# ISO 13347 : The new standard for measuring noise by reverberant room, enveloping surface and intensity methods

**Alain Guédel,**
*CETIAT,*
*Domaine scientifique de la Doua,*
*25, Avenue des Arts,*
*BP 2042,*
*69603 Villeurbanne CEDEX,*

The purpose of ISO 13347, which is being drafted by ISO/TC 117 - WG "Acoustics", is to define laboratory test methods for determining the airborne sound power level radiated in each 1/3 octave frequency band by industrial fans. This standard has been established by using existing national standards i.e. BS 848 Part 2, DIN 45 635 Part 38, NF S 31-021 and AMCA 300 and 320, which themselves are based on general acoustics standards drawn up under the responsibility of ISO/TC 43.

The text of the standard comprises four distinct parts, a general introduction and presentation of the three test methods adopted, i.e. the reverberant room, enveloping surface and intensity methods. Details of these four parts are given below.

## Part 1 : General overview

Part 1 presents the objectives, field of application and general principles that are common to the different test methods.
The Standard 13347 describes the assembly and test conditions and the calculations for determining the sound power per 1/3 octave or octave band emitted by the free fan inlet and/or outlet as well as by the fan casing. In compliance with international terminology, used in particular in ISO 5801 [1], we can distinguish four installation categories for the fans:

- Type A: free inlet, free outlet
- Type B: free inlet, ducted outlet
- Type C: ducted inlet, free outlet
- Type D: ducted inlet, ducted outlet.

The level of inlet noise being generally different from the level of outlet noise and different from the casing noise, enables up to 12 different sound power levels to be distinguished on a single fan. Fan in-duct levels cannot be determined accurately from ISO 13347. It is much more preferable in this case to use ISO 5136 [2] which is adapted for that. This standard has been revised in 2000 following a research work carried out in Germany by Neise [3]. For small unducted fans (type A), ISO 10302 [4], based on measurement with the aid of a mylar plenum, is recommended.
ISO 13347 does not apply to fans such as ceiling fans and table fans, for which IEC 60704-2-7 is best adapted, nor to jet fans, which can be tested in accordance with ISO 13350. ISO 13347 is first of all aimed at measuring fan noises on standardised test installations with engineering grade accuracy. This Standard does not deal with fan noise measurements on-site, even if we can use it to carry out such measurements, bearing in mind that the uncertainty of the result will be greater than on standardised installations.

As the noise level of a fan is highly dependent on its operating point, it is essential to be able to measure the aerodynamic performance of the fan, in accordance with ISO 5801, simultaneously with the acoustic performance. The specifications of the ducts and test assemblies described in this standard enable these measurements to be carried out simultaneously.
Whenever the fan is connected to an inlet and/or an outlet duct in which no sound pressure measurements are being taken, this duct, called a terminating duct, must be equipped with an anechoic termination in order to impose a well defined acoustic impedance and to thereby minimise the duct-end reflections that would distort the measurement of sound power radiated by the

fan on the opposite side. The performance of the termination equipping a terminating duct does not need to be as good as that of a true anechoic termination mounted on a test duct (a duct in which sound pressure measurements are carried out in order to determine fan in-duct sound power levels), to the extent that a simplified anechoic termination can be used, the characteristics of which are described in ISO 13347.

## Part 2 : Reverberant room method

This part of the standard gives details of the method for measuring the sound power level radiated by the free inlet and/or outlet and by the casing of the fan in a reverberant room. It takes up the guiding principles of the North American standard AMCA 300 while relying on the general acoustics standard ISO 3743.
The environment of the fan to be tested must be sufficiently reverberant to satisfy a qualification procedure for the test room described in this part.
The method used is the method by comparison using a reference sound source, in accordance with the principle of ISO 3743-1. It is based on the fact that, in a given acoustic environment, the difference by frequency band between the sound power and the sound pressure is constant whatever the source of the noise.
Therefore, in the test room, a measurement is taken of the fan sound pressure level spectrum at the operating point required as well as the spectrum of the reference source and, knowing the sound power of the reference source, a calculation can be made of the sound power spectrum of the fan. In practice, the fan and reference source sound pressure spectra are measured in several discrete positions (or by continuous circular scanning) in the room and a spatial average of the measured spectra is carried out. In an “ideal” reverberant room the measurement on a single point would suffice, the sound pressure level being constant throughout the room.

Providing a suitable environment is available, this method is very practical to implement and certainly the one that, amongst all the different methods proposed in ISO 13347, leads to the shortest test period.

