AUSTRALIAN ENVIRONMENT COUNCIL

TECHNICAL BASIS FOR THE REGULATION OF NOISE LABELLING OF NEW AIR CONDITIONERS IN AUSTRALIA

JULY 1984

This document has been prepared by the Environmental Noise Control Committee (ENCC), which is one of a number of specialist committees established to provide advice to the AEC, through Standing Committee, on specific areas of environmental concern.

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TECHNICAL BASIS FOR THE REGULATION OF THE NOISE LABELLING OF NEW AIR CONDITIONERS IN AUSTRALIA

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1. SCOPE

1.1. This document specifies the test procedures to be used in determining the noise rating (external sound power level) and hence, label - for each air conditioner manufactured or assembled in, or imported into Australia.

1.2. The requirements apply to all air conditioners of less than 12kW cooling capacity manufactured on or after ..... and intended or offered for sale in Australia.

1.3. The cooling capacity shall be determined by the method contained in AS1861-1981. Nominal thermal conditions shall be those in Table 3.1 operating condition A of that standard.

2. DEFINITIONS

2.1. In this document -

Absorption Coefficient: The ratio which the sound energy absorbed by a surface or material bears to that incident upon it at a given frequency and under specified conditions.

Air Conditioner: A split or packaged mechanical system capable of controlling air temperature and distribution and which may also control the humidity and cleanliness of the air to meet the requirements of the conditioned space, but excluding evaporative type units and heating only units.

Comparison Method: That method in which the sound power level is calculated by comparing the measured sound pressure levels produced by the source in a reverberation room with the sound pressure levels produced in the same room by a reference sound source (RSS) of known sound power output.

Direct Method: That method in which the sound power level is calculated from the measured sound pressure levels produced by the source in a reverberation room and from the volume and reverberation time of the room.

External Sound Power Level: The total sound energy radiated per unit time outside the room being heated or cooled by the air conditioner.

Frequency Range of Interest: The frequency of interest includes the octave bands with centre frequencies between 125 Hz and 8000 Hz.

Reverberation Time: The period of time required for the mean square sound pressure in the enclosure, initially in a steady state, to decrease, after the source is stopped, to one-millionth of its initial value, i.e. by 60 dB. The unit is the second.

Sound Power Level: Ten times the logarithm to the base 10 of the ratio of a given sound power to the reference sound power. The reference sound power is 1 pW. Unit: decibel (dB).

Sound Pressure Level: Ten times the logarithm to the base 10 of the ratio of the mean-square pressure of a sound to the square of the reference sound pressure. The reference sound pressure is 20 μPa. Unit: decibel (dB).

Tonal Component: Any one-third octave A - weighted band with a sound pressure level that exceeds the arithmetic average of the two adjacent one third octave A - weighted band sound levels by more than 5 dB.

3. NOISE MEASUREMENT CONDITIONS

3.1. Instrumentation

3.1.1. Sound measuring equipment shall comply with the appropriate standards as follows:

(a) Sound level meters or similar equipment - AS1259 - 1982, Sound Level Meters Type 1, Precision.

(b) Octave-band pass filters or similar equipment - AS Z41, Octave, half Octave and One-third Octave Band Pass Filters Intended for the Analysis of Sound and Vibrations.

The 'slow' averaging time of the sound level meter shall be selected except that longer averaging times may be used to facilitate time averaging of sound pressure level readings.

Where measurements are made using a continuously traversing microphone, the averaging time shall not exceed one tenth of the traversing time, except that in the case of a room which has insignificant spatial variance a single continuously integrating average may be taken over an integral number of traverse periods.

3.1.2. The accuracy of the sound measurement equipment shall be checked by means of a suitable acoustic calibrator as recommended by the manufacturer of the sound level meter or equivalent. Checks shall be made not more than 30 minutes before and after any measurement is made.

In the case where the sound measuring equipment registers a discrepancy exceeding 1 dB between two consecutive checks, any measurement carried out in the interval between those two checks shall be deemed invalid.

3.1.3. The sound measuring equipment shall have been calibrated in a laboratory equipped for the purpose within the two years prior to the date of any test.

3.2. Test Environment

3.2.1. Test Area The tests shall be conducted in a reverberant room. (Except tests for tonal components, ref 5.1.2).

3.2.1.1. Volume of the Test Room The required minimum volume based on consideration of the physical size of the air conditioner and on the wavelengths of the lowest frequency band being measured is 150 m^3. In some cases however, other considerations will determine the physical dimensions of the room. In particular, see Clause 3.2.2., 3.2.3.

