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BSI Standards Publication

# Portable electrical apparatus for the measurement of combustion flue gas parameters — Guide to their use in the process of commissioning, servicing and maintaining gas fired appliances

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## National foreword

This Published Document is the UK implementation of CLC/TS 50612:2016. It supersedes PD CLC/TS 50612:2013 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee EXL/31, Equipment for explosive atmospheres, to Subcommittee EXL/31/1, Gas detectors.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.


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**Compliance with a British Standard cannot confer immunity from legal obligations.**

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TECHNICAL SPECIFICATION

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# CLC/TS 50612

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Supersedes CLC/TS 50612:2013

English Version

# Portable electrical apparatus for the measurement of combustion flue gas parameters - Guide to their use in the process of commissioning, servicing and maintaining gas fired appliances

Appareils électriques portatifs de mesure des paramètres des gaz de combustion - Guide d'utilisation lié à la procédure de mise en service, d'entretien et de maintenance des appareils à gaz

To be completed

This Technical Specification was approved by CENELEC on 2016-04-18.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

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

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# European foreword

This document (CLC/TS 50612:2016) has been prepared by Technical Committee CLC/TC 216 “Gas detectors”.

This document supersedes CLC/TS 50612:2013.

CLC/TS 50612:2016 includes the following significant technical changes with respect to CLC/TS 50612:2013:

The Scope of the 2013 guidance was limited to the use of portable electrical apparatus for the measurement of combustion flue gas parameters of gas-fired central heating boilers. The Scope of the 2016 guidance has been expanded to cover their use with gas-fired central heating boilers, domestic gas-fired air heaters, independent gas-fired space heaters, gas cooking appliances and domestic gas-fired water heaters.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

The following Technical Committees have collaborated in the development of this document:

- CEN/TC 109 “Central heating boilers using gaseous fuels",
- CEN/TC 62 “Independent gas-fired space heaters”,
- CEN/TC 49 “Gas cooking appliances”, and
- CEN/TC 48 “Domestic gas-fired water heaters”.

NOTE Commentary text is presented in *italic type*. It gives background information and does not constitute a normative element.

# Introduction

This Technical Specification is intended as a guide for operatives who, in the course of their professional activities, are required to measure combustion parameters of gas-fired appliances in domestic premises using combustion flue gas analysers during any or all of the commissioning, servicing and maintenance of such appliances.

It is intended to complement the following through a generic approach:

a) the gas appliance commissioning, servicing and maintenance instructions, and/or

b) national or local regulations or standards.

NOTE 1 A Technical Specification is announced and made available at national level, but conflicting national standards can continue to exist.

NOTE 2 Existing national or local regulations or standards conflicting with the guidance in this Technical Specification have precedence over this guidance.

It is not intended that a combustion gas analysis be used as a substitute for commissioning, servicing and/or maintenance carried out in accordance with the gas appliance instructions. It is meant to be regarded and used as a diagnostic tool to help in the process of carrying out these activities to ensure the safe and efficient operation of the appliance installation.

In the preparation of this Technical Specification, it has been assumed that the execution of its provisions will be entrusted to competent operatives (see Clause 4) for whose use it has been produced.

# 1 Scope

This Technical Specification provides guidance on the selection, use and maintenance of portable electrical apparatus conforming to EN 50379-1 [4] and EN 50379-2 [5] or EN 50379-3 [6] to:

a) measure combustion flue gas parameters of appliances in domestic premises burning 1st, 2nd or 3rd family gases of the following description:

   1) Type A, Type B and Type C gas-fired appliances, except those appliances where the appliance instructions (or design, see 7.3.2.1), prohibit combustion sampling, and,

   2) all gas-fired appliances for which the appliance manufacturer has provided a purpose-designed combustion sampling point or specific sampling instructions,

b) use as a diagnostic instrument to assist an operative:

   1) in confirming satisfactory combustion at the time of commissioning, in accordance with appliance instructions or national or local regulations or standards;

   2) in confirming satisfactory combustion at the time of servicing in accordance with national or local regulations or standards or following servicing in accordance with appliance instructions;

   3) in confirming satisfactory combustion following maintenance, in accordance with appliance instructions or national or local regulations or standards.

NOTE 1 Type A, Type B and Type C classification of gas-fired appliances are defined in **3.1.2** and more fully in CEN/TR 1749 [2].

NOTE 2 Existing national or local regulations or standards conflicting with the guidance in this Technical Specification have precedence over this guidance.

NOTE 3 It is not the intention of this Technical Specification to suggest that portable electrical combustion flue gas analysers are to be used as a substitute for normal service and maintenance carried out in accordance with the gas appliance instructions. Clause 9 describes how analysers can be used in conjunction with the appliance instructions.

NOTE 4 EN 50379–1 [4] specifies general requirements for the construction, testing and performance of portable spot reading apparatus designed to check the combustion performance of appliances in domestic premises using commercially available fuels.

NOTE 5 EN 50379–2 [5] is for apparatus intended to be used for statutory measurements. In several European countries, legal requirements exist for the performance of heating appliances (see EN 50379–1:2012, informative Annex A [4]). Legal consequences resulting from performance measurements makes for strict requirements for the apparatus used (see EN 50379–1:2012, normative Annexes B and C [4]).

NOTE 6 EN 50379–3 [6] is for apparatus intended to be used for non-statutory applications, which allows for reduced performance requirements for the portable electrical apparatus.

NOTE 7 This Technical Specification deals with the determination of levels of combustion gases carbon monoxide (CO), carbon dioxide ($CO_2$) and/or oxygen ($O_2$) in combustion products from gas-fired appliances. Combustion products from gas-fired appliances will contain nitrogen oxides ($NO_X$), predominantly nitrogen monoxide (nitric oxide, NO) and nitrogen dioxide ($NO_2$). This Technical Specification does not deal with the measurement of combustion products such as $NO_X$ and aldehydes.

# 2 Normative references

Not applicable.

# 3 Terms and definitions

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

## 3.1 Type of equipment

**3.1.1**
**portable electrical combustion flue gas analyser**
apparatus that will detect and measure the concentrations of components in combustion gases and clearly display the result

Note 1 to entry: Clause 5 and Annex A provides information on suitable portable electrical combustion flue gas analysers.

