



BSI Standards Publication

**Guide for the use of electronic portable combustion gas analysers for the measurement of carbon monoxide in dwellings and the combustion performance of domestic gas-fired appliances**

### **Publishing and copyright information**

The BSI copyright notice displayed in this document indicates when the document was last issued.

© The British Standards Institution 2015  
Published by BSI Standards Limited 2015

ISBN 978 0 580 77879 7

ICS 13.040.40; 97.100.20

The following BSI references relate to the work on this document:

Committee reference GSE/30

Draft for comment 14/30258585 DC

### **Publication history**

First published as BS 7967-1, BS 7967-2 and BS 7967-3, December 2005

BS 7967-4, June 2007

First published as BS 7967, February 2015

### **Amendments issued since publication**

<b>Date</b>	<b>Text affected</b>
-------------	----------------------

---

## Contents

Foreword	<i>iv</i>
1	Scope 1
2	Normative references 3
3	Terms and definitions 3
4	Competence 5
5	Gas analyser 7
5.1	Selection 7
5.2	Preparation of gas analyser 7
5.2.1	Pre-checks before use 7
5.2.2	Preparation of gas analyser for use 7
6	Investigation of reports of fumes, smells and spillage/leakage of combustion products in dwellings 8
6.1	Determining scope of investigation 8
6.2	Safety principles 8
6.2.1	Basic rules 8
6.2.2	CO investigation action levels 9
6.3	Preliminary procedure for carrying out checks for CO spillage/leakage from gas appliances 9
6.3.1	Possible circumstance identified by preliminary discussion with customer (see Figure 1) 11
6.3.2	Sweep test for open-flue and room-sealed appliances 11
6.3.3	Detailed discussion with customer (see Figure 1) 11
6.4	Confirming safe operation of a gas appliance 12
6.4.1	Investigation of "suspect" gas appliances 12
6.4.2	Detailed examination 14
6.4.3	Additional checks when combustion performance is satisfactory 15
6.4.4	Final checks 15
6.5	Specific gas appliance considerations 15
6.5.1	General 15
6.5.2	Air extraction/circulation systems 15
6.5.3	Flueless (type A) 16
6.5.4	Open-flue (type B) 16
6.5.5	Room-sealed (type C) 16
6.5.6	Warm air heaters 16
6.5.7	Fires 17
6.5.8	Fire/back boilers and fire/back circulators 17
6.5.9	Cookers 18
6.5.10	Appliances in compartments 18
6.6	Check of non-gas appliances and/or for continued smell/presence of CO 18
7	Reacting to activation of CO detectors 20
7.1	General 20
7.2	Electrical CO detector 20
7.3	CO indicator card 22
8	Determining ambient levels of carbon monoxide (CO) in a room 22
8.1	General advice on measurement procedures 22
8.2	Preparation for CO build-up testing 23
8.3	Testing procedures 23
8.3.1	General 23
8.3.2	Room-sealed (type C) appliances 24
8.3.3	Open-flue (type B) appliances 24
8.3.4	Flueless (type A) appliances 24
8.3.5	Additional considerations 25
8.3.6	Identifying external sources of CO 25
9	Information on levels of CO 26
9.1	General 26

9.2	Additional information on levels of CO for gas cookers	26
9.3	Responding to CO levels	26
9.4	CO from appliances other than gas appliances	27
9.5	CO from sources other than appliances	27
9.6	References to information on the effects of CO	28
9.7	Movement of CO	28
9.8	Generation of CO, smells and fumes when no fault with gas installation	28
10	Determination of the combustion performance of an appliance	29
10.1	Types of gas-fired appliance	29
10.2	General procedures	29
10.3	Sample probes	30
10.4	Sampling procedure	30
10.4.1	Flueless (type A) appliances	30
10.4.2	Open-flue (type B) appliances	32
10.4.3	Room-sealed (type C) appliances	34
11	Procedure for commissioning, servicing and maintenance using a gas analyser	34
11.1	General	34
11.2	Confirmation of safe and/or efficient operation at the time of commissioning	35
11.3	Determination of the level of servicing required and subsequent actions (see Figure 5)	35
11.4	Confirmation of satisfactory combustion following servicing in accordance with the gas appliance instructions (Figure 6)	37
11.5	Confirmation of satisfactory combustion following maintenance (Figure 7)	38
12	Combustion action levels	40
12.1	General	40
12.2	CO/CO <sub>2</sub> ratios above the action level	41
12.3	Failure to achieve a satisfactory combustion performance	41
13	Completion and leaving the property	41
14	Reports	42

