BRITISH STANDARD

BS 4856 :
Part 4 : 1997

Methods for

Testing and rating fan coil units, unit heaters and unit coolers

Part 4. Determination of sound power levels of fan coil units, unit heaters and unit coolers using reverberation rooms

ICS 17.140.20; 91.140.20; 91.140.30

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee RHE/6 to Subcommittee RHE/6/1, upon which the following bodies were represented:

HEVAC Association
University of Portsmouth
Co-opted Members

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on
15 September 1997

First published January 1978
Second edition July 1997

The following BSI references relate to the work on this standard:
Committee reference RHE/6
Draft for comment 95/717445 DC

ISBN 0 580 27607 4

Amendments issued since publication

Amd. No.	Date	Text affected

Contents

Foreword

This revision has been prepared by Technical Subcommittee RHE/6/1, and supersedes BS 4856 : Part 4 : 1978 and BS 4856 : Part 5 : 1979, which are both withdrawn.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

Introduction

This British Standard specifies a method for determining the sound power levels of fan coil units, unit heaters and unit coolers, in a reverberation room. It is based on BS 4196 : Part 1 and BS 4196 : Part 2, which describe the acoustic test facilities, instrumentation and procedures to be used for precision grade determination of sound power levels in octave and one-third octave bands of a noise source, having a volume less than 1 % of the volume of the reverberation room.

1 Scope

This British Standard establishes general rules for acoustic testing of fan coil units, unit heaters and unit coolers, in order to determine sound power levels. This standard is applicable to equipment operating under steady state conditions. It applies to sources that produce steady broad-band noise, and to sources that may produce significant discrete frequency components or narrow band noises.

2 References

2.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publications apply to this standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this standard, the definitions given in BS 4727 : Part 3 : Group 08 apply, together with the following.

3.1 breakout/casing noise

The amount of sound energy transmitted via the unit case.

3.2 fan coil unit, unit heater, unit cooler

A fluid-to-air heat exchanger apparatus through which air is passed by an electrically powered fan.

NOTE. This unit may or may not contain filters.

3.3 frequency range of interest

The frequency range that includes octave bands with centre frequencies between 125 Hz and 8000 Hz, or the one-third octave bands with centre frequencies between 100 Hz and 10000 Hz.

3.4 inlet noise

The amount of sound energy transmitted from the inlet of the unit.

3.5 open inlet sound power level

The sound power level transmitted from the inlet of the unit.

3.6 open outlet sound power level

The sound power level transmitted from the outlet of the unit.

3.7 outlet noise

The amount of sound energy transmitted from the outlet of the unit.

3.8 steady state condition

The condition considered to exist, for test purposes, if the air volume flow rate does not vary by more than ± 2 % from the mean value during the test.

3.9 unit noise

The total amount of sound energy attributable to the unit, equal to the sum of inlet noise, outlet noise, and breakout/casing noise, and applicable to non-ducted units only.

4 Test facility, instrumentation and procedures

4.1 General

The acoustic test facilities, instrumentation, and procedures, including room qualification tests, shall be in accordance with BS 4196 : Part 1 or BS 4196 : Part 2.

NOTE. BS 4196 : Part 1 and BS 4196 : Part 2 offer two methods for reverberation room measurements for determining sound power levels: the comparison method uses a reference sound source having a known sound power output, and the direct method uses knowledge of the reverberation time of the room in which the determination is made.

If there are substantial variations in the reverberant room characteristics, due to the presence of the source to be tested, then the test room shall also be qualified according to BS 4196 : Part 1 : 1991 and BS 4196 : Part 2 : 1991, with all the equipment in the room.

4.2 Broad-band noise

BS 4196 : Part 1 shall apply if the noise emitted by the source has a broad-band frequency spectrum without significant narrow-band or discrete frequency components.

NOTE. This is typically the case for the aerodynamic sound of the equipment to be tested in accordance with this standard.

Broad-band sound power levels shall be determined in one-third octave bands and shall be reported in both one-third octave bands and octave bands.

4.3 Noise containing discrete-frequency or narrow band components

If the noise emitted by the source is likely to contain significant narrow-band or discrete-frequency components, accurate data shall be obtained in accordance with BS 4196 : Part 2. The presence of such frequency components shall be verified following the procedures described in BS 4196 : Part 2.

5 Installation and operation of equipment to be tested

5.1 General

Units shall be located on walls or fitted above suspended ceilings, in one of three configurations:

a) open inlet, open outlet (vertical unit);

b) open inlet, ducted outlet (horizontal unit);

c) ducted inlet, ducted outlet (horizontal unit).

Before an acoustic test is carried out, the performance characteristics of the unit shall be determined in accordance with BS 848 : Part 1. Measurements of current, fan rotational speed, voltage and pressure drop across the unit shall be noted and used to define the operating test points of the unit.

For each configuration, the minimum requirements for acoustic tests shall be as specified in table 1.

NOTE. When the equipment is mounted closer than 1 m to one or more reflecting planes, the resultant sound power level may be affected by the position of the equipment relative to these planes.

5.2 Test installation of units for measurement of the sound radiated to the reverberation room

The unit shall be placed in the reverberation room in an operating position representative of normal usage (figures 1 to 4 illustrate typical test room arrangements). Requisite distances from the floor, walls and ceilings (as applicable) for normal air circulation shall be provided.

The equipment shall be located not less than 1 m from any corner of the room and not on a centre line. The manufacturer's fixing instructions shall be followed, if provided, as other mounting arrangements may alter the noise radiation conditions.

Where ducting is required, it shall be a rigid duct of the same shape and cross sectional area as the inlet/outlet of the unit, and the ducting shall be lagged where specified (see figures 3 and 4). Where inlet or outlet noise is to be determined (see figure 2), the duct shall be a set length of 0.5 m ± 0.05 m, and terminate flush with the internal wall of the reverberation room.

Table 1. Acoustic test requirements

Unit type	Test type				
	inlet (i)	outlet (o)	casing (c)	(i) + (c)	unit
open inlet/ open outlet					y
open inlet/ ducted outlet		y		y	
ducted inlet/ ducted outlet	y	y	y		

5.3 Test procedures

NOTE. Acoustic measurements of units are normally carried out at zero heat load. It is not necessary, therefore, to connect the heating or cooling medium flows, except when a special test is required. These special tests may give rise to problems with respect to determination of background noise and to establishment of the heat and moisture balance.

The integrity and stability of the electrical supply shall be maintained for the duration of the test to within ± 2.5 % of nominal voltage.

For all units, information obtained from the air performance tests, i.e. air volume, static pressure, fan rotational speed, and applied voltage to the fan, shall be used to determine the test point.

For non-ducted units with several rotational speeds, sound tests shall be performed for each speed setting (noting the applied voltage to the fan).

For ducted units, sound tests shall be performed at each speed setting (noting the applied voltage to the fan) and for a range of additional external static pressures. The minimum range of external static pressures shall be 0 %, 30 % and 60 % of the unit's maximum static pressure development.

NOTE. Static pressure loading of the unit should take place outside the reverberation room, in such a way as to minimize the load generated noise.

The test procedure shall be carried out in accordance with BS 4196 : Part 1 or BS 4196 : Part 2. Background noise levels measured without the equipment running shall be at least 6 dB below the sound pressure level to be measured in each frequency band of the frequency range of interest. Corrections for background noise shall be calculated in accordance with BS 4196 : Part 1.

All quantities that allow determination of the operating point of the unit on test shall be measured and noted in accordance with BS 848 : Part 1.

5.4 Measurements and calculations

Determination of the significance of discrete-frequency or narrow band components, qualification of the reverberation room, measurement of the sound pressure levels, and calculation of the sound power levels for all octave bands within the frequency range of interest, shall be carried out in accordance with BS 4196 : Part 1 and BS 4196 : Part 2.

NOTE. Uncertainty in the determination of sound power levels is given in table 2.

6 Information to be reported

The test report shall include at least the following:

a) the date and location (name of the test facility) of the test;

b) a description of the unit under test and the test standard used (e.g. BS 4196 : Part 1);

c) the location and mounting of the equipment under test, including a sketch of the test arrangement;

d) the atmospheric conditions, e.g. temperature, barometric pressure, humidity;

e) the operating conditions: air volume, static pressure, voltage, fan rotational speed;

f) for non-ducted units:

– the sound power level per one-third octave and octave band for all operating points of the unit;

g) for ducted units:

– the sound power level per one-third octave and octave band for all operating points of the unit, specifying, where appropriate:

1) the open inlet sound power level;

2) the combined inlet and casing sound power (casing sound power) level;

3) the open outlet sound power level;

4) the length and cross section of the test ducts (see table 1);

h) the overall A-weighted sound power level;

i) an identification of discrete frequencies.

NOTE. The sound power levels determined for the inlet or outlet condition for a unit under test are not the usual in-duct levels for fans with a ducted inlet and/or outlet as specified in BS 848 : Part 2.

Table 2. Uncertainty in determining sound power levels

Octave band centre frequencies	One-third octave band centre frequencies	Standard deviation	A-weighted
Hz	Hz	dB	dB
125	100 to 160	3.0	2
250	200 to 315	2.0	2
500 to 4000	400 to 5000	1.5	2
8000	6300 to 10000	3.0	2

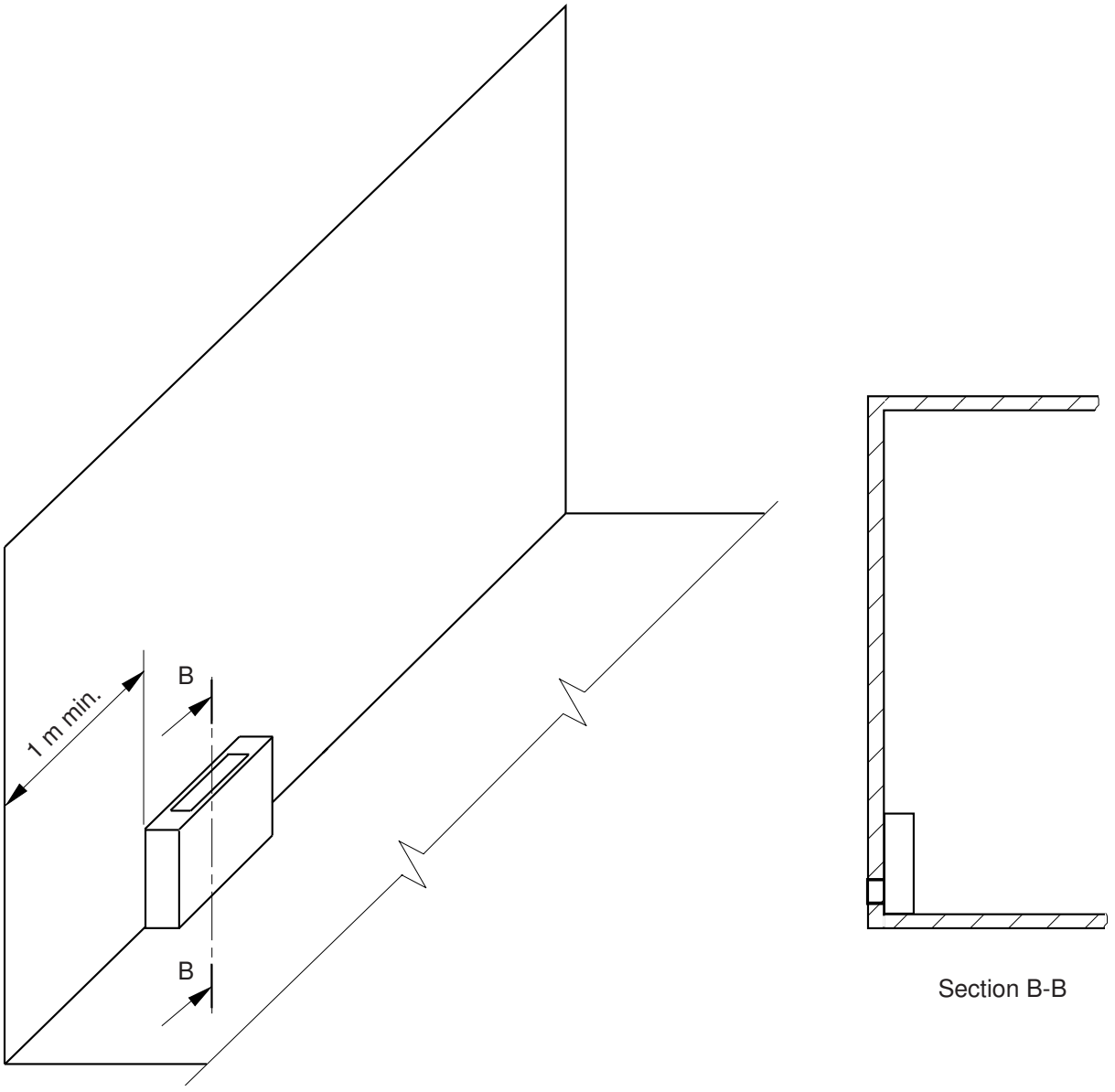


Figure 1. Typical test installation for a wall-mounted unit

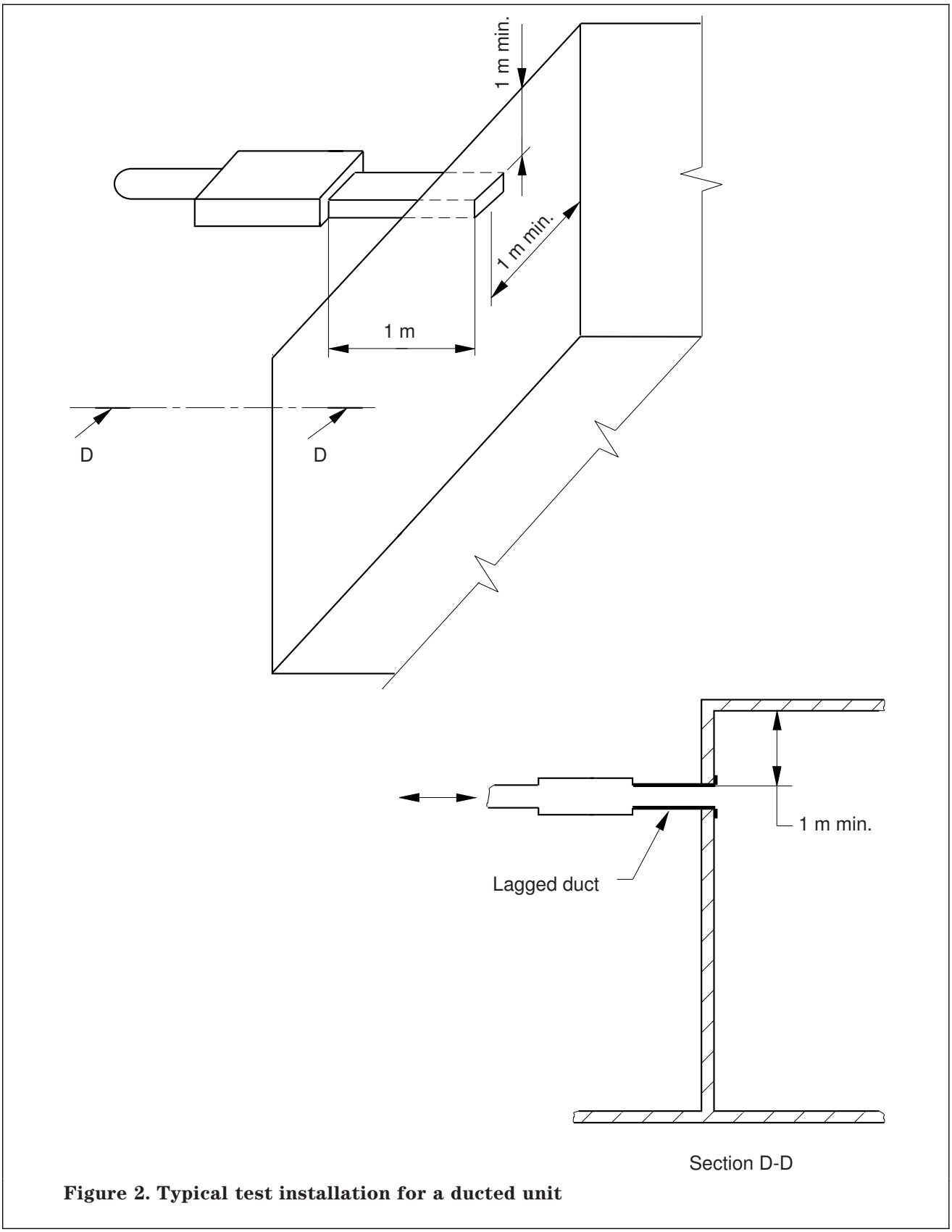
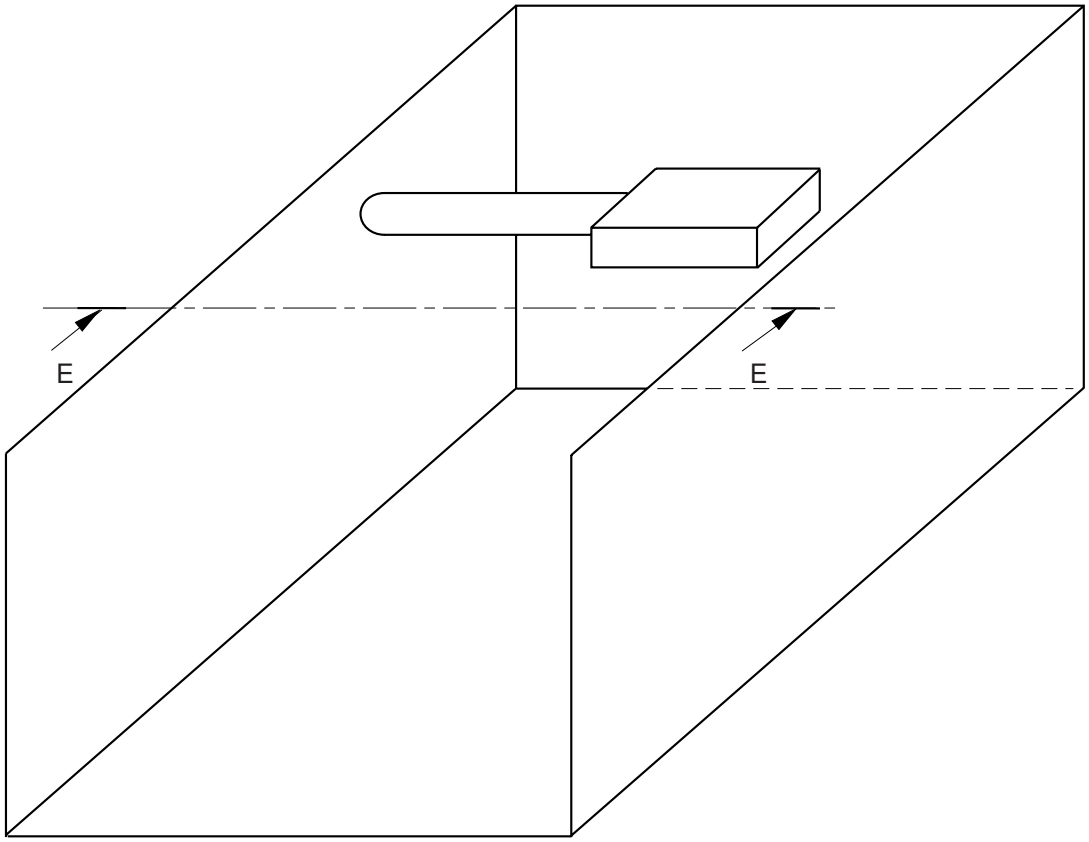


Figure 2. Typical test installation for a ducted unit



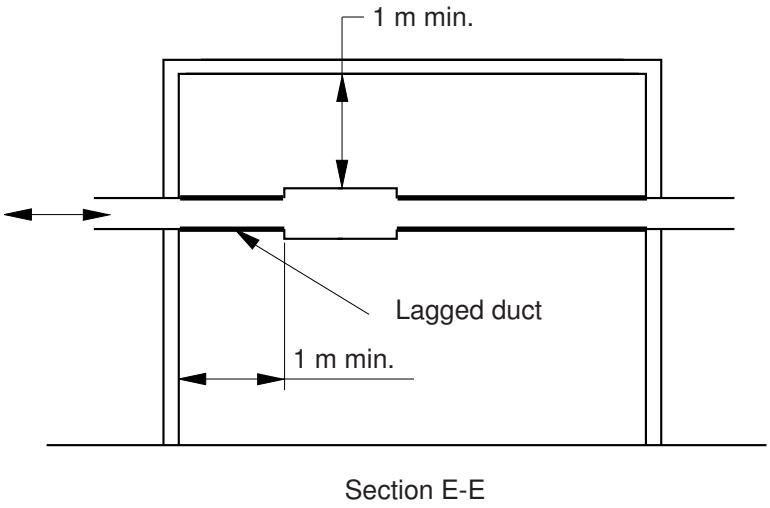


Figure 3. Typical test installation for the open inlet and case radiated noise test

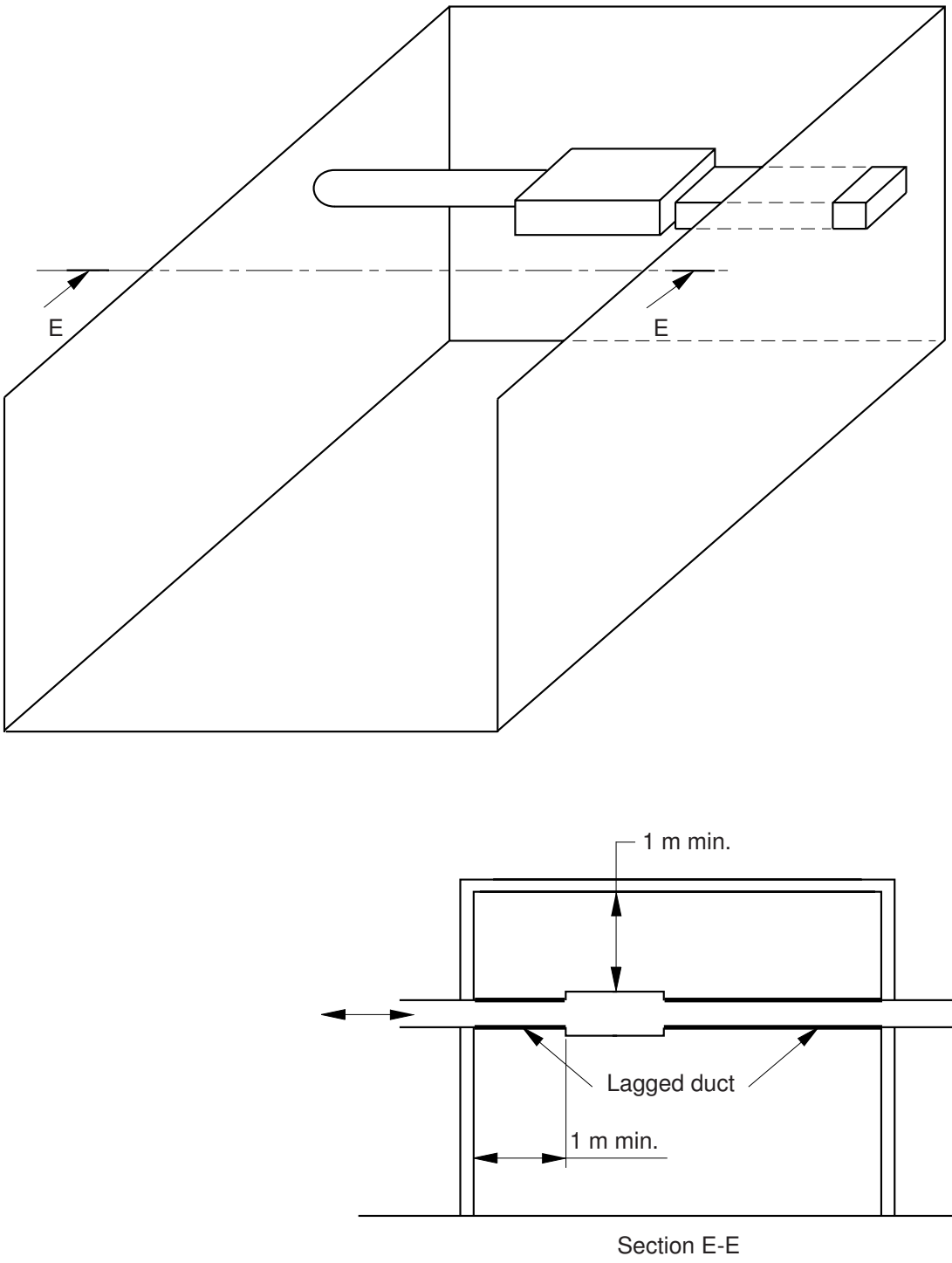


Figure 4. Typical test installation for the case radiated noise test

Annex

Annex A (informative)
Bibliography

The following standards are recommended for further reading.

BS 4856 :	*Methods of testing and rating fan coil units, unit heaters and unit coolers*
BS 4856 : Part 1 : 1972	*Thermal and volumetric performance for heating duties: without additional ducting*
BS 4856 : Part 2 : 1975	*Thermal and volumetric performance for cooling duties: without additional ducting*
BS 4856 : Part 3 : 1975	*Thermal and volumetric performance for heating and cooling duties: with additional ducting*

List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 848 :	*Fans for general purposes*
BS 848 : Part 1 : 1997	*Methods of testing performance*
BS 4196 :	*Sound power levels of noise sources*
BS 4196 : Part 1 : 1991	*Precision methods for determination of sound power levels for broad-band sources in reverberation rooms*
BS 4196 : Part 2 : 1991	*Precision methods for determination of sound power levels for discrete-frequency and narrow-band sources in reverberation rooms*
BS 4727 :	*Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms*
BS 4727 : Part 3 :	*Terms particular to telecommunications and electronics*
BS 4727 : Part 3 : Group 08 : 1995	*Acoustics and electroacoustics*

Informative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 848 :	*Fans for general purposes*
BS 848 : Part 2 : 1985	*Methods of noise testing*

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL