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**BSI Standards Publication**

# **Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings**

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### Summary of pages

This document comprises a front cover, an inside front cover, pages i to v, pages 1 to 86, 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 June 2015. 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.

### Supersession

This British Standard supersedes BS 8485:2007, which is withdrawn.

### Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- inclusion of more detailed recommendations on the interpretation of gas monitoring data and assignment of the gas screening value;
- inclusion of four building type definitions and amendments to the gas protection scores recommended for different characteristic situations;
- inclusion of recommendations for reporting of gas protection measures at the design, installation and post-construction (verification) stages;
- revision of recommendations on the design of ventilation protective measures;
- inclusion of recommendations on membrane selection and verification;
- inclusion of a method of site characterization without gas monitoring data (based on RB17 [1]);
- inclusion of worked examples of solution choices for a range of different ground gas conditions and building types;
- inclusion of informative guidance on radon gas and volatile organic compounds in Annex G and Annex H, respectively;
- inclusion of cross references to BS 8576:2013 and BS 10175:2011+A1:2013 as the key sources of good practice on investigations for ground gas; and
- inclusion of cross references to other relevant UK good practice guidance published since the publication of BS 8485:2007, including guidance from CIRIA, NHBC, CL:AIRE and Wilson, Card and Haines.

### Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

### Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its 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.*

The word “should” is used to express recommendations of this standard. 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.

Notes and commentaries are provided throughout the text of this standard. 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.**



## Introduction

Toxic, asphyxiating and flammable and potentially explosive ground gases can enter buildings and other structures on and below the ground. They variously pose potential risks to occupants and users, and to the structures themselves.

This British Standard is intended to be used by designers of gas protection measures and by regulators involved in the assessment of design solutions. It recognizes that there are a number of factors requiring consideration which affect the sensitivity of a development to the effects of ground gas, and that there is a range of design solutions available for different situations. It is anticipated that specialist advice is needed in the assessment of the ground gas data and in the risk assessment phase.

This British Standard provides a framework, in line with *Model procedures for the management of land contamination*, CLR11 [2], which provides designers with information about what is needed for an adequate ground gas site investigation. It also provides an approach to determine appropriate ground gas parameters that can be used to identify a range of possible design solutions for protection against the presence of methane and carbon dioxide on a development site. The framework is not prescriptive and professional judgement may be made as to the acceptability of risk and whether there might be benefit in undertaking more rigorous site assessment or adopting conservative measures in design. Emphasis is placed on the justification and recording of risk assessments and design decisions throughout the process.

A variety of gases might be present in the ground naturally, or be present as a result of contamination of the ground, or arise from buried wastes. In addition to the main components found in air (nitrogen and oxygen), ground gas can contain other gases (e.g. methane, carbon dioxide, carbon monoxide, hydrogen sulfide, ammonia, helium, neon, argon, xenon, radon, etc.). It can also contain volatile organic compounds (VOCs) or inorganic vapours (mercury).

Methane (which is flammable and an asphyxiant) and carbon dioxide (which is toxic and an asphyxiant) can originate from a range of sources including:

- land-filled wastes;
- degradable material present within the soil matrix of made ground;
- peat and organic matter within alluvial deposits;
- migrating landfill leachate;
- spilled or leaked petroleum hydrocarbons;
- silt formed in water bodies (e.g. ponds, docks and rivers);
- some natural deposits (e.g. chalk and coal measure strata); and
- leaks of mains gas (natural gas) and sewer gas.

Wherever biodegradable materials are present, microbial activity produces methane and/or carbon dioxide depending on whether conditions are aerobic or anaerobic. A number of additional trace gases can also be produced.

Permanent gases such as methane, carbon dioxide and carbon monoxide which might be present in coal measure strata can also emanate from old mine workings (guidance is given in *CIRIA Report 130* [3]). Combusting coal measure strata, including waste in colliery spoil tips, can release carbon monoxide, as can smouldering domestic waste. Under some circumstances, sulfur rich deposits such as gypsum waste and some slags can release substantial quantities of hydrogen sulfide; for example, when sulfur-bearing wastes and domestic refuse are mixed.

## 1 Scope

This British Standard gives recommendations on ground gas site characterization and the choice of solutions for the design of integral gas protective measures for new buildings to prevent entry of carbon dioxide and methane, and provide a safe internal environment.

This British Standard gives a process that can be used to demonstrate that risks posed by the potential or actual presence of carbon dioxide and methane have been addressed.

This British Standard does not cover protection of new buildings against other hazardous ground gases. Nor does this British Standard cover protection of buildings into which methane and carbon dioxide might be introduced by the activities for which they are used (for example, water pumping stations).

The retrospective design of protection measures for completed buildings and the design of retrospective protection measures after completion of building construction are not covered in this British Standard.

*NOTE 1* Guidance on radon and VOCs is given in Annex G and Annex H.

*NOTE 2* This British Standard does not give recommendations on oxygen depletion.

*NOTE 3* The assessment and decision making stages are presented in the form of process flow charts (Figure 3, Figure 5 and Figure 6), accompanying information and explanatory guidance and, where appropriate, references to other guidance and information. The contents of this British Standard are shown in the document flow chart in Figure 1.

*NOTE 4* Full protection of buildings might require a range of measures (for example, to control gas migration, to protect car parking and garden areas, and to monitor gas concentrations) in addition to those incorporated into the building. However, guidance on these is not provided and is available in the Ground Gas Handbook [4] and CIRIA Report 149 [5].

## 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 8576:2013, *Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)*

BS 10175:2011+A1:2013, *Investigation of potentially contaminated sites – Code of practice*

BS EN 13137, *Characterisation of waste – Determination of total organic carbon (TOC) in waste, sludges and sediments*

### Other publications

[N1] MALLETT, H., COX, L. (nee TAFFEL-ANDUREAU), WILSON, S. and CORBAN, M. *Good practice on the testing and verification of protection systems for buildings against hazardous ground gases (C735)*. London: CIRIA, 2014.