### Annexes

Annex A (informative)	Gas analyser	43
Annex B (informative)	Movement of CO in buildings	43
Annex C (normative)	Multi-hole sample probes	45
Annex D (informative)	Flue/draught diverter configurations for warm air heaters	46
Annex E (informative)	Background to the use of a gas analyser in regular servicing	47
Annex F (informative)	Dwelling investigation report	48
Annex G (informative)	Gas appliance investigation report	49
Bibliography		50

### List of figures

Figure 1	Flow chart of the preliminary procedure for carrying out checks for CO spillage/leakage from gas appliances	10
Figure 2	Flow chart for confirming safe operation of a gas appliance	12
Figure 3	Flow chart for non-gas appliances and/or continued smell/presence of CO	19
Figure 4	Responding to electrical CO detector (alarm) activations	21
Figure 5	Procedure for use of a gas analyser to determine whether or not the combustion performance is satisfactory, and the subsequent actions to be performed	36

Figure 6 – Procedure for the use of a gas analyser as an aid to checking combustion performance subsequent to servicing carried out in accordance with the gas appliance instructions 38

Figure 7 – Procedure for the use of a gas analyser to confirm satisfactory combustion following maintenance 39

Figure C.1 – Probe for gas cooker grill 45

Figure C.2 – Angled probe 45

Figure D.1 – Flue/draught diverter configurations for warm air heaters 46

Figure F.1 – Example format of a dwelling investigation report 48

Figure G.1 – Example format of a gas appliance investigation report 49

#### **List of tables**

Table 1 – Approval bodies and statutory regulations by country/territory 6

Table 2 – Competence requirements by country/territory 6

Table 3 – Combustion performance (CO/CO<sub>2</sub> ratio) action levels 13

#### **Summary of pages**

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 52, an inside back cover and a back cover.

## Foreword

### Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 28 February 2015. It was prepared by Panel GSE/30/-/21, *Gas Analysers*, under the authority of Technical Committee GSE/30, *Gas installations (1st, 2nd and 3rd family gases)*. A list of organizations represented on this committee can be obtained on request to its secretary.

### Supersession

This British Standard supersedes BS 7967-1:2005, BS 7967-2:2005, BS 7967-3:2005 and BS 7967-4:2007, which are withdrawn. BS 7967-5, which covers the use of electronic portable combustion gas analysers in non-domestic premises, remains current.

### Information about this document

This British Standard is intended to be used in conjunction with the gas appliance commissioning, servicing and maintenance instructions and the *Gas Industry Unsafe Situations Procedure* [1].

Its purpose is to provide:

- a) information that is intended to assist gas operatives (see **3.12**) in considering all the relevant issues and circumstances relating to the identification of sources of fumes and smells and the cause of carbon monoxide (CO) detector activation, or when spillage/leakage of combustion products is suspected or encountered from an unknown source;
- b) information on combustion performance characteristics of a range of gas appliance types and the levels at which remedial action is to be taken;
- c) advice on the actions to be taken when elevated concentrations of carbon monoxide (CO) are identified in dwellings;
- d) the appropriate method(s) for using an electronic portable combustion gas analyser to:
  - check the combustion performance of gas appliances;
  - measure the concentrations of CO within a dwelling and, in certain circumstances (see Clause 1, Notes 4 and 5, and Commentary on 8.1), detect the presence of carbon dioxide (CO<sub>2</sub>); and
  - identify sources of the CO spillage/leakage;
- e) good practice guidance on the use of electronic portable combustion gas analysers as part of a servicing and/or maintenance procedure for gas appliances in dwellings; and  
*NOTE Electronic portable combustion gas analysers are often referred to colloquially as "flue gas analysers" (FGAs).*
- f) guidance on the use of combustion gas analysis as a diagnostic tool to assist a gas operative to confirm the safe and efficient functioning of a gas appliance when work has been done on that appliance.

