



BSI Standards Publication

Brown coals and lignites — Determination of the volatile matter in the analysis sample

Part 1: Two-furnace method

National foreword

This British Standard is the UK implementation of [ISO 5071-1:2021](#). It supersedes [BS ISO 5071-1:2013](#), which is withdrawn.

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INTERNATIONAL STANDARD

ISO
5071-1

Third edition
2021-12-09

Brown coals and lignites — Determination of the volatile matter in the analysis sample —

Part 1: Two-furnace method

*Charbons bruns et lignites — Détermination des matières volatiles
dans l'échantillon pour analyse —*

Partie 1: Méthode avec utilisation de deux fours



Reference number
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Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 27, *Coal and coke*, Subcommittee SC 5, *Methods of analysis*.

This third edition cancels and replaces the second edition ([ISO 5071-1:2013](http://www.iso.org/iso/5071-1:2013)), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

- referenced documents have been updated;
- terms and definitions have been added;
- sample has been added;
- calculation and expression of results have been amended;
- precision has been amended;
- test report has been amended.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The volatile matter is determined as the loss in mass, corrected for moisture, when an analysis sample of brown coal or lignite is heated out of contact with air under specified conditions. The test is empirical and, in order to obtain reproducible results, it is essential that the rate of heating, the final temperature and the overall duration of the test be carefully controlled. Due to the nature of brown coals and lignites, initial heating of the sample at 400 °C is necessary to minimize the possibility of ejection of sample from the test crucible.

Mineral matter associated with the sample may also lose mass under the conditions of the test, the magnitude of the loss being dependent on both the nature and the quantity of the minerals present.

Brown coals and lignites — Determination of the volatile matter in the analysis sample —

Part 1: Two-furnace method

1 Scope

This document specifies a method of determining the volatile matter of brown coals and lignites.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[ISO 1170](#), *Coal and coke — Calculation of analyses to different bases*

[ISO 1213-2](#), *Solid mineral fuels — Vocabulary — Part 2: Terms relating to sampling, testing and analysis*

[ISO 5068-2](#), *Brown coals and lignites — Determination of moisture content — Part 2: Indirect gravimetric method for moisture in the analysis sample*

[ISO 13909-4](#), *Hard coal and coke — Mechanical sampling — Part 4: Coal — Preparation of test samples*

[ISO 18283](#), *Coal and coke — Manual sampling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 1213-2](#) apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

