BS EN 16314:2013

BSI Standards Publication

# Gas meters — Additional functionalities

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**National foreword**

This British Standard is the UK implementation of EN 16314:2013.

The UK participation in its preparation was entrusted to Technical Committee GSE/25, Gas Meters.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EUROPEAN STANDARD

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**EN 16314**

July 2013

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English Version

# Gas meters - Additional functionalities

Compteurs à gaz - Fonctionnalités supplémentaires

Gaszähler - Zusatzfunktionen

This European Standard was approved by CEN on 18 April 2013.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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# Contents

Page

# Foreword

This document (EN 16314:2013) has been prepared by Technical Committee CEN/TC 237 “Gas meters”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by January 2014, and conflicting national standards shall be withdrawn at the latest by January 2014.

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## Introduction

This European Standard has been drafted as part of the work being undertaken by the European Standards Organisations (CEN/CENELEC/ETSI) under the Commission Mandate M/441. This standard utilises the six functionalities agreed by the Smart Meters Coordination Group (SM-CG) (see Annex C) as the basis for its additional functionalities. It is not necessary for the Additional Functionality Device (AFD) to incorporate all functions. This standard builds on CEN/TR 16061 by providing specific requirements for the additional functionality that can be fitted to a gas meter.

This standard contains requirements for gas valves integral within the meters and controlled by an AFD where the capacity of the gas meter does not exceed 10 $m^3/h$. Such gas valves are intended for interruption of the gas supply but do not replace any valve intended to isolate the gas supply.

Communications for gas meters are outside the scope of this standard and are covered by the appropriate parts of EN 13757, which provide a number of protocols and transport layers for meter communications for Gas, Water and Heat meters.

A number of methods can provide the additional functionality for gas meters: these are illustrated below, see Figure 1, and described in detail within this standard. The AFD can be integral to the gas meter, attached to the meter or remote from the meter.

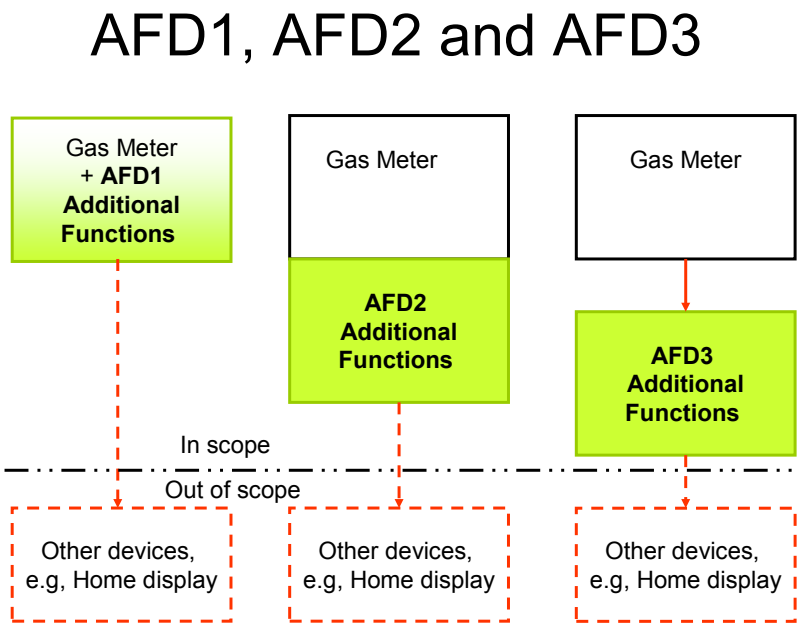



**Figure 1 — Additional functionality device**

## 1 Scope

This European Standard specifies the additional requirements and tests for gas meters with a maximum capacity of 40 $m^3$/h and a maximum operating pressure of not exceeding 500 mbar, conforming to EN 1359, EN 12261, EN 12480, EN 12405 and EN 14236, which have battery powered devices providing additional functionalities that form part of the gas meter (hereafter referred to as meter) or contained in an Additional Functionality Device (AFD). It also covers the additional requirements when an electronic index is used rather that a mechanical one. Where the option of an integral valve to the meter is specified, this standard only gives requirements for meters having a maximum capacity not exceeding 10 $m^3$/h.

This European Standard is applicable to first, second and third family gases according to EN 437.

This European Standard specifies the construction requirements for electronic components but communication protocols are dealt within other European Standards, e.g. appropriate parts of EN 13757.

NOTE This European Standard covers connections to auxiliary devices but not the requirements for these devices.

This European Standard applies to AFDs that are installed in locations with vibration and shocks of low significance and in:

— closed locations (indoor or outdoor with protection as specified by the manufacturer) with condensing or with non-condensing humidity,

or, if specified by the manufacturer:

— open locations (outdoor without any covering) with condensing humidity or with non-condensing humidity,

— locations liable to temporary saturation,

and in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial buildings or similar buildings.

This European Standard does not cover the changing of metrological software within the meter or the upload/download of metrological software.

This European Standard only covers valves integral to the meter.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1359, *Gas meters — Diaphragm gas meters*

EN 12261, *Gas meters — Turbine gas meters*

EN 12405-2, *Gas meters — Conversion devices — Part 2: Energy conversion*

EN 12480, *Gas meters — Rotary displacement gas meters*

EN 13611, *Safety and control devices for gas burners and gas-burning appliances — General appliances*

EN 13757-1, *Communication system for meters and remote reading of meters — Part 1: Data exchange*

EN 13757-2, *Communication systems for remote reading of meters — Part 2: Physical and link layer*

EN 13757-3, *Communications systems for and remote reading of meters — Part 3: Dedicated application layer*

EN 13757-4, *Communication systems for meters and remote reading of meters — Part 4: Wireless meter readout (radio meter reading for operation in the 868 MHz to 870 MHz SRD band)*

EN 13757-5, *Communications systems for and remote reading of meters — Part 5: Wireless relaying*

EN 13757-6, *Communications systems for and remote reading of meters — Part 6: Local bus*

EN 14236, *Ultrasonic domestic gas meters*

EN 55022, *Information Technology Equipment — Radio disturbance characteristics — Limits and methods of measurement*

EN 60079 (all parts), *Explosive atmospheres*

EN 60086-1, *Primary batteries — Part 1: General*

EN 60086-4, *Primary batteries — Part 4: Safety of lithium batteries*

EN 60529, *Degrees of protection provided by enclosures (IP code)*

EN 60950-1, *Information technology equipment — Safety — Part 1: General requirements*

EN 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

EN 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

EN 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test*

EN 61000-4-5, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test*

EN 61000-4-6, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields*

EN 61000-4-8, *Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test*

EN 61000-4-9, *Electromagnetic compatibility (EMC) — Part 4-9: Testing and measurement techniques — Pulse magnetic field immunity test*

EN 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments*

EN 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*

EN 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements*

EN 62056-21, *Electricity metering — Data exchange for meter reading, tariff and load control — Part 21: Direct local data exchange*

EN ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps (ISO 4892-3)*

EN ISO 6270-1, *Paints and Varnishes — Determination of resistance to humidity — Part 1: Continuous condensation (ISO 6270-1)*

EN ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1)*

IEC 61508-1, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 1: General Requirements*

ISO 7724-3, *Paints and Varnishes — Colorimetry — Part 3: Calculation of colour differences*

ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics (edition 11)*

# 3 Terms, definitions and abbreviated terms

## 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1.1**
**function**
process which constantly or at defined intervals, automatically or on demand, performs specific activities such as sampling data, reading a data set, verifying or changing a status, or activating a switch

**3.1.2**
**additional functionality**
functions over and above that within the meter, which can be integral to the meter, or included within a connected device

**3.1.3**
**additional functionality device**
carries out the additional functionalities

**3.1.4**
**additional functionality device Type 1**
factory fitted additional functionality integral within the meter

**3.1.5**
**additional functionality device Type 2**
factory or field fitted additional functionality directly attached to the meter

**3.1.6**
**additional functionality device Type 3**
field fitted additional functionality connected to the meter

**3.1.7**
**meter**
instrument designed to measure, memorise and display the quantity of gas (volume or mass) that has passed it

Note 1 to entry: A volume conversion device is a sub-assembly of a meter and therefore in this standard it is part of the meter.

**3.1.8**
**automatic meter reading**
technology for obtaining metering data from an on-site meter by communication from an access point outside the premises

**3.1.9**
**connector**
mechanical device, or pair of devices, that makes a semi-permanent circuit between the meter and a cable

**3.1.10**
**universal time coordinated**
world time, without daylight savings

**3.1.11**
**index**
current reading of the total volume (mass) passed through the meter

**3.1.12**
**metrological software**
software identified during the type testing examination, which is part of the meter and is critical to its metrological characteristics

**3.1.13**
**register**
electronic component which memorises the values of the meter and/or the AFD

**3.1.14**
**maximum permissible error**
extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system

**3.1.15**
**tariff**
price structure (normally comprising a set of one or more rates of charge) applied to the consumption of a product or service provided to a consumer

**3.1.16**
**event**
condition requiring action or to log an action

**3.1.17**
**display**
shows visual information in either numbers or text

## 3.2 Abbreviated terms

**Table 1 — Abbreviations**

| | |
|---|---|
| AFD1 | Additional functionality device Type 1 |
| AFD2 | Additional functionality device Type 2 |
| AFD3 | Additional functionality device Type 3 |
| UTC | Universal Time Coordinated |
| MPE | Maximum Permissible Error |

# 4 General requirements

## 4.1 Meter

A meter shall comply with one of the following European Standards: EN 1359, EN 12405-2, EN 12261, EN 12480 or EN 14236 as applicable.

## 4.2 Meters with electronic index

Where a meter conforming to 4.1 is equipped with a primary electronic index, the electronic index and its associated software and hardware shall meet the requirements of Annex C and the relevant parts of this standard and the meter standard.

## 4.3 Suitability – AFD/Meter combination

The AFD shall work at the same minimum operating conditions as the meter required by the appropriate above mentioned standards.

The AFD shall be connected to the meter and tested as a combined unit in all the tests given in 4.4 to 4.17 to ensure the connection of the AFD to the meter has no metrological influence. The connection of the AFD to the meter or any labelling on the meter/AFD shall not obscure or damage the metrological seals of the meter.

The index on the meter shall not be obscured by the connection of the AFD and the index shall be accessible to the consumer without the use of tools.

The manufacturer of the AFD shall declare the conditions for compatibility with any interface and meters.

## 4.4 Types of additional functionality devices

The additional functionality shall be provided by one of the following devices:

a) AFD1,

b) AFD2,

c) AFD3.

In the case of an AFD1, all functions shall be within the same casing as the meter.

In the case of an AFD2, the AFD2 shall be directly attached to the meter.

In the case of an AFD3, the AFD3 shall be connected to the meter.

The fitting of the AFD to the meter shall not obstruct or obscure the metrological seal.

The AFD shall be connected to the meter in accordance with the manufacturer's instructions during all tests specified in this standard.

The index shall be easily read without the use of tools by the consumer and shall be unambiguously and boldly displayed within the index.

## 4.5 AFD1

### 4.5.1 Requirements

When tested in accordance with 4.5.2, the AFD shall have no influence on the metrological characteristics of the meter.

### 4.5.2 Test

Test the meter with the AFD1 incorporated according to the appropriate standard, i.e. EN 1359, EN 12405-2, EN 12480, EN 12261 or EN 14236, to ensure conformity.

## 4.6 AFD2

### 4.6.1 Requirements

a) When tested in accordance with 4.6.2 a), the AFD shall have no influence on the metrological characteristics of the meter.

b) If the AFD provides a facsimile of the meter's results, it shall be tested in accordance with 4.6.2 b) to ensure these results are identical to that on the meter.

c) When tested in accordance with 4.6.2 c), the AFD shall operate with the interfaces specified by the manufacturer and display the information as specified by the manufacturer.

d) There shall be the possibility to be able to apply a protective seal between the ADF and the meter.

### 4.6.2 Test

a) Fit the AFD to the meter and undertake the relevant tests specified in Clauses 4 and 7.

b) Examine the meter and AFD and ensure these results are identical to that on the meter.

c) Verify the AFD is interoperable with those interfaces specified by the manufacturer.

d) Examine the meter and AFD and ensure there is the possibility to apply a protective seal between the ADF and the meter.

## 4.7 AFD3

### 4.7.1 Requirements

a) When tested in accordance with 4.7.2 a), the AFD shall have no influence on the metrological characteristics of the meter.

b) If the AFD provides a facsimile of the meter's results, it shall be tested in accordance with 4.7.2 b) to ensure these results are identical to that on the meter.

c) The AFD manufacturer shall ensure interoperability and specify the types of interface with which it is compatible.