**3.1.2**
**gas-fired appliance**
unit of the following type placed on the market as a complete appliance designed to deliver safely and effectively the service claimed from burning gaseous fuel:

— Type A – appliance not intended for connection to a flue or to a device for evacuating the products of combustion to the outside of the room in which the appliance is installed;

— Type B - appliance intended to be connected to a flue that evacuates the products of combustion to the outside of the room in which the appliance is installed; the combustion air is drawn directly from the room;

— Type C – appliance in which the combustion circuit (air supply, combustion chamber, heat exchanger and evacuation of the products of combustion) is sealed with respect to the room in which the appliance is installed.

Note 1 to entry: Types A, B and C classifications of gas-fired appliances are described fully in CEN/TR 1749 [2].

## 3.2 Place of installation

**3.2.1**
**domestic premises**
house or building, or part thereof, being the place of residence or home of a household, family or person

**3.2.2**
**appliance compartment**
enclosure specifically constructed or adapted to accommodate one or more gas-burning appliance

## 3.3 Type of person

**3.3.1**
**customer**
occupier of the domestic premises, owner of the domestic premises, and person with the authority, for the time being, to take appropriate action in relation to any gas appliance/fitting therein

**3.3.2**
**operative**
person who is **competent** (as described in 3.4.8 and Clause 4) in respect of **work** (3.4.1) associated with the inspection, commissioning, servicing or maintenance of the particular gas-fired appliance and the use of a portable electrical combustion flue gas analyser

## 3.4 Action of the operative

**3.4.1**
**work**
installation, maintenance, servicing, removal, permanent adjustment, repair, changing the position, alteration or renewal of a gas appliance or fitting, or purging of air or gas

**3.4.2**
**servicing**
regular and planned (usually annual) activity carried out on an appliance to check and ensure that it is working safely and correctly

**3.4.3**
**maintenance**
unplanned work carried out on an appliance to repair any defect

**3.4.4**
**safety check**
examinations and tests to ensure that a gas appliance and any associated chimney operate safely

Note 1 to entry: Some countries have mandatory safety checks written into their national or local regulations.

**3.4.5**
**full strip and clean**
work involving, but not exclusively, the gaining of access to the heat exchanger and burner assemblies and the removal of any corrosion products (such as shale) or debris, which might impair the safe and efficient operation of the appliance

**3.4.6**
**satisfactory combustion**
appliance combustion measured values that meet the requirements detailed in the gas appliance instructions and/or national or local regulations or standards

**3.4.7**
**action levels**
appliance measured combustion values as detailed in the gas appliance instructions and/or national or local regulations or standards, at which corrective action should be taken

Note 1 to entry: See Clause 8.

**3.4.8**
**competence**
ability gained by appropriate training, knowledge and experience to supervise or carry out the work being undertaken in a safe and appropriate manner

Note 1 to entry: See Clause 4.

## 3.5 Condition of the appliance

**3.5.1**
**shaling**
progressive corrosion of the flueways of a cast iron heat exchanger, leading to the development of rust flakes

Note 1 to entry: Shaling can block the heat exchanger over time.

**3.5.2**
**gas family**
group of gaseous fuels with similar burning behaviour linked together by a range of Wobbe indices

Note 1 to entry: See Clause 8, f), and EN 437:2003+A1:2009, Table 1 [1].

**3.5.3**
**gas quality**
stated composition and energy content of the gas supplied, where the energy content is expressed as a range of Wobbe indices

Note 1 to entry: See Clause 8, f) and Commentary on Clause 8.

## 4 Competence

For the scope of this Technical Specification, competence shall include, as a minimum:

a) access to, and appropriate understanding of, the appliance instructions specific to the appliance being worked on;

b) knowledge of any relevant national or local regulations pertaining to the work being undertaken;

c) knowledge regarding the selection (Clause 5), care, use and maintenance (Clause 6) of portable electrical combustion flue gas analysers;

d) knowledge of the properties of the fuel gas for the appliance, the resulting combustion process, the possible dangers resulting from the combustion process and the precautions to take;

e) knowledge of the electrical services associated with the installation and operation of the appliance being worked on, the dangers they can give rise to and the precautions to take.

***Commentary on Clause 4**: Competence requires sufficient knowledge, practical skill and experience to carry out the job in hand safely, with due regard to good working practice. The installation should be left in a safe condition for use. Knowledge should be kept up-to-date with changes in law, technology and safe working practice.*

*Some countries require independently assessed and documented proof of competence in accordance with national or local regulations.*

## 5 Selection of portable electrical combustion flue gas analyser

For the determination of CO, $CO_2$ and/or $O_2$ in the combustion products from gas-fired appliances, an analyser should conform to:

a) EN 50379-2 [5] for statutory inspections and assessment of combustion performance,

b) EN 50379-2 [5] or EN 50379-3 [6] for non-statutory assessment of combustion performance during commissioning and following servicing and maintenance.

NOTE 1 To provide proof of compliance with EN 50379 series, EN 50379–1 [4] requires that the analyser manufacturer provide a durable label on the apparatus, or moulded into the casing, carrying either the number of the European Standard or the third party certification.

The analyser should have as a minimum the following measuring capabilities:

— oxygen ($O_2$) and/or $CO_2$, and

— CO.

NOTE 2 To determine $CO_2$ levels, some analysers measure $O_2$ and calculate $CO_2$ (see Annex A).

Where appliance instructions require oxygen measurement for the excess air factor, the analyser should use an $O_2$ sensor. In this case, the analyser manufacturer should be consulted to establish that the $O_2$ sensor is either insensitive to $CO_2$ or compensated for $CO_2$.

***Commentary on Clause 5**: Appliance manufacturers can require the measurement of room temperature, flue gas temperature, air inlet temperature, heating water flow temperature and chimney draught when measuring combustion values in order to provide "benchmark" reference conditions for comparison purposes in the event of subsequent investigation.*

*Consequently, some analysers have the ability to:*

— *measure temperature,*

— *measure pressure (draught),*

— *automatically record measured values (see Clause 10).*

*National or local regulations or standards can also require the ability to measure flue gas temperature and/or other parameters.*

# 6 Care, use and maintenance of portable electrical combustion flue gas analyser

## 6.1 Before use

Analysers should be treated with care, and used and maintained in accordance with the analyser instructions.

Analysers should only be used by a person who:

— is competent in their use, and

— has an understanding of the results obtained and an awareness of the necessary safety actions detailed in the gas appliance instructions and/or national or local regulations or standards.

Before using the analyser, it is essential to read operator manuals and, as appropriate, ensure that:

a) the batteries are correctly inserted, charged and not leaking,

b) the analyser has a current proof of calibration:

NOTE The analyser instructions or specific national or local regulations or standards will identify requirements for verifying the proof of calibration of the analyser.

***Commentary on b)**: Some analysers are designed to accept pre-calibrated sensor modules; however, it should not be assumed that fitting a pre-calibrated sensor module will automatically guarantee accurate calibration of the complete instrument, i.e. in combination with the probe.*

c) the display is functioning correctly;

d) the analyser is zeroed and purged in accordance with the analyser instructions;

e) the pump is working;

f) filters and water traps are clean and dry;

g) the sensor is working correctly, see 6.2;

h) the sample tubing from the sample probe to the analyser is free from leaks and damage.

### 6.2 Sensor check

Analysers read very low levels, near to zero. Since they can fail to give any reading due to sensor failure, the sensor should be checked in accordance with the analyser instructions to determine whether it is operating correctly.

### 6.3 Safety warning

An analyser should only be used in well-ventilated locations.

***Commentary on 6.3:*** *An analyser extracts combustion gases that can be toxic in relatively low concentrations. These gases are exhausted from the instrument. Operatives should consider their own safety as well as that of the occupants and ensure they are not in atmospheres in which potentially dangerous levels of CO are present.*

### 6.4 Inappropriate use

Analysers should not be used to identify leakage of combustion products from the appliance combustion circuit except where their use for this purpose is detailed in the appliance instructions.

NOTE For Type B appliances particularly, the suction from the analyser can inadvertently induce spillage of combustion products that could be incorrectly identified as a leakage of combustion products.

### 6.5 Sensor cross-sensitivity

An analyser's sensor response for CO and $CO_2$ can be affected by the presence of other gases and vapours that can come, for example, from cooking activities or common household materials such as cleaning fluids, polishes and paints. This sensor cross sensitivity can lead to inaccurate readings.

If the analyser instructions do not advise what substances could interfere with analyser operation or reliability in the short or long term, the analyser manufacturer should be consulted.

## 7 Determination of the combustion performance of an appliance

### 7.1 General

The analyser should be switched on and prepared for use in accordance with the analyser instructions.

Unless national or local regulations or standards specify differently:

a) If a purpose designed combustion sampling point is provided on the appliance and/or specific guidance on carrying out combustion checks is provided in the appliance instructions, the combustion checks should be carried out in accordance with the appliance instructions.

b) Except where the appliance instructions prohibit combustion sampling, (see 7.3.2.1), if a purpose designed combustion sampling point and/or specific guidance on carrying out combustion checks is not provided in the appliance instructions, the relevant procedure in 7.2, 7.3 or 7.4 should be used.

c) The combustion measured values should be recorded when the appliance has been operating at the maximum rated input for 30 min or when the reading is steady or decreasing, whichever is the least time. To set the appliance at its maximum rated input, the method specified in the appliance instructions should be followed.

For many applications, the open-ended sampling probe and connection tubing usually supplied with an analyser will be suitable to collect a thoroughly mixed and representative sample of the combustion products. However, where this type of probe and/or connection tubing is not suitable, the analyser manufacturer should be contacted to obtain a suitable probe and/or connection tubing specification.

Guidance on satisfactory measured combustion values is normally given in the appliance instructions, or national or local regulations or standards. In the event that there is no information in the appliance instructions

or relevant information in the national or local regulations or standards, the appliance manufacturer should be contacted.

If the measured combustion values are unsatisfactory then the appropriate action recommended in the appliance instructions and Clause 9 should be carried out. Commentary on Clause 8 also provides some suggestions for possible causes of unsatisfactory measured combustion values.

It should be noted that certain components in the appliance could contain volatile compounds for which it will be necessary to “burn off the newness” before reliable measurements can be obtained. Examples include insulation and adhesives. Consequently, if such a component is fitted as a replacement, it will be necessary to burn off the newness before a reliable measurement can be obtained.

When a new component has been fitted, the appliance should be operated at maximum rate and a combustion reading taken after 10 min. If the measured values are unacceptable or still rising, continue sampling at 20 min intervals until a satisfactory stable level is reached or the level stabilizes at an unacceptable level. For the latter, if the level does not fall within 20 min, then a further inspection of the appliance should be made to establish the cause of the high reading.

## 7.2 Type A appliances

### 7.2.1 Cookers

#### 7.2.1.1 Grill

The probe should be positioned in the combustion products stream.

Where the appliance design allows, the probe and its position should be as shown in Figure C.1 of Annex C.

If the design does not permit the position shown in Figure C.1 (e.g. where the combustion products exit via a vertical grille on the front of a built in cooker), the sampling probe shown in Figure C.2 should be positioned close to the combustion products outlet duct, in the combustion products stream.

If the sampling probe shown in Figure C.2 is used, its position should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

The grill pan should be in position at the highest level allowed by the cooker instructions during the test.

#### 7.2.1.2 Oven

If the design permits (e.g. where the combustion products exit via a vertical grille on the front of a built in cooker), the sampling probe shown in Figure C.2 should be positioned close to the combustion products outlet duct, in the combustion products stream.

Where the design does not permit, an open-ended sampling probe should be used, positioned within the oven combustion products outlet duct, in the combustion products stream.

Whichever sampling probe is used, its position should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

#### 7.2.1.3 Griddles and covered burners

For griddles and covered burners an open-ended sampling probe should be positioned in the combustion products stream and should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

#### 7.2.1.4 Uncovered hotplate burners

The design of uncovered hotplate burners does not permit tests to be carried out without specialized equipment usually only available in a laboratory.

Ensure the burners and pan supports are of a type approved by the cooker manufacturer, correctly fitted, not damaged and burner ports are unobstructed by cooking or cleaning residue. Incorrect or damaged parts should be replaced.

Visually confirm that the flame picture is satisfactory.

***Commentary on 7.2.1.4**: For combustion performance, cosmetic damage to the burner and pan supports, e.g. chipping of the enamel, is not a reason to replace the part.*

#### 7.2.2 Refrigerators

An open-ended sampling probe should be used, positioned within the combustion products outlet duct, in the combustion products stream. The position of the probe should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

#### 7.2.3 Gas lamps

An open-ended sampling probe should be positioned in the combustion products stream and adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

#### 7.2.4 Space heaters

##### 7.2.4.1 Fixed space heaters

The sampling probe shown in Figure C.2 should be positioned in the combustion products stream directly above the outlet grille. The position of the probe should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

##### 7.2.4.2 Mobile portable liquefied petroleum (LPG) heaters

The heater should be in a draught free area and the sampling probe shown in Figure C.2 should be positioned in the combustion products stream directly above the outlet grille. The position of the probe should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

#### 7.2.5 Water heaters

The sampling probe shown in Figure C.2 should be positioned in the combustion products stream directly above the outlet grille. The position of the probe should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

### 7.3 Type B appliances

#### 7.3.1 Boilers and water heaters

##### 7.3.1.1 General

To obtain a well-mixed representative sample the sampling probe tip should be positioned at least 200 mm into the secondary flue. This position can be achieved either by inserting the probe into the secondary flue or, where national standards allow, by inserting the probe horizontally through a hole drilled into the secondary flue and the hole sealed afterwards with an appropriate robust means that does not compromise the integrity of the flue.

##### 7.3.1.2 Boilers and water heaters whose combustion products evacuation design incorporates a draught diverter

An open-ended sampling probe should be positioned in the combustion products stream of the secondary flue after the draught diverter (see 7.3.1.1) and its position adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

##### 7.3.1.3 Boilers and water heaters in compartments

The combustion performance of appliances installed in compartments requires the combustion products to be sampled with the installation operating as normal, i.e. operating so that the openable servicing access to the compartment does not provide a greater level of ventilation than usual. Sampling should therefore take place with any door to the compartment closed.

One method of sampling is with the tubing connected between the combustion analyser and the sampling probe passing via permanent ventilation openings associated with the installation. This will then enable the readings to be taken from outside the compartment.

The general procedures when sampling different types of appliances in compartments should be those outlined in 7.3.1.1 and 7.3.1.2, as appropriate.

### 7.3.2 Space heaters

#### 7.3.2.1 General

If the chosen sampling probe cannot be positioned as described in 7.3.2.2 without either partially dismantling the space heater or removing the space heater from its installed position, the test of 7.3.2.2 should not be carried out as the combustion sample obtained will not be a reliable indication of the combustion performance of the space heater in its “as found” condition.

NOTE “As found” is the condition of the installed appliance when the operative first enters the dwelling.

#### 7.3.2.2 Combustion sampling (general)

To obtain a well-mixed representative sample a sampling probe conforming to Figure C.2 should be used where practical. If not, an open ended probe can be used.

The sampling probe should be positioned at least 200 mm up inside the flue in the combustion products stream and as far away from the burning gas as practicable.

When using an open ended probe this position can be achieved either by inserting the probe into the secondary flue or, where national standards allow, by inserting the probe horizontally through a hole drilled into the secondary flue and the hole sealed afterwards with an appropriate robust means that does not compromise the integrity of the flue.

The position of the sampling probe should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

#### 7.3.2.3 Space heaters whose combustion products evacuation design incorporates a draught diverter

The sampling probe should be positioned in the combustion products stream of the secondary flue after the draught diverter.

### 7.3.3 Warm air heaters

#### 7.3.3.1 General

To obtain a well-mixed representative sample the tip of the open-ended sampling probe should be positioned at least 200 mm into the secondary flue or, where national standards allow, by inserting the probe horizontally through a hole drilled into the secondary flue and the hole sealed afterwards with an appropriate robust means that does not compromise the integrity of the flue.

The position of the sampling probe should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

#### 7.3.3.2 Warm air heaters whose combustion products evacuation design incorporates a draught diverter (see Figure D.1 a) to e) in Annex D)

The sampling probe should be positioned in the combustion products stream of the secondary flue after the draught diverter.

For the appliance types shown in Figure D.1 d) and e) access to the combustion products stream is possible from the front of the appliance.

For the appliance types shown in Figure D.1 b) and c), depending on the installation design, the access to the combustion products stream can be free access, limited access, or not possible with the standard sampling probe supplied with the gas analyser.

For the appliance type shown in Figure D.1 a) there is generally free access or limited access to the combustion products stream.

Where there is only limited access, access to the draught diverter can sometimes be improved by removal of a slot fit panel or closure panel.

NOTE It will not be possible to measure the combustion products where:

a) access to the combustion products in a manner as described above is not possible, and

b) national standards do not allow for an open ended probe to be inserted horizontally through a hole drilled into the secondary flue and the hole sealed afterwards with an appropriate robust means that does not compromise the integrity of the flue.

### 7.4 Type C appliances

Where a sampling point is not provided by the appliance manufacturer, the sampling probe should be positioned 200 mm inside the combustion products outlet duct or, where national standards allow, by inserting the probe horizontally through a hole drilled into the combustion products outlet duct and the hole sealed afterwards with an appropriate robust means that does not compromise the integrity of the duct.

NOTE 1 On some installations, due to where the appliance is sited (e.g. an appliance installed in a block of flats and not having a purpose designed sampling point or national standards do not allow the drilling of a hole in the combustion products outlet duct), it will not be possible to gain access to the flow of combustion products. In such instances, it will not be possible to measure the combustion products.

NOTE 2 Care will need to be taken when sampling in the outlet of a fanned flue appliance to ensure that the probe does not damage the fan.

Whenever sampling, the position of the probe should be adjusted until the highest steady-state value of $CO_2$ or lowest steady-state value of $O_2$ is obtained.

## 8 Measured combustion values above the action level (see 3.4.7)

Having determined that the combustion gas analyser is working correctly (see Clause 6), in some cases high measured combustion values might be, but are not necessarily limited to, the result of one or more of the following:

a) incorrect measuring process;

b) misuse of the appliance;

c) lack of regular servicing of the appliance;

d) damage to the appliance;

e) ageing of the appliance;

f) incorrect gas family or, inappropriate gas quality for the appliance installed;

g) incorrect operating gas pressure/gas flow rate;

h) adverse weather conditions;

i) inappropriate positioning of the chimney outlet for Type B appliances;

j) inappropriate positioning of the combustion air supply and products evacuation ducts for Type C appliances.

