BS EN 16340:2014

BSI Standards Publication

Safety and control devices for burners and appliances burning gaseous or liquid fuels — Combustion product sensing devices

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee GSE/22, Safety and control devices for gas and oil burners and gas burning appliances.

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

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English Version

Safety and control devices for burners and appliances burning gaseous or liquid fuels - Combustion product sensing devices

Dispositifs de commande et de sécurité pour brûleurs et appareils utilisant des combustibles gazeux ou liquides - Dispositifs de détection des produits de combustion

Sicherheits- und Regeleinrichtungen für Brenner und Brennstoffgeräte für gasförmige oder flüssige Brennstoffe - Abgasfühler

This European Standard was approved by CEN on 14 May 2014.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 16340:2014) has been prepared by Technical Committee CEN/TC 58 “Safety and control devices for burners and appliances burning gaseous or liquid fuels”, 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of an identical text or by endorsement, at the latest by December 2014, and conflicting national standards shall be withdrawn at the latest by December 2014.

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This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2009/142/EC.

For relationship with EU Directive 2009/142/EC, see informative Annex ZA, which is an integral part of this document.

This document is intended to be used in conjunction with EN 13611:2007+A2:2011. This document refers to clauses of EN 13611:2007+A2:2011 or adapts clauses by stating “with the following modification”, “with the following addition”, “is replaced by the following” or “is not applicable” in the corresponding clause. This European Standard adds clauses or subclauses to the structure of EN 13611:2007+A2:2011 which are particular to this standard. These clauses and subclauses are not indicated as an addition. i.e. subclauses or annexes which are additional to those in EN 13611:2007+A2:2011 are numbered starting from 101 or are designated as Annex AA, BB, CC etc. When referring to EN 13611:2007+A2:2011 the word “control” is understood as “combustion product sensing device”.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the safety, construction and performance requirements for combustion product sensing devices intended to be used in combustion control systems, hereinafter referred to as CPSD.

This European Standard applies to sensing devices for the measurement of combustion products from burners and appliances for domestic, commercial and industrial use burning:

— gaseous fuels according to EN 437; or

— liquid fuels having a viscosity at the burner inlet of 1,6 mm^2/s (cSt) up to 6 mm^2/s (cSt) at 20 °C, higher boiling petroleum based first raffinates (viscosity greater than 6 mm^2/s), that require preheating for proper atomisation.

This European Standard applies to all types of stationary sensing devices measuring flue gas components O_2, CO, CO_2, H_2, C_xH_y, NO_X, SO_2 or for a combination of them (multiple gasses).

This European Standard applies also to sensing devices for extractive systems.

This European Standard does not cover sensor requirements for combustible gas, combustible gas mixture and oil quality.

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 1856-1:2009, *Chimneys - Requirements for metal chimneys - Part 1: System chimney products*

EN 10088-1:2005, *Stainless steels - Part 1: List of stainless steels*

EN 13611:2007+A2:2011, *Safety and control devices for gas burners and gas burning appliances - General requirements*

EN 14241-1, *Chimneys - Elastomeric seals and elastomeric sealants - Material requirements and test methods - Part 1: Seals in flue liners*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13611:2007+A2:2011 and the following apply.

3.101
Combustion Product Sensing Device (CPSD)
Combustion Product Sensing Element (CPSE) combined with control unit and a signal conditioner

Note 1 to entry: The combustion product sensing element is hereafter referred to as CPSE.

Note 2 to entry: The CPSE control unit and/or the signal conditioner can be integrated in the combustion control system (see Figure 1).

Note 3 to entry: Additional components (e.g. heater, flame arrester) used or necessary for operation are considered as parts of the CPSD.

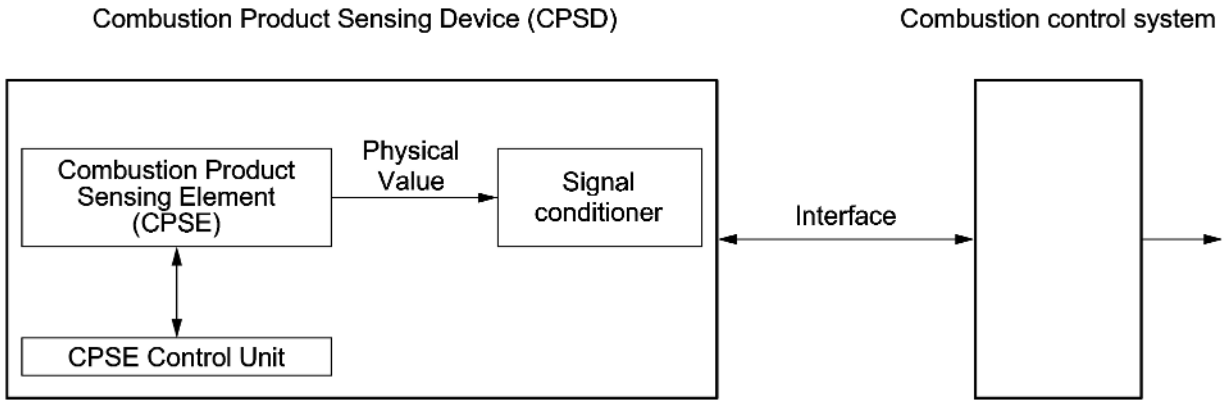


Figure 1 — CPSD coupled with combustion control system

3.102
Combustion Product Sensing Element (CPSE)
part of the CPSD, which transforms the concentration of the sensed combustion product into a physical value (e.g. voltage, current, resistance)

3.103
CPSE control unit
unit that provides additional functions in order to operate the sensing element

Note 1 to entry: Example of additional function is the control of the heating element.

3.104
signal conditioner
electronic circuit that transforms the physical value from the sensing element into an output signal

Note 1 to entry: The signal conditioner may consist of functional electronics as well as electronics which cause the CPSD to be classified as Class B or C according to EN 13611:2007+A2:2011.

3.105
measuring range
declared range between two values that can be measured by the CPSD with the accuracy stated in the installation and operating instructions

3.106
offset
positive or negative deviation of the zero point value

3.107
accuracy
ability of the CPSD to provide an indicated value close to the true value

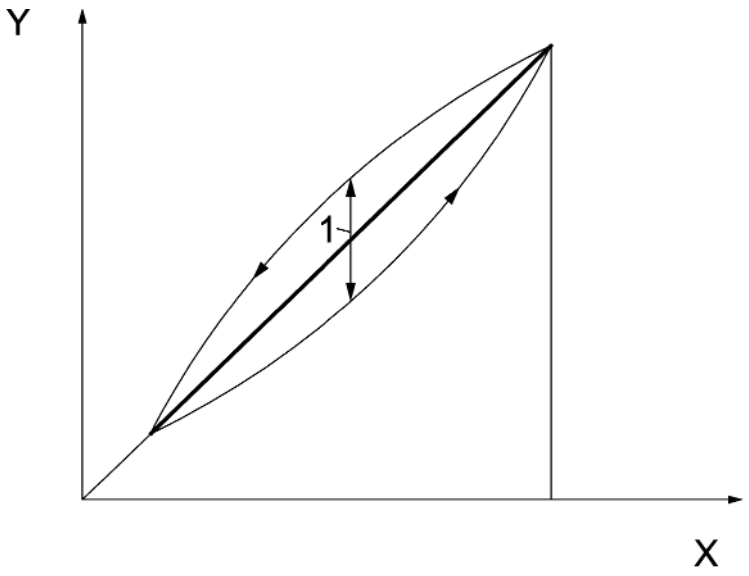
3.108
linearity
highest value of the deviation between the CPSD output characteristic from the ideal curve

3.109
drift
difference between the value indicated/measured value by the CPSD before and after the endurance test

3.110
temperature range (flue gas)
temperature range of the medium to be measured

3.111
hysteresis
the highest value of the difference between the ascending and the descending CPSD output characteristic

Note 1 to entry: For illustration refer to Figure 2.



Key
1 hysteresis
X combustion product concentration
Y CPSD output signal

Figure 2 — Clarification of definitions for CPSD

3.112
repeatability
ability of the CPSD to provide similar output signals whilst measuring the same concentration of combustion product under the same test condition

3.113
flue gas pressure
differential pressure from flue gas side to reference (ambient) side

3.114
flue gas velocity
speed of the combustion product flow at the location of measurement of the CPSD (m/s)

3.115
warm up time
time from power on until specified operation

3.116
stand by mode
non-operational mode in which the CPSD is able to come in operation after a start up time

3.117
start up time
time from stand by mode until specified operation

3.118
response time
Tx
time interval from the start of the gas concentration step shaped change until the output signal of the CPSD has reached x % of the final value

3.119
useful lifetime
time span where the CPSD fulfils the specifications as stated in the installation and operating instructions

3.120
combustibles
gaseous, liquid, and solid fuels

Note 1 to entry: Combustibles can be oil, gas, bio-fuel, etc.