### 4.7.2 Test

a) Fit the AFD to the meter in accordance with the AFD manufacturer's instructions and repeat the relevant tests specified Clauses 4 and 7.

b) Examine the meter and AFD and ensure these results are identical to that on the meter.

c) Undertake an assessment of the documented evidence provided by the manufacturer.

## 4.8 Resistance to high ambient temperature

If the manufacturer declares the meter associated with any AFD1 or AFD2 is resistant to high ambient temperatures, the connection or incorporation of the AFD shall not affect its resistance to high ambient temperature.

NOTE Further information is provided in the appropriate meter standard for the requirements for meter's resistance high ambient temperature.

## 4.9 Climatic environments

### 4.9.1 General

For an AFD1 and AFD2, the AFD shall be at least suitable for the same climatic requirements as the meter. This shall be achieved by fulfilling the requirements given in 4.9.2, 4.9.3, 4.9.4, 4.9.5 and 4.9.6.

The AFD3 and any physical connection shall meet the requirements given in 4.9.2, 4.9.3, 4.9.5 and 4.9.6.

### 4.9.2 Closed location

#### 4.9.2.1 Requirement

All meters/AFDs shall meet this requirement.

a) When tested in accordance with 4.9.2.2 a), the AFD shall meet the requirements of EN 60529 for an IP54 code.

b) When tested in accordance with 4.9.2.2 b), the functions specified by the manufacturer of the meter/AFD shall be maintained and the index/register markings shall remain legible.

#### 4.9.2.2 Test

a) Test one meter/AFD in accordance with EN 60529 and confirm it is suitable for an IP54 code.

b) Test one meter/AFD in accordance with EN ISO 6270-1 for a period of 120 h. Then check the functions of the AFD for correct operation, and ensure the index/register marking and information are legible.

### 4.9.3 Open location

#### 4.9.3.1 General

When the manufacturer declares that the meter/AFD is suitable for 'Open locations' it shall meet the following requirement and shall be marked in accordance with Clause 8.

#### 4.9.3.2 Requirement

a) When tested in accordance with 4.9.3.3 a), the AFD shall meet the requirements of EN 60529 for an IP65 code.

b) When tested in accordance with 4.9.3.3 b), the functions specified by the manufacturer of the meter/AFD shall be maintained and the index/register markings shall remain legible.

c) All markings on the meter/AFD, the index and index plate when viewed through the index window and any separate data plate, if fitted, shall remain easily legible after being subjected to the test given in 4.9.3.3.c).

Total colour difference measured in accordance with ISO 7724-3 shall be inside the following limits:

— $\Delta L^* \leq 7$

— $\Delta a^* \leq 7$

— $\Delta b^* \leq 14$

Light transmission in accordance with ASTM D1003 shall have Haze ≤ 15 %.

#### 4.9.3.3 Test

a) Test one meter/AFD in accordance with EN 60529 and confirm it will be suitable for an IP65 code.

b) Test one meter/AFD in accordance with EN ISO 6270-1 for a period of 340 h. Then check the functions of the AFD for correct operation, and ensure the index/register marking and information are legible.

c) One meter/AFD shall be exposed for 66 days to artificial weathering and exposure to artificial radiation in accordance with EN ISO 4892-3 and the parameters in Table 2.

Prior to exposure measurements will be made to enable the test criteria to be assessed.

**Table 2 — Solar Radiation**

| Test cycle | Wavelength/ Lamp type | Irradiance | Black panel-temperature |
|---|---|---|---|
| 8 h dry | UVA 340 | 0,76 W($m^{-2}$•$nm^{-1}$) at 340 mm | (60 - 3) °C |
| 4 h condensation | | light out | (50 - 3) °C |

Following exposure, the meter shall be visually inspected for legibility. All markings on the meter, the index and index plate when viewed through the index window and any separate data plate, if fitted, shall remain legible. Appropriate tests shall be carried out to check the requirements for colour difference and transmission of light are met.

### 4.9.4 Location liable to temporary saturation

#### 4.9.4.1 General

When the manufacturer declares that the meter/AFD is suitable for locations liable to temporary saturation, it shall meet the following requirement and shall be marked in accordance with Clause 8.

#### 4.9.4.2 Requirement

a) When tested in accordance with 4.9.4.3 a), the meter/AFD shall meet the requirements of EN 60529 for an IP67 code.

b) When tested in accordance with 4.9.3.2 b) and 4.9.3.2 c), the function of the meter/AFD specified by the manufacturer of the meter/AFD shall be maintained and the index/register markings shall remain legible.

#### 4.9.4.3 Test

a) One meter/AFD shall be tested for its function before and after the testing in accordance with the IP67 code of EN 60529.

b) Test one meter/AFD in accordance with 4.9.3.2 b) and check the functions of the meter/AFD for correct operation. Test one meter/AFD in accordance with 4.9.3.2 c) and check if the requirements of 4.9.3.1 c) are met.

### 4.9.5 Mechanical (Vibration) class

#### 4.9.5.1 Requirements

As declared by the manufacturer, the AFD shall retain its functions before and after being subjected to the vibration test described in 4.9.5.2.

#### 4.9.5.2 Test

In the case of an AFD2 it shall be directly attached to the meter.

Carry out the functions test to secure that the functions of the AFD are correct.

Secure the AFD under test to the vibration test rig, a diagrammatic layout of which is shown in Figure 2, by means of a horizontal clamp across the top of the AFD.

In Figure 2, the AFD under test (2) is shown mounted to the spindle of an electrodynamic shaker (1), which is driven by an amplified sine wave from a voltage generator. The head of the shaker can be rotated through 90° for the fore-aft and lateral planes.

The acceleration level is sensed using an accelerometer (3) (piezoelectric transducer) whose output is conditioned using a charge amplifier (4).

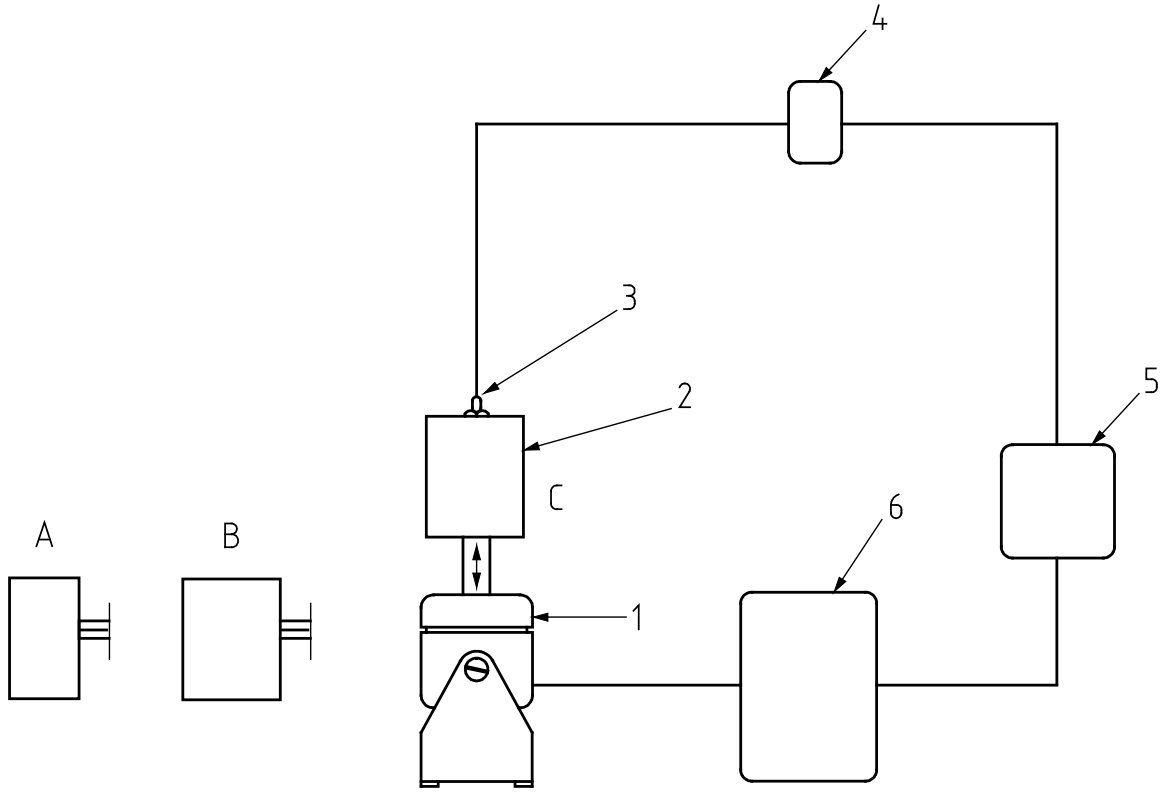
An automatic vibration exciter control (5), which is inserted between the conditioned accelerometer signal and the power amplifier (6), is used in a sweeping mode in which the frequency is cycled between a pair of selected frequencies, alternatively increasing and decreasing.

Subject the AFD under test to a swept frequency of between 10 Hz and 150 Hz (± 5 %) at a sweep rate of 1 octave per minute with a peak acceleration of 2 $g_n$ (± 5 %), for 20 sweeps in the vertical plane, 20 sweeps in the fore-aft plane and 20 sweeps in the lateral plane.

Recheck the functions of the AFD under test.

The clamping force should be sufficient to restrain the AFD under test without causing damage or distortion to the AFD case.

NOTE An octave is a band of frequency where the upper frequency limit of the band is exactly twice the lower limit, e.g. 10 Hz to 20 Hz, 20 Hz to 40 Hz, 40 Hz to 80 Hz and 80 Hz to 160 Hz. Therefore, the time taken to sweep from 10 Hz to 100 Hz at a sweep rate of 1 octave per minute is 3 min 15 s.




**Key**

1 electronic shaker
2 AFD
3 accelerometer
4 charge amplifier
5 automatic vibration exciter control
6 power amplifier
A ADF for-aft plane
B ADF lateral plane
C ADF vertical plane

**Figure 2 — Diagrammatic layout of the vibration test apparatus**

#### 4.9.6 Temperature range

As a minimum, the AFD shall be capable of meeting the requirements for the minimum storage temperature range of ≤ -20 °C to ≥ +60 °C.

For an AFD1 or AFD2 the manufacturer shall specify the ambient temperature range with a minimum temperature range of 50 °C for the climatic environment, and the minimum temperature limit being either -40 °C, -25 °C, -10 °C or 5 °C, and the maximum temperature limit being either 30 °C, 40 °C, 55 °C or 70 °C. An AFD1 or AFD2 shall have at least the same ambient temperature range as the meter.

For an AFD3, the manufacturer shall specify the ambient temperature range with a minimum temperature of at least +5°C to +30 °C.

## 4.10 Gas temperature range

For an AFD1, the gas temperature range shall be a minimum of 40 °C and be within the ambient temperature range.

## 4.11 Safety Requirements

### 4.11.1 Pressure Absorption

Any additional functionality shall not cause the pressure absorption to be greater than that required by the appropriate meter standard.

NOTE 1 EN 1359 and EN 14236 have requirements for the pressure absorption of the meter. Pressure at the appliance is very important to safe use of gas, especially for older appliances which may lack flame failure detection.

NOTE 2 Correct operation of valves and their impact on pressure absorption is given in 7.13.

### 4.11.2 Use in hazardous areas

When the manufacturer declares that the meter / AFD is suitable for use in hazardous zones as defined in EN 60079-10-1, the manufacturer shall declare the zone for which it is intended and shall identify the route to compliance as defined in EN 60079-0. The general requirements for, construction and marking of the meter / AFD shall then comply with EN 60079-0.

### 4.11.3 Electrical Safety

The manufacturer of the AFD shall declare:

a) any electrical safety requirements;

b) suitable environments where it can be fitted;

c) how to install, maintain and use it.

When the AFD incorporates a radio communications device it shall meet the general safety requirements as defined in EN 61010-1 or EN 60950-1.

## 4.12 Immunity to electromagnetic disturbances

### 4.12.1 General

The meter/AFD shall be designed and manufactured in such a way to tolerate the effects of magnetic fields, electrostatic discharge and other electromagnetic disturbances.

### 4.12.2 Permanent magnetic fields

#### 4.12.2.1 Requirements

When tested in accordance with 4.12.2.2, the difference in mean errors and the errors during the positioning of a permanent magnet that generates a magnetic field of 200 mT shall not exceed one third of the MPE specified in the appropriate meter standard. The functionalities of the AFD as declared by the manufacturer shall remain operable without any loss of data.