***Commentary to Clause 8:*** *If b), c), d) or e) is thought to be the cause of the high measured values, it is recommended to:*

*1) examine the appliance thoroughly,*

*2) replace damaged parts with new parts that are approved by the appliance manufacturer,*

*3) clean or replace excessively soiled parts.*

*If f) is thought to be the cause of the high measured values, it is recommended that the appliance be replaced by an appliance suited for the distributed gas family / group or made compatible with the gas quality supplied on site, in accordance with the appliance instructions.*

*If there is any doubt as to the suitability of the particular gas supplied on site for the gas type stated on the appliance data badge, the appliance manufacturer should be consulted.*

*For example, a high Wobbe Index will result in high-energy content of the gas supplied. This requires more oxygen to burn efficiently; if the Wobbe Index of the gas supplied is higher than the appliance has been designed to use, it is unlikely that the appliance will be able to deliver sufficient oxygen, resulting in incomplete combustion, causing two problems:*

— *production of carbon monoxide – a highly poisonous gas, bringing the risk of fatalities;*

— *production of soot – an inconvenience that leads to higher maintenance costs.*

*If g) is thought to be the cause of the high measured values then it is recommended that the gas pressure/flow rate be adjusted to the value required by the appliance instructions.*

*If h), i) or j) is thought to be the cause of the high measured values it is recommended to consider whether the siting of the appliance is suitable and National or local regulations or standards be consulted as to what action to take.*

*For Type B appliances, some examples of issues to consider are:*

— *the siting of the chimney outlet at or near the ridge of a pitched roof is often preferable to siting it on the slope of a roof,*

— *a combination of factors or any one of the following factors can affect the performance of the appliance, such as the chimney being external to the building, a steep pitch to the roof, complex nearby roof geometry, the property built on a sloping site, adjacent buildings, nearby hills or very large structures.*

*In every case, it is recommended the appliance be re-tested to confirm that the action taken has rectified the problem.*

# 9 Procedure for use of a portable electrical combustion flue gas analyser at the time of commissioning, servicing or maintenance

## 9.1 General

**9.1.1** A portable electrical combustion flue gas analyser may be used in connection with the commissioning, servicing or maintenance of a gas-fired appliance:

a) to determine that the combustion performance at the time of commissioning of the appliance is in accordance with the requirements detailed in the appliance instructions or national or local regulations or standards (see 9.2),

b) to determine the level of servicing required where permitted by national or local regulations or standards (see 9.3),

NOTE For example, in the UK, providing the essential safety checks required by UK Regulations confirm that the appliance installation, its physical integrity and operation are satisfactory, the UK standard allows servicing of some specified types of gas-fired appliance in accordance with the appliance instructions to be deferred for a further 12 months if the appliance combustion is found to be less than the nationally accepted combustion ratio for that type of appliance when assessed using a combustion flue gas analyser.

c) to confirm satisfactory combustion at the time of servicing in accordance with national or local regulations or standards, or following servicing in accordance with appliance instructions (see 9.4 and Figure 1),

d) to confirm satisfactory combustion following maintenance (see 9.5 and Figure 2).

The appliance instructions should be consulted as they can specify particular requirements for individual appliances, e.g. maximum/minimum values for $CO_2$, $O_2$, CO or $CO/CO_2$ combustion ratio.

**9.1.2** A portable electrical combustion flue gas analyser should not be used for gas-fired appliances connected to a chimney serving more than one appliance where the appliance draws the air for combustion from that chimney. Where an appliance is fitted in such a way, the appliance should be serviced in accordance with the appliance instructions, which will often necessitate a full strip and clean.

NOTE Air for combustion in such chimneys contains variable amounts of combustion products from other appliances. Any combustion products readings cannot, therefore, be relied upon as an accurate indication of combustion performance.

## 9.2 Determination of the combustion performance at the time of commissioning

Check the national or local regulations or standards and appliance instructions to determine if a combustion check at the time of commissioning is required.

NOTE Some manufacturers will specifically stipulate in the appliance instructions that the appliance has been checked, adjusted and pre-set at the factory for operation on the gas type specified on the appliance data plate and consequently advise that no combustion check is required at the time of commissioning.

If a combustion check is required at the time of commissioning it shall be carried out in accordance with the appliance instructions or in accordance with national or local regulations or standards.

If the combustion measured value is not in accordance with requirements, remedial action should be carried out in accordance with appliance instructions.

***Commentary on 9.2:*** *The appliance instructions might advise that if the combustion measured value does not match that stated in the instructions the manufacturer should be contacted for advice/remedial action. It is important that this advice be followed.*

## 9.3 Determination of the level of servicing required and subsequent actions

**9.3.1** A portable electrical combustion flue gas analyser may be used to determine the level of servicing required when:

a) the national or local regulations or standards permit; and

b) the appliance is provided with a combustion gas sampling point or it is otherwise practical to gain access to the flow of combustion products in accordance with the guidance given in Clause 7.

**9.3.2** The procedure for determining the level of servicing required, and subsequent actions, should be in accordance with national or local regulations or standards.

## 9.4 Confirmation of satisfactory combustion following servicing in accordance with the appliance instructions (Figure 1)

**9.4.1** In circumstances where the criteria in 9.3.1, a), are not met, servicing should be undertaken in accordance with the appliance instructions. Following any such servicing, a portable electric combustion flue gas analyser may be used, where appropriate, to check that the combustion of the appliance is satisfactory following the procedure in Figure 1.

**9.4.2** When setting the maximum heat input rating (Figure 1) the appliance shall not be over rated as this can adversely affect the combustion performance and hence the measured combustion values.

Some modulating gas-fired appliances will incorporate a facility that will ensure the appliance operates at the designed maximum heat input rating for the period required to complete any combustion gas analysis. For specific details of this facility and/or how to set the appliance so that it is operating at its designed maximum heat input, reference should be made to the appliance instructions.

**9.4.3** For a reading to be satisfactory (see Figure 1) it should conform to either the figure(s) stated in the appliance instructions and/or, as appropriate, the figures stated in national or local regulations or standards.

**9.4.4** At the point in Figure 1 where this subclause is referenced, safety checks shall include, as appropriate to the appliance type:

a) the integrity and efficiency of the combustion products evacuation system;

b) the adequacy and efficiency of any required ventilation;

c) heat input and/or operating pressure or, where necessary, both;

d) signs of spillage and/or leakage of combustion products;

e) water leaks;

f) heat stress;

g) mechanical deterioration (e.g. corrosion);

h) integrity of the appliance case seals and joints;

i) consulting the appliance instructions for any special requirements, e.g. checking the operation of safety devices and controls and condensate removal systems.

**9.4.5** At the point in Figure 1 where Checks (A) is referred to, in the absence of any national or local regulations/requirements the following should be checked as appropriate to the appliance type:

a) the effectiveness of any flue;

b) the supply of combustion air;

c) the appliance’s operating pressure or heat input or, where necessary, both.

**9.4.6** At the point in Figure 1 where (B) is referred to, in the absence of any national or local regulations/requirements, all reasonable practicable steps should be taken to notify any defect to the person responsible for the appliance and, where different, the owner of the premises in which the appliance is situated or, where neither is reasonably practicable, in the case of an appliance supplied with liquefied petroleum gas, the supplier of gas to the appliance or, in any other case, the transporter.