3.2.1.2. Shape of the Test Room The shape shall be:

(a) Rectangular with the ratio of any two dimensions not equal to an integer, or

(b) Rectangular with sufficient diffusing elements introduced, or

(c) Skew shape with no two surfaces parallel

Note: Ratios of 3:2:5 and 1:2 1/3: 4 1/3 for height, width and length of a rectangular room have been found to give good results.

3.2.1.3. Absorption Coefficient of the Test Room

The average sound absorption coefficient of all surfaces of the test room shall not exceed 0.06 over the frequency range of interest, except that in the 125 Hz and 250 Hz bands a maximum 0.15 is permissible.

3.2.2. Air conditioner Position Since the air conditioner under test is generally associated with the one reflecting plane on which it is mounted, it shall be placed in a corresponding position in a surface of the test room with only the external part of the air conditioner in the room, at least 0.3 m from the centre of said surface, and at least 0.8 m away from all other surfaces of the test room. The unit shall be mounted using brackets and other equipment recommended or supplied by the manufacturer and shall not be mounted in such a way as to allow significant leakage of air around the unit, or excessive vibration of the unit during operation. The test room shall be cleared of all objects which may interfere with the measurements.

3.2.3. Microphone Positions The microphone system shall consist of:

(a) an array of at least six fixed microphones or six predetermined microphone locations for a single movable microphone. Positions must be spaced not less than 1.5 m from the acoustic centre of the test unit, not less than 1.4 m from each other and not less than 0.7 m from any room surface, or

(b) a single microphone continuously traversing a similar space. At least six measurements shall be made over a path length of at least 8 m, and the points which mark the commencement of each measurement shall be equally spaced along the path. The microphone shall not pass within 1.5 m of the acoustic centre of the unit under test nor within 0.7 m of any room surface.

3.2.4. Ambient Sound The ambient sound pressure level in each octave band under consideration within the test room should be at least 10 dB below the level attained when the unit under test is running. Where the ambient is within 10 dB of the level with the unit running, the result shall be corrected according to the following table:

Difference between levels	Correction to be subtracted from sound pressure level of source
6	1.3
7	1.0
8	0.8
9	0.6
10	0.4

3.3. Operating Conditions The unit under test shall be operated as follows:

3.3.1. The unit shall be operated continuously for at least five minutes before any sound level measurements are made.

3.3.2. When the unit has only a cooling cycle the controls shall be set for maximum cooling.

3.3.3. When the unit has both cooling and heating cycles, the controls shall be set to either maximum cooling or maximum heating, whichever produces the greater sound power level.

3.3.4. The compressor and fan(s) shall be operating continuously during the test and fans shall be operated at the highest available speed setting. (If necessary, the thermostatic cut-out on the compressor may be by-passed or made inactive in order to ensure continuous compressor operation.)

3.3.5. Air vents on the unit shall be closed during sound level measurements.

3.3.6. No ice shall be visible on any part of the unit during sound level measurements.

3.3.7. If the unit has a water trough it shall be filled.

4. NOISE LEVEL DETERMINATION

4.1. Tests shall be conducted to determine the external sound pressure levels and hence sound power levels in each octave band in the frequency range of interest. Either the direct method or comparison method of testing shall be used.

4.2. Direct Method

4.2.1. When measuring the reverberation time of the room, a sufficient number of decays shall be measured to ensure reliability of reverberation time T.

4.2.2. In the case of fixed microphone positions (including a traversing microphone which halts) the time-averaged sound pressure level at each position shall be measured over a period of at least 30 s for the 125 Hz band and 10 s for the other bands. In the case of a continuously traversing microphone the measurements shall commence as the microphone passes each of the several predetermined positions on its path, except as provided for in 3.1.1.

4.2.3. Computation of Mean Sound Pressure Level (L_p)

If the range of the values (L_i) of the sound pressure levels is less than 6 dB the test room may be assumed to be suitable for measuring the sound power of the unit concerned. Also a simple arithmetic average may be taken, that is:

$$L_p = \frac{1}{N} \sum L_i$$

If the range of values is 6 dB to 10 dB inclusive, the mean sound pressure level L_p shall be determined as:

$$L_p = 10 \log_{10} \frac{1}{N} \sum 10^{.1Li}$$

If the range exceeds 10 dB, the sound field deviates too far from uniformity to be used for accurate measurement of sound power, and the test room is unsuitable for the unit under test.