3.121
cross sensitivity
influence on the measured value by any predictable flue gas component

Note 1 to entry: Flue gas components can be O_2, CO_2, H_2O, SO_2, NO_x, CO, H_2, C_xH_y, etc.

3.122
maximum concentration
highest concentration at which the CPSD may be operated

3.123
withstand concentration
concentration that is withstood without a degraded characteristic after returning below the maximum concentration

3.124
poisoning
damage to the CPSE by certain substances, reducing the useful lifetime of the CPSD

3.125
inoperative state
state of the output signal that indicates the inoperative condition of the CPSD

4 Classification

4.1 Classes of control

EN 13611:2007+A2:2011, 4.1 is not applicable.

4.2 Groups of control

EN 13611:2007+A2:2011, 4.2. is not applicable.

4.3 Classes of control functions

Shall be according to EN 13611:2007+A2:2011, 4.3.

5 Units of measurement and test conditions

5.1 Dimensions

Shall be according to EN 13611:2007+A2:2011, 5.1.

5.2 Pressures

Shall be according to EN 13611:2007+A2:2011, 5.2.

5.3 Bending moments and torques

Shall be according to EN 13611:2007+A2:2011, 5.3.

5.4 Test conditions and measurement tolerances

Shall be according to EN 13611:2007+A2:2011, 5.4 with the following additions and modification:

Modification:

The paragraphs 1, 2, 3 and 4 of EN 13611:2007+A2:2011, 5.4 are not applicable.

Addition:

The measurement uncertainty of the test equipment used for the test in Clause 6 and 7 shall not exceed the values given in 5.4 of EN 13611:2007+A2:2011 and Table 1.

Table 1 — Measurement uncertainties

Type of Measurement	Uncertainties
Temperature above 50 °C	± 2 % of absolute measurement value in °C
Test gas concentration	1/3 of the accuracy as declared for the CPSD under test.
Flow rate/velocity	± 10 %
Differential pressure	± 10 %

6 Construction requirements

6.1 General

Shall be according to EN 13611:2007+A2:2011, 6.1 with the following addition:

All parts of a CPSD in contact with flue gas shall withstand the chemical stresses to which it is subjected under normal conditions.

6.2 Mechanical parts of the control

6.2.1 Appearance

Shall be according to EN 13611:2007+A2:2011, 6.2.1.

6.2.2 Holes

EN 13611:2007+A2:2011, 6.2.2 is not applicable.

6.2.3 Breather holes

EN 13611:2007+A2:2011, 6.2.3 is not applicable.

6.2.4 Test for leakage of breather holes

EN 13611:2007+A2:2011, 6.2.4 is not applicable.

6.2.5 Screwed fastenings

EN 13611:2007+A2:2011, 6.2.5 is not applicable.

6.2.6 Jointing

EN 13611:2007+A2:2011, 6.2.6 is not applicable.

6.2.7 Moving parts

EN 13611:2007+A2:2011, 6.2.7 is not applicable.

6.2.8 Sealing caps

Shall be according to EN 13611:2007+A2:2011, 6.2.8.

6.2.9 Dismantling and reassembly

Shall be according to EN 13611:2007+A2:2011, 6.2.9 with the following modification and addition:

Modification:

The 2nd and 3rd paragraphs of EN 13611:2007+A2:2011, 6.2.9 are not applicable.

Addition:

If closure parts, including those of measuring and test points, may be dismantled for service or adjustment then sufficient details shall be provided in the installation and operating instructions on the materials to be used and procedures to be applied.

6.2.101 Protection against blockage of inlets

Inlets for reference gas and combustion product gas shall be protected against blockage or they shall be located such that they do not easily become blocked.

6.3 Materials

6.3.1 General material requirements

Shall be according to EN 13611:2007+A2:2011, 6.3.1.

6.3.2 Housing

EN 13611:2007+A2:2011, 6.3.2 is not applicable.

6.3.3 Test for leakage of housing after removal of non-metallic parts

EN 13611:2007+A2:2011, 6.3.3 is not applicable.

6.3.4 Zinc alloys

EN 13611:2007+A2:2011, 6.3.4 is not applicable.

6.3.5 Springs providing closing and/or sealing force

EN 13611:2007+A2:2011, 6.3.5 is not applicable.

6.3.6 Resistance to corrosion and surface protection

EN 13611:2007+A2:2011, 6.3.6 is not applicable.

6.3.7 Impregnation

EN 13611:2007+A2:2011, 6.3.7 is not applicable.

6.3.8 Seals for glands for moving parts

EN 13611:2007+A2:2011, 6.3.8 is not applicable.

6.3.101 Mounting and fixing elements

Mounting and fixing elements of the CPSD shall not affect the accuracy of the CPSD itself.

6.3.102 Prevention from igniting

6.3.102.1 Requirement

If the sensing element uses a heating element for operation and if the sensing element or the heating element is placed in the sensed medium, possible ignition of combustibles shall be prevented by:

— the use of flame arresters; or

— having a Class B CPSE control unit, preventing the heating element from reaching a temperature above the ignition temperature of the foreseeable combustibles under fault condition of the CPSE control unit; or

— using a heating element which cannot exceed the lowest possible ignition temperature of the foreseeable combustibles, e.g. by using a thermal fuse not igniting the combustibles.

The design documentation should specify how this requirement is achieved.

If a Class B CPSE control unit is used this shall be assessed by the requirements of 6.6.3.

If a flame arrester is implemented it shall be designed in a way that prevents mechanical impact (e.g. widening of meshes) rendering it ineffective.

The installation and operating instruction shall state the combustibles for which the used flame arrester of the CPSD is suitable. Testing of CPSD incorporating a flame arrester shall be according to 6.3.102.2.

6.3.102.2 Testing of CPSD with flame arrester

The CPSD shall be installed into a test chamber (see Figure 3) with the following constraints:

— The volume of the test chamber shall be 200 times larger than the volume of the CPSD part containing the hot ignition source (CPSE, heating, etc.) including the gas volume of the flame arrester but at least 1 000 cm^3.

— All distances between CPSD housing and chamber walls (except the mounting wall) shall be at least 50 mm to avoid wall effects.

— The flow in the test chamber shall be such that the gas exchange in the flame arrester is guaranteed without cooling down the CPSE.

To reduce test gas consumption an explosion proof fan may be installed inside the test chamber. In that case a minimum distance of 50 mm between fan and CPSD shall be maintained.

— The test gas mixture shall consist of 5 -% (V/V) propane and 95 -% (V/V) air.

— The absolute air pressure inside the test chamber shall be 101 kPa ± 10 %.

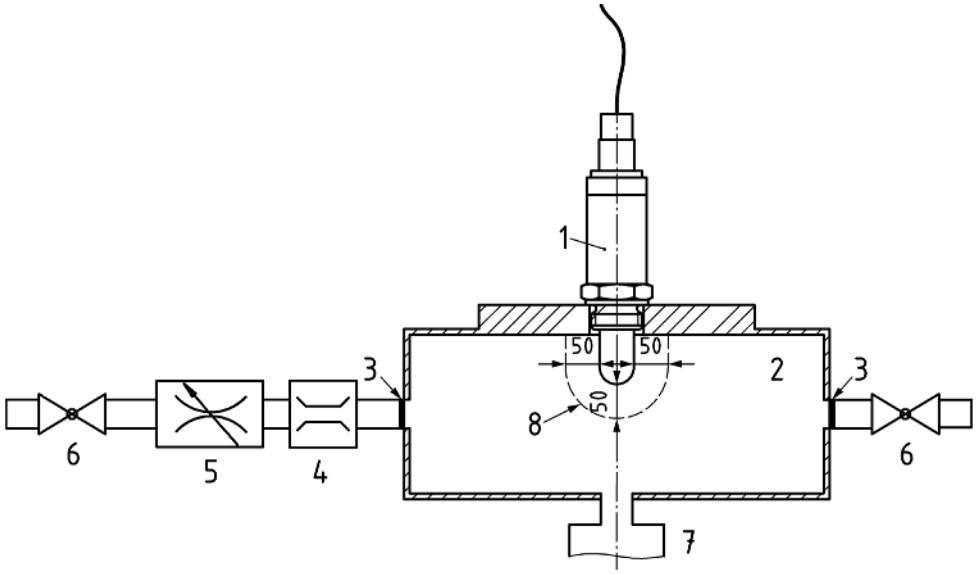
— The gas temperature inside the test chamber shall be at least 20 °C.

The installation shall be done as stated in the installation and operating instructions paying particular attention to immersion depth and angle to horizontal.

The test gas mixture shall flow continuously through or within the test chamber and the CPSD shall be operated in a way that causes the highest specified temperature of the CPSE (the 5/95 % propane/air mixture is the condition with the highest probability of ignition, so no additional requirements are needed). After temperature stabilisation, the test shall be performed for a minimum period of 5 × T60 or 1 min, whichever is the longer.