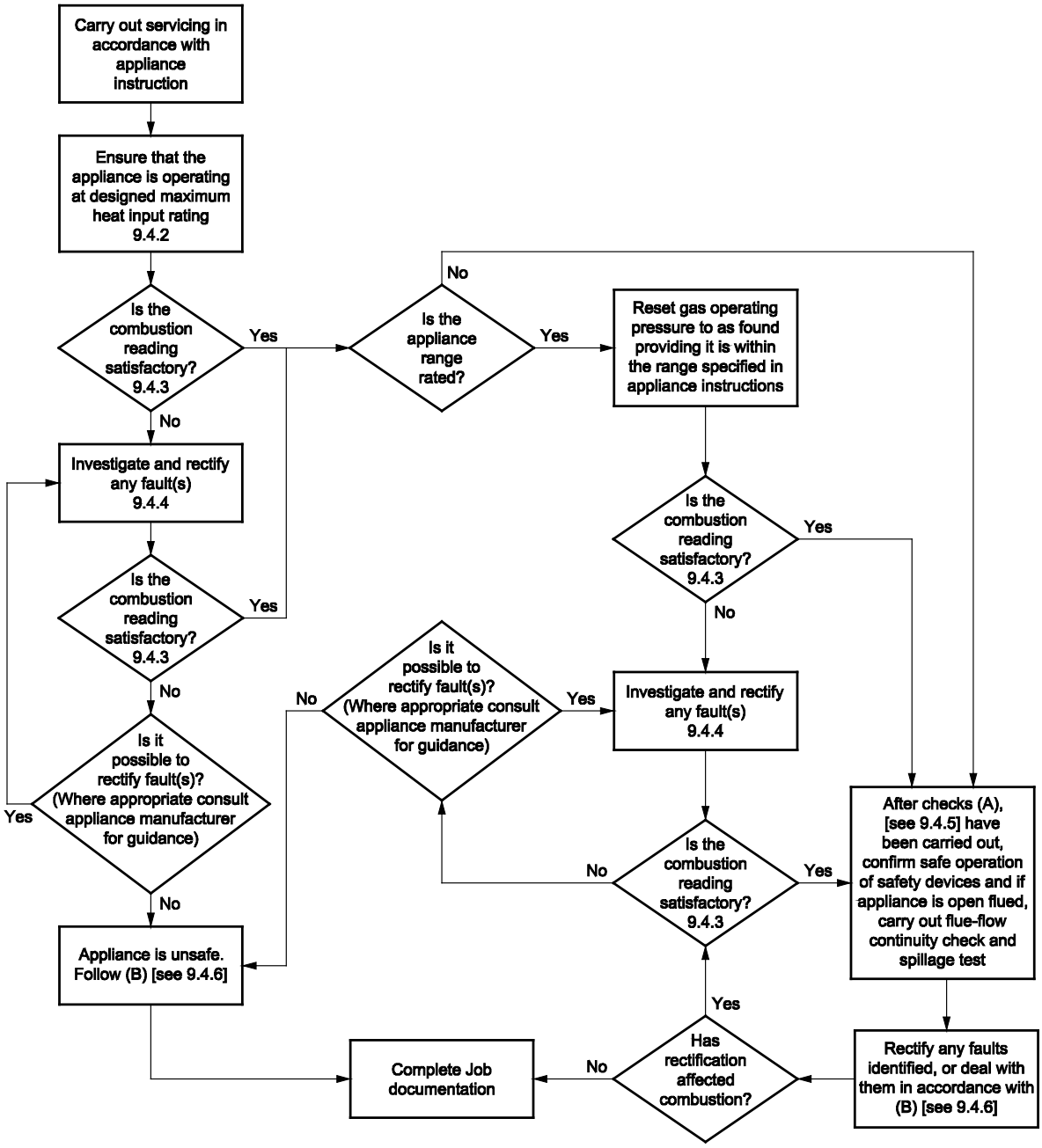



**Figure 1 — Confirmation of satisfactory combustion following servicing in accordance with the appliance instructions**

## 9.5 Confirmation of satisfactory combustion following maintenance (Figure 2)

**9.5.1** A portable electrical combustion flue gas analyser may be used, where appropriate, to confirm satisfactory combustion following maintenance. Where this is the case, the procedure in Figure 2 should be adopted.

**9.5.2** For a reading to be satisfactory (see Figure 2) it should conform to either the figure(s) stated in the appliance instructions and/or, as appropriate, the figures stated in national or local regulations or standards.

**9.5.3** At the point in Figure 2 where this subclause is referenced, essential safety checks include, but are not necessarily limited to the list below, as appropriate to the appliance type:

a) the integrity and efficiency of the combustion products evacuation system;

b) the adequacy and efficiency of any required ventilation;

c) heat input and/or operating pressure or, where necessary, both;

d) signs of spillage and/or leakage of combustion products;

e) water leaks;

f) heat stress;

g) mechanical deterioration (e.g. corrosion);

h) integrity of the appliance case seals and joints;

i) consulting the appliance instructions for any special requirements, e.g. checking the operation of safety devices and controls and condensate removal systems.

**9.5.4** At the point in Figure 2 where Checks (A) is referred to, in the absence of any national or local regulations/requirements, the following should be checked as appropriate to the appliance type:

a) the effectiveness of any flue;

b) the supply of combustion air;

c) the appliance's operating pressure or heat input or, where necessary, both.

**9.5.5** At the point in Figure 2 where (B) is referred to, in the absence of any national or local regulations/requirements, all reasonable practicable steps should be taken to notify any defect to the person responsible for the appliance and, where different, the owner of the premises in which the appliance is situated or, where neither is reasonably practicable, in the case of an appliance supplied with liquefied petroleum gas, the supplier of gas to the appliance or, in any other case, the transporter.