#### 4.12.2.2 Test

Ensure the AFD is connected to the meter in accordance with the manufacturer's instructions. Stabilise the meter/AFD to room temperature and test the meter three times at $\underline{Q_{max}}$ and 0,2 $\underline{Q_{max}}$ in accordance with the appropriate meter standard.

Place the magnet on all surfaces of the AFD in a grid pattern 4 cm wide. Test on every point of the grid at $\underline{Q_{max}}$.

Retest the meter but again, stabilising the AFD to room temperature and test the meter three times at $\underline{Q_{max}}$ and 0,2 $\underline{Q_{max}}$ in accordance with the appropriate meter standard.

### 4.12.3 Electrostatic discharge

#### 4.12.3.1 Requirements

When tested in accordance with 4.12.3.2, the difference in mean errors shall not exceed one third of the *MPE* specified in the appropriate meter standard and the additional functionalities of the AFD as declared by the manufacturer shall remain operable without any loss of data.

#### 4.12.3.2 Test

Ensure the AFD is connected to the meter in accordance with the manufacturer's instructions.

Stabilise the meter/AFD to room temperature and test the meter three times at $Q_{max}$ and 0,2 $Q_{max}$ in accordance with the appropriate meter standard.

With no flow through the meter, test the meter in accordance with EN 61000-4-2 using 10 contact discharges to each of:

a) the conductive surfaces;

b) a horizontal;

c) a vertical coupling plane with a charge voltage of 6 kV (EN 61000-6-1 and EN 61000-6-2) at intervals of a minimum of 1 s, with the battery fitted.

With no flow through the meter, test the meter in accordance with EN 61000-4-2 using 10 air discharges (to insulating surfaces) with a charge voltage of 8 kV (EN 61000-6-1 and EN 61000-6-2) at intervals of a minimum of 1 s, with the battery fitted.

During the test, connect the inlet boss of the meter under test to the 'ground plane'.

Retest the meter but again stabilise the meter/AFD to room temperature and test the meter three times at $Q_{max}$ and 0,2 $Q_{max}$ in accordance with the appropriate meter standard.

Confirm there has been no loss of data.

### 4.12.4 Radio frequency electromagnetic field

#### 4.12.4.1 Requirements

During the test specified in 4.12.4.2 a), the meter index shall neither increment nor decrement and the additional functionalities declared by the manufacturer shall remain operable and without loss of data.

During the test specified in 4.12.4.2 b), the flow rate calculated from the meter readings shall not vary by more than three times the *MPE* and after testing in accordance with 4.12.4.2 b), the mean errors shall be within the *MPE* specified in the standard.

#### 4.12.4.2 Test

Ensure the AFD is connected to the meter in accordance with the manufacturer's instructions.

a) Set the flow rate to zero.

Read the volume register and non-volatile memory

Test the meter in accordance with EN 61000-4-3, under the classification E1:

frequency band: 26 MHz to 3 000 MHz

test field strength: 10 V/m

amplitude modulation: 80 %, 1 kHz sine wave

Read the volume register and non-volatile memory and compare with the value before the high frequency test.

b) Arrange the test equipment so that it is possible to pass air through the test meter while it is being subjected to the electromagnetic field.

NOTE One way of achieving this is to use a sonic nozzle between the meter outlet and a vacuum line.

Test the meter under the conditions given below. During the test, read the index and elapsed time at suitable intervals. From these readings, calculate the corresponding flow rates.

Stabilise the meter/AFD to room temperature and test the meter three times at $Q_{max}$ in accordance with the appropriate meter standard and determine its MPE. Maintain the meter at $Q_{max}$ and subject the meter/AFD to the range of high frequency field in accordance with EN 61000-4-3, under the classification E1:

frequency band: 26 MHz to 3 000 MHz

test field strength: 10 V/m

amplitude modulation: 80 %, 1 kHz sine wave

With the high frequency field switched off retest the meter/AFD in accordance with the appropriate meter standard at $Q_{max}$ and ensure the meter is still within its MPE.

Confirm there has been no loss of data and the mean errors have remained within the *MPE* specified in the standard.

### 4.12.5 Electromagnetic induction (power frequency)

#### 4.12.5.1 Requirements

When tested in accordance with 4.12.5.2 a), the AFD register/index shall neither increment nor decrement and the additional functionalities declared by the manufacturer shall remain operable and without loss of data.

During the test described in 4.12.5.2 b), the flow rate calculated from the meter readings shall not vary by more than six times the MPE specified in the appropriate meter standard, during any of the eight periods of the test without showing an error flag (excluding any error flag designed to appear when entering a test mode).

After testing in accordance with 4.12.5.2 b), the mean errors shall be within the MPE of the appropriate meter standard.

#### 4.12.5.2 Test

a) Set the flow rate to zero.

Read the volume register and non-volatile memory

Test the meter /AFD to test level 4 of EN 61000-4-8 for 5 min for the continuous field test and 3 s for the short duration test.

Read the volume register and non-volatile memory and compare with the value before the electromagnetic induction power frequency.

b) Arrange the test equipment so that it is possible to pass air through the test meter while it is being subjected to the electromagnetic field.

NOTE One way of achieving this is to use a sonic nozzle between the meter outlet and a vacuum line.

Test the meter under the conditions given below. During the test, read the index and elapsed time at suitable intervals. From these readings, calculate the corresponding flow rate.

Stabilise the meter/AFD to room temperature and test the meter at 0,2 $Q_{max}$ in accordance with the appropriate meter standard. During this test the meter/AFD shall be subjected to electromagnetic induction (power frequency) in accordance with test level 4 of EN 61000-4-8 for 1 min in each of eight orientations, four with the meter horizontal at 0°, 90°, 180° and 270°, and four with the meter vertical at 0°, 90°, 180° and 270°.

With the power frequency switched off, retest the meter/AFD in accordance with the appropriate meter standard at 0,2 $Q_{max}$.

Confirm there has been no loss of data.

### 4.12.6 Electromagnetic induction (pulsed field)

#### 4.12.6.1 Requirements

The meter shall satisfy the following requirements.

During test described in 4.12.6.2 a), the meter index shall neither decrement nor increment and the additional functionalities declared by the manufacturer shall remain operable and without loss of data.

During the test specified in 4.12.6.2 b), the flow rate calculated from the meter readings shall not vary by more than half of the MPE specified in the appropriate meter standard, during any of the eight periods of the test without displaying an error flag.

After testing in accordance with 4.12.6.2 b), the mean errors shall be within the MPE specified in the appropriate meter standard.

#### 4.12.6.2 Test

a) Set the flow rate of the meter to zero.

Read the volume register and non-volatile memory.

Test the meter/AFD in accordance with test level 4 of EN 61000-4-9 for 1 min in each of eight orientations, four with the meter horizontal at 0°, 90°, 180° and 270°, and four with the meter vertical at 0°, 90°, 180° and 270°.

Read the volume register and non-volatile memory and compare with the value before the pulsed field test.

b) Arrange the test equipment so that it is possible to pass air through the test meter while it is being subjected to the pulsed field.

NOTE One way of achieving this is to use a sonic nozzle between the meter outlet and a vacuum line.

Test the meter under the conditions given below. During the test, read the index and elapsed time at suitable intervals. From these readings, calculate the corresponding flow rates.

Stabilise the meter/AFD to room temperature and test the meter at 0,2 $Q_{max}$ in accordance with the appropriate meter standard. During this test the meter/AFD shall be subjected to a pulse field in accordance with test level 4 EN 61000-4-9 for 1 min in each of eight orientations, four with the meter horizontal at 0°, 90°, 180° and 270°, and four with the meter vertical at 0°, 90°, 180° and 270°.

With the pulsed field switched off, retest the meter/AFD in accordance with the appropriate meter standard at 0,2 $Q_{max}$.

Confirm there has been no loss of data.

#### 4.12.7 Radio interference emission

##### 4.12.7.1 Requirements

When tested in accordance with 4.12.7.2, the electro magnetic interference generated by the AFD shall be limited.

##### 4.12.7.2 Test

Check that the AFD satisfies class B radio interference limits in EN 55022 at zero flow.

### 4.13 Immunity to electromagnetic disturbances for Meters / AFD's with external ports

#### 4.13.1 General

Where meters / AFD's include DC power or signal ports the requirements defined in 4.13.2.1, 4.13.3.1 and 4.13.4.1 shall apply.

#### 4.13.2 Radio Frequency common mode

##### 4.13.2.1 Requirements

When tested in accordance with 4.13.2.2, the meter index shall neither increment nor decrement and where the AFD includes additional registers or stores of data these shall not be affected.

##### 4.13.2.2 Test

Ensure the AFD is connected to the meter in accordance with the manufacturer's instructions.

Record the meter index and AFD data prior to performing the test described below.

Perform the test as described in EN 61000-4-6, as detailed in Table 3.

Note the meter Index and AFD data and confirm that no unexpected changes in data have occurred.

**Table 3 — Radio frequency tests**

| Port | Test Conditions | Units | Basic Standards | Remarks | Performance Criterion |
|---|---|---|---|---|---|
| Signal | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% AM (1KHz) | EN 61000-4-6 | The test level is the r.m.s. value of the unmodulated carrier [a, b] | A |
| DC Power | 0,15 to 80<br>10<br>80 | MHz<br>V<br>% AM (1KHz) | EN 61000-4-6 | The test level is the r.m.s. value of the unmodulated carrier [a, b] | A |

[a] The test level can also be defined as the equivalent current into a 150 Ω load.

[b] Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.

### 4.13.3 Fast Transient Bursts

#### 4.13.3.1 Requirements

When tested in accordance with 4.12.3.2, the meter index shall neither increment nor decrement and where the AFD includes additional registers or stores of data these shall not be affected.

#### 4.13.3.2 Test

Ensure the AFD is connected to the meter in accordance with the manufacturer's instructions.

Note the Meter Index and AFD data prior to performing the test described below.

Perform the test as described in EN 61000-4-4 as detailed in Table 4.

Note the meter Index and AFD data and confirm that no unexpected changes in data have occurred.

**Table 4 — Fasten transient bursts test**

| Port | Test Conditions | Units | Basic Standards | Remarks | Performance Criterion |
|---|---|---|---|---|---|
| Signal | ± 1<br>5/50<br>5 | KV (open circuit test voltage)<br>Tr/Th ns<br>Repetition frequency kHz | EN 61000-4-4 | Capacitive clamp used [a] | B |
| DC Power | ± 1<br>5/50<br>5 | KV (open circuit test voltage)<br>Tr/Th ns<br>Repetition frequency kHz | EN 61000-4-4 | None | B |
| [a] Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m. | | | | | |

### 4.13.4 Surges

#### 4.13.4.1 Requirements

When tested in accordance with 4.13.4.2, the meter index shall neither increment nor decrement and where the AFD includes additional registers or stores of data these shall not be affected.

#### 4.13.4.2 Test

Ensure the AFD is connected to the meter in accordance with the manufacturer's instructions.

Note the Meter Index and AFD data prior to performing the test described below.

Perform the test as described in EN 61000-4-5 as detailed in Table 5.

Note the meter Index and AFD data and confirm that no unexpected changes in data have occurred.

**Table 5 — Surge tests**

| Surge test | | | | | |
|---|---|---|---|---|---|
| **Port** | **Test Conditions** | **Units** | **Basic Standards** | **Remarks** | **Performance Criterion** |
| Signal | N/A | N/A | N/A | N/A | N/A |
| DC Power<br>line to earth<br>line to line | 1,2/50 (8/20)<br>± 2<br>± 1 | Tr/Th µs<br>kV (o/c test voltage)<br>kV (o/c test voltage) | EN 61000-4-5 | | |

## 4.14 Resistance to mishandling

### 4.14.1 Requirement

The AFD shall withstand the handling required during its transport and installation. Before testing in accordance with 4.14.2, the meter under test shall conform to the following:

a) the AFD shall function as specified by the manufacturer;

b) if the meter incorporates a valve, it shall be tested for pressure absorption in accordance with the appropriate meter standard and shall not exceed the initial maximum pressure absorption value given in the appropriate meter standard.

After undergoing the mishandling test described in 4.14.2, the AFD under test shall conform to the following requirements:

c) the AFD function as specified by the manufacturer;

d) if the meter incorporates a valve check, the post endurance maximum permissible pressure absorption value given in the appropriate meter standard is not exceeded;

e) the valve is in the same position as before the test was performed.

### 4.14.2 Test

Hold the AFD or meter (if incorporating a valve) under test, with no packaging, in the upright position (in its horizontal plane), and drop vertically, from rest, on to a flat, hard, horizontal surface from a height as given in Table 6. The heights given refer to the distance from the bottom of the AFD or meter under test to the surface onto which it will fall.

If the meter incorporates a valve, undertake the test with the valve in the open and closed position.

