

Most consultants who carry out building acoustics testing will be familiar with the use of tapping machines, which are used for determining footfall noise transmission between vertically adjacent spaces.

These have been in use for many years and allow a single number quantity to be determined for assessing the effectiveness of a floor construction. However, there are situations where the subjective response of floors does not correlate well with the measured data obtained using tapping machines.

Anecdotal evidence from residents and respondents show that noise generated by certain types of impacts (such as those of children jumping and people walking in bare feet) do not always agree that good levels of impact sound insulation have been delivered.

Alternative methods for testing

The primary cause of these discrepancies is often due to impacts that have a lot of energy in low frequencies, when compared to the more normal types of impact sound transmission. To attempt to overcome these low frequency discrepancies, ISO 10140-3:2010 introduced alternative methods for impact sound insulation testing that

can be used where the aim is to have a strong correlation between a ‘real’ source (e.g. a child jumping or someone walking in bare feet) and the source used for testing. These methods require either the modification of a tapping machine or using a dedicated rubber ball.

BS EN ISO 16283-2:2018 was introduced in February 2018 to detail the latest procedure to be used for the field measurement of impact sound insulation and replaced the procedure from ISO 140-7, which was withdrawn. ISO 16283-2:2018 refers to the use of these alternative methods for assessing ‘heavy, soft’ impacts; however, only the rubber ball method is included within the Standard, so the use of modified tapping machines may not be used for field sound insulation testing. Within this article, the rubber ball will be examined and the difference between it and the tapping machine will be discussed.

Rubber ball spec

The rubber ball allowed to be used for field sound insulation tests consists of a hollow ball of 180 mm diameter and 30 mm in thickness and a mass of 2.5 kg. The ball is dropped from a height of 1 m above the floor under test. An example of the type of ball which can be used for the testing is shown in Figure 1.

The specification for the rubber ball, including the material type and the force input characteristics and the frequency response are all given in ISO 10140-5:2010. These types of ball are now available as standard items of equipment from many manufacturers. A quick internet search in preparation for this article found them listed on the websites of many of the major manufacturers, including Norsonic, Rion and Svantek.

Testing methods

The differences in the testing methods when compared to those required for using a tapping machine are not great. When measuring the sound pressure level in the receiving room using a rubber ball, the Standard requires at least four source positions, which is the same as when using a tapping machine. The receiving room measurements should be carried out using fixed microphone locations, either hand-held or tripod mounted, which are also permissible when using a tapping machine. The tapping machine additionally allows the use of mechanically or manually swept microphones, which cannot be used when using the rubber ball as the source.

The first big difference between the two source methods is the metric used to measure the sound pressure in the receiving room. **P34**

Main image (on page 30): Anecdotal evidence from residents and respondents show that noise generated by certain types of impacts (such as those of children jumping) do not always agree that good levels of impact sound insulation have been delivered

Below: Figure 1: Example of a rubber ball for impact sound insulation testing (pictures courtesy of Norsonic).



The tapping machine requires the use of an energy-averaged sound pressure level, whereas the rubber ball uses the maximum sound pressure level measured with a fast time weighting and energy averaged across each source position. The methods used for measuring the reverberation time of the receiving room are identical for both the tapping machine and the rubber ball.

The major difference with using a rubber ball when compared to a tapping machine is the frequency range which the measurements cover. For a conventional tapping machine, measurements are carried out in the frequency range covering the one-third octave bands between 100 Hz and 3150 Hz, which can be extended to cover 50 Hz to 5000 Hz, with the additional low frequency range requiring a special procedure for rooms with a volume of less than 25 m³. The frequency range for the rubber ball covers the one-third octave bands between 50 Hz and 630 Hz.

The low frequency procedure for a tapping machine requires additional measurements in the corners of rooms of a defined volume (<25 m³), whereas the rubber ball does not require these additional measurements to cover the lower frequency bands. This difference may yield savings in surveys times when carrying out field measurements.

When presenting the results from the impact sound insulation testing, the results from using a tapping machine are presented in terms of L'_n in one-third octave bands between 50 Hz and 5 kHz, and when rating in accordance with

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ISO 717-2, allows the calculation of a single number rating, $L'_{n,w}$. These can either be presented as the standardised values or normalised for reverberation time.

When using the rubber ball, the results are presented as a standardised maximum sound pressure level $L'_{i,Fmax,VT}$ in one-third octave bands between 50 Hz and 630 Hz. The standards do not currently allow for the calculation of a single number rating for impact sound insulation when using a rubber ball as the source.

Interpretation of data

One aspect of using a rubber ball that needs to be borne in mind is that there are currently no guidance values within Standards against which to assess the measured data. Therefore, the interpretation of any data acquired by this method will need to be assessed by the practitioner. Most of the Standards and guidance used in the UK are based on carrying out impact sound insulation tests with a tapping machine as the sound source. This means that until guidance values are published, it is unlikely that the rubber ball will see much use as part of a standard suite of tests for sound insulation.

Building Regulations compliance

The important aspect of any instrumentation is where it would be most useful and save practitioners time. The current revision of the Building Regulations includes Approved Document E, which was last amended in 2015. This version states that impact sound insulation testing should be carried out in accordance with ISO 140-7:1998,

which has now been withdrawn and does not include for using the rubber ball.

Therefore, any measurements done for Building Regulations compliance should be done according to the

withdrawn Standard, at the time of writing this article. This will preclude the use of the rubber ball for the measurements that would most likely benefit from its use. However, there will be other situations where impact sound insulation testing is required, and the use of the new Standard will allow the rubber ball to be used and may be useful for assessing the performance of heavy, soft impacts. However, any such measurements should be undertaken with the consideration of there being any guidance values against which to assess the results, which may limit the usefulness of the results.

Results

Developers and regulators prefer the use of single number values when setting regulations or contract specifications as it makes it simple to decide if something has passed or failed. The results from rubber ball tests do not currently have single number values to assess against, which limits their use in many circumstances. But their use does give developers the opportunity to give further evidence of the performance of their buildings beyond that required by the Building Regulations. But widespread adoption may be limited until a better evidence base exists to compare results against.

Evidence from impact sound insulation testing indicates that the use of tapping machines may not always provide results that, while compliant with the Building Regulations, correlate well with the subjective response of residents. The rubber ball has been introduced in Standards to attempt to address this potential shortcoming of the tapping machine method. However, the lack of guidance values against which to assess the results from the rubber ball, alongside the method yet being adopted in the Building Regulations, may mean that the rubber ball will not become a regularly used item of instrumentation for many years. ©

BELOW: The ball is dropped from a height of 1 m above the floor under test