During the test no ignition shall occur.

Dimensions in millimetres



Key

1 CPSD under test
2 Test chamber
3 flame arrester of the test chamber
4 flow metre
5 throttle
6 valve
7 burst foil
8 free space surrounding the CPSD

Figure 3 — Ignition test fixture

6.3.103 Metallic materials for components in contact with combustion products

In accordance with EN 1856-1 components in contact with combustion products are assumed to be sufficiently durable without further testing if they consist of materials listed in Table 2.

Table 2 – material specification

Material no. (according to EN 10088–1:2005**)**	**Symbol**
1.4301	X5CrNi 18–10
1.4307	X2CrNi 18–9
1.4401	X5CrNiMo 17–12–2
1.4404	X2CrNiMo 17–12–2
1.4571	X6CrNiMoTi 17–12–2
1.4432	X2CrNiMo 17–12–3
1.4539	X1NiCrMoCu 25–20–5

The suitability of metallic materials others than listed in Table 2 shall be proven according to EN 1856-1:2009, A.2.

6.4 Gas connections

6.4.1 Making connections

EN 13611:2007+A2:2011, 6.4.1 is not applicable.

6.4.2 Connection sizes

EN 13611:2007+A2:2011, 6.4.2 is not applicable.

6.4.3 Threads

EN 13611:2007+A2:2011, 6.4.3 is not applicable.

6.4.4 Union joints

Shall be according to EN 13611:2007+A2:2011, 6.4.4 with the following addition.

This requirement is only applicable when the gases are extracted from a main flow.

6.4.5 Flanges

EN 13611:2007+A2:2011, 6.4.5 is not applicable.

6.4.6 Compression fittings

Shall be according to EN 13611:2007+A2:2011, 6.4.6.

6.4.7 Nipples for pressure test

EN 13611:2007+A2:2011, 6.4.7 is not applicable.

6.4.8 Strainers

EN 13611:2007+A2:2011, 6.4.8 is not applicable.

6.4.101 CPSD connections

The type, material and size of the connections for combustion products, for reference gas, purge gas and test gas shall be stated in the installation and operating instructions including the type, material and size of hose and metal pipe, if applicable

6.5 Electronic parts of the control

6.5.1 General

Shall be according to EN 13611:2007+A2:2011, 6.5.1 with following modification and addition:

Modification:

The 4th paragraph and note of EN 13611:2007+A2:2011, 6.5.1 are not applicable.

Addition:

For gas sensing technologies used a safety analysis shall be performed to describe the specific failure modes, requirements and tests for the type of technology in addition to the relevant requirements in this standard. In particular the specific failure mode of the CPSE shall be determined including the failure mode at the end of life.

NOTE 1 This safety analysis can result in additional requirements (e.g. external controls) and/or additional failure modes to be included into the fault assessment. Together with the relevant requirements of this standard, this is a set of conditions under which the technology can be used.

NOTE 2 In general the basic risk of fire and/or explosion as a result of uncontrolled gas air ratio is considered as a Class C risk.

6.5.2 Protection provided by the enclosure

Shall be according to EN 13611:2007+A2:2011, 6.5.2.

6.5.3 Electrical components

6.5.3.1 Performance of electrical components

Shall be according to EN 13611:2007+A2:2011, 6.5.3.1.

6.5.3.2 Test

Shall be according to EN 13611:2007+A2:2011, 6.5.3.2.

6.5.3.3 Sensing element

Shall be according to EN 13611:2007+A2:2011, 6.5.3.3 with the following addition:

NOTE For CPSE, the product lifetime is the useful lifetime depending on the application e.g. O_2 sensor used in gas or oil application.

6.6 Protection against internal faults for the purpose of functional safety

6.6.1 Design and construction requirements

6.6.1.1 Fault avoidance and fault tolerance

Shall be according to EN 13611:2007+A2:2011, 6.6.1.1 with the following addition.

For CPSD performing Class B or Class C functions the failure modes determined according to 6.5.1 shall be considered during the fault assessment according to 6.6.3 and 6.6.4.

If applicable, the inoperative state and the external factors causing the CPSD to go in the inoperative state shall be stated in the installation and operating instructions.

6.6.1.2 Reset device

EN 13611:2007+A2:2011, 6.6.1.2 is not applicable.

6.6.1.3 Documentation

Shall be according to EN 13611:2007+A2:2011, 6.6.1.3.

6.6.2 Class A

Shall be according to EN 13611:2007+A2:2011, 6.6.2.

6.6.3 Class B

6.6.3.1 Design and construction requirements

Shall be according to EN 13611:2007+A2:2011, 6.6.3.1.

6.6.3.2 First fault

EN 13611:2007+A2:2011, 6.6.3.2 is replaced by the following:

Any first fault (see 6.5.1 and Annex E) in any one component or any one fault together with any other fault arising from that first fault shall result in either:

a) the CPSD proceeding to the inoperative state within the fault reaction time;

b) the CPSD continuing to operate, the fault being identified within the declared fault tolerance time, the result being a);

c) the CPSD remaining operational in accordance with the safety related functional requirements of this standard.

6.6.3.3 Fault introduced during lock-out or safety-shut-down

EN 13611:2007+A2:2011, 6.6.3.3 is not applicable.

6.6.3.4 Fault introduced during the inoperative state

Whenever the CPSD is in the inoperative state without an internal fault, the following requirements shall apply.

Any first fault (together with any other fault arising from that fault) in any one component (see 6.5.1 and Annex E), induced while the CPSD is staying in the inoperative state, shall result in either:

a) the CPSD remaining in the inoperative state;

b) the CPSD coming into operation again resulting in a) as mentioned in this clause.

If the cause of the inoperative state no longer remains and the CPSD comes again in operation it shall operate in accordance with the safety related functional requirements of this standard.

6.6.4 Class C

6.6.4.1 Design and construction requirements

Shall be according to EN 13611:2007+A2:2011, 6.6.4.1.

6.6.4.2 First fault

EN 13611:2007+A2:2011, 6.6.4.2. is replaced by the following:

Any first fault (see 6.5.1 and Annex E) in any one component or any one fault together with any other fault arising from that first fault shall result in either:

a) the CPSD proceeding to the inoperative state within the fault reaction time;

b) the CPSD continuing to operate, the fault being identified within the declared fault tolerance time, the result being a);

c) the CPSD remaining operational in accordance with the safety related functional requirements of this standard.

6.6.4.3 Second fault

EN 13611:2007+A2:2011, 6.6.4.3 is replaced by the following:

If the assessment of the first fault results in the CPSD remaining operational in accordance with the safety related functional requirements of this standard (see 6.6.4.2 c)), any further independent fault considered together with the first fault shall result in either 6.6.4.2 a), b) or c).

During assessment, the second fault shall only be considered to occur 24 h after the first fault.

6.6.4.4 Faults during lock-out or safety-shut-down

EN 13611:2007+A2:2011, 6.6.4.4 is not applicable.

6.6.4.101 Faults during inoperative state

6.6.4.101.1 General

Whenever the CPSD is in the inoperative state without an internal fault, an assessment according to 6.6.4.101.2 and 6.6.4.101.3 shall be performed.

Whenever the CPSD is in the inoperative state with an internal fault, an additional single fault assessment according to 6.6.4.101.3 shall be performed.

6.6.4.101.2 First fault introduced during inoperative state

Whenever the CPSD is in the inoperative state without an internal fault, the following requirements shall apply.

Any first fault (together with any other fault arising from that fault) in any one component (see 6.5.1 and Annex E), induced while the CPSD is staying in the inoperative state, shall result in either:

a) the CPSD remaining in the inoperative state;

b) the CPSD coming into operation again resulting in a) as mentioned in this clause.

If the cause of the inoperative state no longer remains and the CPSD comes again in operation it shall operate in accordance with the safety related functional requirements of this standard.

6.6.4.101.3 Second fault introduced during inoperative state

Any second fault (together with any other fault arising from that fault) in any one component (see 6.5.1 and Annex E), induced while the CPSD is staying in the inoperative state, shall result in either 6.6.4.101.2 a) or b).

During assessment, the second fault shall not be considered to occur within 24 h after the first fault.

6.6.5 Circuit and construction evaluation

6.6.5.1 Test conditions

Shall be according to EN 13611:2007+A2:2011, 6.6.5.1 with the following addition:

Addition for e) applying to those parts of the enclosure that protect persons against access to hazardous parts.

The evaluation of CPSDs shall

— either be carried out under influence of the gas to be measured at a concentration of approximately 2/3 of the maximum declared value of the measurement range,

— or alternatively, be performed by equivalent simulation of the CPSE signal.

6.6.5.2 Test criteria

Shall be according to EN 13611:2007+A2:2011, 6.6.5.2.