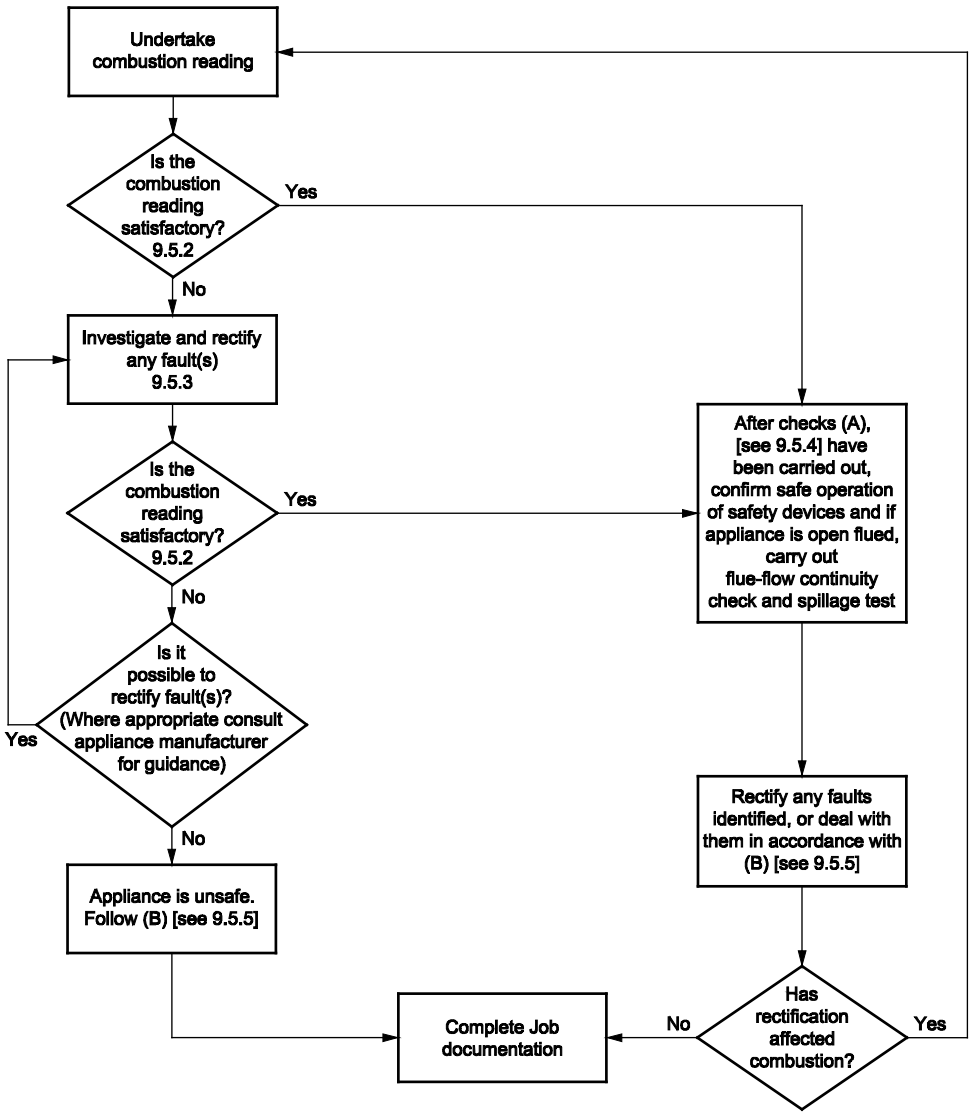



**Figure 2 — Confirmation of satisfactory combustion following maintenance**

***Commentary on 9.3, 9.4 and 9.5:*** *The following is a list of considerations to be taken into account when servicing and maintaining boilers using portable electrical flue gas analysers:*

*a) For boilers with a cast iron heat exchanger, and under certain circumstances, corrosion can take place, causing shaling to occur. Debris can also accumulate in other types of heat exchangers. Over time, this can result in the heat exchanger becoming blocked. It is important therefore, when servicing Type B boilers that a visual examination is made on the condition of the heat exchanger and any restriction within the heat exchanger flueways is removed.*

*b) Experience has shown that for boilers with close-finned, copper fabricated, heat exchangers, the burner flame picture can appear satisfactory but the portable electrical combustion analyser reading could reveal that combustion is unsatisfactory, even though the heat exchanger appears to be clear. These heat exchangers are prone to restriction by the accumulation of deposits, which appear as a white dust on the fins. Small quantities of deposits can cause restriction within the heat exchanger, which in turn can significantly affect the combustion. These deposits can be difficult to remove with conventional brushing and it might be necessary to wash the heat exchanger.*

*c) With some types of heat exchanger construction, washing might be the only available method for cleaning. Where washing is appropriate this will normally be referred to in the appliance instructions.*

*For all appliances never assume that a final measured combustion value above the "action level" is due to incorrect sampling technique or failure of the portable electrical combustion flue gas analyser. It might be necessary to consult the gas appliance manufacturer for further guidance.*

## 10 Completion report

A report (see Annex B) should be provided to the customer on completion of work involving the use of a portable electrical combustion flue gas analyser and should include the "as left" measured combustion values and/or other readings required in the appliance instructions or by national or local regulations or standards.

NOTE "As left" measured combustion values are the combustion values recorded after all relevant work on the gas-fired appliance and/or installation (in accordance with Figure 1 or Figure 2, as appropriate) has been completed.

# Annex A
(informative)

# Portable electrical combustion flue gas analysers

Portable electrical flue gas analysers extract a continuous sample of combustion products. They dry and filter the sample, and measure, calculate and display its characteristics before exhausting it from the analyser.

EN 50379-1 [4], EN 50379-2 [5] and EN 50379-3 [6] were published as the European performance standards for portable electrical combustion flue gas analysers in 2004 and revised in 2012. Analysers that conform to the EN 50379 series:

a) are hand-held or portable with a display and keypad for information and control;

b) are battery and/or mains powered;

c) use a probe to sample combustion products for measurement and calculation within the analyser;

d) may use a filter/water trap to remove particles and water vapour from the combustion products sample;

e) measure the combustion products sample for $O_2$ and CO;

f) calculate $CO_2$ and may calculate $CO/CO_2$ ratio of the combustion products sample.

Analysers that conform to the EN 50379 series are identified by a label on the analyser.

Analysers might also measure temperature, nitrogen monoxide (nitric oxide, NO), pressure, draught, excess air and combustion efficiency.

NOTE CO detectors conforming to EN 50291–1 [3], which detect and indicate or alarm if a predetermined CO exposure level is present in the space where they are fitted, are unsuitable for use as combustion gas analysers.

Portable electrical combustion flue gas analysers that conform to the EN 50379 series [4], [5], [6] are not designed for continuous measurement and should not be used for this purpose. If in doubt, contact the manufacturer.

# Annex B
(informative)

# Completion report

The following is a suggestion for the type of information that can be useful to be recorded as a completion report in addition to the “as left” measured combustion values.

**a) Report date**

Date of combustion measurement.

**b) Reason for report**

Commissioning/service/maintenance (delete as appropriate).

