

BS 8576:2013



BSI Standards Publication

# Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)

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## Contents

Foreword *iii*

1	Scope	1
2	Normative references	1
3	Terms and definitions	2
4	General	4
5	Health and safety	5
6	Development of preliminary conceptual model and preliminary risk assessment	7
7	Setting objectives	13
8	Developing the investigation strategy	13
8.1	General considerations	13
8.2	Preparation of monitoring and sampling plan	15
8.3	Installation options	16
8.4	Location of monitoring installations	24
8.5	Response zones (monitoring depths)	25
8.6	Timing and frequency of monitoring of permanent gases	25
8.7	Deciding the appropriate level of gas monitoring of permanent gases	31
8.8	Timing and frequency of monitoring of VOCs	32
8.9	Personnel	32
9	Field work – permanent gases	33
9.1	General considerations	33
9.2	Construction of gas monitoring wells	34
9.3	Instruments for on-site use	42
9.4	Recording information when monitoring or sampling	49
9.5	Making on-site measurements	49
9.6	Sampling for laboratory measurements	53
9.7	Storage and transport of samples for laboratory analysis	54
10	Field work – VOCs	54
10.1	General considerations	54
10.2	Construction of unsaturated zone gas monitoring wells to sample for VOCs	54
10.3	Construction of near-surface monitoring ports to sample VOCs in ground gas	59
10.4	Installation of flux box to sample VOCs in ground gas	60
10.5	Instruments for on-site use	61
10.6	Recording information when monitoring or sampling	62
10.7	Making on-site measurements	63
10.8	Sampling for laboratory measurements	63
10.9	Storage and transport of samples for laboratory analysis	68
11	Monitoring and sampling reports	69
12	Quality assurance	70
12.1	General	70
12.2	Field checks on instruments	70
12.3	Calibration of instruments	70
12.4	Chain of custody	71
12.5	Quality control samples	71
13	Refining the conceptual model	73
14	Report on the investigation	73
<b>Annexes</b>		
Annex A (informative) Regulation of land contamination		74
Annex B (informative) Radon		78
Annex C (informative) Anaerobic degradation and the formation of methane and carbon dioxide		85
Annex D (informative) Sources, properties and hazards of selected gases		87
Annex E (informative) Sampling protocols – Permanent gases		94

Annex F (informative) Assessment of whether sufficient gas monitoring data have been collected	95
Annex G (informative) Portable equipment for measurement of concentrations of permanent gases	98
Annex H (informative) Apparatus for measurement of gas-flow rate	100
Annex I (informative) Installation and sampling train leakage tests	101
Bibliography	104

### List of figures

Figure 1 – Example conceptual model cross section and targeted response zones for permanent gases	9
Figure 2 – Example conceptual model cross section and targeted response zones for permanent gases	10
Figure 3 – Example of conceptual model cross section and targeted response zones for VOCs	11
Figure 4 – Key ground gas ingress routes and accumulation areas within buildings	12
Figure 5 – High-frequency data	29
Figure 6 – Decision matrix for initial monitoring	31
Figure 7 – Typical well design	36
Figure 8 – Driven monitoring probe	40
Figure 9 – Small diameter sampling probes for gas monitoring	41
Figure 10 – Example monitoring well construction for collection of ground gas samples for VOCs analysis	58
Figure C.1 – Decomposition of domestic waste	86
Figure I.1 – Potential sources of leakage when collecting ground gas samples	102

### List of tables

Table 1 – Methods of intrusive investigation that can also be used for sampling of permanent gases	18
Table 2 – Minimum specifications for ground gas analysis	43
Table 3 – Portable equipment to measure permanent gases	44
Table 4 – Portable equipment to measure flow rates and borehole pressure	45
Table 5 – Options for monitoring well installations to sample VOCs in ground gases in the unsaturated zone	56
Table 6 – Portable equipment to measure VOCs in ground gases	61
Table 7 – Containers and adsorbent devices for sampling ground gas for VOCs analysis	65
Table 8 – Acceptance criteria for quality control samples	73
Table I.1 – Results of screening measurements and conclusions	80
Table L.1 – Effects of carbon monoxide	89
Table E.1 – Pre-site checks	94
Table E.2 – Calibration chart	94
Table E.3 – Meteorological conditions	94
Table E.4 – Actions at each sampling point	95
Table E.5 – Monitoring results during sampling	95
Table F.1 – Assessing sufficiency of data	96
Table F.2 – Summary of data	96
Table F.3 – Assessing sufficiency of data	97
Table G.1 – Portable equipment to measure permanent gases	98
Table H.1 – Apparatus for measuring gas flow rate	100

### Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 110, 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 30 April 2013. It was prepared by Technical Committee EH/4, *Soil Quality*. A list of organizations represented on this committee can be obtained on request to its secretary.