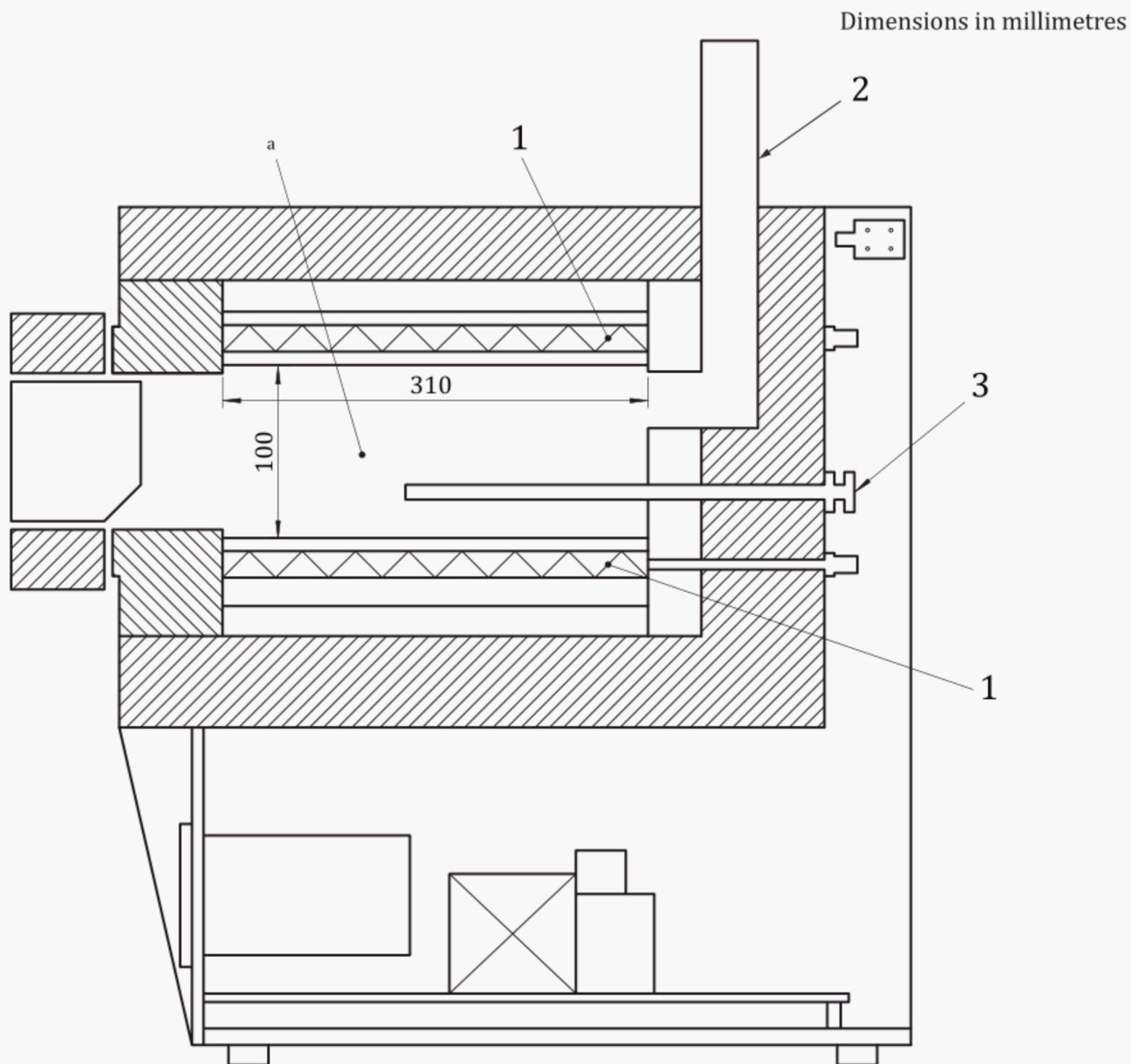
4 Principle

The coal is heated out of contact with air for 7 min at 400 °C, then immediately transferred to another furnace and heated at 900 °C for a further 7 min. The volatile matter mass fraction is calculated from the loss in mass of the oven-dried sample or from the loss in mass of the analysis sample corrected for moisture.

5 Reagents

5.1 Desiccants, fresh or freshly regenerated and preferably self-indicating. Suitable desiccants are magnesium perchlorate, silica gel, activated alumina and anhydrous calcium sulfate.

WARNING — Magnesium perchlorate is a strong oxidizing agent. Do not attempt to regenerate the absorbent. Do not permit contact with organic materials or reducing agent.



Key

- 1 heating system
- 2 flue
- 3 thermocouple
- a Chamber width is 200 mm.