**c) Customer details**

Customer name;

Customer address;

Customer telephone number.

**d) Operative’s details**

Operative’s name (please print);

Company name;

Company address;

Company telephone number.

**e) Appliance details**

Appliance make and model;

Appliance serial number.

**f) Analyser details**

Analyser make and model;

Analyser serial number;

Analyser calibration status.

**g) Boilers - Central heating mode**

Gas rate;

Burner operating pressure (if applicable) or gas inlet pressure;

Central heating flow temperature.

**h) Combination boilers only – domestic hot water mode**

Gas rate;

Burner operating pressure (at maximum rate) or gas inlet pressure;

Water flow rate.

**i) All other appliances**

Gas rate;

Burner operating pressure (if applicable) or gas inlet pressure.

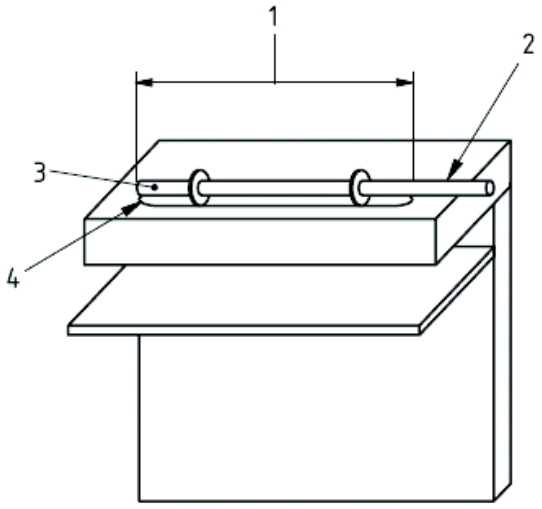
**j) "As left" combustion measured value**

$CO_2$ (%) or CO (ppm) or $CO/CO_2$ ratio.

# Annex C
(informative)

# Multi-hole sample probes

It is recommended that multi-hole sampling probes shown in Figure C.1 and Figure C.2 should be made from thin walled rigid 6 mm OD metallic tubing.

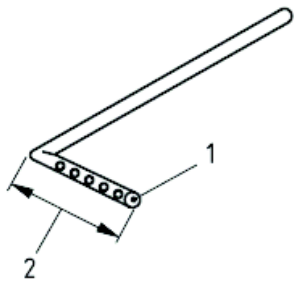



Seven 1,8 mm diameter sampling holes should be spread evenly along the sampling section of the probe.

**Key**

| | | | |
|---|---|---|---|
| 1 | Sampling section of 250 mm | 3 | Sealed end of sampling probe |
| 2 | Sampling probe | 4 | Grill opening |

**Figure C.1 — Probe for gas cooker grill**




Five 1,8 mm diameter sampling holes should be spread evenly along the sampling section of the probe.

**Key**

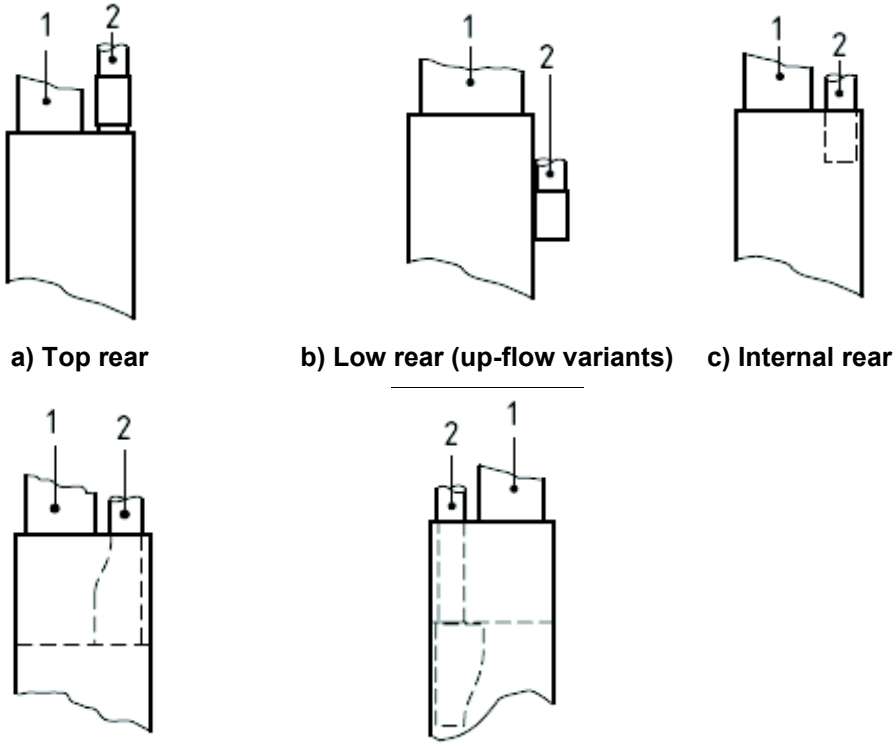
| | | | |
|---|---|---|---|
| 1 | Sealed end of sampling probe | 2 | Sampling section of 125 mm |

**Figure C.2 — Angled probe**

# Annex D
(informative)

# Flue/draught diverter configurations for warm air heaters

Typical flue/draught diverter configurations for air heaters are shown in Figure D.1.




**a) Top rear** **b) Low rear (up-flow variants)** **c) Internal rear**

**d) Internal rear (front venting)** **e) Low front (up-flow variants)**

**Key**

1 return air duct 2 combustion products duct

**Figure D.1 — Flue/draught diverter configurations for warm air heaters**

# Bibliography

[1] EN 437:2003+A1:2009, *Test gases — Test pressures — Appliance categories*

[2] CEN/TR 1749, *European scheme for the classification of gas appliances according to the method of evacuation of the combustion products (types)*

[3] EN 50291-1, *Electrical apparatus for the detection of carbon monoxide in domestic premises — Part 1: Test methods and performance requirements*

[4] EN 50379-1:2012, *Specification for portable electrical apparatus designed to measure combustion flue gas parameters of heating appliances — Part 1: General requirements and test methods*

[5] EN 50379-2, *Specification for portable electrical apparatus designed to measure combustion flue gas parameters of heating appliances — Part 2: Performance requirements for apparatus used in statutory inspections and assessment*

[6] EN 50379-3, *Specification for portable electrical apparatus designed to measure combustion flue gas parameters of heating appliances — Part 3: Performance requirements for apparatus used in non-statutory servicing of gas fired heating appliances*

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