which the meter is required to give indications within the maximum permissible error tolerance and determined as a function of the numerical value of the meter designation

NOTE It is expressed in cubic metres per hour.

3.6**flowrate range**

range, limited by the overload flowrate q_s , and the minimum flowrate q_{min} , in which the meter indications are not to be subject to an error in excess of the maximum permissible error

NOTE This range is divided into two zones called the "upper" and "lower zone", separated by the transitional flowrate.

3.7**permanent flowrate** q_p

flowrate at which the meter is required to operate in a satisfactory manner (see 3.6) under normal conditions of use, for example under steady and/or intermittent flow conditions

NOTE It is expressed in cubic metres per hour.

3.8**transitional flowrate** q_t

flowrate value, occurring between the overload and minimum flowrates, at which the flowrate range is divided into two zones, the "upper zone" and the "lower zone", each characterized by a maximum permissible error in this zone

NOTE It is expressed in cubic metres per hour.

3.9**volume flow**

volume of water passing through the water meter, disregarding the time taken

3.10**indicating device**

device displaying the volume flow

3.11**nominal pressure****PN**

numerical designation which is a rounded number for reference purposes

NOTE All equipment of the same nominal size (DN) designated by the same PN number has compatible mating dimensions.

3.12**maximum admissible working pressure****MAP**

for a water meter, the maximum internal pressure that it can withstand permanently at a given temperature

3.13**nominal size****DN**

numerical designation common to all the components of a pipe system, excluding those designated by their external diameter or by the thread dimension

NOTE It is a whole number used for reference only, approximating the constructional dimensions.

3.14**pressure loss**

that loss in pressure caused by the presence of the water meter in the pipeline at a given flowrate

3.15**maximum admissible temperature****MAT**

for a water meter, the maximum temperature that it can withstand permanently at a given internal pressure

3.16
meter designation
N

numerical value, preceded by the capital letter N, to designate the meter in relation to tabulated values of dimensions

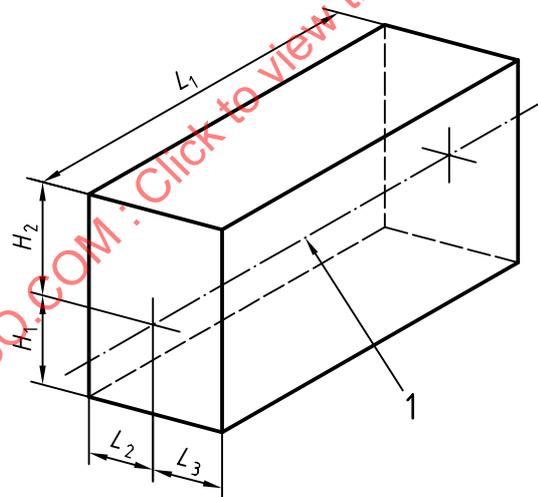
4 Technical characteristics

4.1 Meter size and overall dimensions, meter designation and permanent flowrate

4.1.1 Meter size and overall dimensions

Meter size is designated either by the thread size of the end connections or by the nominal size of the flange. For each meter size there is a corresponding fixed set of overall dimensions (see Figure 1) as specified in Tables 1 and 2.

- $H_1 + H_2$, L_1 and $L_2 + L_3$ define the height, length and width respectively of a cuboid within which the water meter can be contained (the cover being at right angles to its closed position).
- H_1 , H_2 , L_2 and L_3 are maximum dimensions.
- L_1 is a fixed value with specified tolerances. For threaded end connections, two minimum dimensions, a and b , are specified (see 4.1.4).



Key
 1 Axis of pipework

Height: $H_1 + H_2$
 Length: L_1
 Width: $L_2 + L_3$

Figure 1 — Overall dimensions of a meter

4.1.2 Relationship between meter designation and permanent flowrate

The numerical value of the permanent flowrate q_p , expressed in cubic metres per hour, shall be at least equal to the numerical value to the meter designation. In cases where it is greater than the numerical value of the meter designation, it shall be equal to one of the values given in Tables 1 and 2 for meter designation, provided that the relationship between the meter size and the meter designation specified in 4.1.3 is maintained.

Table 1 — Hot water meters with threaded end connections — Meter designation, meter sizes and dimensions

Dimensions in millimetres

Meter sizes		Meter dimensions						
Meter designation N	Meter size ^a	Thread	a_{\min}	b_{\min}	$L_1 \begin{smallmatrix} 0 \\ -2 \end{smallmatrix}$	$L_2 \max$ and $L_3 \max$	$H_1 \max$	$H_2 \max$
—	—	G 3/4 B	10	12	80	50	50	180
N 0,6	G 3/4 B ^b	G 3/4 B	10	12	110	50	50	180
N 1	G 3/4 B ^b	G 3/4 B	10	12	130	50	50	180
N 1,5	G 3/4 B ^b	G 3/4 B	10	12	165	50	50	180
N 2,5	G 1 B ^b	G 1 B	12	14	190	65	60	240
N 3,5	G 1 1/4 B	G 1 1/4 B	12	16	260	85	65	260
N 6	G 1 1/2 B	G 1 1/2 B	13	18	260	85	70	280
N 10	G 2 B	G 2 B	13	20	300	105	75	300

^a Nominal size of threaded end connection.

^b The thread size of the next larger value is acceptable as an alternative.

Table 2 — Hot water meters with flanged end connections — Meter designations, meter sizes and dimensions

Dimensions in millimetres

Meter size DN	Meter sizes		Meter dimensions								
	Meter designation N		L_1 : $L_1 \begin{matrix} 0 \\ -2 \end{matrix} \leq 200$ $200 < L_1 \begin{matrix} 0 \\ -3 \end{matrix} \leq 400$ $400 < L_1 \begin{matrix} 0 \\ -5 \end{matrix} \leq 600$		$L_{2 \max}$ and $L_{3 \max}$		$H_{1 \max}$		$H_{2 \max}$		
	Volume- tric, single-jet and multi-jet meters	Woltman type meters	Volume- tric, single-jet and multi-jet meters	Woltman type meters		Volume- tric, single-jet and multi-jet meters	Woltman type meter	Volume- tric, single-jet and multi-jet meters	Woltman type meter	Volume- tric, single-jet and multi-jet meters	Woltman type meter
				either	or						
—	—	—	80	—	—	50	—	50	—	180	—
15	N 0,6	—	110	—	—	50	—	50	—	180	—
15	N 1	—	130	—	—	50	—	50	—	180	—
15	N 1,5	—	165	—	—	50	—	50	—	180	—
20	N 2,5	—	190	—	—	65	—	60	—	240	—
25	N 3,5	—	260	—	—	85	—	65	—	260	—
32	N 6	—	260	—	—	85	—	70	—	280	—
40	N 10	—	300	—	—	105	—	75	—	300	—
50	N 15	N 15	350	300	200	135	135	115	100	300	390
65	N 20	N 25	450	300	200	150	135	130	110	320	390
80	N 30	N 40	500	350	200	180	135	150	120	320	410
100	N 50	N 60	650	350	250	225	135	215	140	320	440
125	—	N 100	—	350	250	—	135	—	140	—	440
150	—	N 150	—	500	300	—	175	—	180	—	500
200	—	N 250	—	500	350	—	190	—	200	—	500
250	—	N 400	—	600	450	—	210	—	220	—	500

4.1.3 Relationship between meter size and meter designation

Meter size and hence overall dimensions are in principle linked to the designation of the water meter as specified in Tables 1 and 2. For a given meter size, nevertheless it is permitted to adopt the immediately adjacent larger or smaller meter size, provided that the metrological requirements are met. In such a case, the meter shall be designated not only by its numerical N value but also by its DN. End connections shall be the same at the water meter inlet and outlet.

4.1.4 Threaded connection

Dimensions for the threaded connection are specified in Table 1. Threads shall comply with ISO 228-1. Figure 2 defines dimensions *a* and *b*.

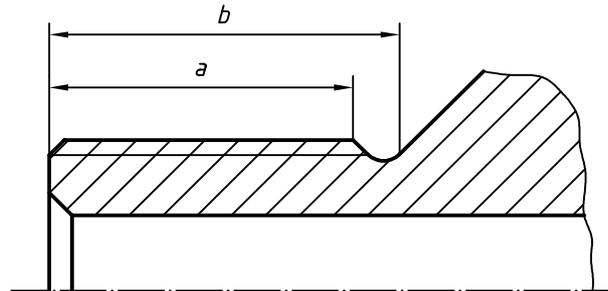


Figure 2 — Dimensions a and b

4.1.5 Flanged connection

Flanged end connections shall comply with ISO 7005-1, ISO 7005-2 and ISO 7005-3 (as appropriate) for a nominal pressure corresponding to that of the water meter. Dimensions are specified in Table 2.

The manufacturer shall provide a reasonable clearance behind the rear face of the flange to allow access for installation and removal.

4.2 Indicating device

4.2.1 General requirements

4.2.1.1 Function

The indicating device shall provide an easily read, reliable and unambiguous visual indication of the volume flow.

The device shall include visual means for verification and calibration.

The device may include additional elements for verification and calibration by other methods, for example automatic means.

4.2.1.2 Unit of measurement — Symbol and its position

The volume of water measured shall be expressed in cubic metres. The unit symbol m^3 shall appear on the dial or immediately adjacent to the numbered display.

4.2.1.3 Indicating range

The indicating device shall be able to record, without passing zero, the volume expressed in cubic metres corresponding to at least 1 999 h of operation at the permanent flowrate. This provision is formulated in Table 3.

Table 3 — Minimum indicating range

q_p m^3/h	Indicating range m^3
$0,6 \leq q_p \leq 5$	9 999
$5 < q_p \leq 50$	99 999
$50 < q_p \leq 400$	999 999

4.2.1.4 Colour coding

The colour black shall be used to indicate cubic metres and multiples thereof. The colour red shall be used to indicate submultiples of cubic metres.

These colours are applicable to the pointers, indexes, numbers, wheels, disks, dials or aperture frames as appropriate.

4.2.1.5 Direction of indicator movement

The rotational movement of pointers or circular scales shall be clockwise.

The linear movement of pointers or scales shall be left to right.

The movement of numbered roller indicators shall be upwards.

4.2.1.6 Incremental change of electronic digital indicator

The incremental change of electronic digital indication shall be instantaneous.

4.2.2 Types of indicating device

The types of indicating device specified in 4.2.2.1 to 4.2.2.3 are permissible.

4.2.2.1 Type 1 — Analog device

The volume of water is given by continuous movement of:

- a) one or more pointers moving relative to graduated scales; or
- b) one or more circular scales or drums each passing an index.

The value, expressed in cubic metres, for each scale division shall be of the form 10^n , where n is a positive or negative whole number or zero, thereby establishing a system of consecutive decades. Each scale shall be either:

- graduated in values expressed in cubic metres, or;
- accompanied by a multiplying factor ($\times 0,001$; $\times 0,01$; $\times 0,1$; $\times 1$; $\times 10$; $\times 100$; $\times 1\ 000$, etc.).

4.2.2.2 Type 2 — Digital device

The volume of water is given by a line of adjacent digits appearing in one or more apertures.

The advance of any given digital unit shall be completed at the same time that the digit of the immediately next lower value changes from 9 to 0.

The decade of the lowest value may have a continuous movement, the aperture being large enough to permit a digit to be unambiguously read.

The apparent height of digits shall be at least 4 mm.

4.2.2.3 Type 3 — Combination of analog and digital devices

The volume of water is given by a combination of devices of types 1 and 2 and the respective requirements of each shall apply.

The decade of the lowest value of the digital indicator may have a continuous movement.

4.2.3 Supplementary devices

In addition to the indicating device itself (4.2.2), the water meter may include supplementary devices which may be permanently incorporated or added temporarily. Supplementary devices may be used, for example:

- a) to detect a movement of the measuring device before this is clearly visible on the indicating device;
- b) where national regulations permit, as a control element for testing and initial verification for the water meter provided that other means guarantee the satisfactory operation of the indicating device in accordance with the requirements of 4.3.3; and
- c) for remote reading of the water meter in accordance with the requirements of 4.6.

The presence of supplementary devices and their general manner of use shall not change the metrological characteristics of the water meter.

4.3 Verification devices — Control element and verification scale interval

4.3.1 General

The indicator element displaying the decade of the lowest value is called the control element. Its smallest scale division is called the verification scale interval.

The visual verification display may have either a continuous or a discontinuous movement.

Every indicating device shall provide means for visual non-ambiguous verification and calibration through a control element.

In addition to visual verification displays, an indicating device may include provisions for rapid testing by using additional elements (e.g. stars or disks) read by external electronic means which convert the signals registered into numerical data.

4.3.2 Visual verification displays

4.3.2.1 Value of the verification scale interval (see Table 4)

The value, in cubic metres, of the verification scale interval shall be expressed as 1×10^n , 2×10^n , or 5×10^n , where n is a positive or negative whole number or zero.

For analog and digital indicating devices with continuous movement of the control element, the verification scale interval may be formed from the division into two, five or ten equal parts of the interval between two consecutive digits of the control element. Numbering shall not be applied to those divisions.

For digital indicating devices with discontinuous movement of the control element, the verification scale interval is the interval between two consecutive digits or incremental movements of the control element.

4.3.2.2 Form of the verification scale interval

On indicating devices with continuous movement of the control element, the length of the verification scale interval shall be no less than 1 mm and no more than 5 mm. The scale shall consist either of lines of equal thickness not exceeding one-quarter of the distance between the axes of two consecutive lines and differing only in length, or of contrasting bands of a constant width equal to the length of the scale division.

The width of the pointer index tip shall not exceed one-quarter of the verification scale interval length and in no case shall it be greater than 0,5 mm.

Table 4 — Verification scale interval

Meter designation N	Maximum value of verification scale interval m ³							
	Analog and digital devices with continuous movement of the control element				Digital devices with discontinuous movement of the control element			
	class A	class B	class C	class D	class A	class B	class C	class D
N 0,6	0,000 1	0,000 05	0,000 02	0,000 02	0,000 05	0,000 02	0,000 02	0,000 02
N 1	0,000 2	0,000 1	0,000 05	0,000 05	0,000 1	0,000 05	0,000 02	0,000 02
N 1,5	0,000 2	0,000 2	0,000 1	0,000 1	0,000 2	0,000 1	0,000 05	0,000 05
N 2,5	0,000 5	0,000 2	0,000 1	0,000 1	0,000 2	0,000 1	0,000 05	0,000 05
N 3,5	0,001	0,000 5	0,000 2	0,000 2	0,000 5	0,000 2	0,000 1	0,000 1
N 6	0,001	0,000 5	0,000 2	0,000 2	0,000 5	0,000 2	0,000 2	0,000 2
N 10	0,002	0,001	0,000 5	0,000 5	0,001	0,000 5	0,000 2	0,000 2
N 15	0,005	0,002	0,000 5	—	0,002	0,001	0,000 2	—
N 20	0,01	0,002	0,000 5	—	0,005	0,002	0,000 2	—
N 25	0,01	0,005	0,001	—	0,005	0,002	0,000 5	—
N 30	0,01	0,005	0,001	—	0,005	0,002	0,000 5	—
N 40	0,02	0,005	0,001	—	0,01	0,002	0,000 5	—
N 50	0,02	0,01	0,002	—	0,01	0,005	0,001	—
N 60	0,02	0,01	0,002	—	0,01	0,005	0,001	—
N 100	0,05	0,02	0,002	—	0,02	0,01	0,002	—
N 150	0,05	0,02	0,005	—	0,02	0,01	0,002	—
N 250	0,1	0,05	0,01	—	0,05	0,02	0,005	—
N 400	0,2	0,05	0,01	—	0,1	0,02	0,005	—

4.3.2.3 Maximum value of the measurement uncertainty caused by reading

The subdivisions of the verification scale shall be small enough to ensure that the measurement uncertainty caused by reading the meter does not exceed 0,5 % during the test, and that at the minimum flowrate the test shall not take more than 1 h 30 min.

When the display of the control element is continuous, account shall be taken of a possible reading error in each reading of no more than half the length of the smallest scale division.

When the display of the control element is discontinuous, account shall be taken of a possible reading error in each reading of one digit.