### Information about this document

This standard is intended to be read in conjunction with BS 10175, *Investigation of potentially contaminated sites – Code of practice*.

**Test laboratory accreditation.** Users of this British Standard are advised to consider the desirability of selecting test laboratories that are accredited to BS EN ISO/IEC 17025 by a national or international accreditation body.

### 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.

### 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".

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

### 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.**

## Introduction

This standard, which is intended to be used in conjunction with BS 10175, provides guidance on the monitoring and sampling of ground gases. It covers volatile organic compounds (VOCs) and permanent gases such as carbon dioxide, methane and oxygen with particular reference to development sites and the risks posed by gassing sites to neighbouring land and developments. However, it is also relevant to investigations under Part 2A of the Environmental Protection Act 1990 [1] and under the Environmental Damage Regulations [2] (e.g. in respect of spills of oils, etc.).

A variety of gases might be present in the ground naturally, or as a result of contamination, or deposition of wastes. In addition to the main components found in air (nitrogen, oxygen, carbon dioxide), ground gas can contain other gases (methane, carbon monoxide, hydrogen sulfide, ammonia, helium, neon, argon, xenon, radon, etc.). It can also contain volatile organic compounds or inorganic vapours (mercury) which are of special interest in relation to the investigation of soil and groundwater contamination.

In order to complete an assessment of the risks posed by the presence of permanent and other ground gases, it is necessary to understand the potential sources of gas in and around a site. It is important to collect information on the other aspects of the site, including for example the history of the site, the natural and man-made geology of the site and surrounding areas, the hydrogeological regime, and the uses of the site and surrounding land. It is also useful to collect data on the nature of man-made soils including measurements of organic carbon content. These aspects are dealt with in BS 10175.

This information is used to develop a conceptual model of the site and surrounding area. The conceptual model is a description and/or representation of the site, incorporating what is known about the ground and groundwater conditions; the actual and potential contamination; the actual or potential presence of naturally occurring hazardous substances; the physical conditions and environmental setting; the receptors; and potential pathway linkages between contamination sources and receptors.

Development of the conceptual model requires an understanding of both the short-term (e.g. explosion or asphyxiation) and long-term hazards posed by the permanent gases and VOCs that might be present. Some relevant information is provided in Annex D of this standard.

Depending upon the objectives of the investigation, it could be relevant to consider new future receptors associated with the construction and completion of a new development, as well as existing receptors. Potential changes in the environmental setting (e.g. rising ground and surface water level) might also be relevant. The conceptual model leads to the formulation of contamination-related and other hypotheses, which the investigation process examines through the collection of relevant data.

The conceptual model is first formulated during the preliminary investigation (desk study and site reconnaissance) and informs subsequent investigations, if these are necessary, to meet the objectives of the overall investigation. One of the objectives will be reduction of uncertainty in the conceptual model. Consequently, the conceptual model is subject to regular review and updating as the work progresses.

Site investigation is an integral part of risk assessment (see CLR 11 [3]) and throughout this standard, the need for the information requirements for satisfactory risk assessment to inform the design of the site investigation programme is emphasized. However, there will be occasions where a risk assessment has been completed, and the primary purpose of the investigation is to collect additional information to aid design of protective measures, whilst of course, using the newly collected information to refine the risk assessment. Guidance is not provided on risk evaluation and characterization but guidance can be found in CIRIA C665 [4], CIRIA Report C682 [5], *Ground Gas Handbook* [6] and *Guidance on managing the risk of hazardous gases when drilling near coal* [7]. A hazard-fault/event-consequence probability analysis might be required when dealing with gas (see CIRIA report 152, *Risk assessment for methane and other gases in the ground* [8]). BS 8485, which is expected to be revised after publication of this standard (April 2013), gives recommendations and describes methods for the assessment of methane and carbon dioxide during new development of affected sites and appropriate protective measures for buildings. It does not consider ground gases other than methane and carbon dioxide. Guidance on protective measures has also been published by others (see references [9] to [13] in the Bibliography).