Figure 1 — Example of a suitable furnace

Dimensions in millimetres

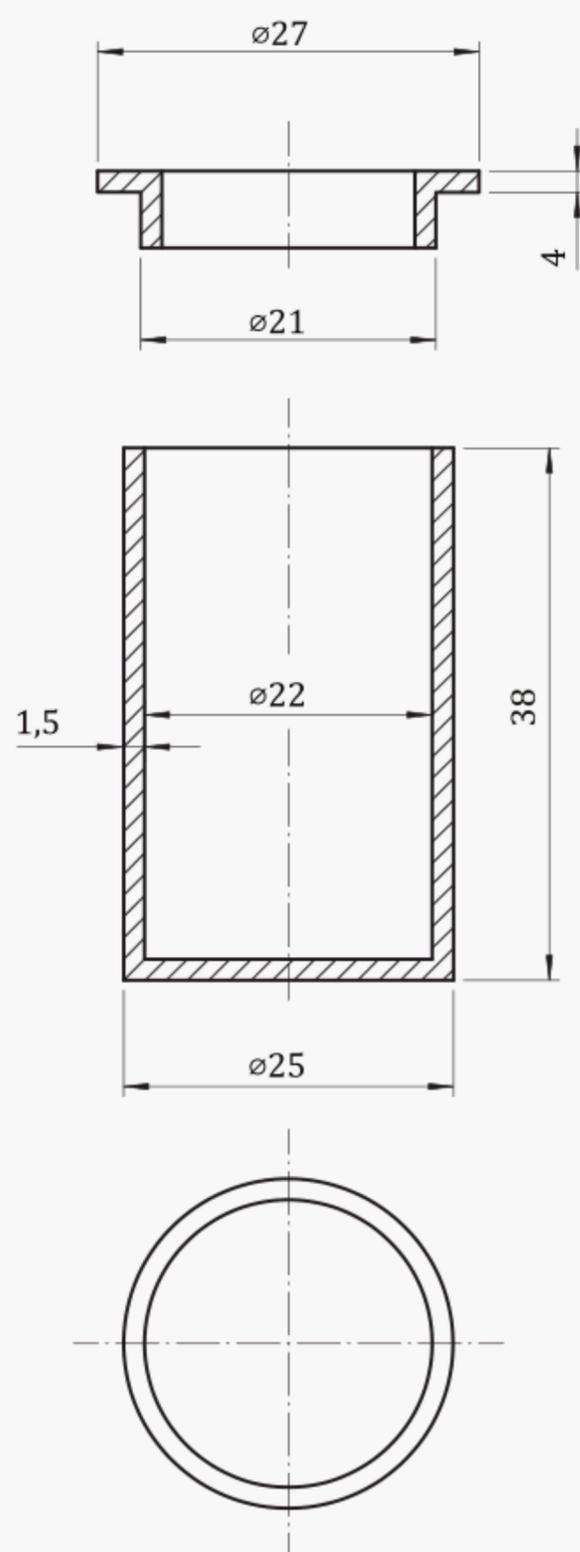