6.6.5.3 Assessment

Shall be according to EN 13611:2007+A2:2011, 6.6.5.3.

7 Performance

7.1 General

Shall be according to EN 13611:2007+A2:2011, 7.1 with the following modifications and additions:

Modification:

First indent is not applicable.

The fourth indent is applicable for AC controls only

Additions:

— full range of gas concentrations as stated in the installation and operating instructions;

— full range of flue gas (combustion products) temperatures, velocities and pressures as stated in the installation and operating instructions;

— full range of calibration gas and reference gas flow rates and pressures, if applicable, as stated in the installation and operating instructions.

— For DC supplied controls within the scope of Annex I a tolerance of 20 % to the minimum and the maximum rated voltage applies. For DC supplies of other types the tolerance shall be stated in the installation and operating instructions.

7.2 Leak-tightness

EN 13611:2007+A2:2011, 7.2 is replaced by the following:

During the leak-tightness test, hose connectors for gases (e.g. test gas, purge gas, reference gas) shall either be connected to the gas supply or gas tight sealed as stated in the installation and operating instructions.

Gas connections tightened by hand shall be fastened as stated in the installation and operating instructions.

7.2.101 Leak-tightness provided by the housing and mounting to ambient

CPSD together with the mounting elements shall ensure leak-tightness from combustion products compartment to ambient.

When tested according to 7.3.101, leakage rate (air) shall not exceed 100 cm^3/h when the CPSD is subjected to a differential pressure in the flue pipe with respect to ambient pressure of 200 Pa (2 mbar) or any higher differential pressure as stated in the installation and operating instructions.

7.2.102 Leak-tightness of the CPSD including mounting elements, nipples and connections

Influence of the leakage on the accuracy of the CPSD, when tested according to 7.3.102, shall be declared in the installation and operating instructions.

7.3 Test for leak-tightness

7.3.1 General

Shall be according to EN 13611:2007+A2:2011, 7.3.1 with the following modification:

Modification:

Paragraph 3 and further are not applicable.

7.3.2 External leak-tightness

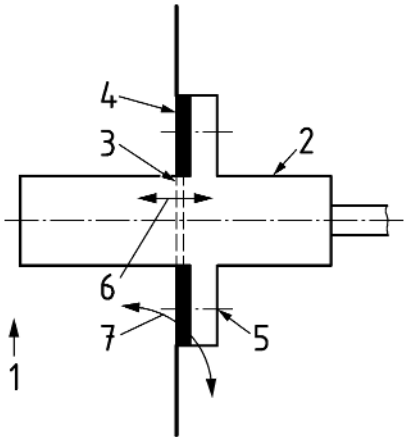
EN 13611:2007+A2:2011, 7.3.2 is not applicable.

7.3.3 Internal leak-tightness

EN 13611:2007+A2:2011, 7.3.3 is not applicable.

7.3.101 Leak-tightness test for CPSD

The test is carried out with air at ambient conditions and CPSD mounted into a test equipment as stated in the installation and operating instructions, see for instance Figure 4, with all connections to CPSD in place.



Key

1 flue gas
2 CPSD
3 inner sealing
4 outer sealing
5 mounting element
6 inner leakage
7 outer leakage

Figure 4 — Leak-tightness provided by the housing and mounting

Carry out the test with a test pressure of 200 Pa (2 mbar) in respect to ambient or at a higher pressure if stated in the installation and operating instructions.

Measure the flow from test equipment to ambient, using a method which gives reproducible results. Examples of such methods are shown in:

— Annex B (volumetric method) for test pressures up to and including 15 kPa (150 mbar);

— Annex C (pressure loss method) for test pressures above 15 kPa (150 mbar).

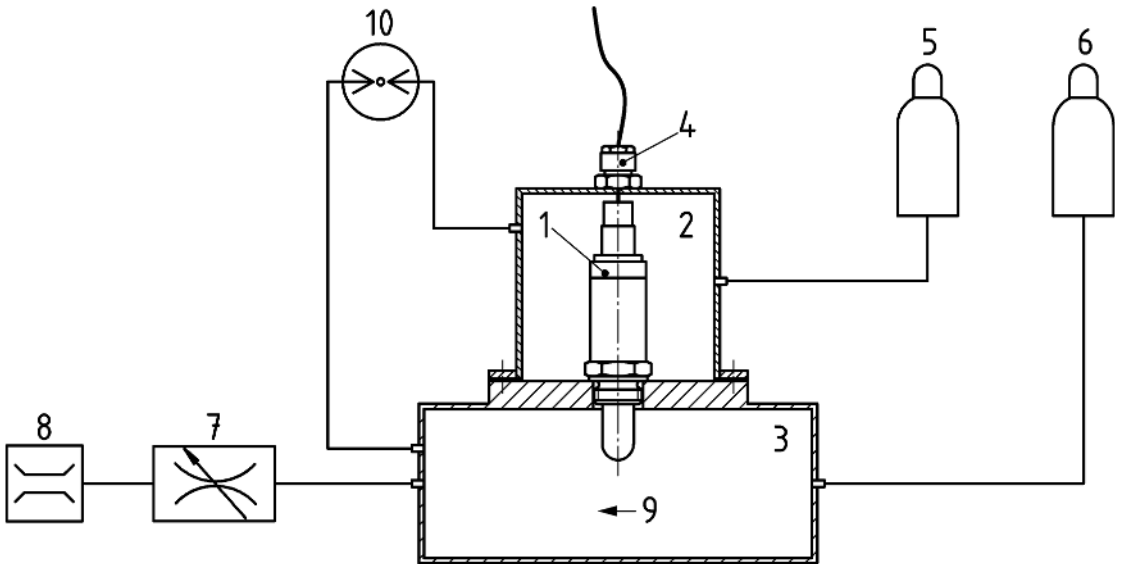
— The formula for conversion from the pressure loss method to the volumetric method is given in Annex D.

Measured flow shall meet the requirements of 7.2.101.

7.3.102 Influence of leakage on measurement value

7.3.102.1 General

The CPSD shall be mounted into the test equipment as shown in Figure 5 and as stated in the installation and operating instructions, with all connections to the CPSD in place.



Key

1 CPSD
2 reference chamber
3 test chamber
4 bulkhead cable gland
5 air
6 test gas
7 throttle
8 flow meter
9 test gas velocity m/s
10 differential pressure

Figure 5 — Test equipment for influence of leakage on measurement value

7.3.102.2 Flue pipe to ambient

Dismantle the closure head of the reference chamber (2).

The pressure (10) between test chamber (3) and ambient should be 200 Pa (2 mbar) or higher if stated in the installation and operating instructions.

The test gas velocity (9) in the test chamber shall be the minimum flue gas velocity stated in the installation and operating instructions or 0,1 m/s if not stated. The test gas concentration shall be 1/3 and 2/3 of the measurement range stated in the installation and operating instructions. Measurement of the output signal of the CPSD shall meet the requirement of 7.2.102.

7.3.102.3 Ambient to flue pipe

The differential pressure (10) between reference chamber (2) and test chamber (3) should be +100 mbar. The test gas velocity (9) in the test chamber shall be the minimum flue gas velocity stated in the installation and operating instructions or 0,1 m/s if not stated. The test gas concentration shall be 1/3 and 2/3 of the measurement range stated in the installation and operating instructions. Measurement of the output signal of the CPSD shall meet the requirement of 7.2.102.

7.4 Torsion and bending

7.4.101 General

Shall be according to EN 13611:2007+A2:2011, 7.4.1 with the following modification.

Second paragraph is not applicable.

7.4.102 Torsion

EN 13611:2007+A2:2011, 7.4.2 is replaced by the following:

After testing according to 7.5, there shall be no permanent deformation and any leakage shall not exceed the values specified in 7.2 of this standard.

7.4.103 Bending moment

EN 13611:2007+A2:2011, 7.4.3 is replaced by the following:

If connecting elements (gas or electrical connections) can apply bending moment to the CPSD, the bending test according to 7.5.102 is performed at the maximum bending force/moment stated in the installation and operating instructions.

7.5 Torsion and bending tests

EN 13611:2007+A2:2011, 7.5 is replaced by the following:

7.5.101 Torsion test

All connecting elements and fastenings of the CPSD that are mounted applying a torque shall be subjected to 1,3 times the mounting torque stated in the installation and operating instructions. After removing the tool generating the torque the CPSD is tested according to the requirements of 7.4.102.

7.5.102 Bending test

The connecting elements (gas or electrical connections) shall be subjected to 1,3 times the maximum bending force/moment stated in the installation and operating instructions. With the force/moment still applied the CPSD is tested according to 7.2

7.6 Rated flow rate

EN 13611:2007+A2:2011, 7.6 is not applicable.

7.7 Test for rated flow rate

EN 13611:2007+A2:2011, 7.7 is not applicable.