4.3.3 Additional verification elements

Additional verification elements may be used provided that their verification scale interval is small enough for the measurement uncertainty caused by reading the meter not to exceed 0,5 % of the volume flow and that at the minimum flowrate the test shall not take more than 1 h 30 min.

4.4 Adjustment device

Meters may be fitted with an adjustment device allowing the adjustment of the indicated volume to volume flow.

4.5 Accelerating device

The use of an accelerating device for increasing the speed of the meter below q_{\min} is prohibited.

4.6 Remote output systems

Hot water meters may be fitted with remote output systems which allow the meter to be read at a distance from the metering site.

Remote output systems consist of a number of elements as follows: remote output, transmission link and remote reading device. The requirements of this part of ISO 10385 relate to certain aspects of the remote output.

The addition of a remote output device to a water meter shall not alter the metrological performance of the meter.

The remote output device may be incorporated within the body of the meter or its indicating device, or it may be fitted externally. Where the device is fitted externally it shall be provided with protective devices and seals in accordance with 4.10.

The remote output device together with the cable gland and cable shall be capable of operation under humid conditions with a protection classification of IP 65 in accordance with IEC 60529. Special versions may be called for which are capable of operation when submerged in water, classification IP 68.

4.7 Materials

Water temperature variations, within the working temperature range, shall not adversely affect the materials used in the construction of the water meter. All materials of the water meter which are in contact with the water flowing through the water meter shall be non-toxic and non-tainting. They shall be in conformity with national regulations in force.

The water meter shall be constructed throughout of materials which are resistant to normal internal and external corrosion or which are protected by some suitable surface treatment.

The water meter shall be made of materials of strength adequate for the purpose for which it is to be used.

The indicating device of the water meter shall be protected by a transparent window (made of glass or other material). Further protection may be provided by a suitable cover.

The water meter shall be provided with means for the removal of condensation if the latter can occur on the underside of the window of the indicating device of the water meter.

4.8 Strainers

Volumetric and multi-jet water meters shall be provided with an internal strainer located upstream of the measuring element.

4.9 Behaviour in case of flow reversal

Where meters may be subjected to an accidental reversal of flow, they shall be capable of withstanding the reversal without any deterioration or change in their metrological characteristics and, at the same time, shall record such a reversal.

4.10 Sealing

Water meters shall have protective devices which can be sealed in such a way that after sealing, both before and after the water meter has been correctly installed, there is no possibility of dismantling or altering the water meter or its adjustment device without damaging the protective devices.

5 Metrological characteristics

5.1 Maximum permissible errors

The maximum permissible error in the lower zone from q_{min} inclusive up to but excluding q_t is $\pm 5\%$.

The maximum permissible error in the upper zone from q_t inclusive up to and including q_s is $\pm 3\%$.

5.2 Metrological classes

Hot water meters are divided into four metrological classes on the basis of the values of q_{min} and q_t as shown in Table 5.

Table 5 — Metrological classes

Metrological class	Numerical value N of meter designation N m ³ /h	
	$N < 15$	$N \geq 15$
Class A		
q_{min}	0,04 N	0,08 N
q_t	0,10 N	0,20 N
Class B		
q_{min}	0,02 N	0,04 N
q_t	0,08 N	0,15 N
Class C		
q_{min}	0,01 N	0,02 N
q_t	0,06 N	0,10 N
Class D		
q_{min}	0,01 N	—
q_t	0,015 N	—

6 Pressure loss

From the results of tests, hot water meters are divided into four groups on the basis that the pressure loss corresponds to one of the following maximum values: 1 bar; 0,6 bar; 0,3 bar and 0,1 bar over the entire flowrate range.

7 Marking

All water meters shall be clearly and indelibly marked with the following information (see Table 6), either grouped or distributed on the casing, the indicating device dial, an identification plate, or the water meter cover if not detachable:

- a) the name or trade mark of the manufacturer;
- b) the metrological class, the meter designation and the pressure loss, expressed in bars; where the numerical value of the permanent flowrate q_p is not equal to the numerical value of the meter designation N , the value of q_p shall be indicated in addition to the meter designation N ;