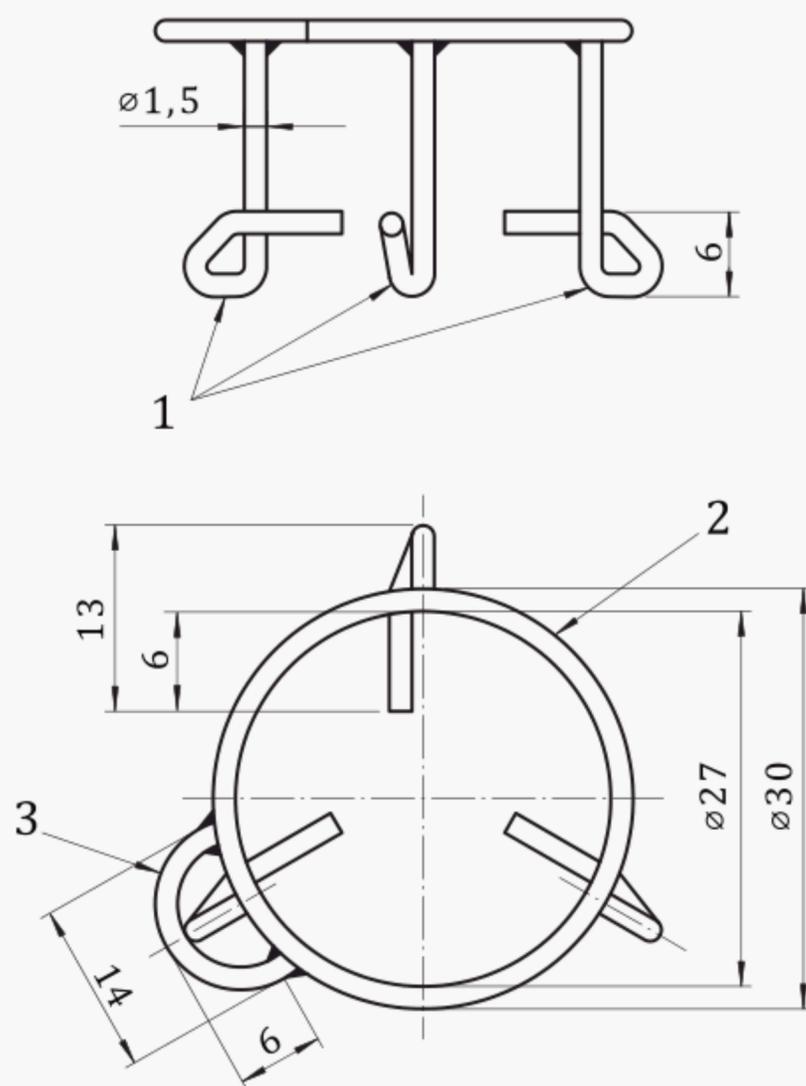
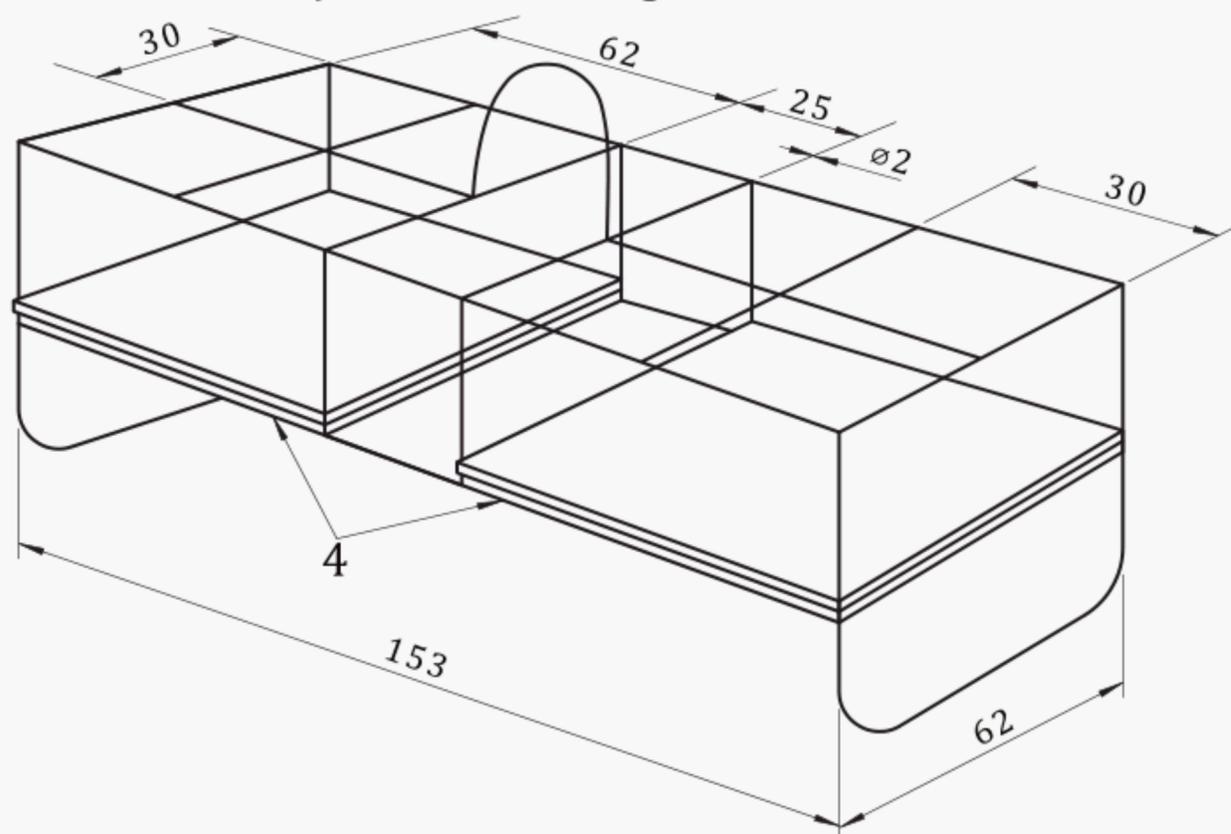