7.8 Durability

7.8.1 Elastomers in contact with gas

EN 13611:2007+A2:2011, 7.8.1 is replaced by the following.

For outer sealing, see Figure 4, elastomers (e.g. O-rings) in contact with combustion products shall comply with EN 14241-1.

For inner sealing, see Figure 4, the specified elastomer shall withstand the mechanical, chemical and thermal stresses to which it is subjected.

7.8.2 Marking

Shall be according to EN 13611:2007+A2:2011, 7.8.2.

7.8.3 Tests for marking

Shall be according to EN 13611:2007+A2:2011, 7.8.3.

7.8.4 Resistance to scratching

EN 13611:2007+A2:2011, 7.8.4 is not applicable.

7.8.5 Scratch test

EN 13611:2007+A2:2011, 7.8.5 is not applicable.

7.8.6 Resistance to humidity

EN 13611:2007+A2:2011, 7.8.6 is replaced by the following.

Components in contact with combustion products shall conform to 6.3.103.

7.8.7 Humidity test

EN 13611:2007+A2:2011, 7.8.7 is not applicable.

7.9 Performance tests for electronic controls

EN 13611:2007+A2:2011, 7.9 is not applicable.

7.10 Long-term performance for electronic controls

7.10.1 General

EN 13611:2007+A2:2011, 7.10.1 is not applicable.

7.10.2 Stress test

7.10.2.1 Thermal stress test

EN 13611:2007+A2:2011, 7.10.2.1 is not applicable.

7.10.2.2 Vibration test

Shall be according to EN 13611:2007+A2:2011, 7.10.2.2.

7.10.3 Long term performance test

EN 13611:2007+A2:2011, 7.10.3 is not applicable.

7.101 Operation of the CPSD

7.101.1 General

The relationship between the output signal of the CPSD and the concentration of the combustion product for which the CPSD is specified shall be stated in the installation and operating instructions.

The following factors can have an influence on total accuracy of CPSDs, and shall be stated in the installation and operating instructions:

— Linearity;

— Offset;

— Drift ;

— Flue gas temperature;

— Ambient temperature;

— Hysteresis;

— Repeatability;

— Pressure;

— Supply voltage;

— Cross interference;

— Resolution in case of digital signal processing;

— Gas velocity;

— Humidity;

— Mounting position.

The test gas velocity in the following tests shall be 0,1 m/s unless otherwise stated in the design documentation.

Where the term “balanced N_2“ in relation to test gas with minimum, ⅓, ⅔ and maximum concentration is used, the test gases are mixed with a relative amount of N_2 to obtain the required concentration

7.101.2 Resolution

For CPSDs with digital signal processing, the installation and operating instructions shall state the resolution with an explanation on which this is based.

7.101.3 Repeatability

7.101.3.1 Requirement

The repeatability of the CPSD under test, measured according to 7.101.3.2 shall be within the repeatability range as stated in the installation and operating instructions.

7.101.3.2 Test

A repeatability test is performed at 1/3 of maximum, 2/3 of maximum and maximum concentration of the declared measurement range.

Test procedure:

a) Expose CPSD to ambient conditions for a period of 10 times the declared response time.

b) Expose CPSD to a concentration of the relevant gas for 1/3 of the declared maximum concentration for a period of 10 times the declared response time and after that measure the output signal and recalculate the concentration by using the declared characteristic.

c) Repeat a) and b) three times.

d) Calculate the arithmetic average of the values of step b)

The repeatability at 1/3 of the declared maximum concentration is the maximum calculated from the differences between the measured values of step b) and the value of step d) divided by the value of step d).

Repeat a), b), c) and d) at 2/3 of the declared maximum concentration (instead of at 1/3). The repeatability at 2/3 of the declared maximum concentration is the maximum calculated from the differences between the measured values of step b) and the value of step d) divided by the value of step d).

Repeat a), b), c) and d) at the declared maximum concentration (instead of at 1/3). The repeatability at the declared maximum concentration is the maximum calculated from the differences between the measured values of step b) and the value of step d) divided by the value of step d).

Repeatability is the highest value of the above calculated values.

7.101.4 Hysteresis and Linearity

7.101.4.1 Requirement

The hysteresis, measured according to 7.101.4.2, shall be within the hysteresis range as stated in the installation and operating instructions.

Linearity, measured according to 7.101.4.2, shall be within the linearity range as stated in the installation and operating instructions.

7.101.4.2 Test

Measure the characteristic of the CPSD at minimum concentration, 1/3, 2/3 and maximum concentration and back to 2/3, 1/3 and minimum three times. Every time that concentration is changed, wait for 10 times the response time T60 before recording the measurement.

Calculate E_{HY} for 1/3, and 2/3 of the maximum concentration with the formula below,

$$E_{\mathrm{HY}} = CPSD_{\mathrm{OD}} - CPSD_{\mathrm{OA}} \quad (1)$$

where

$CPSD_{\mathrm{OD}}$ is the measured highest value of the CPSD output signal on the descending characteristic;

$CPSD_{\mathrm{OA}}$ is the measured lowest value of the CPSD output signal on the ascending characteristic.

The hysteresis is the highest value of the calculation results of E_{HY}.

Calculate E_L for 1/3, 2/3 and the maximum concentration with the formula below,

$$E_L = \left| CPSD_{Omax} - CPSD_{Onom} \right| \quad (2)$$

where

$CPSD_{Omax}$ is the highest or lowest measured value of the CPSD output signal caused by deviation;

$CPSD_{Onom}$ is the nominal CPSD output signal at the specific concentration.

The linearity is the highest value of the calculation results of E_L

7.101.5 Drift

7.101.5.1 Requirement

The drift, being the maximum difference between the CPSD characteristics before and after the endurance test, shall, when measured in accordance with 7.101.5.2, be within the drift range as stated in the installation and operating instructions.

7.101.5.2 Test

Measure the CPSD characteristic of at least three devices before and after the endurance test of 7.102. Calculate from this the drift of each device.

Calculate E_D for 1/3, 2/3 and the maximum concentration with the formula below,

$$E_D = CPSD_{ODA} - CPSD_{ODB} \quad (3)$$

where

$CPSD_{ODA}$ is the highest or lowest measured value of the CPSD output signal caused by drift;

$CPSD_{ODB}$ is the CPSD output signal at the specific concentration before endurance.

The drift is the highest value of the calculation results of E_D

7.101.6 Supply voltage variations

7.101.6.1 Requirement

Changes in output signal due to supply voltage changes, measured according to 7.101.6.2, shall be within the specification as stated in the installation and operating instructions.

7.101.6.2 Test

Measure the output signals of the CPSD at 1/3 of maximum, at 2/3 of maximum and maximum declared concentration and back to minimum declared concentration three times at minimum, nominal and maximum supply voltage. Every time that concentration is changed, wait for 10 times the response time T60 before recording the measurement.

Calculate E_{SV} for 1/3, 2/3 and the maximum concentration with the formula below,

$$E_{SV} = CPSD_M - CPSD_{NSV} \quad (4)$$

where

$CPSD_M$ is the measured value of the CPSD output signal caused by variation of supply voltage;

$CPSD_{NSV}$ is the CPSD output signal at the nominal supply voltage.

The influence of the supply voltage on the output signal is the highest value of the calculation results of E_{SV}.

7.101.7 Effect of gas velocity

7.101.7.1 Requirement

Changes in CPSD output signal due to gas velocity changes within the declared gas velocity range shall be within the specification as stated in the installation and operating instructions when tested according to 7.101.7.2.

The CPSD output signal outside the rated gas velocity range shall be stated in the installation and operating instructions.

7.101.7.2 Test

Fit the CPSD to an appropriate gas hood or test chamber and ensure there is no exhaust tubing or similar present (to avoid back pressure).

Purge the gas hood or test chamber with 1/3 of the maximum specified concentration of gas at ambient temperature, balanced N_2, flowing at the minimum gas velocity stated in the installation and operating instructions and record the CPSD output signal after 3 min ($CPSD_{GV\,min}$).

Increase the gas velocity to the maximum value stated in the installation and operating instructions and after 3 min record the CPSD output signal ($CPSD_{GV\,max}$).

The effect of gas velocity E_{GV} is calculated as follows:

$$E_{GV} = CPSD_{GV\,max} - CPSD_{GV\,min} \quad (5)$$

7.101.8 Response time and offset

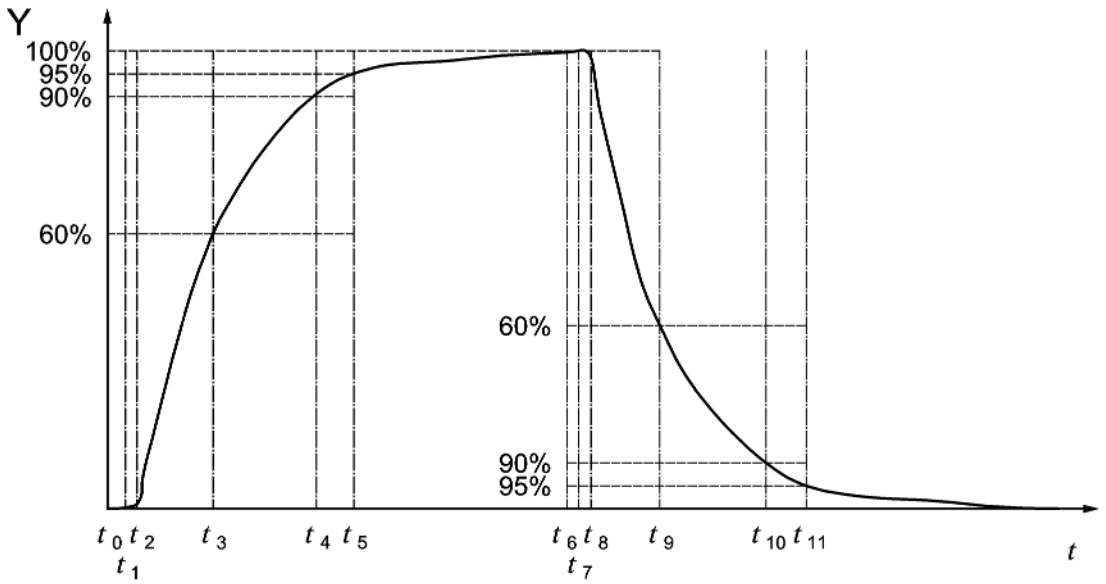
7.101.8.1 Requirement

The response time and offset of the CPSD shall be within the specification as stated in the installation and operating instructions when tested according to, 7.101.8.2 and 7.101.8.3 and at ambient conditions.

Test for response time and offset can be combined.

7.101.8.2 Test for response time (Tx)

For response times see Figure 6.



Key

t time
Y CPSD output signal
t_0 switch of test gas to maximum concentration
t_1- t_0 dead time of test equipment
t_2- t_1 dead time of CPSD
T60 = $t_3 - t_1$
T90 = $t_4 - t_1$
T95 = $t_5 - t_1$
t_6 switch of test gas to minimum concentration
t_7-t_6 dead time of test equipment
t_8-t_7 dead time of CPSD
T60 = $t_9 - t_7$
T90 = $t_{10} - t_7$
T95 = $t_{11} - t_7$

Figure 6 — Response times

Fit the CPSD into the test setup that guarantees to switch between two different concentrations.

Figure 7 shows two alternatives for this test.

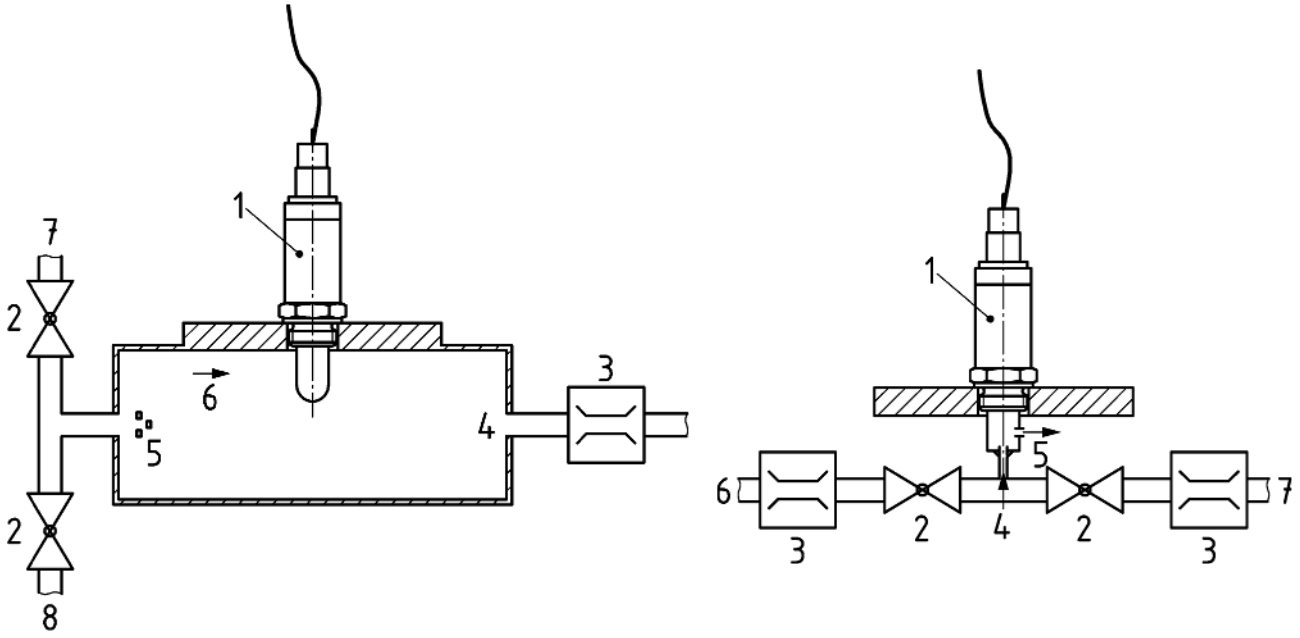
The CPSD shall be operated as stated in the installation and operating instructions and allow for stabilisation.

At minimum flow, switch the gas into the test equipment from air to the maximum concentration, wait for stabilisation of the output signal, switch back to air, wait for stabilisation and record the output signal of the CPSD during this sequence.

Repeat this sequence with maximum flow as stated in the installation and operating instructions and record the measured value.

To calculate the response time T60, T90, T95, the dead time of the test equipment shall be taken into account.

The response time will be the longest T60 time of the above test.



a) CPSD which does not need a direct flow through the CPSD

Key

1 CPSD
2 valve
3 flow meter
4 test chamber
5 diffuser
6 velocity at the CPSD
7 inlet of air
8 inlet of measuring gas

b) CPSD which needs a direct flow through the CPSD

1 CPSD
2 valve
3 flow meter
4 short tube
5 flow through the CPSD
6 inlet of air
7 inlet of measuring gas

Figure 7 — Alternative test equipment for response time

7.101.8.3 Test for offset

Fit the CPSD into the test setup.

Record the signal until it has stabilised and note the output signal reading at the specified time below after the following gas exposures:

— Flow the test gas with the maximum concentration as stated in the installation and operating instructions, for 60 s through the test setup. Record the output signal of the CPSD (R1).

— Switch the gas to 100 % N_2 or air whichever is applicable and flow for further 3 min or 2 × T95 whichever is higher. Record the output signal of the CPSD (R2).

— Switch the test gas back to the maximum concentration and flow for further 3 min or 2 × T95 whichever is higher. Record the output signal of the CPSD (R3).

Offset is the deviation of the measured value from the theoretical zero point of the CPSD output signal and is either the value R2 or R3 depending on the characteristic of the CPSD.

7.101.9 Ambient pressure

7.101.9.1 Requirement

The change in steady-state of the CPSD output signal as a function of the ambient pressure, tested to 7.101.9.2, shall be within the values stated in the installation and operating instruction.

7.101.9.2 Test

Fit the CPSD inside the test chamber, see Figure 5.

Test chamber 3 shall have the maximum concentration of the relevant gas. Both the test chamber and reference chamber shall have the same pressure p_1 and equal ambient pressure level with a tolerance of less than 10 mbar.

Record the output signal after 10 × T60 minimum ($CPSD_{O1}$).

Without changing the concentration of gas in the test chamber 3, flush the chambers 2 and 3 with the maximum declared pressure (p_{max}) and ensure that the differential pressure (10) is zero.

Record the output signal after 10 × T60 minimum ($CPSD_{O2}$).

The pressure dependency E_P of the CPSD between declared pressure at minimum (p_{min}) and maximum (p_{max}) is calculated by:

$$E_P = CPSD_{O2} - CPSD_{O1} \quad (6)$$

7.101.10 Ambient temperature

7.101.10.1 Requirement

The change in steady-state output signal of the CPSD as a function of ambient temperature shall be within the values stated in the installation and operating instructions.

7.101.10.2 Test

Place the CPSD into test chamber.

Sequence the test chamber temperatures through the temperatures listed below and wait for thermal static conditions. Flow the maximum concentration of the relevant gas, wait for 10 × T60 and measure the CPSD output signal.

Temperature sequence:

— at the minimum ambient temperature as stated in the installation and operating instructions or 0 °C whichever is lower (T_{min});

— at the maximum ambient temperature as stated in the installation and operating instructions or 60 °C whichever is higher (T_{max});

The test shall be performed for at least 3 cycles. Record the output signal at maximum and minimum ambient temperature.