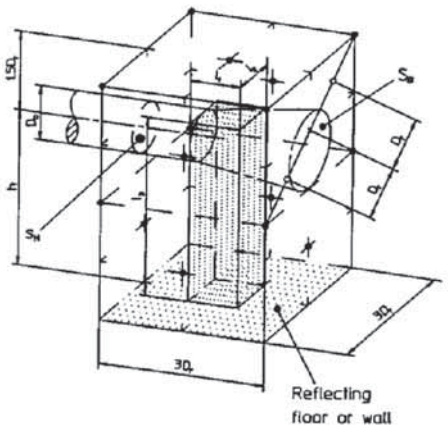


**Fig. 1: Enveloping surface method - Rectangular parallelepiped**

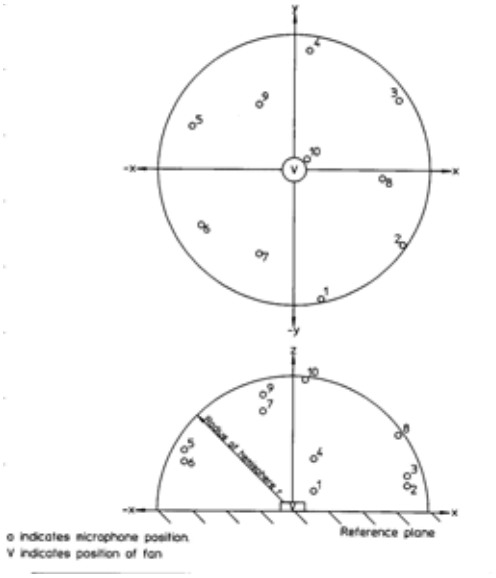


**Fig. 2 : Enveloping surface method - Large hemisphere**

## Part 3 : Enveloping surface method

This method is based on ISO 3744 by using the assembly and test conditions of the Acoustics Standards for fans BS 848 Part 2, DIN 45635 part 38 and NF S 31-021. The test environment must be in compliance with the ISO 3744 specifications, i.e. being close to an acoustic environment of the free field type with one or several reflecting planes. In practice, measurements can be made both outside as well as inside the premises providing there is sufficient space around the fan and that the background noise is lower than the fan noise in each frequency band by at least 6 dB.

The sound power spectrum radiated by the fan is determined from the measurement of the sound pressure spectrum averaged at several points on a measuring surface surrounding the fan. Three different measuring surfaces are recommended in the standard: a rectangular parallelepiped (Figure 1), a large hemisphere resting on a reflecting surface (Figure 2) and a small hemisphere surrounding the fan air inlet (Figure 3).

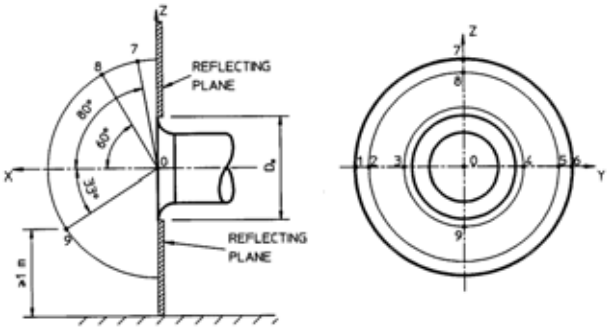


**Fig. 3 : Enveloping surface method - Small hemisphere**

In order to obtain the sound power spectrum of the fan, the test site must first of all have been qualified by determining the band environmental correction K2 (in dB) as defined in ISO 3744. This correction is obtained using a reference sound source, mounted in place of the fan, based on the

fact that, as already pointed out for the reverberant room method, in a given environment, the difference between the sound power and sound pressure levels is independent from the noise source.
The advantage of this method in comparison to the other two is that it does not need a specific acoustic environment or a special measurement device. It only requires the background noise level to be sufficiently low in relation to the fan noise.

## Part 4: Sound intensity method

This method is based on the principles of ISO 9614 and follows the specifications of AMCA 320 draft standard. It is based on the measurement of the sound intensity on a surface surrounding the fan, and necessitates having a sound intensity probe available with a properly adapted means of treatment. The test room must not be too reverberant, if not the method is inapplicable.
In order to qualify the system of measurement, the appropriateness of the site as well as that of the test operator, the sound measurements are conducted not only with the fan itself, but also with a reference sound source mounted in the test room in place of the fan. The difference between the sound power of the reference source measured by the intensity method and its power obtained from a calibration enables the correction of the power measurement carried out on the fan to be made, according to the same principle as that of the reverberant room method.

The advantage of this method in comparison to the two preceding methods is that it does not require a specific test room and that it is much less demanding in terms of background noise. On the other hand, it requires a properly adapted device and more thorough training for the test operator.

## Conclusion

The objective of ISO 13347, which is in the process of being drawn up by the WG2 of ISO/TC 117, is to offer manufacturers and fan integrators a certain number of standardised test methods enabling the sound power radiated by the free inlet or outlet and the casing of fans to be quantified. These methods are rigorous from a scientific point of view, because they are based on the principles of general acoustics standards drawn up by ISO/TC 43, and they are also adapted to industrial requirements because they aim in particular to allow for the simultaneous measurement of aerodynamic and acoustic fan performances. They also aim to simplify test assemblies and procedures as much as possible.

## Bibliography

**[1] ISO 5801: Industrial Fans - Performance testing using standardised airways (1997)**

**[2] ISO 5136: Acoustics - Determination of sound power radiated into a duct by fans and other air-moving devices - In-duct method. (2000)**

**[3] W. NEISE: The revised edition of ISO 5136 – Induct noise measuring standard for air moving devices – IMechE Seminar Publication 2000-14 (2000)**

**[4] ISO 10302: Acoustics - Method for the measurement of air-borne noise emitted by small air-moving devices (1996)**