4.2.4. Computation of Sound Power Level(L_W)

The sound power level can then be calculated as follows:

$$L_W = Lp - 10 \log_{10} \frac{T}{To}$$

$$+ 10 \log_{10} \frac{V}{Vo} + 10 \log_{10} \left(1 + \frac{S\lambda}{8V} \right) - 14$$

In this formula -

L_W is the sound power level of the machine under test re 1 pW

$Lp = 20 \log_{10} \frac{Pm}{Po}$, the mean sound pressure level of the machine under test with respect to Po = 20 μPa

T = reverberation time in seconds of the test room

To = 1 second

V = volume of the room in m^3

$Vo = 1\ m^3$

S = surface area of room surfaces in m^2

λ = wavelength of sound at centre frequency of octave band, in m.

4.3. Comparison Method

4.3.1. The mean sound pressure level in each band shall be determined for both the unit under test and a reference sound source of known sound power Wr by following the procedure of 4.2.1 and 4.2.2.

The Reference Sound Source shall be positioned as closely as possible to (but not within .8 m of) the unit being tested.

4.3.2. The sound power level is then calculated as follows:

$$L_w = L_p + L_{wr} - L_{pr}$$

where

L_w is the sound power level of the unit under test re 1 pW.

$Lp = 20 \log_{10} \frac{Pm}{Po}$, the mean sound pressure level with respect to Po = 20 μPa.

$L_{wr} = 10 \log_{10} \frac{Wr}{Wo}$, the sound power level of the reference source with respect to Wo = 1 pW.

$Lpr = 20 \log_{10} \frac{Pmr}{Po}$, the mean sound pressure level of the reference source with respect to Po = 20 μPa.

5. DETERMINATION OF SOUND POWER LEVEL

5.1.1 The A-weighted sound power level L_{WA} in decibels re 1 pW of the unit shall be calculated as follows:

$$L_{WA} = 10 \log_{10} \sum_{j=1}^{7} 10^{0.1 (Wj + Bj)}$$

Wj is the sound power level in the octave band with centre frequency f_j Hz, and the values of Bj are as tabulated

j	f_j	Bj
1	125	-16.1
2	250	- 8.6
3	500	- 3.2
4	1000	0
5	2000	+ 1.2
6	4000	+ 1.0
7	8000	- 1.1

5.1.2(a)The L_{WA} shall be adjusted by +5 dB(A) when the noise of the unit under test has one or more tonal components.

Tonal components may be verified by free field testing of the unit with 1/3 octave band analysis.

5.1.2(b)The resulting L_{WA} shall be adjusted to a whole number as follows:

fraction	rounding
< 0.5	down to whole number
≥ 0.5	up to whole number

5.2 Where measurements have been made on both cooling and heating cycles, the higher of the two A-weighted sound power levels shall be used for the purposes of the label.

5.3 The Outside Sound Power Level shall be the A-weighted sound power level L_{WA} adjusted in accordance with the requirements of parts 5.1.2(a), 5.1.2(b) and 5.2 of this Technical Basis.

6. LABEL FORMAT

6.1. The Sound Power Level of a unit shall be displayed on a label with dimensions 6 cm x 10 cm. The Sound Power Level number shall be displayed in figures at least 1 cm high.

6.2. The label shall have a permanent clearly visible black legend on a white or a polished metal background.

6.3. The label shall have the format indicated below:

OUTSIDE SOUND POWER LEVEL **80** dBA
(LOWER LEVELS MEAN LOWER OUTSIDE NOISE) THE LEVEL SHOWN ABOVE MAY BE USED TO ESTIMATE WHETHER THE OUTSIDE NOISE FROM THE PROPOSED INSTALLATION OF THIS UNIT WILL BE WITHIN ACCEPTABLE LIMITS **CONSULT YOUR SUPPLIER BEFORE INSTALLATION**
(MANUFACTURER) (MODEL No.)

7. REQUIREMENTS RELATING TO LABELLING OF NEW A/C's

7.1. All air conditioning units covered by this Technical Basis shall have securely affixed to the air conditioner in a conspicuous manner, a metal label on which is displayed in the above form the Outside Sound Power Level which will not be exceeded by the unit when determined in accordance with this Technical Basis.

7.2. All air conditioning units covered by this Technical Basis shall have securely affixed to the outer packaging of the air conditioner, in a conspicuous manner, a label on which is displayed in the above form the Outside Sound Power Level which will not be exceeded by the unit when determined in accordance with this Technical Basis.

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