**Table 6 — Drop height**

| $Q_{max}$ **($m^3/h$)** | **Height of dropping (m)** |
|---|---|
| 1 to 10 | 0,5 |
| 16 to 40 | 0,3 |

## 4.15 Resistance to storage temperature

### 4.15.1 Requirement

When tested in accordance with 4.15.2, the AFD functions specified by the manufacturer shall continue to operate without loss of data.

### 4.15.2 Test

Maintain the AFD under test under the following conditions:

a) 3 h at a temperature of -20 °C, or lower if declared by the manufacturer;

b) 3 h at a temperature of +60 °C, or higher if declared by the manufacturer.

At the end of each period, the AFD under test is returned to normal laboratory ambient temperature and perform the functions specified by the manufacturer.

## 4.16 Ageing test

### 4.16.1 Requirement

When tested in accordance with 4.16.2, the functions specified by the manufacturer shall continue to operate without loss of data.

### 4.16.2 Test

Test all the functions specified by the manufacturer and ensure all are operable.

Subject the AFD to the temperature and corresponding time given in Table 7 which has been specified by the manufacturer.

On completion of the test, return the AFD to normal laboratory temperature and carryout the functions as initially specified by the manufacturer.

**Table 7 — Temperature/times ageing periods**

| Temperature (°C) | Time period (days) |
|---|---|
| 70 ± 2 | 50 |
| 60 ± 2 | 100 |
| 50 ± 2 | 200 |

## 4.17 Expected lifetime

### 4.17.1 Requirement

The manufacturer shall declare the expected lifetime of the AFD. The manufacturer shall state the method used for this estimate. The expected lifetime estimated shall be supported by international standards providing guidance on Reliability Prediction, Accelerated Life and Reliability Testing (e.g. for electronic instrument a predictive model is described in EN 62059-41) and/or any methods to indicate if long-term stability of the AFD is affected. As a result, the functions of the AFD shall continue to operate without loss of data. This shall be verified by carrying out the test in 4.17.2.

### 4.17.2 Test

Undertake an assessment of the documented evidence provided by the manufacturer.

# 5 Security

## 5.1 General

The AFD shall be constructed in such a way that any unauthorised intervention shall either cause permanently visible damage to the AFD or its protective seals, or set an alarm which shall be visible on the AFD's display and memorised in the event register. Any physical seals shall be visibly fixed, and easily accessible.

## 5.2 Software, data and hardware security

### 5.2.1 Requirement

When tested in accordance with 5.2.2, the requirements below shall be met.

All available connections, ports and interfaces of the AFD which can be used for unauthorised adjustment of the AFDs characteristics and additional functionality shall be effectively secured and protected against unauthorised interference by protective seals.

No access shall be allowed to software/firmware by unauthorised persons. Software and data shall be protected against accidental or intentional changes by the breaking of a physical seal or by using an electronic seal.

For electronic seals, the following requirements shall be met:

a) access shall only be obtained by using a password or a code;

b) any unauthorised intervention shall be registered in the event log and identify the type of intervention, and where available include its date and time.

Unauthorised access shall cause permanently visible damage to the AFD or its protective seal.

In the case of intended customer access to menus, it shall be ensured that access to menus by the costumer cannot inadvertently drain the battery capacity.

### 5.2.2 Test

Compliance with the above requirements shall be checked by visual inspection and evaluation of the manufacturer's Technical Documentation.

## 5.3 Firmware upgrade

This standard does not cover Software/firmware metrological upgrades; however, it does allow non-metrological upgrades providing there is clear separation between the metrological and / or non-metrological functions.

The procedure for updating firmware shall not affect the on-going measurement of the meter and the calibration of the meter.

Firmware download shall only be carried out when the correct AFD has been identified, authentication has been made and data integrity check has been completed.

Downloading and the subsequent installation of software shall take place automatically to ensure that the software protection and security remains unchanged and is not compromised by manual interferences.

The target device shall be equipped with a fixed relevant software part that contains all the functions necessary for checking the following characteristic: authentication, integrity and traceability. If one of the checks fails, the instrument shall be capable of detecting if the download or installation failure.

If the download or installation is unsuccessful or is interrupted, the original status of the AFD shall be unaffected.

On successful completion of the installation, all protective means shall be restored to their original state unless there is an authorisation to change them. The new software shall be activated immediately or at a fixed date and time.

Following any upgrade, the information/functionality of the AFD shall be as declared by the manufacturer. Any data still present shall be the same as prior to the upgrade.

A typical routine is given in Annex A.

In addition, special consideration of the control of the valve should be made during the firmware upgrade process.

### 5.4 Software identification

Any firmware identifier shall be easily available.

The software shall have an unambiguous identifier that is inextricably linked to the software itself and that is easily retrievable. The identifier shall be presented on command or during operation without the use of special tools.

Any modification of the software shall have a new identifier.

## 6 Power system

### 6.1 General

For an AFD1, the battery shall be integral to the meter. For an AFD2, the battery shall either be integral to AFD or to the meter.

During the battery exchange, all information contained within the AFD shall be retained. Following the battery exchange, any clock shall maintain the correct time.

Where the battery is intended to operate for the full life of the AFD, then there shall be no access to the battery except by disassembly of the AFD.

The device shall assess the remaining battery life on a regular basis by assessing the operating conditions defined by the manufacturer. The device shall provide diagnostic indicators which allow the meter operator to identify specific usage of the meter.

Power shall be prioritised as the battery nears end of life.

The following order of priority is recommended:

1) Safety (including the unexpected opening of the valve);

2) Metrology;

3) Local datalogging and calculations;

4) Communications and valve closure.

### 6.2 Battery

#### 6.2.1 General

The manufacturer shall specify the type of battery used.

#### 6.2.2 Requirements

When tested in accordance with 6.2.2, batteries shall comply with EN 60086-1. Lithium batteries shall comply with EN 60086-4.

NOTE A battery can be one or more cells.

#### 6.2.3 Test

Visually inspect the battery(s) to ensure they meet the requirements of 6.2.2.

### 6.3 Battery life

#### 6.3.1 Requirements

When tested in accordance with 6.3.2:

a) The manufacturer shall declare the lifetime of the battery and the conditions under which the tests are undertaken. The lifetime of the battery shall be greater than 5 years.

b) The AFD shall show an indication that 90 % of the battery lifetime has been used or the AFD shall provide this information to the IT system.

c) Where the same battery is used to operate the metrological part of the meter and the additional functionalities, the manufacturer shall also declare the measures that have been taken to protect the metrological part.

#### 6.3.2 Tests

**Test a)**

Using the manufacturer's declaration produce a list of all additional functionalities, internal discharges and their associated power requirements.

Undertake the tests in accordance with the manufacturer's declaration using the declared temperature profile and maximum of all frequency inputs and confirm the lifetime of any replaceable or non-replaceable battery to support all functions.

**Test b)**

Simulate 90 % of the usage of the battery as declared by the manufacturer.

**Test c)**

Check that the metrology battery life is protected and that priority is given to protecting the metrological functions.

### 6.4 Battery compartment

#### 6.4.1 Requirements

When tested in accordance with 6.4.2, the battery compartment shall be sealed such that there shall be visual evidence of tamper or other unauthorised interference.

The manufacturer shall apply an electronic or physical seal to the battery compartment of the AFD after fitting the battery.

Cells and batteries shall be of a type from which there can be no spillage of electrolyte or they shall be enclosed to prevent damage by the electrolyte to components. Any leak from the battery shall be contained in the battery compartment and shall not damage the corrosion protection requirements of the meter/AFD. The battery shall be chemically isolated from the electronic components of the meter or its index / display.

#### 6.4.2 Test

Examine the manufacturer's declaration, technical documentation and undertake a visual inspection.

### 6.5 Battery replacement

#### 6.5.1 Requirements

a) When tested in accordance with 6.5.2 a), any battery shall be replaceable without breaking any metrological seal. Access to the battery and other non-metrological compartments shall be available without damaging metrological seal, e.g. after opening the battery cover. Protection shall be ensured by non-metrological sealing.

b) When tested in accordance with 6.5.2 b), the battery replacement shall be:

   1) accessible from the front of the AFD and be so designed that the battery can be replaced by authorised personnel without removing the AFD from the installation or its fixings;

   2) designed in a way that it is possible to perform the mechanical procedure of the battery exchange within 2 min and that the metrological authority seal is not broken when replacing the battery;

   3) such that battery connections can only be made with the correct polarity:

c) When tested in accordance with 6.5.2 c), following the battery replacement the gas valve shall be in the open or closed position as declared by the manufacturer.

#### 6.5.2 Tests

**Test for a):**

Remove the battery in accordance with the manufacturer's instructions.

**Test for b)1:**

Remove the battery in accordance with the manufacturer's instructions.

**Test for b)2:**

When changing the battery in accordance with the manufacturer's instructions note the time taken to complete the task. In addition, ensure the metrological authority seal is not broken.

**Tests for b)3:**

By visual inspection.

**Test for c):**

Remove the battery in accordance with the manufacturer's instruction and confirm the manufacturer's declaration.

## 6.6 Battery lifetime totaliser

### 6.6.1 Requirement

The AFD shall incorporate a battery lifetime totaliser.

When tested in accordance with 6.6.2, the battery lifetime totaliser shall revert back to the initial value defined by the manufacturer and fault / tamper alarm are reset.

The lifetime totaliser shall take into account predicted usage of energy and take in account the real number of times functions with large energy use are utilised e.g. valve. When tested in accordance with 6.6.2, the totaliser shall operate as declared by the manufacturer.

### 6.6.2 Test

Check to ensure the AFD incorporates a battery lifetime totaliser and change the battery in accordance with the manufacturer's instructions.

Check the working of the totaliser by using all functions of the meter/AFD.

## 6.7 Voltage interruptions

### 6.7.1 Requirements

When tested in accordance with 6.7.2, the AFD shall retain all displayed and stored data and the clock shall not have deviated by more than 5 s, or the clock shall be synchronised according to the manufacturer's instruction.

### 6.7.2 Test

During the test, ensure no gas passes through the meter.

Using a reference clock, compare the time on each clock noting their values.

Confirm the displayed and stored data, noting these values.

Remove and replace the battery three times in succession, waiting 5 min before each replacement. Following the three removals of the battery, examine the AFD to ensure all displayed and stored data is available and has not changed.

Following the manufacturer's declaration, check the deviation of the clock, or verify the resynchronisation.

## 6.8 Operating voltage

### 6.8.1 Requirements

When tested in accordance with 6.8.2, the manufacturer's minimum operating voltage of the AFD shall be used to ensure operability. If the battery is temporarily replaced by using an alternative power supply source, the internal impedance of the battery shall also be specified.

### 6.8.2 Test

Replace the battery by a voltage controlled power supply set to the manufacturer's specified minimum operating voltage and impedance; then check its operability.

# 7 Additional Functionalities

## 7.1 General

Additional functionality shall be at the discretion of the manufacturer. Any additional functionality shall comply with this clause. Additional functionality above and beyond that described in this clause shall be allowed providing the additional functionality does not influence the metrological characteristics of the meter.

Annex B shows the implementation method of how conformity to the SM -CG Additional Functionalities have been met.

This standard only covers gas valves within the meter case.

## 7.2 Display

### 7.2.1 General

This section specifies general requirements for an electronic display that may be incorporated in the meter and / or AFD 1, AFD 2 or AFD3.

### 7.2.2 Requirements

When tested in accordance with 7.2.3, information shall be indicated either on:

a) the display fitted to the meter;

b) the display of an AFD1, AFD2 or AFD3;

c) a combination of the above;

d) the method by which the information and flags is displayed shall take one of the following forms:

   1) by means of direct user action e.g. the depression of push buttons. If after a minimum of 30 s and a maximum of 255 s there has been no user operation, the display shall revert to showing the cumulative volume or switch off;

   2) by means of automatic and sequential scrolling through the information.

The identification and the unit of each quantity or parameter that can be indicated shall be clearly shown next to or upon the display unit.

The manufacturer shall declare what information can be displayed.

### 7.2.3 Test

By visual inspection.

## 7.3 Diagnostics

The manufacturer shall declare any diagnostic registers and events and the method of retrieving the data.

## 7.4 Metrological influence

### 7.4.1 Requirement

When tested in accordance with 7.4.2, the AFD shall have no inadmissible influence on the metrological characteristics of the meter. The equipment used for this test shall have an uncertainty of measurement of not greater than one fifth of the MPE.

### 7.4.2 Test

Connect the meter and AFD complete with all its additional functionalities operable and in series with a reference standard. Record the start index of the reference standard and that which is under test. This shall be undertaken at the start of each test.

With air passing through the meter stream at $Q_{min}$ and $Q_{max}$, operate each additional function that could have an effect on the metrological characteristics of the meter separately. Operate each additional function continuously for 1 h or for a minimum of 10 operations at $Q_{min}$ and $Q_{max}$.

Compare the index reading of the reference standard to the meter under test and ensure that the reading has not deviated by more than one fifth of the MPE.

## 7.5 AFD connections

Any wired or wireless connections to the AFD shall allow the sending and/or receiving of signals/pulses. The method of connection used shall be described in the manufacturer's instructions.

## 7.6 Input to AFD

### 7.6.1 General

The input to the AFD 2 or AFD 3 shall be in the form of incremental volume pulses or data stream. For an AFD1, the manufacturer shall choose the appropriate solution.

### 7.6.2 Requirement (For AFD 2 and AFD 3 only)

The input for an AFD shall either be provided via a connector, fixed lead, optical or wireless (RF). The AFD shall be marked how to connect the input, which shall also be detailed in the AFD manufacturer’s instructions. Incorrect connection shall be eliminated by design.

The AFD manufacturer's instructions shall include the electrical characteristics and parameters, the type and method of connection, installation, operating system of the AFD. The communication between the meter and AFD shall be compatible by the use of an open standard or one that is publically available.

When tested in accordance with 7.6.3, a signal described by the manufacturer shall be detected.

### 7.6.3 Test

Connect in accordance with the manufacturer's instructions and ensure a pulse or data stream is recognised and correct assembly is obvious.

## 7.7 Output from AFD

### 7.7.1 General

The output from the AFD shall be either in the form of incremental volume pulses or data stream.

The output shall either be provided via a connector, fixed lead, optical or wireless. The AFD shall be marked how to connect the output, which shall also be detailed in the manufacturer's instructions. Incorrect connection shall be eliminated by design.

The manufacturer's instructions shall include the electrical characteristics and parameters, the type and method of connection, installation, operating and maintenance requirements.

#### 7.7.2 Requirement

When tested in accordance with 7.7.3, an output signal or data stream shall be detected.

#### 7.7.3 Test

Connect the AFD in accordance with the manufacturer's instructions and ensure a signal is recognised.

### 7.8 Data storage

#### 7.8.1 General

NOTE General information on this subject is given in CEN/TR 16061.

The manufacture shall declare how to access the stored data.

The AFD shall be capable of storing static data, e.g. supplier/site/meter information.

Stored data shall be retained in the event of battery failure.

#### 7.8.2 Interval data storage

Interval stored data shall be time stamped configurable over specific time periods. The AFD manufacturer shall specify sufficient memory to store readings for at least two months. Stored readings shall enable the index value at the time stamp to be easily calculated as well as indicating the alarm status and the active tariff rate, time stamp, where applicable.

#### 7.8.3 Event data storage

The AFD shall be capable of recording and storing one or more of the following events:

a) clearing of stored data;

b) fault event;

c) corruption of data base;

d) activation of change of tariff programme;

e) activation of firmware upgrade;

f) resetting and clearing of data base;

g) low battery voltage;

h) battery replacement:

i) opening and closing of valve;

j) setting of the clock;

k) perceived tamper events e.g. fraud attempts.

The list above is not exhaustive.

There shall be enough memory to store at least 100 events and each event shall be identifiable.

Memory shall be deleted on a first in first out basis. At the discretion of the manufacturer, priority shall be given to certain types of events which shall not be deleted unless the removal is carried out by a suitably authorised person.

## 7.9 Time interval accuracy

### 7.9.1 Introduction

Stored data shall be time stamped.

It is recommended that the time stamp within the AFD uses UTC.

The manufacture shall declare how to access the time interval data.

Time interval data shall be retained in the event of battery failure.

The accuracy shall be suitable for its intended use.

### 7.9.2 Requirements

Test in accordance with 7.9.3, if the manufacturer declares that the AFD has a clock. The test shall be confirmed that the accuracy of the clock in accordance with the requirements of EN 62054-21:2004, 7.5.2.

The design of the interval functionality shall guarantee that the sum of interval values will be equal the change of the main register.

### 7.9.3 Test

Consider the manufacturer’s evidence and ensure it is correct.

### 7.9.4 Requirements

Test in accordance with 7.9.5, if the manufacture declares that the AFD is able to manage and display local time, this shall be displayed on the AFD.

### 7.9.5 Test

By inspection.

### 7.9.6 Requirement

When tested in accordance with 7.9.7, the meter and AFD shall only have one reference clock or both clocks shall be synchronised.

### 7.9.7 Test

By inspection.

#### 7.9.8 Requirement

When tested in accordance with 7.9.9, the clock accuracy shall be maintained according to a strategy determined by the manufacturer.

#### 7.9.9 Test

By inspection.

#### 7.9.10 Requirements

If the manufacturer declares that the AFD has a clock that can be synchronised with the meter, when tested in accordance with 7.9.11, it shall be possible to carry out this synchronisation.

A record shall also be placed in the event log showing what action was taken.

#### 7.9.11 Test

Using the manufacturer's procedure, synchronise the clock on the AFD to that on the meter and verify an event has been recorded in the log.

#### 7.9.12 Requirements

If the manufacturer allows setting of the clock, when tested in accordance with 7.9.13, it shall only be achieved by the use of an electronic seal or the breaking of a physical seal.

A record shall also be placed in the event log showing what action was taken.

#### 7.9.13 Test

Using the manufacturer's procedure, use the password or break the physical seal, as appropriate and check the event log shows the action that has taken place.

### 7.10 Energy Calculation within the meter/AFD

Where the manufacturer considers it appropriate to allow an upload of values to determine the energy usage, this shall be permitted.

NOTE Further information can be found in EN 12405-2 and EN 1776; however these possibilities may be subject to national requirements.

### 7.11 Tariffs

Where a manufacturer declares that the AFD has the ability to display and support a tariff, the measured values shall be used as the basis on the price to pay and the meter/AFD shall have sufficient registers and memory to support the tariff structure. In addition, one or more of the following requirements could apply:

a) the meter/AFD shall be able to receive the gas characteristics (e.g. calorific value, estimated pressure and/or temperature) and the cost per unit of energy via a secure communication system;

b) the meter/AFD shall be able to display and/or to calculate the price to price to pay;

c) the customer shall, without the use of tools, be able to view the elements that make up the tariff structure;

d) a method of providing a tariff update in advance with an activation time and date shall be provided;

e) the meter/AFD shall have a programmable billing period and a method of storing snap shot readings at the end of each billing period.

NOTE EN 13757-1 contains information on tariff data management and recent updates to the DLMS Blue book are also helpful in this area.

## 7.12 Display/Human interface

Displayed data that is consumer relevant shall be easily legible and available without the use of tools.

## 7.13 Gas valve and System

### 7.13.1 General

The valve requirements below are only intended for interruption of the gas supply and shall not replace any valve intended to isolate the gas supply, e.g. an Emergency Control Valve or similar. It shall not be regarded as a thermal or safety shut off valve.

Any changes that affect consumer usage of a gas meter or gas supply to the home, shall involve a thorough consideration of human factor risks prior to implementation. The restoration of the gas supply has significant risks associated with it; as such, it is essential that systems ensure that the restoration of the supply at the gas meter/AFD is undertaken in a safe manner.

### 7.13.2 Design Quality

#### 7.13.2.1 Requirements

When tested in accordance with 7.13.2.2, the manufacturer shall provide a risk analysis that demonstrates that the risks associated with operation of the valve are acceptable. The failure of any single part of the meter/AFD shall not cause the valve to unexpectedly open or partially open once it has closed unless this is caused by failure of the valve components directly responsible for sealing of the valve.

#### 7.13.2.2 Test

The manufacturer's evidence is to be examined to prove compliance by the following:

a) use EN 13611: Class B, or EN ISO 13849-1: Performance level C, or IEC 61508-1: SIL 2, to determine a satisfactory Safety Integrity Level, and then show that this level is appropriate and the meter design achieves the level determined; and

b) document Failure Modes, Effects, and Controls Analysis. Consider unexpected opening of the valve, and the possibility of a valve open or close process leaving the valve in a partially open condition.

### 7.13.3 Valve operation

#### 7.13.3.1 Requirements

a) When tested in accordance with 7.13.3.2.1 (ensuring credit is available), the valve shall not be capable of opening without direct manual intervention at the meter, or the meter/AFD shall incorporate a check for an uncontrolled release of gas.

b) When tested in accordance with 7.13.3.2.2, the valve opening procedure shall either:

   1) place a notice on the meter which instructs the local operator how activate the valve to prevent an uncontrolled release of gas, or

2) incorporate a check for an uncontrolled release of gas. There shall be automatic closure of the valve or no opening of the valve if there is an uncontrolled release of gas; or

3) 1) and 2).

c) If a valve closure procedure is declared by the manufacturer following an event, then each declared event shall be tested in accordance with 7.13.3.2.3 to ensure the valve closes correctly.

d) When tested in accordance with 7.13.3.2.4 a), check a flag is displayed indicating a fault has occurred and this is recorded on event log.

e) When tested in accordance with 7.13.3.2.4 b), ensure the valve closes correctly and no flag is displayed indicating a fault has occurred.

#### 7.13.3.2 Test

**7.13.3.2.1** Examine the design of the meter to determine that it is not possible for the valve to operate without manual intervention at the meter, or in accordance with 7.13.3.2.2.b).

**7.13.3.2.2** Perform tests a) to c) as appropriate:

a) Undertake the valve opening procedure and verify the presence of an instruction to the operator how to prevent an uncontrolled release of gas.

b) Ensure the valve in the meter is in the open position. Set the flow rate from the meter (air with density 1,2 kg/m$^3$ and a pressure of 75 mbar) at 10 % above that specified by the meter manufacturer and close the valve. Instruct the valve to open and verify it remains closed or closes after uncontrolled release of air has been detected.

c) Test the meter in accordance with a) and b) above.

**7.13.3.2.3** Simulate the events as declared by the manufacturer and confirm an ordered shut down of the valve has taken place.

**7.13.3.2.4** Prevent the valve from operating, e.g. by insertion of an obstruction. Initiate the valve operation procedure by the various modes possible and monitor the valve control circuits to ensure a valve operation is attempted. Repeat the attempts to operate the valve for a minimum of three times, or the number of times declared by the manufacture, whichever is the greater, until the retry limit is reached.

**7.13.3.2.5** Attempt to operate the valve repeatedly until the manufacturer's declared retry limit is reached. Repeat the above test until one minus the attempted valve closure number used and then remove the obstruction.

### 7.13.4 Valve performance

#### 7.13.4.1 General

The opening and closing of the valve shall be managed so that it does not become a safety issue.

#### 7.13.4.1.1 Requirement

When tested in accordance with 7.13.4.1.2:

a) Unexpected opening of the valve shall cause an event.

b) At the discretion of the manufacturer the meter/AFD shall be configured not open its valve while any resettable fault events remain un-cleared.

c) The valve shall not require any electrical power to keep its position.

d) The method used to activate a valve shall be secure to prevent communication errors or malicious interference causing unintended operation.

#### 7.13.4.1.2 Test

a) The valve is to be forced to open by both mechanical and electrical means. Following operation, the presence of a tamper alarm is to be verified.

b) The valve is to be closed by a means that generates a resettable fault. Following closure, attempts are to be made to reopen the valve without clearing the fault. The fault is then to be cleared and the valve reopened.

c) Ensure the valve in the meter is in the closed position. Set the pressure to 75 mbar at the meter inlet and disconnect the power supply; leave the valve in the closed position for at least 6 h. After the test period, check the valve is still in the closed position. Reenergise the valve and place the valve in the open position and leave the valve in the open position for at least 6 h. After the test period, check the valve is still in the open position.

d) Review the precautions taken by the manufacturer.

### 7.13.4.2 Display of valve related information

#### 7.13.4.2.1 Requirement

When tested in accordance with 7.13.4.2.2, the meter / AFD shall display:

a) a warning message prior to allowing the valve to be opened, if 7.13.3.1, 2 a) and c) is used;

b) whether the valve is open or closed;

c) if the valve fails to close when instructed;

d) if the check for an uncontrolled release of gas in-accordance with 7.13.3.1, 2 b) was not successful.

#### 7.13.4.2.2 Test

Open the valve and examine the display for the presence of an appropriate “valve opening” warning message. The meter is to be operated in accordance with the manufacturer’s instructions to ensure that the meter displays the status of the valve.

### 7.13.4.3 Electrical safety

#### 7.13.4.3.1 Requirement

When tested in accordance with 7.13.4.3.2, where the manufacturer specifies that the electrical components of the valve are built into the gas-ways within the meter, these components of the valve shall be suitable, for use in a zone 2 area, as defined in EN 60079-10-1.

#### 7.13.4.3.2 Test

The manufacturer is to provide evidence of compliance to the relevant part of the EN 60079 series.

#### 7.13.4.4 Pressure absorption

##### 7.13.4.4.1 Requirement

When tested in accordance with 7.13.4.4.2, the total pressure absorption across the meter with a valve incorporated shall not exceed that specified in the appropriate meter standard.

##### 7.13.4.4.2 Test

With the meter connected to an air supply with air of density 1,2 kg/m$^3$ with the valve in the open position, a flow rate of $Q_{max}$ is to be passed through the meter. The pressure absorption of the measuring element including any valve (in the open position) is to be determined by a suitable measuring device with an accuracy of at least $\pm$ 5 %.

#### 7.13.4.5 Valve closing

##### 7.13.4.5.1 Requirement

When tested in accordance with 7.13.4.5.2, the rate of leakage through the valve is at the discretion of the manufacturer and shall not exceed the values given in Table 8 below.

##### 7.13.4.5.2 Test

With the meter connected to an air supply of density 1,2 kg/m$^3$, at a flow rate of $Q_{max}$, the test pressure given in Table 8, close the valve at each of the specified pressures. Following closure, the leak rate past the valve is to be determined by a suitable measuring device with an accuracy of at least $\pm$ 5 %.

**Table 8 — Maximum gas valve internal leakage**

| **Maximum gas valve internal leakage requirements (l/h)** | | |
|---|---|---|
| Test pressures | Type 1 | Type 2 |
| at 20 mbar | 1 | 5 |
| at 75 mbar | 1 | 5 |
| at 150 mbar or $P_{max}$ of the meter, whichever is the greater | 5 | 5 |

#### 7.13.4.6 Valve opening

##### 7.13.4.6.1 Requirement

When tested in accordance with 7.13.4.6.2, the valve shall be able to open under normal operating conditions, against an inlet pressure of 75 mbar.

##### 7.13.4.6.2 Test

The pressure at the inlet of the meter shall be set to 75 mbar. The outlet of the meter shall be connected to a throttle that will limit flow through the meter to $Q_{max}$ with 75 mbar at the inlet.

The meter is to be instructed to open the valve in the way envisaged in normal operation. The valve shall open normally.

#### 7.13.4.6.3 Resistance to Toluene/ISO-Octane and water vapour

When tested in accordance with Annex D.3 and D.4, the rate of leakage through the valve shall meet the requirements of 7.13.4.5.1.

### 7.13.4.7 Storage temperature range

#### 7.13.4.7.1 Requirement

When tested in accordance with 7.13.4.7.2, the rate of leakage through the valve shall meet the requirements of 7.13.4.5.1.

#### 7.13.4.7.2 Test

Maintain the meter with the valve in the open position under test, with no gas flowing through it, under the following conditions:

a) 3h at a temperature of -20°C, or lower if declared by the manufacturer;

b) 3h at a temperature of +60°C, or higher if declared by the manufacturer.

At the end of the test, the meter with the valve under test is returned to normal laboratory ambient temperature. A valve closure is then to be initiated. When the valve is in the closed position, it is to be tested in accordance with 7.13.4.5.2 to determine the internal leakage rate.

### 7.13.4.8 Endurance

#### 7.13.4.8.1 Requirement

When tested in accordance with 7.13.4.8.2, the valve shall operate for 4 000 cycles. Following 4 000 cycles operation the valve shall comply with the internal leakage requirement in 7.13.4.5.1.

#### 7.13.4.8.2 Test

With the meter connected to an air supply at a pressure between 25 mbar and 50 mbar, the valve is to be cycled open/closed/open at a frequency not exceeding 1 operation per 5 s for 4 000 cycles in accordance with D.2. After 4 000 cycles, the valve is to be tested in accordance with 7.13.4.5.2 to determine the internal leakage rate.

### 7.13.4.9 Resistance to contaminants in the gas stream

#### 7.13.4.9.1 Requirement

When tested in accordance with 7.13.4.9.2, all three meters shall comply with 7.13.4.5.1.

#### 7.13.4.9.2 Test

Test a minimum of three meters. Where more than one installation orientation is specified by the manufacturer, test a minimum of three meters in each orientation.

The test equipment used for this test need not have absolute traceability provided that each meter is tested on equipment that does have such traceability prior to commencing the test.

Test the meter in accordance with 7.13.4.5.2.

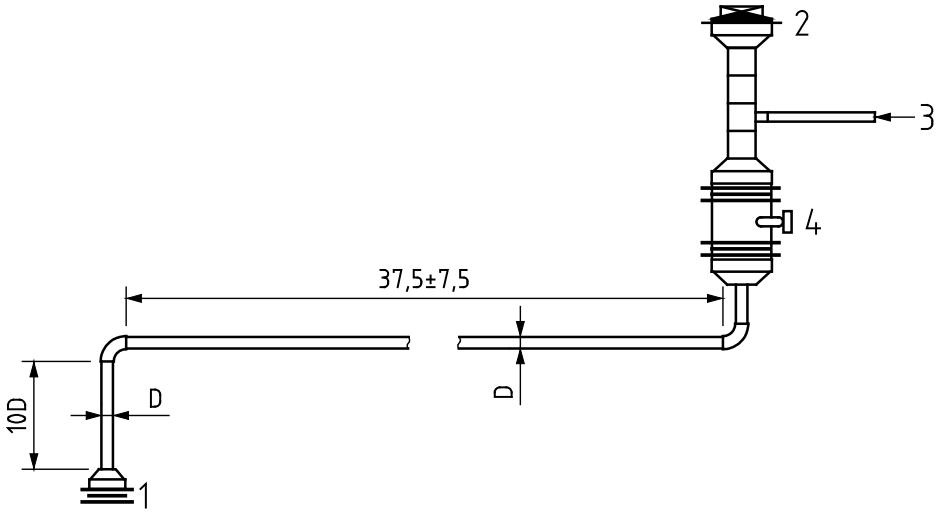
Attach the meter to a dust rig that has 10 *D* of vertical pipe before the meter and pass air through the meter for 5 min at $Q_{max}$. Stop the air supply and add 5 g of 300 to 400 grade dust to the rig inlet. Start the air supply and maintain a flow of $Q_{max}$ for a further 5 min.

Repeat this procedure with 5 g of each dust grade in the order 200 to 300, 100 to 200 and 0 to 100.

Test the meter in accordance with 7.13.4.5.2.

For meters covered by this European Standard, *D* = 15 mm.

Dimensions in millimetres




**Key**

1 meter connection
2 dust inlet (screwed plug)
3 air supply (fan)
4 fast acting full bore valve

**Figure 3 — Example of a typical test rig for the addition of dust**

Referring to Figure 3, the apparatus consists of the following components:

a) 10 *D* of vertical parallel bore pipe, to connect to the meter inlet;

b) a removable screwed plug, for the addition of dust;

c) a ball valve, to release the dust;

d) a length of straight pipe 30 *D* to 45 *D* in length, to ensure that all dust is airborne before entering the meter;

e) copper pipework with soldered or compression fittings is preferred. Steel pipe fittings are not recommended as the dust will adhere to the screw threads.

Other designs of test rig may be used, so long as the following requirements are met.

Check the effectiveness of a test rig design on a regular basis, using a test box. This is to ensure that when 20 g of dust is added using the procedure mentioned above at least 18 g is deposited inside the test box fitted to the rig outlet. Ensure that the test box has a similar volume and shape to the meter to be tested and fitted with a filter on the outlet to minimise the dust passing through the outlet.

Four separate batches of dust shall be used with 95 % of the particles in each batch in the appropriate size range given below:

1) 0 μm to 100 μm Average size (50 ± 10) μm;

2) 100 μm to 200 μm Average size (150 ± 10) μm;

3) 200 μm to 300 μm Average size (250 ± 10) μm;

4) 300 μm to 400 μm Average size (350 ± 10) μm.

Each of the above batches shall have a composition by mass of:

Black iron oxide ($Fe_3O_4$) 79 %

Red iron oxide (FeO) 12 %

Mineral silica flour (SiO) 8 %

Paint residual flake 1 %

Close the valve and confirm that the leak rate does not exceed the values given in 7.13.4.5.1.

### 7.14 Registers

A register to the AFD shall be fitted at the manufacturer's discretion.

### 7.15 Prepayment System with valve

The meter/AFD shall be capable of accepting information that the consumer has made payment for energy/volume whether or not the valve is closed.

The meter/AFD shall maintain a balance that shows how much payment or energy/volume remains until the valve is closed. The meter/AFD shall be capable of displaying this balance to the consumer.

The valve shall close according to the manufacturers declared procedure.

Where the balance held by the meter/AFD is at an appropriate level, the meter/AFD shall only allow an authorised user (declared by the manufacturer) to re-open the valve.

Where the balance held by the meter/AFD is maintained in currency values (rather than volume or mass) then the meter/AFD shall also display the tariff structure which is applied (see also 7.8).

At the manufacturer's discretion, prepayment functions shall include one or more of the following:

a) a function to have an emergency balance available, which can be invoked by the consumer;

b) a function that prevents closure of the valve for the purposes of prepayment during times of day, week, or year (non-disconnect/friendly credit);

c) a function that maintains an additional separate balance on the meter/AFD for accrued customer debt, which is reduced as a function of time, payment information, or a combination of the two;

d) an alternative method of accepting information that the customer has made payment for energy, e.g. to be used when the primary communications have failed;

e) any other function related to payment.

## 7.16 Prepayment system without a valve

At the manufacturer's discretion, prepayment systems without a valve shall be available.

## 7.17 History of Consumption

### 7.17.1 Requirement

At the discretion of the manufacturer, he shall provide data which will allow gas consumption for specific periods of time to be displayed on the meter/AFD.

### 7.17.2 Test

By visual inspection.

## 7.18 Memory

### 7.18.1 General

#### 7.18.1.1 Requirement

When tested in accordance with 7.18.1.2:

a) The volatile and non-volatile memory shall have a capacity which is sufficient for the intended purpose.

b) Overwriting of data shall not occur before the end of the data storage period that is foreseen and documented by the manufacturer.

c) Non-volatile memory shall be updated automatically and periodically according to the reading interval, but this updating shall be at least every 6 h.

#### 7.18.1.2 Test

Inspect manufacturer’s documentation.

### 7.18.2 Access profiles

#### 7.18.2.1 Requirement

When tested in accordance with 7.18.2.2, the manufacturer shall declare access profiles to different data set, commands and configurations. Ensure different combinations operate correctly and ensuring any other combination is inoperable.

#### 7.18.2.2 Test

Perform tests using different combinations.

### 7.18.3 Non-volatile memory

#### 7.18.3.1 Cumulative volume

##### 7.18.3.1.1 Requirement

When tested in accordance with 7.18.3.1.2, the recorded cumulative volume shall be shown by the display and stored in a non-volatile storage device for a minimum of 36 months. The manufacturer shall declare the memory retention time.

##### 7.18.3.1.2 Test

Confirm by visual inspection. The memory retention time can be based on calculations from data for the relevant components, or from the results of manufacturer's own relevant tests.

#### 7.18.3.2 Updating

##### 7.18.3.2.1 Requirement

The non-volatile memory shall:

— be accessible at the extremes of the ambient temperature range; and

— be maintained without any power source across the maximum and minimum storage temperatures, as declared by the manufacturer.

When tested in accordance with 7.18.3.2.2 a), the non-volatile memory shall remain accessible and unchanged at the extremes of the temperature range.

When tested in accordance with 7.18.3.2.2 b), there shall be no difference between the readings before and after the test.

##### 7.18.3.2.2 Test

a) Extreme ambient temperature range:

   1) access the information in the non-volatile memory as specified by the manufacture;

   2) prevent any registration;

   3) note the information which is in the non-volatile memory;

   4) subject the AFD to the extremes of ambient temperature, as specified by the manufacturer, for a minimum of 3 h at each temperature;

   5) at each of the temperature extremes, at the end of the dwell time, read the information from the non-volatile memory;

   6) compare the information as noted in 3) and 5) above.

b) Power source:

   1) access the information in the non-volatile memory as specified by the manufacture;

   2) simulate a flow rate equal to $Q_{max}$ for a period of 5 min;

   3) confirm that the simulated flow rate has been registered;

4) prevent further registration;

5) note the information which is in the non-volatile memory;

6) leave the AFD at room temperature for a minimum of 6 h 5 min;

7) disconnect the non-volatile memory from the power supply and subject the AFD to the minimum and maximum storage temperatures, as specified by the manufacturer, for a minimum of 3 h at each temperature;

8) reconnect the power supply;

9) note information in the non-volatile memory;

10) compare the information as noted in 5) and 9) above.

# 8 Marking

## 8.1 Requirements

When tested in accordance with 8.2, the AFD shall as a minimum be marked as follows:

a) the number and date of this standard;

b) identification mark or name of the manufacturer;

c) serial number and year of manufacture;

d) if the AFD is declared as meeting the requirements of EN 60079 then the marking requirements of EN 60079 apply;

e) mark with IP 65 (EN 60529) and additionally with H3, when suitable for use in an open location (see 4.9.3);

f) mark with IP 67 (EN 60529), when suitable for use in locations liable for temporary saturation (see 4.9.4);

g) ambient temperature range if greater than -10 °C and 40 °C;

h) any additional marking as required by legislation.

With the exception of b) and c), if all applicable information cannot be shown on the AFD this shall be provided on the packaging or with the AFD literature.

## 8.2 Test

This test is carried out by visual inspection.

# 9 Documentation

## 9.1 General

The following information shall be provided with each AFD or group of AFD’s used in the same location.

### 9.2 Declaration of conformity

The manufacturer shall provide a declaration of conformity to this European Standard and all relevant Directives.

### 9.3 Technical documentation

A full set of technical documentation shall accompany the AFD when the AFD is submitted for test. This shall include a sealing drawing describing the method of sealing.

### 9.4 Instruction manual

The operating instructions shall be available in written form or electronic format and shall identify the name and address of the manufacturer and the date of issue.

Each AFD, or group of AFD's, shall be delivered with installation, operation and maintenance manuals, in a language acceptable by the user and easily understandable, giving appropriate information on:

— safe use;

— gas family;

— rated operating conditions;

— possible installation positions;

— mechanical and electromagnetic environment classes;

— safety requirements concerning commissioning and de-commissioning procedures;

— statement if a maintenance is possible and a relevant instruction;

— hazards arising from misuse and particular features of the design when appropriate;

— way of controlling the proper installation and operation;

— conditions for compatibility with interfaces;

— provisions, if any, for transport and handling;

— how to trace the right spare parts;

— storage requirements for spare parts if relevant;

— a description of each of the additional functionalities;

— the type of communication protocol used e.g. which parts of EN 13757 are used;

— electrical compatibility and safety.

## 10 Environmental considerations

Further guidance can be found in CEN Guide 4 [8].

# Annex A
(informative)

# Download software

Example of an Acceptable Solution:

A utility program resident in the fixed part of the software that:

a) handshakes with the sender and checks for consent;

b) automatically inhibits measurement unless correct measurement can be guaranteed;

c) automatically downloads of relevant software to a secure holding area;

d) automatically checks the integrity and authenticity of the downloaded software;

e) automatically installs the software into the correct location;

f) takes care of housekeeping, e.g. deletes redundant files, etc.;

g) initiates the appropriate fault handling procedures if a fault occurs.

NOTE Further information is available is available in WELMEC Guide 7.2.

# Annex B
(informative)

# Implementation method – Conformity to the SM-CG Additional Functionalities

**Table B.1 — Additional functionalities list**

| | SM-CG Additional functionalities | Items considered | Implementation method |
|---|---|---|---|
| 1 | Remote reading of metrological register(s) and provision to designated market organisation(s) | • Static data e.g. Supplier/Site/meter information<br>• Output (Absolute data (direct index reading) /pulse for unit volume)<br>• Storage and retrieval of data<br>• Fraud detection<br>• One way communication | 7.6, 7.7, 7.8, 7.15, 7.18. Annex C - Storage and retrieval via communications port – memory required<br>7.6, 7.7 - Pulse / absolute encoder / direct index data<br>7.2, 7.9, 7.12, 7.18. Annex C - Display, clock, memory and calculator<br>C.6 – Flags |
| 2 | Two-way communication between the metering system and designated market organisation(s) | • Communication channel(s)<br>• Upload/download non-metrological software<br>• Fraud detection | 7.12 - Port or interface<br>5.3 - Local or remote updates<br>C.6 - Flags |

**Table B.1** *(continued)*

| | SM-CG Additional functionalities | Items considered | Implementation method |
|---|---|---|---|
| 3 | To support advanced tariffing and payment systems | • Ability to measure and record usage in different registers | 7.8, 7.11 - Number of registers |
| | | • Measurement of time | 7.9 – Clock |
| | | • Prepayment / pay-as-you-go management | 7.13, 7.15, 7.16- System plus valve |
| | | | 7.2, 7.11, 7.12 Annex C - Retrieval from Registers, index and displays |
| | | • History of consumption | 7.11 - Not a priority |
| | | • Peak hourly consumption | 7.11 - Not a priority |
| | | • Demand metering (instantaneous peak) | 7.2, 7.9, 7.12, 7.18. Annex C - Display, clock, memory and calculator |
| | | • Storage and retrieval of data | 7.2, 7.11, 7.12, Annex C - Buttons/Display |
| | | • Human/Consumer interaction | 7.10, 7.11 - Temp/pressure measured / CVDD or attributed |
| | | • Temperature, pressure, Z, CV | 7.9, Clock, 7.18. Annex C - memory |
| | | • Interval metering | 7.2, 7.12, Annex C - Calculate or / display |
| | | • Calculation engine (e.g. kWh, money) | |
| 4 | To allow remote disablement and enablement of supply and flow | Status of the valve (open/closed) | 7.13, C.6 - Flags/position status / indicators |
| | | Safe reinstatement of supply consider | 7.13 - Valve |
| | | *Note: Flow limitation is not applicable for gas* | 7.13 - Safety interlock |
| 5 | To provide secure communication enabling the smart meter to export data for display and potential analysis to the end consumer or a third party designated by the end consumer | • Communication channel(s) | 5.2 Port or interface |
| | | • Human / Consumer interaction | 7.2, 7.11, 7.12, C.8 - Buttons / Display |

**Table B.1** *(continued)*

| | SM-CG Additional functionalities | Items considered | Implementation method |
|---|---|---|---|
| 6 | To provide information via web portal / gateway to an in-home/building display or auxiliary equipment | • Storage and retrieval of data | 7.9, 7.18. Annex C Display, clock, memory and calculator |
| | | • Human/Consumer interaction | 7.2, 7.11, 7.12, Annex C Buttons/Display |
| | | • History of consumption | 7.2, 7.11, 7.12, Annex C - Retrieval from Registers / memory, index and displays |
| | | • Peak hourly consumption | Not a priority |
| | | • Demand metering (instantaneous peak) | Not a priority |

# Annex C
(normative)

# Electronic index

## C.1 General

When a meter conforming to EN 1359, EN 12261 or EN 12480 is equipped with a primary electronic index, this annex and the relevant parts of this standard and the appropriate meter standard shall be used to demonstrate conformity.

In addition to meeting the relevant requirements of this standard, a meter with the electronic index shall, in all circumstances, withstand the influence factors and disturbances as defined in the appropriate meter standard.

All the constituent elements of an electronic index shall be constructed of materials having appropriate quality to resist the various forms of degradation which can occur under normal operating conditions as specified by the manufacturer.

Additional indications shall not be able to be confused with any other indications on the meter.

## C.2 Display

### C.2.1 Requirements

The display on any meter shall have a means to demonstrate that the display is operating correctly.

### C.2.2 Test

Confirm by visual inspection and that the display is functioning correctly.

## C.3 Display reset

### C.3.1 Requirements

On the display of any meter/AFD it shall not be possible to reset the metrological result without breaking the metrological seal.

### C.3.2 Test

Confirm by visual inspection. Using suitable equipment and commands, supplied by the manufacturer, attempt to reset.

## C.4 Test signal

### C.4.1 Requirement

If test signal injection is used, when tested in accordance with C 4.2, the means of initiating this test signal injection shall be capable of being sealed such that unauthorised interference is detectable, and such that the metrological seal need not be broken to operate this facility.

### C.4.2 Test

By visual inspection.

## C.5 Non-volatile memory

### C.5.1 Requirements

Non-volatile memory shall be incorporated into any AFD that processes metrological and/or financial data.

The non-volatile memory shall be continuously updated at least every 6 h and shall:

a) be accessible at the extremes of the ambient temperature range, as declared by the manufacturer, and

b) be maintained without any power source across the maximum and minimum storage temperatures, as declared by the manufacturer.

When the AFD is tested in accordance with C.5.2 a), the non-volatile memory shall remain accessible and constant at the extremes of the temperature range.

When the AFD is tested in accordance with C.5.2 b), there shall be no difference between the index readings recorded in 3) and 6).

### C.5.2 Test

**a) Access to non-volatile memory**

1) Determine a method for accessing the volume index in the non-volatile memory. Ensure that there is no difference between the two readings. The manufacturer shall declare how this can be performed;

2) cap the meter to prevent any registration;

3) note the meter/AFD index on the display and in the non-volatile memory;

4) subject the meter or AFD to the extremes of ambient temperature, as specified by the manufacturer, for a minimum of 3 h at each temperature;

5) at each of the temperature extremes, at the end of the dwell time, read the volume index from the non-volatile memory.

**b) Maintenance of non-volatile memory**

1) Note the meter/AFD index;

2) immediately apply a flow rate equal to $Q_{max}$ to the meter for a period of 5 min;

3) confirm that the meter/AFD has registered the gas flow, then cap the meter to prevent further registration and immediately note the new meter index, time and relevant information;

4) leave the meter/AFD at room temperature for a minimum of 6 h 5 min after the time noted in 3) above;

5) remove the battery and subject the meter/AFD to the minimum and maximum storage temperatures, as specified by the manufacturer, for a minimum of 3 h at each temperature;

6) reconnect the battery and compare the current index reading with the reading noted in 3) above.

## C.6 Flags and alarms information

### C.6.1 Requirement

All flags and alarms shall be stored in the event log (see 7.8.3). All information related to alarms shall be stored in a non-volatile memory after voltage interruptions.

The manufacturer shall declare the form of the flags and the scope of information related to each alarm.

Clearing of alarm flags shall require authorisation.

The resetting of the cleared alarm shall be possible only if the cause of the alarm has been eliminated. The reset device shall be capable of being sealed.

### C.6.2 Test

By visual inspection.

## C.7 Interfaces

### C.7.1 Requirement

Interfaces for communication shall meet the requirement given in the appropriate parts of EN 13757.

Communication interfaces for connection to any home automation system shall meet the requirements from the appropriate parts of EN 13757.

### C.7.2 Test

Confirm the communication meets the requirement given in the appropriate parts of EN 13757.

## C.8 Ports

### C.8.1 Requirement

Where a local physical Interface is fitted it shall meet the requirements given in EN 62056-21.

### C.8.2 Test

The manufacturer presents an appropriate test report, which could be from a third party.

## C.9 Durability

### C.9.1 Requirement

If the electronic index assembly and its associated drive incorporates moving parts, when tested in accordance with C.9.2.1 the electronic index shall register volume by detecting signals generated by the meter.

When tested in accordance with C.9.2.1 and C.9.2.2, the construction of all associated elements shall ensure the proper registering of the gas volume by the index during the lifetime of the meter. The input shall respond to every signal in such a manner that no signal is gained or lost; neither reverse nor zero flow shall be registered as an increase or decrease of the volume.

### C.9.2 Test

#### C.9.2.1 Signal detection test

Test the electronic index indicating to the input the number of signals which is equivalent for durability test according to appropriate standard for the meter (e.g. 5 000 h at $Q_{max}$ for meter conforming to EN 1359). Stop signal being transmitted for at least 20 times in a period of 1 h in non-regular intervals.

Record the number of signals that has been provided to the index input, using separated test device working independently from the index.

After the test, compare the volume or number of signals registered in the index memory with the volume or signals indicated by separated device. The difference shall not exceed 0,05 %.

The test can be performed at the index associated with the drive.

#### C.9.2.2 Reverse flow test

When the meter does have a protection against the reverse flow, this point does not apply.

Test the meter using methodology described in C.9.2.1 indicating 10 sets of signals. Each set consists of at least 200 correct flow signals and at least 200 reverse flow signals.

After the test, compare the number of signals registered for each direction in the index memory with the volume or pulses indicated by separated device and compare the difference.

# Annex D
(normative)

# Valve type test plan

## D.1 List of tests

The valve shall be tested as part of a meter. Subject to agreement with the test house, these tests shall be made in conjunction with formal testing of the meter to the appropriate European Standard.

— Three meters (incorporating valves) shall be subjected to D.2. All shall pass.

— One meter (incorporating a valve) shall be subjected to D.3 and shall pass.

— One meter (incorporating a valve) shall be subjected to D.4 and shall pass.

— Two meter (incorporating a valve) shall be subjected to D.5 and shall pass.

If, after testing one meter in accordance with D.3, one meter in accordance with D.4 and two meters in accordance with D.5, the meters are found to comply with these clauses, the meters shall be deemed to be satisfactory.

## D.2 Endurance Test

The meter shall be tested in accordance with 7.13.4.5.2. The meter shall be filled with gas or air at the manufacturer's discretion. The valve within the meter shall be opened and closed a minimum of:

1) 400 cycles at the minimum temperature of the meter,

2) 400 cycles at maximum temperature of the meter, and

3) 3,200 cycles at test room temperature.

After each step, the meter shall pass the tests in 7.13.4.5.2.

## D.3 Toluene/iso-octane test

### D.3.1 Sequence

Before carrying out the tests below, the meter (incorporating a valve) shall pass the test given in 7.13.4.5.2.

At the end of Test 1 the meter (incorporating a valve) shall pass the test given in 7.13.4.5.2.

At the end of Test 2 the meter (incorporating a valve) shall pass the test given in 7.13.4.5.2.

### D.3.2 Test 1

Pass through the meter (incorporating a valve) under test nitrogen to which has been added approximately 3 % by gaseous volume of a 30 % toluene/70 % iso-octane mixture (see A.1.4.6) for 42 days (1 008 h) at

(20 ± 2) °C, (65 ± 10) % relative humidity and a flow rate of not less than 0,25 $Q_{max}$ of the meter to which the meter is to be fitted.

NOTE It is important that, when removing the meter from the exercise rig in order to check its operation that the ports be sealed, to prevent the ingress of air, until the meter operation is about to be checked.

### D.3.3 Test 2

After Test 1, exercise the meter (incorporating a valve) under test with air for a further period of 7 days (168 h) at (20 ± 2) °C, (65 ± 10) % relative humidity and a flow rate of not less than 0,25 $Q_{max}$ of the meter on which the meter is to be used. Check the operation of the meter as specified in 7.13.4.5.2.

### D.3.4 Example of a typical apparatus

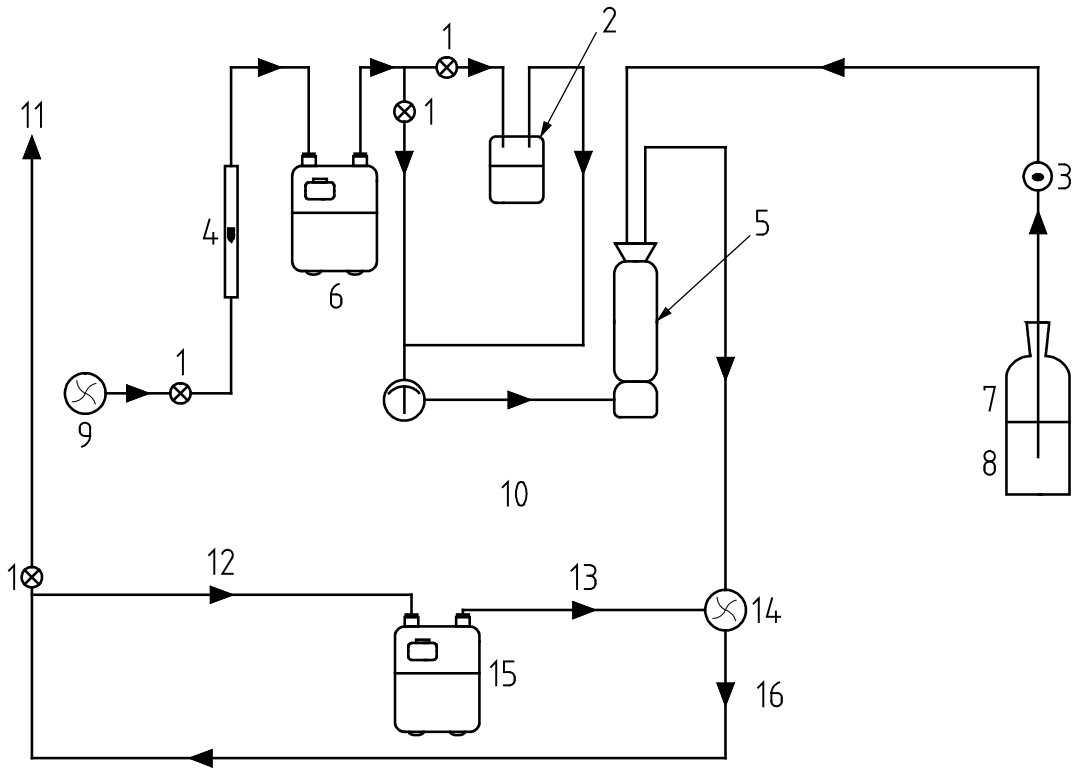
Referring to Figure D.1, the apparatus consists of the following components:

a) An exercise rig (A), open to atmosphere, fitted with a suitable circulating pump or blower.

b) A nitrogen supply with a flow rate measurement capability (B). (Rotameter, meter or both).

c) Relative humidity control (C), comprising a water reservoir and meters capable of giving a relative humidity of (65 ± 10) %. The relative humidity is measured by a hair or paper hygrometer or by a moisture meter.

d) Solvent addition (D). The toluene/iso-octane mixture is added to the top of the vaporisation tower by means of a micro-metering pump. The tower has a bottom diffuser plate and is filled with alternate layers of small glass beads and cotton fabric (or other material) to give a large surface area. The tower is surrounded with a heating blanket which produces a high temperature at the blanket/tower interface to speed up vaporisation.




**Key**

1 valves
2 water reservoir for moisture adjustment
3 micro-metering pump
4 rotameter
5 vaporisation tower filled with alternative layers of glass beads and cotton fabric and surrounded by a heating blanket
6 gas meter for volume check
7 toluene/iso-octane reservoir
8 solvent addition (D)
9 blower
10 moisture meter
11 exhaust
12 gas provision and measurement (B)
13 relative humidity control (C)
14 circulating blower
15 valve under test
16 meter exercise rig (A)

**Figure D.1 — Diagram of toluene/iso-octane test apparatus**

### D.3.5 Procedure

Allow the toulene/iso-octane mixture (see D.3.6) to percolate down the tower and vaporise. Introduce the carrier gas, at a controlled flow rate, through the diffuser at the bottom of the tower where it picks up the vaporised solvent. Pass the gaseous mixture into the exercise rig where it is circulated through the meter under test. A fresh supply of solvent is continuously added to give a stable concentration.

### D.3.6 Preparation of a 3 % by volume of a 30 % toluene/70 % iso-octane mixture with nitrogen

It is estimated that under conditions of normal temperature and pressure 1 g/ml of an ideal gas would occupy 22,4 l. Whilst the vapours of toluene and iso-octane cannot be considered ideal, this principle has been used to calculate the (approximate) concentration of 3 % by volume of a 30 % toluene/70 % iso-octane mixture in nitrogen.

### D.3.7 Calculation

Toluene has a molecular mass of 92,13 and a density of 0,866 94 g/ml.

Iso-octane has a molecular mass of 114,23 and a density of 0,691 8 g/ml.

92,13 g equalling 106 ml toluene will occupy 22,4 l at normal temperature and pressure (NTP).

114,23 g equalling 165 ml iso-octane will occupy 22,4 l at normal temperature and pressure (NTP).

A 3 % dosage of 30/70 toluene/iso-octane mixture will therefore require:

0,9 % toluene = 95,4 ml toluene; and 2,1 % iso-octane = 346,5 ml iso-octane per 2 240 l of carrier gas.

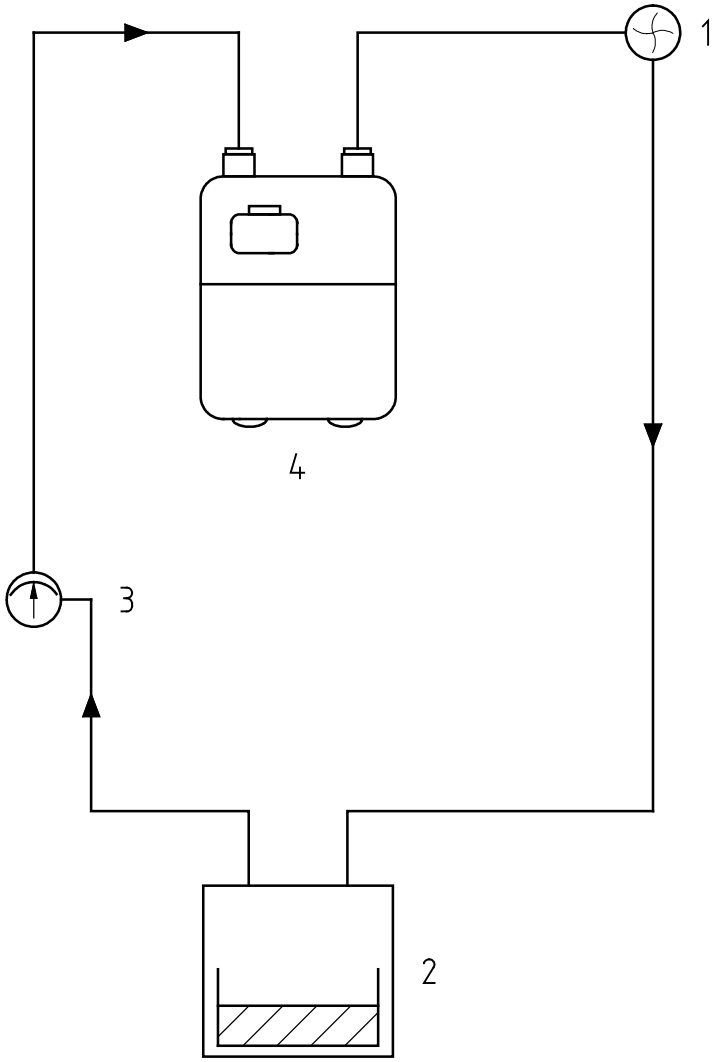
The total volume of solvent mixture to be added to 2 240 l of carrier gas to give a 3 % concentration by volume of 30 % toluene/70 % iso-octane is 441,9 ml. This is equivalent to 0,197 ml per litre of carrier gas.

NOTE The actual amount of solvent to be added to the system will be dependent on the carrier gas flow rate and the conditions inside the tower.

## D.4 Water Vapour Test

Check the operation of the meter (incorporating a valve) in accordance with 7.13.4.5.2.

Connect the meter to the water vapour test rig (see Figure D.2).




**Key**

1 circulating blower
2 saturated solution for humidity control (2)
3 moisture meter
4 valve under test

**Figure D.2 — Example of a water vapour test apparatus**

In Figure D.2, the meter is shown connected to a test rig which consists of a closed circuit containing a suitable circulating pump or blower (1), a chamber containing either a saturated solution of Potassium Acetate (CH3COOK) to give a relative humidity of 20 % at 20 °C, or a saturated solution of Potassium Hydrogen Sulphate (KHSO4) to give a relative humidity of 86 % at 20 °C (2), and a hair or paper hygrometer with a range of 0 % to 100 % relative humidity (3).

Pass air having a relative humidity of less than 20 % through the meter for 7 days (168 h) at (20 ± 2) °C and a flow rate of not less than 0,25 $Q_{max}$ of the meter on which the meter is to be used. At this point, check that the meter passes the test given in 7.13.4.5.2.

On completion of this low humidity performance test, pass air having a relative humidity of (85 ± 5) % through the meter for 42 days (1 008 h) at (20 ± 2) °C and a flow rate of not less than 0,25 $Q_{max}$ of the meter on which the meter is to be used. At the end of this test, check that the meter passes the test given in 7.13.4.5.2.

Pass air having a relative humidity of less than 20 % for at least 7 days (168 h) at (20 ± 2) °C and a flow rate of not less than 0,25 $Q_{max}$ of the meter on which the meter is to be used. At the end of this test, check that the meter passes the test given in 7.13.4.5.2.

## D.5 Ageing Test

Check the operation of the valve in accordance with 7.13.4.5.2.

Store two valves at any of the temperatures given in Table D.1, with one valve in the closed and the other in the open position for the selected time period given in Table D.1.

The temperature at which the test is to be carried out is declared by the meter manufacturer.

On completion of the test, return the valve to normal laboratory temperature and check the operation of the valve and the leakage in-accordance with the requirements in 7.13.4.5.1 and 7.13.4.6.1.

**Table D.1 — Temperature/times ageing periods**

| Temperature (°C) | Time period (days) |
|---|---|
| 70 ± 2 | 50 |
| 60 ± 2 | 100 |
| 50 ± 2 | 200 |

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