The temperature dependency is the highest value of the calculation results of E_T using the following formula.

$$E_T = CPSD_{O,T_{max}} - CPSD_{O,T_{min}} \quad (7)$$

where

$CPSD_{O,Tmax}$ is the CPSD output signal at T_{max};

$CPSD_{O,T_{min}}$ is the CPSD output signal at T_{min};

7.101.11 Flue gas temperature

7.101.11.1 Requirement

The change in steady-state output signal of the CPSD as a function of flue gas temperature shall be within the values declared in the installation and operating instructions.

7.101.11.2 Test

Install the CPSD as stated in the installation and operating instructions. During test, keep the ambient temperature constant

Expose the CPSE to the test gas with a constant concentration between 1/3 and 2/3 of the maximum:

— at the minimum flue gas temperature as stated in the installation and operating instructions or 20 °C whichever is higher (TF_{min});

— at the maximum flue gas temperature as stated in the installation and operating instructions or any other temperature but at least 100 °C higher than TF_{min} (TF_{max});

wait for thermal static conditions and measure the CPSD output signal.

The test shall be performed for at least 3 cycles. Record the difference in output signal between maximum and minimum temperature.

The flue temperature dependency is the highest value of the calculation results of E_{FT} using the following formula:

$$E_{FT} = CPSD_{O,TFmax} - CPSD_{O,TFmin} \quad (8)$$

where

$CPSD_{O,TFmax}$ is the CPSD output signal at TF_{max};

$CPSD_{O,TFmin}$ is the CPSD output signal at TF_{min}

7.101.12 Overload

7.101.12.1 Requirement

The effects of elevated concentrations of the relevant gas on signal stability and recovery performance shall be within the values declared in the installation and operating instructions when tested according to 7.101.12.2.

7.101.12.2 Test

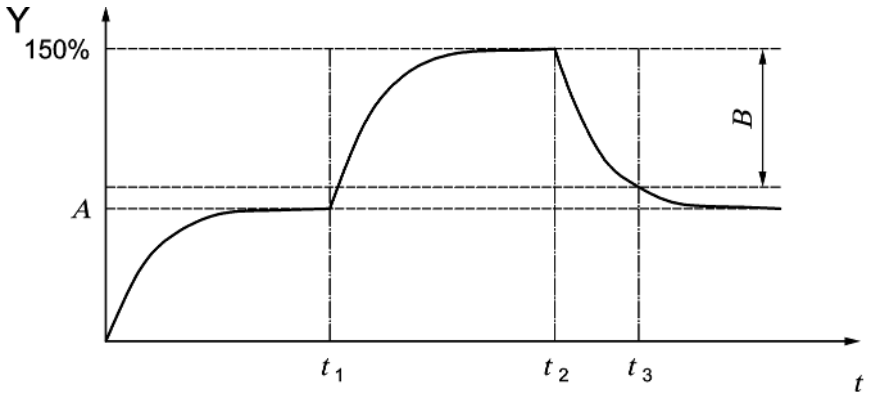
Measure the CPSD output signal at a rate higher than 1 reading per second.

Expose CPSE to 2/3 of the maximum declared concentration of the relevant gas for 10 × T60.

Switch gas to overload concentration of 150 % of the maximum declared concentration or to the declared withstand concentration whichever is lower for 10 min.

Switch back to 2/3 of the maximum declared concentration of the relevant gas until original steady-state readings have been obtained.

R90 is the time counted from the end of overload concentration until the output signal has reached 90 % of the difference from overload concentration to 2/3 of the value for maximum concentration as stated in the installation and operating instructions, see Figure below.



Key

t_1	start of overload concentration	t	time
t_2	end of overload concentration	Y	CPSD output signal
t_3	time when CPSD output signal reaches 90 % of final value	A	2/3 of maximum concentration
		B	90 % of final value after end of overload concentration

R90 = t_3 - t_2

Figure 8 — Recovery time R90

7.101.13 Humidity Dependency

7.101.13.1 Requirement

The effect of humidity changes on steady-state output signal shall be within the value stated in the installation and operating instruction when tested according to 7.101.13.2.

7.101.13.2 Test

The test shall be performed with test gas at 1/3 of maximum, 2/3 of maximum and maximum declared concentration.

a) Fit the CPSD into the test setup with a test gas temperature of 60 °C. Ensure that flow of the test gas out of the delivery system at the concentration mentioned above is constant for steps b) to d).

b) Set up a split gas delivery system such that one arm passes through the humidifier system (for further information refer to Dreschler bottle(s) or vapour delivery system as specified in the standards series VDI 3490) to get a dew point of 60 °C whilst the other arm remains dry. Monitor the humidified arm until steady-state humidity is achieved. All tubes with humid gas (also the tubes where humid and dry gases are mixed) shall be kept at the temperature of 60 °C.

c) Flow the dry gas with the concentration mentioned above wait 10 × T60 and measure the CPSD output signal (R_0).

d) Switch successively to the following humidity values (Table 3) by blending the wet and dry gas lines while flowing the same concentration . Wait 10 × T60 before measuring the CPSD output signal (R_{30}, R_{60}, R_{100}) and verify the actual dew point which shall correspond to the values in Table 3. For CPSDs which are intended only to measure in flue gases with a dew point lower than 49 °C respectively 36 °C, the measurements R_{100} and R_{60}, respectively, may be omitted.

NOTE Gas burner flue gas can reach a dew point of 60 °C.

Table 3 — Saturation vapour pressure

relative humidity rH/% at 60 °C, 1013 hPa	dew point T_d/°C	saturation vapour pressure p_{sat}/hPa
100	60	200
60	49	120
30	36	60
< 5	< 5	< 9

e) The measured gas concentration by the gas amount that was squeezed out by water vapour shall be corrected using the following formula:

$$R_{n,dry} = R_n \times \frac{p}{(p - p_{n,sat})} \quad (9)$$

where

n is 30, 60 respectively 100;

p is the actual air pressure;

p_{sat} is the saturation vapour pressure at the specific dew point.

f) All three humidity coefficients shall be calculated using the following formula:

$$E_{\mathrm{n,H}} = R_{\mathrm{n,dry}} - R_0 \tag{10}$$

The humidity dependency is the highest value of all calculated humidity coefficients $E_{\mathrm{n,H}}$.

7.101.14 Cross Interference

7.101.14.1 Requirement

The effect of cross interference in the CPSD output signal shall be within the specification as stated in the installation and operating instruction, when tested to 7.101.14.2. The interfering components listed in Table 4 shall be examined. In case that the CPSD is designed for multiple gasses, these gasses shall be excluded from the list in Table 4.

7.101.14.2 Test

Fit the CPSD into the test setup.

Flow gas with the typical operating concentration stated in the installation and operating instruction for 10 × T60 and record (R1).

Blend in the candidate cross interference gas with concentration of Table 4. Once steady-state signal has been reached, but ensuring a minimum of 10 × T60 exposure, measure the CPSD output signal and record (R2).

Repeat above procedure for all remaining candidate interference gases of the list of Table 4. The cross interference shall be calculated for each gas, using the formula:

$$E_{\mathrm{CI}} = 100 \times \frac{R_2 - R_1}{R_1} \tag{11}$$

Cross Interference will be the highest value of above calculated values E_{CI}.

Table 4 — Interfering components and their concentration

Component	Concentration [mg/m^3]	Volume fraction at 25 °C, 1013 hPa
O_2	—	3 % and 21 %
CO	1 000	874 ppm
CO_2	—	15 %
CH_4	50	76 ppm
NO	300	245 ppm
SO_2	200	76 ppm

7.101.15 Mounting position influence

7.101.15.1 Requirement

The effect of mounting position of the CPSD on the output signal shall be within the specification as stated in the installation and operating instruction, when tested according to 7.101.15.2.

7.101.15.2 Test

If mounting position influence is excluded by the design of the CPSD this test is not applicable.

Ensure that test is conducted in a well ventilated but not draughty space.

Fit the CPSD into the test setup in the position according to the design documentation and expose the CPSD to gas with the typical operating concentration stated in the installation and operating instructions. Measure the output signal of the CPSD after 10 × T60 and record (R1).

Repeat the test for the declared mounting positions.

Mounting position influence is the highest value of deviation between R1 and the other measurements.

7.102 Endurance

7.102.101 Requirement

After the endurance test CPSD shall comply with the following requirements:

— accuracy requirements as declared in 7.101.4, 7.101.5 and 7.101.8.3 shall be within specification;

— declared response time of 7.101.8.2.

After having verified the compliance with the requirements the CPSD shall be tested for leak tightness in accordance with 7.3.101 and 7.3.102.2.

7.102.102 Test

The following endurance tests as specified in a) and b) shall be performed with separate samples:

a) Expose the CPSD to air for 14 days at the following electrical and thermal conditions and rate of operation:

— Electrical conditions: The system is loaded according to the ratings stated in the installation and operating instructions, the voltage then being increased to 110 % of maximum declared rated voltage except that for 30 min during each 24 h period of the test the voltage is reduced to 90 % of minimum declared rated voltage. The change of voltage shall not be synchronised with the change of temperature. Each 24 h period shall also include at least one period in the order of 30 min during which the supply voltage is switched off.