Carbon dioxide and methane are both powerful greenhouse gases and their uncontrolled release from landfills, etc. into the atmosphere is of concern in respect of their potential to contribute to climate change (in this sense the atmosphere is a receptor). The investigation of landfills, coal mines and other potential sources in order to design schemes for collection and/or beneficial use of gaseous emissions is outside the scope of this standard. Guidance on this has been published by the Environment Agency and others (see Bibliography for useful further reading).

The design of control measures (e.g. to prevent gas migration to adjacent land) and protective measures for buildings and other structures is outside the scope of this standard. However, when selecting such measures, it is advisable to consider the possible effects of the proposed measures on climate change in accordance with national policy.

As far as practical, the guidance on investigations for permanent gases and VOCs is provided together in an integrated text. Only where the approach required differs are they dealt with separately. It is important to consider them together rather than as separate issues because they commonly occur together. For example, petroleum hydrocarbons will degrade to form carbon dioxide under aerobic conditions and to form carbon dioxide and methane under anaerobic conditions. Indeed, the presence of carbon dioxide and/or methane is a powerful indicator that natural attenuation of hydrocarbons is taking place. Similarly, tipped wastes sometimes contain soil contaminated with VOCs and/or plumes of VOCs. Radon could also be present in conjunction with other gases and VOCs.

BS 10175 advises early consultation with regulators when potentially contaminated sites are to be investigated. This advice applies equally to investigations for ground gas. Annex A describes the regulatory framework in the UK in March 2013 and the roles performed by different regulators. It is expected that Annex A of this standard will supersede BS 10175:2011, Annex I, when BS 10175 is amended to take account of the publication of this standard.

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# 1 Scope

This British Standard provides guidance on the monitoring and sampling of ground gases. It covers volatile organic compounds (VOCs) and permanent gases such as carbon dioxide, methane and oxygen. It is intended to be read in conjunction with BS 10175.

Guidance is not provided on:

- risk evaluation and characterization;

*NOTE 1* Guidance can be found in CLR 11 [3], CIRIA C665 [4], CIRIA C682 [5] and the Ground Gas Handbook [6].

- selection and design of protective measures;
- the verification of protective measures, although the site investigation methodologies described can be used when appropriate;
- the sampling of atmospheric gases;
- monitoring and sampling for radon.

*NOTE 2* Radon occurs naturally at varying concentrations in large parts of the United Kingdom. It is commonly present in mine gas and can also be released from groundwater when it is extracted from the ground. It can also arise from deposited wastes such as those from the nuclear industry, phosphorus slags, and coal ash. Its importance lies in the fact that the risks associated with exposure to it are serious and its effects on the human condition are backed by extensive epidemiological information. There are established or draft international Standards for investigation and determination of radon in soils (BS ISO 18889 series) and in air (BS ISO 11665-1). The latter provides guidance on analysis of historic records, site reconnaissance, identification of preferential migration pathways, development of a sampling plan and how to measure radon in air once it has been emitted from the ground (see Annex B for further information). At the time of publication of this standard, the committee are not aware of any international standards or other authoritative guidance on the measurement and sampling of radon in the ground analogous to that provided in this standard for permanent gases and VOCs. The state-of-the-art is not sufficiently developed in the UK to provide such guidance as part of this standard but some preliminary guidance is provided for information in Annex B.

*NOTE 3* The term "permanent gas" (3.10) is used rather than "bulk gas" as used in much UK guidance. The two are not synonyms. "Permanent gas" is an accepted international term in use for over 100 years. Its usage does not indicate any relationship between the proportion of a gas present and its properties in the way that the terms "bulk gas" and "trace gas" do. These terms were originally used in connection with "landfill gas". "Permanent gas" is considered more appropriate for the range of sources covered by this standard.

*NOTE 4* "Ground gas" has the same meaning as "soil gas" as defined in BS ISO 11074, i.e. "gas and vapours in the pore spaces of soils".

# 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.

BS 5930, *Code of practice for site investigations*

BS 10175, *Investigation of potentially contaminated sites – Code of Practice* <sup>1)</sup>

<sup>1)</sup> BS 10175:2011 is also referenced in this standard informatively.