This standard:

- 1) is not intended to be an exhaustive step-by-step procedure, and gas operatives need to hold an appropriate certificate of gas safety competence (see Clause 4) and use sound judgement in deciding how best to respond to individual cases. Where a gas operative is carrying out routine servicing or repair work on an appliance, testing could indicate a spillage/leakage problem. In such cases, there is no obligation to carry out all the considerations, inspections and tests described in this guidance as the gas operative has personally identified the

issue and the source of spillage/leakage is known. Only those subclauses in this standard that are concerned with the particular appliance involved would be relevant in such circumstances;

- 2) supplements gas appliance manufacturers' servicing requirements through a generic approach to servicing and maintenance activity and by identifying situations where combustion gas analysis cannot be deployed or is not appropriate;
- 3) does not intend that a combustion gas analysis be used as a substitute for normal servicing and/or maintenance carried out in accordance with the gas appliance instructions;
- 4) recognizes that it is important that the gas appliance instructions are followed; and
- 5) continues to use the term "flue" in its traditional UK sense, as any structure used to conduct the combustion products from an appliance to the outside air; as opposed to the European approach in standards, where a "flue" is only the passageway in the structure through which the combustion products flow.

The documents available as downloads from the sites referenced throughout the document were last accessed on 10 February 2015.

### Use of this document

As a guide, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to competent people (see Clause 4 for information on competence), for whose use it has been produced.

### Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should". The word "may" is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word "can" is used to express possibility, e.g. a consequence of an action or an event.

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

### Contractual and legal considerations

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

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

Attention is drawn to the following statutory regulations.

- The Gas Safety (Installation and Use) Regulations 1998 [2]
- The Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004 [3]
- The Gas Safety (Application) Order (Isle of Man) 1996 [4]
- The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 [5]
- The Gas Safety (Management) Regulations 1996 [6]
- The Gas Safety (Management) Regulations (Northern Ireland) 1997 [7]



# 1 Scope

1.1 This standard provides guidance for gas operatives on:

- a) the general use of an electronic portable combustion gas analyser conforming to BS EN 50379-3 and BS 7927:1998 incorporating Amendment No. 1:1999;

*NOTE 1 This standard assumes that a portable combustion gas analyser [often referred to colloquially as a "flue gas analyser" (FGA)] of the type specified in BS EN 50379-3 or BS 7927:1998 incorporating Amendment No. 1:1999 is available to the gas operative and the operative is competent in its use and the interpretation of any reading obtained. This competence can be demonstrated by satisfactory completion of the relevant ACS assessments, which cover the use of electronic portable combustion gas analysers. See Clause 4 for further information on competence.*

*NOTE 2 BS EN 50379-3 superseded BS 7927:1998 incorporating Amendment No. 1:1999 on 1 March 2007. However, electronic portable combustion gas analysers conforming to BS 7927:1998 incorporating Amendment No. 1:1999 remain acceptable for the purposes of this standard.*

- b) the use of such an electronic portable combustion gas analyser to determine ambient levels of carbon monoxide (CO) and, in certain circumstances (see Notes 4 and 5, and Commentary on 8.1), detect the presence of carbon dioxide (CO<sub>2</sub>) in dwellings;

*NOTE 3 A definition of a dwelling is given in 3.7.*

*NOTE 4 One of the main combustion products from gas appliances is CO<sub>2</sub>, which is mainly regarded as an asphyxiant, but is also a toxic substance which could be present in the air in sufficient quantity to prove harmful. For guidance on the occupational health considerations of CO<sub>2</sub>, reference can be made to the HSE Guidance note on Workplace exposure limits, EH40/2005 [8].*

*NOTE 5 Electronic portable combustion gas analysers that calculate CO<sub>2</sub> levels from an oxygen (O<sub>2</sub>) measurement are:*

- well proven for calculating CO<sub>2</sub> levels in combustion gases in the flue of an appliance;
- not suitable for measuring ambient levels of CO<sub>2</sub> in dwellings; and
- able to detect increases in the ambient CO<sub>2</sub> levels in ambient atmospheres and such increases in CO<sub>2</sub> will provide an early indication of increasing build-up of products of combustion in the room (see Commentary on 8.1).

- c) the use of an electronic portable combustion gas analyser to measure CO and CO<sub>2</sub> in combustion products from the following types of gas-fired appliances:

- 1) flueless appliances (type A appliances);
- 2) open-flue appliances (type B appliances);
- 3) room-sealed appliances (type C appliances); and
- 4) all appliances for which the gas appliance manufacturer has provided a purpose-designed sampling point or specific sampling instructions;

*NOTE 6 Type A, type B and type C classification of gas-fired appliances is described in PD CEN/TR 1749 and in 3.21.*

- d) the use of an electronic portable combustion gas analyser as a diagnostic instrument to assist a gas operative:

- 1) in confirming safe and/or efficient operation at the time of commissioning, in accordance with gas appliance instructions;
- 2) in determining the level of servicing required for a gas-fired appliance;