— Thermal conditions: The ambient temperature and/or the mounting surface temperature are varied between the maximum declared ambient temperature or 60 °C, whichever is higher, and the minimum declared ambient temperature or 0 °C, whichever is lower, to cause the temperature of the components of the electronic circuit to be cycled between the resulting extremes. The rate of ambient and/or mounting surface temperature change shall be in the order of 1 K/min and the extremes of temperature maintained for approximately 1 h.

— For CPSDs with heater which are not continuously heated, within these 14 days, the heating system shall be shut off 5 000 times and, if applicable, in addition shut down 50 000 times to a stand by power stated in the installation and operating instructions.

  — During each off condition, the CPSE shall reach the temperature below 1/3 of the working temperature and during each stand by condition the CPSE shall reach the temperature below 2/3 of the working temperature.

— The number of cycles completed during this test shall be recorded and if this number is less than 5 000 or 50 000 respectively, the remaining cycles shall be executed at the declared rated voltage and at ambient temperature.

b) With the CPSD sensing flue gas originating from a typical burner installation, using combustibles as stated in the installation and operating instructions. The test system (burner) has to be switched off in the test period of 1 000 h at least 1 000 times.

If the CPSD is tested for heavy oil, the test for light oil and natural gas is not necessary.

If the CPSD is tested for light oil, the test for natural gas is not necessary.

8 EMC/Electrical requirements

8.1 Protection against environmental influences

Shall be according to EN 13611:2007+A2:2011, 8.1 with the following addition and modification:

Additions:

EN 13611:2007+A2:2011, 8.1 to 8.10 are not applicable for CPSDs classified as Class A.

EMC tests shall be subjected to the stand-alone CPSD or shall be performed as an EMC system test in case the CPSE Control Unit and/or Signal Conditioner is dedicated to a Combustion Control System and/or gas appliance. During the EMC test the CPSE is fully operated.

If specific levels of supply voltage disturbances are stated in the installation and operating instructions, these shall be applied during the tests as described in 8.4 to 8.10

Modification:

Assessment criterion I and II are replaced by the following:

For assessment criterion I, the control shall continue to operate in accordance with Clause 7.

For assessment criterion II, the control shall:

— continue to operate in accordance with Clause 7 or;

— the output signal(s) of the CPSD shall represent the inoperative state(s) in accordance with 6.6.

8.2 Supply voltage variations below 85 % of rated voltage

Shall be according to EN 13611:2007+A2:2011, 8.2.

8.3 Short-term voltage interruptions and decreases

Shall be according to EN 13611:2007+A2:2011, 8.3.

8.4 Supply frequency variations

Shall be according to EN 13611:2007+A2:2011, 8.4.

8.5 Surge immunity test

Shall be according to EN 13611:2007+A2:2011, 8.5.

8.6 Electrical fast transient/burst

Shall be according to EN 13611:2007+A2:2011, 8.6.

8.7 Immunity to conducted disturbances

Shall be according to EN 13611:2007+A2:2011, 8.7.

8.8 Immunity to radiated fields

Shall be according to EN 13611:2007+A2:2011, 8.8.

8.9 Electrostatic discharge immunity test

Shall be according to EN 13611:2007+A2:2011, 8.9.

8.10 Power frequency magnetic field immunity test

Shall be according to EN 13611:2007+A2:2011, 8.10.

8.11 Electrical requirements

Shall be according to EN 13611:2007+A2:2011, 8.11.

9 Marking, installation and operating instructions

9.1 Marking

Shall be according to EN 13611:2007+A2:2011, 9.1.

9.2 Installation and operating instructions

Shall be according to EN 13611:2007+A2:2011, 9.2 with the following additions:

a) useful lifetime and failure mode at end of life, see 6.5.1;

b) factors affecting the accuracy according to 7.101.1;

c) electrical data;

d) ambient temperature range;

e) mounting position(s);

f) combustion products connections;

g) Class of control function (see 4.3)

h) connection for reference gas or air if applicable;

i) inoperative state

j) fault reaction time;

k) acceptable materials for installation which do not affect the functionality of the CPSD;

l) mounting Instructions for CPSD including required flue pipe mechanical properties and maximum torque;

m) poisoning gasses, vapours and solids that are not allowed;

n) gasses, vapours and solids that are allowed with their maximum allowed concentration and their cross interference effect;

o) degree of protection according to EN 60529:1991;

p) measuring range;

q) maximum vibrations/shock, if applicable;

r) warm up time,

s) start up time;

t) maximum concentration;

u) withstand concentration;

v) response time (see 7.101.8);

w) overload (see 7.101.12);

x) rated flue gas velocity range and CPSD output signal outside the rated velocity range;

y) relationship between the output signal of the CPSD and the concentration of the combustion product for which the CPSD is specified;

z) the recovery time (R90) from overload concentration;

aa) instructions for dismantling and reassembly of closure parts, if applicable;

bb) combustibles for which the flame arrester is suitable, if applicable.

9.3 Warning notice

Shall be according to EN 13611:2007+A2:2011, 9.3.

Annex A
(informative)

Gas connections in common use in the various countries

EN 13611:2007+A2:2011, Annex A is not applicable.

Annex B
(informative)

Leak-tightness test — volumetric method

Shall be according to EN 13611:2007+A2:2011, Annex B.

Annex C
(informative)

Leak-tightness test — pressure loss method

Shall be according to EN 13611:2007+A2:2011, Annex C.

Annex D
(normative)

Conversion of pressure loss into leakage rate

Shall be according to EN 13611:2007+A2:2011, Annex D.

Annex E
(normative)

Electrical/electronic component fault modes

Shall be according to EN 13611:2007+A2:2011, Annex E with the following addition.

Specific failure modes of the CPSE are determined according to 6.5.1.

Annex F
(normative)

Additional requirements for safety accessories and pressure accessories as defined in EU Directive 97/23/EC

EN 13611:2007+A2:2011, Annex F is not applicable.

Annex G
(normative)

Materials for pressurized parts

EN 13611:2007+A2:2011, Annex G is not applicable.

Annex H
(informative)

Additional materials for pressurized parts

EN 13611:2007+A2:2011, Annex H is not applicable.

Annex I
(normative)

Requirements for controls used in DC supplied gas burners and gas burning appliances

Shall be according to EN 13611:2007+A2:2011, Annex I.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2009/142/EC relating to appliances burning gaseous fuels

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2009/142/EC relating to appliances burning gaseous fuels.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive (Directive 2009/142/EC relating to appliances burning gaseous fuels)

Clause(s)/Sub-clause(s) of this EN	Essential Requirement (ERs) of Directive 2009/142/EC		Qualifying remarks/Notes
	1	**GENERAL CONDITIONS**	
1; 6; 7	1.1	design and construction	
9.2 9.3 9.3 9.2	1.2	instructions installer; warning notices on appliance; on packaging; official language;	
6; 7 9.2	1.3	fittings: instructions;	
	2	**MATERIAL**	
6.1; 6.3.1; 7.8	2.1	appropriate for their purpose	
	3	**DESIGN AND CONSTRUCTION**	
	3.1	**General**	
6	3.1.1	safety of construction	
7.1	3.1.5	normal fluctuation of auxiliary energy	
8	3.1.6	abnormal fluctuation of failure of auxiliary energy	
8.11	3.1.7	hazards of electrical origin	
6.1	3.1.8	pressurized parts	
6.3.101; 6.5; 6.6	3.1.9	failure of devices	
6.6	3.1.10	overruling safety devices	
6.2.8	3.1.11	adjustment protection	
7.8.2	3.1.12	clear marking of devices	
	3.2	**Unburned gas release**	

Clause(s)/Sub-clause(s) of this EN	Essential Requirement (ERs) of Directive 2009/142/EC		Qualifying remarks/Notes
7.2; 7.3	3.2.1	risk of gas leakage:	
	3.4	**Combustion**	
7.2; 7.3	3.4.2	no accidental release of combustion products;	
7.2; 7.3	3.4.3	no release in dangerous quantity;	
7.2; 7.3	3.4.4	CO concentration;	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

Shall be according to EN 13611:2007+A2:2011, Bibliography with the following additions:

[1] EN 437, *Test gases — Test pressures — Appliance categories*

[2] EN 15267-3:2007, *Air quality - Certification of automated measuring systems - Part 3: Performance criteria and test procedures for automated measuring systems for monitoring emissions from stationary sources*

[3] EN ISO 16852:2010, *Flame arresters - Performance requirements, test methods and limits for use (ISO 16852:2008, including Cor 1:2008 and Cor 2:2009)*

[4] VDI 3490 (all parts):1980, *Measurement of gases*

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