Figure 2 — Silica crucible and lid

Dimensions in millimetres



a) Suitable for a single determination



b) Suitable for multiple determinations

Key

- 1 three legs spaced 120° apart
- 2 ring

- 3 handle
- 4 ceramic plates

Figure 3 — Crucible stands

a cold stand and its crucibles. Remove the crucible(s) and cool and determine their mass in the same manner as for the empty crucible(s) (see [8.1](#)).

NOTE 1 Precisely similar treatment of the crucible(s) and lid(s) before and after the determination minimizes the effect of any film of water absorbed on its surface, while the rapid cooling reduces absorption of moisture by the coal residue.

NOTE 2 If multiple determinations are being made, fill any vacant places in the stand with empty crucibles.

NOTE 3 Certain brown coals and lignites can consistently produce ash deposits either on the crucible lid or the sample stand when tested using the two-furnace procedure. In such a case, it is recommended to press the air-dried sample into small pellets, then determine the volatile matter.

9 Calculation and expression of results

Calculate the mass fraction of volatile matter, expressed as a percent, on a dry basis, $w_{V,d}$, according to [Formula \(1\)](#) in [9.1](#) and [Formulae \(2\)](#) and [\(3\)](#) in [9.2](#).

9.1 For oven-dried coal

$$w_{V,d} = 100 \times \frac{(m_2 - m_3)}{m_2 - m_1} \quad (1)$$

where

- m_1 is the mass, in grams, of the empty crucible and lid (see [8.1](#));
- m_2 is the mass, in grams, of crucible, lid and oven-dried sample (see [8.3](#));
- m_3 is the mass, in grams, of crucible, lid and sample after heating in the furnace (see [8.3](#));
- 100 is conversion factor from dimensionless mass fraction to percent, in %.

9.2 For air-dried coal

$$w_{V,ad} = \frac{100(m_2 - m_3)}{m_2 - m_1} - M_{ad} \quad (2)$$

$$w_{V,d} = \frac{100}{100 - M_{ad}} \times w_{V,ad} \quad (3)$$

where

- m_1 is the mass, in grams, of the empty crucible and lid (see [8.1](#));
- m_2 is the mass, in grams, of crucible, lid and air-dried sample (see [8.2](#));
- m_3 is the mass, in grams, of crucible, lid and sample after heating (see [8.4](#));
- M_{ad} is the moisture mass fraction, expressed as a percent, in the air-dried sample, determined according to [ISO 5068-2](#);
- $w_{V,ad}$ is the volatile matter mass fraction on an air-dried basis, expressed as a percent;
- 100 is conversion factor from dimensionless mass fraction to percent, in %.

9.3 The results (the mean of duplicate determinations) shall be reported to the nearest 0,1 %. Calculation of the results on other bases shall be calculated by the specification in [ISO 1170](#).

10 Precision

10.1 Repeatability limit

The results of duplicate determinations, carried out in the same laboratory by the same operator with the same apparatus within a short interval of time on representative portions taken from the same analysis sample, shall not differ by more than the values of the repeatability limit, r , shown in [Table 1](#).

10.2 Reproducibility limit

The mean of the results of duplicate determinations, carried out in each of the two laboratories, on the representative portions taken from the same sample at the last stage of sample preparation, shall not differ by more than the values of the reproducibility limit, R , shown in [Table 1](#).

Table 1 — Repeatability limit and reproducibility limit

Test parameter (dry basis) %	Maximum acceptable differences between results	
	absolute, %	
	Repeatability limit r	Reproducibility limit R
$w_{V,d}$	1,0	3,0

11 Test report

The test report shall include the following information:

- identification of the sample tested;
- the method used by reference to this document, i.e. [ISO 5071-1:2021](#);
- the date of the determination;
- the results and the method of expression used.

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BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK