BM TRADA

Technical information

Acoustic testing

Achieving compliance

01 Introduction

Acoustic testing became mandatory in England & Wales in 2003, when Approved Document E was updated.

Approved Document E requires new buildings and buildings formed by a material change of use to achieve a reasonable level of sound insulation between dwellings.

There are two ways of complying with the requirements of Approved Document E, you can either build to Robust Details or have on-site pre-completion sound insulation tests conducted.

At face value, Robust Details would appear to be the obvious choice, however, Robust Details are quite limited in the range of construction types and applications. For instance, Robust Details cannot be used on a material change of use project and there are only certain combinations of wall and floor constructions that can be used together. In many cases the cost of building to Robust Details is often similar to that of having sound insulation tests conducted.

There is a level of apprehension with conducting pre-completion sound insulation tests on site, mainly due to the fear of failure. It should be noted, however, that if the design specification is followed, and a good standard of workmanship is maintained on site, there is very little chance of failure. Robust Details are equally strict when it comes to quality and specification. If you deviate from the specification, or the level or quality of workmanship is low, then it is likely that they would require on-site testing to be conducted anyway.

02 Testing regime

The results of these tests only apply to the particular constructions tested, but are indicative of the performance of the same type of construction in the same development.

As such plots within a development are divided into groups, i.e. dwelling-houses, flats and rooms for residential purpose.

These groups are then further divided into sub-groups. Sub-groups are defined by the construction of the separating wall and/or floor, and also significant differences in the construction of the rest of the building. In general though, a block of flats all of the same construction would be classified as one group. A development of houses where there are significant differences in layout and construction type would need to be divided into sub-groups as appropriate.

Approved Document E requires a minimum of one 'set' of tests for every ten units in each group and/or sub group.

For instance, if you have a block of 100 flats, all of the same construction, you would usually conduct 10 'sets' of tests. If you have a development of 25 houses, with five different sub-groups (5 units in each) then you would usually conduct 5 'sets' of tests.

A set of tests usually consists of two airborne tests of separating walls and two airborne tests and two impact tests on separating floors. If no separating floors are available, i.e. in semi-detached or terraced houses, one set of tests would consist of two airborne tests of separating walls only.

In large or phased developments it is always advisable to progress a number of units ahead of the rest, so that some testing can be done as soon as possible. These tests will then give a good indication of how the building is performing and any alterations or adjustments can be made.

03 The sound insulation testing process

BS EN ISO 140-4:1998 and BS EN ISO 140-7:1998 describe the procedures for conducting airborne and impact sound insulation testing.

To test the airborne sound insulation performance of a floor or wall, a sound source, which consists of an amplifier and loud speaker, is set up on one side of the wall or floor that is to be tested. Pink noise (similar to white noise) is then produced. Pink noise sounds like the static that can be heard on a radio that is 'off station'. This type of noise is used because it is made up of sound at all frequencies, giving an indication of performance for a wide range of sounds that may be experienced within a dwelling.

This pink noise is measured in the room which contains the sound source using a sound level meter and then is also measured on the other side of the wall or floor that is being tested. In simple terms, the difference between these two levels is the amount of sound that is stopped by the wall or floor. The result is then corrected and adjusted depending on the reverberation time (echo) of the rooms, and any background noise to give the airborne sound insulation result ($D_{nT,w}$). The poor low frequency performance correction (C_{tr}) is calculated by the testing equipment and added to the result.

To test the impact sound transmission performance of a floor, a tapping machine which consists of five small hammers that are dropped onto the floor to simulate foot fall, is placed on the floor. The resultant noise in the room below is measured with a sound level meter and the amount of noise that passes through the floor

	Airborne sound insulation $D_{nT,w} + C_{tr}$ (Minimum values)	Impact sound transmission $L'_{nT,w}$ (Maximum values)
Purpose built dwelling-houses and flats		
Walls	45 dB	-
Floors and stairs	45 dB	62 dB
Dwelling-houses and flats formed by material change of use		
Walls	43 dB	-
Floors and stairs	43 dB	64 dB

Table 1a: Dwelling-houses and flats – performance standard for separating walls, separating floors and stairs that have a separating function

	Airborne sound insulation $D_{nT,w} + C_{tr}$ (Minimum values)	Impact sound transmission $L'_{nT,w}$ (Maximum values)
Purpose built dwelling-houses and flats		
Walls	43 dB	-
Floors and stairs	43 dB	62 dB
Dwelling-houses and flats formed by material change of use		
Walls	43 dB	-
Floors and stairs	43 dB	64 dB

Table 1b: Rooms for residential purposes – performance standard for separating walls, separating floors and stairs that have a separating function

is the impact sound transmission level and is expressed as a single number. This result is then corrected and adjusted depending on the reverberation time (echo) of the rooms, and any background noise to give the impact sound transmission result ($L'_{nT,w}$).

The results of these tests are then compared to the performance criteria of Approved Document E and a pass or fail certificate is produced (see **Tables 1a** and **1b**).

04 Actions following a failed test

If pre-completion tests are conducted and the results do not satisfy the performance criteria of Approved Document E, the first action is to determine why the tests have failed.

The test engineer will usually give an indicative result on site. If the results are marginal, then it is usually beneficial to conduct additional testing there and then to try and gain a broader understanding of how the building or separating constructions are performing.

The test engineer will attempt to determine the possible causes of failure. This may be to do with detailing around services or at junctions, or simply, poor design. Once the results have been calculated and graphs produced, an acoustician (with the aid of the information from the test engineer, the results of the tests and information about the construction) should be able to determine the specific cause of failure.

Once a specific reason for failure has been determined, the acoustician can then advise the client on remedial actions that can be undertaken.

05 Construction types and common site issues

There are two main types of construction, lightweight frames and joists, either timber or metal, or heavyweight blockwork and concrete.

5.1 Lightweight walls

Lightweight walls work by providing separation between two independent frames that are clad on either room face with plasterboard. The combination of the mass of the plasterboard and the separation between the frames provides good all round performance.

One of the main details that can cause issues are service penetrations through the wall linings, i.e. switch socket backing boxes which allow sound to pass in and out of the wall. Typically the switch socket backing boxes are fitted to noggings that are lined with plasterboard which continues the line of plasterboard behind the backing box and helps to maintain performance. It is also important that services are not installed back to back on a party wall.

If lightweight framed walls are installed within a masonry construction, care must be paid to the junction of wall linings and the surrounding constructions. Deflection head details are often specified which call for a gap between the top of the wall and the underside of a masonry floor slab. These gaps allow sound to easily pass though the head of the wall and lead to greatly reduced performance. Manufacturer installation instructions and best practice guides should be closely followed when installing for best results.

Socket backing boxes can allow sound to pass in and out of walls.

Manufacturer installation instructions and best practice guides should be closely followed when installing for best results.

Small gaps at blockwork joints reduce overall performance.

The floating floor layer must not come into contact with any of the surrounding structure.

5.2 Heavyweight walls

Heavyweight walls usually consist of one or two leaves of dense blockwork. The density and mass of the wall absorbs sound energy that is passing through. This mass works well at reducing low frequency (bass) sounds and gives good all round performance.

One of the main causes of reduced performance is small air gaps at blockwork joints. These small gaps allow high frequency sound to pass though and reduce overall performance. As such, a parge coat or wet plaster finish helps to block and fill these small gaps.

Deflection head details can also be an issue with masonry walls. As with lightweight walls, these deflection heads must be tightly packed with dense mineral wool and sealed with a cover strip where possible.

5.3 Lightweight floors

As with lightweight walls, the performance of floors is based on mass and isolation. Typical floor specifications call for a 'floating floor' and a resilient bar ceiling. A floating floor consists of either foam clad timber battens on which the floor deck rests or a layer of dense mineral wool. This provides isolation and absorbs foot fall energy. The floor deck usually consists of a laminate of plasterboard and chipboard. It is important that this floating deck does not come into contact with the surrounding structure to ensure that the isolation created by the resilient battens or mineral wool is not bridged.

Ceilings are typically clad with two layers of plasterboard fixed to the underside of the joists via metal resilient bars. These bars again help to provide isolation between the ceiling linings and the floor structure.

5.4 Heavyweight floors

Typically, heavyweight floors consist of precast concrete floor planks or a poured in-situ reinforced concrete slab. With precast concrete planks, it is important to grout between the planks to maintain the integrity of the floor structure.

Both of these floors are usually overlaid with a resilient layer of foam and then a screed is poured on top. As with the lightweight floors, it is important that this floating layer does not come into contact with any of the surrounding structure.

Ceilings usually consist of a layer of plasterboard fitted to a metal framed ceiling system.

06 Who should perform the tests?

Approved Document E states that pre-completion testing bodies should be third party accredited (ideally though UKAS). Members of the ANC (Association of Noise Consultants) Registration Scheme are also regarded as qualified. Most Building Control Officers will require evidence of competence on submission of the sound insulation test reports.

07 Related services

- Acoustic testing for acoustic performance of schools (BB93) and healthcare premesis (Health Technical Memorandum 08-01)
- Air tightness testing
- Energy assessment (SAP, SBEM, EPC, DEC, etc.)
- Thermographic survey.

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testing@bmtrada.com

bmtrada.com

+44 (0) 1494 569800

CHILTERN INTERNATIONAL FIRE LTD CHILTERN HOUSE, STOCKING LANE, HUGHENDEN VALLEY, HIGH WYCOMBE, BUCKS, HP14 4ND, UK