EUROVENT 8/6 - 1984

ACOUSTICAL MEASUREMENTS OF SPLIT SYSTEM TYPE ROOM AIR CONDITIONERS IN REVERBERATION ROOMS

EUROVENT 8/6

First Edition 1984

Published by EUROVENT/CECOMAF
15 rue Montorgueil
F-75001 PARIS
Tel 33 1 40 26 00 85
Fax 33 1 40 26 01 26

TABLE OF CONTENTS

1. PURPOSE

The purpose of this document is to describe a method for the determination of the sound power of split system-type room air conditioners. The sound power level is calculated in frequency bands from sound pressure measurements in a reverberation room.

This method gives no information regarding the directivity.

2. USE OF DATA

The primary use of the sound power level data obtained from these tests is for the comparison of the noise levels generated by various units.

As the method does not yield information regarding directivity, the sound power level must be employed cautiously for the prediction of the sound pressure level. Generally reverberant sound pressure level may be reliably predicted, but near field and direct field sound pressure levels will require additional directivity informations.

3. DEFINITIONS

3.1 Split system-type room air conditioned

Equipment designed to provide free delivery of conditioned air to an enclosed space. It includes a source of refrigeration for cooling and dehumidification and a means for the circulation and the cleaning of air. The compressor and the condenser are arranged together as an outdoor unit, while the evaporator is inside the building. *(see fig. 1)*

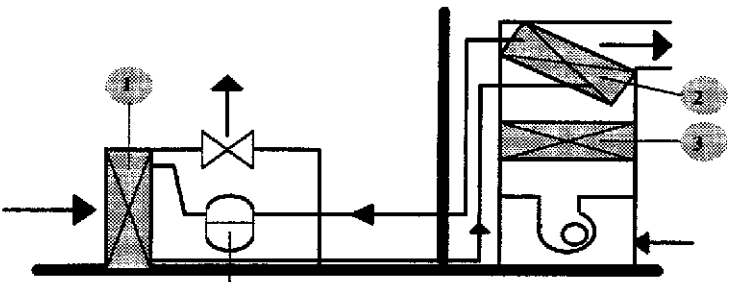

Fig. 1

3.2 Sound pressure level L_p

$$Lp = 20 \log_{10} \left(\frac{p}{p_o}\right) \quad (dB)$$

where

p is the mean square sound pressure (Pa)

p_o is the reference sound pressure (2.10^{-5} Pa)

3.3 Sound power level L_W

$$L_W = 10 \log_{10} \left(\frac{W}{W_o}\right) \quad (dB)$$

where

W is the sound power (W)

W_o is the reference sound power (10^{-12} W)

3.4 Fresquency range of interest

The frequence range of interest in this document includes the octave bands with centre frequencies from 125 to 8000 Hz.

125	250	500	1000	2000	4000	8000

3.5 Reverberant sound field

The sound field resulting from the super-position of many sound waves dues to respected reflections at the boundaries.
In this region the influence of sound received directly from the source is considered to be negligible.

4. METHOD OF TESTING TO BE USED

It is generally recognized that the sound spectrum of room air conditioners contains discrete frequency components which may have an important influence on the nuisance caused by the noise. The method of testing to be used is therefore that one which allows the determination of the sound power of sources emitting discrete-frequency sounds.

Hence these test rules are based on the Standard ISO 3742.

5. TEST SET-UP

5.1 Reverberation room

Sounb measurements of split-system type room air conditionners are performed in a reverberation room, which shall be qualified for the measurement of broad-band noise according to the Standard ISO 3741.

Since the sound spectrum of room air conditioners usually contains discrete-frequency components it would be useful to qualify the room for the measurement of this type of noise according to the Standard 3742.

If this latter qualification is not possible, the test can be carried out, but will require more time.

5.2 Equipment location

To test the indoor section of the air conditioner the unit shall be placed in the reverberation room in an operating position representative of its normal usage. It will be connected to the outdoor section through the wall of the reverberation room. The distance from the floor, from the wall or from the ceiling of the room required for the normal air circulation pattern of the equipment shall be respected.

Except for special cases, the equipment shall be located not less than 1.5 m from any corner of the room and not on one of the center lines.

If the apparatus is equipped with feet and if no fixing is provided, if is recommended to isolate the equipment from the floor by means of a resilient material of low rigidity.

If the equipment is to be fixed on the floor or on the walls, any suitable device may be used taking its bearing on the fixing points provided by the manufacturer. Any other mounting arrangement may alter the noise radiation
For floor mounted units the equipment location is shown in fig. 2a et 2b.

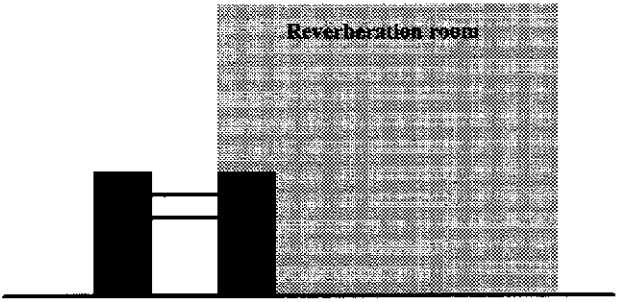

Fig. 2a

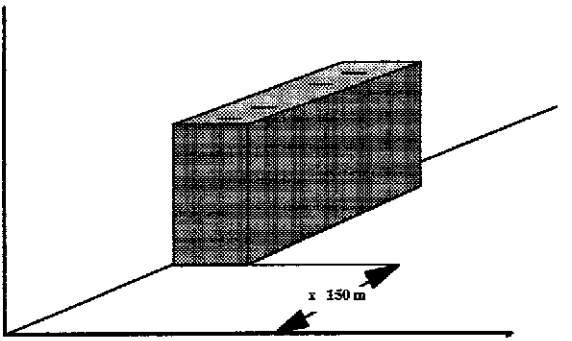

Fig. 2b

To test the outdoors section containing the compressor, its separation from the walls in the reverberation room shall be not less than 1.5 m *(see fig. 3a et 3b)*.
It will be connected to the indoor section through the wall of the reverberation room..

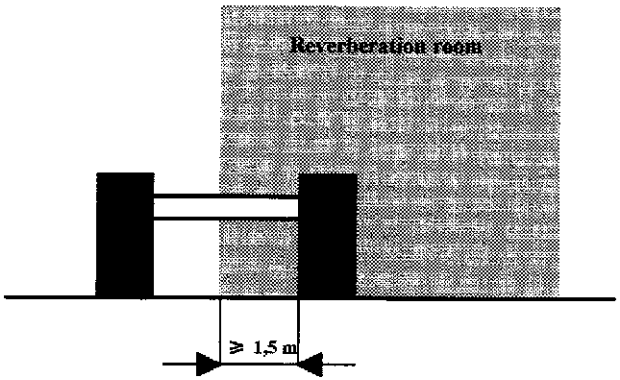

Fig. 3a

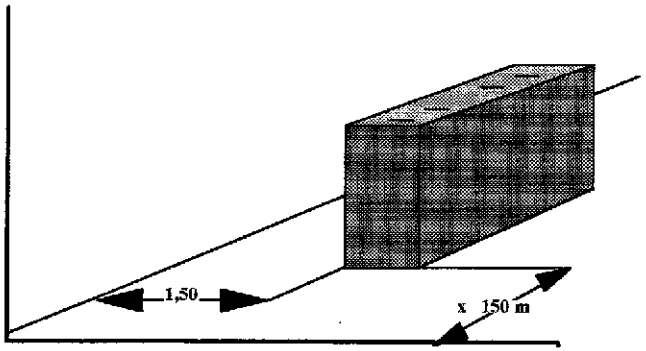

Fig. 3b

5.3 Test conditions

Acoustical measurements of the split system room air conditioners must be performed with the compressor operating.

The temperature and humidity must be maintained to keep the unit working within its normal operating range.

The measurements at all cases shall be performed at steady environmental conditions which should be recorded. The noise caused by any compensation equipment will belong to the background noise and care must be taken that it remains within the limits allowed by the fundamental acoustical Standard ISO 3741.

The control and the stability of the normal supply voltage to the equipment shall be assured.

5.4 Operating conditions

The supply voltage shall be adjusted and maintained at the value specified by the manufacturer. If an operating range is indicated then the value during the test must be recorded.

The setting of any control devices *(dampers, grilles, etc...)* shall be specified and recorded for each test.

For units with several settings tests shall be performed for all the operating conditions for which results are required.

6. TEST PROCEDURE

6.1 Measurement of sound pressure level

The test will be qualified according to ISO 3741. However the test procedure will be carried out acording to ISO 3742. Hence at least six measuring microphone locations will be necessary to establish the standard deviation of the sound pressure level for each octave band.

Should the value of this standard deviation conform to the qualification *(table n° 3 in ISO 3742)* then further source locations will not be required to establish the octave band sound pressure level. Otherwise the number of locations will be calculated using table n° 3 and equation 3 in ISO 3742.

6.2 Measurement of background noise

The background noise level *(measured without the section under test 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.

Special attention must be paid to the noise radiated by the outdoor compressor section when measuring the indoor section. This background level must be measured with the compressor working.

The corrections for background noise shall be calculated according to the ISO Standard 3741, Par.. 7.2.3.

6.3 Additional quantities to be measured

In addition to the quantities defined in the acoustical standard required for the calculation of emitted sound power, all quantities allowing the determination of the operating point of the room air conditioner on test shall be measured *(see 5.4)*.

6.4 Calculation of sound power level

The sound power of each section of the room air conditioner shall be calculated in each octave frequency band from the time and space averaged value of sound pressure measured in the reverberation room

For this calculation, the ISO Standards recommend two methods :

- the direct method which requires a knowledge of the reverberation time in the room,

- the comparison method, where the measured sound pressure levels are compared with the sound pressure levels produced in the same room by a reference sound source of known sound power output.

7. PRESENTATION OF THE RESULTS

The test report shall include :

- **Sound power level per octave band**

- Sound power level expressed in dB *(A)*, calculated from the spectrum according to ISO 3741 annex C.

- All indications particular to the tests and described in this document or in the acoustical standards previously mentioned.

8. REFERENCES

To perform the acoustical measurements according to this document the requirements specified in the two following fundamental acoustical standards shall be followed :

a/ **ISO 3741**

Determination of sound power levels of noise sources.
Precision methods for broad-band sources in reverberation rooms.

b/ **ISO 3742**

Determination of sound power levels of noise sources.
Precision methods for discrete-frequency and narrow-band sources in reverberation rooms.

LIST OF THE MEMBER ASSOCIATIONS

BELGIUM

FABRIMETAL

Groupe 9/5

21 rue des Drapiers - B 1050 BRUXELLES

Tél. 32/2/51C2311 - Fax : 32/2/5102301 - Tx 21078

GERMANY

Fachgemeinschaft Allgemeine Lufttechnik im VDMA

Postfach 710864 - D-6000 FRANKFURT/MAIN 71

Tél. 49/69/6603227 - Fax : 49/69/6603511 - Tx : 411321

SPAIN

AFEC

Asociacion de Fabricantes de Equipos de Climatizacion

Francisco Silvela, 69-1°C - E.28028 MADRID

Tel : 34/1/4027383 - Fax : 34/1/4027638

FRANCE

SYNDICAT DE L'AERAULIQUE

Cedex 72 - FR 92038 PARIS LA DEFENSE

Tél : 33/1/47176292 - Fax : 33/1/47176427 - Tx : 616034

GREAT BRITAIN

HEVAC

Heating Ventilating and Air Conditioning Manufacturers Association

Sterling House - 6 Furlong Road - GB-BUCKS SL 8 5DG

Tel : 44/628/531186/7 - Fax : 44/628/810423

ITALY

ANIMA

Associazione Nationale Industria Meccanica Varia ed Affine

Via Battistotti Sassi, 11 - IT-20133 MILANO

Tel : 39/2/7397.1 - Fax : 39/2/7397/316 - Tx 310392

NORWAY

NVEF

Norsk Ventilasjon og Energiteknisk Forening

P.O. Box 850 Sentrum - N-0104 OSLO 1

Tel. 47/2/413445 - Fax : 47/2/424664

NETHERLANDS

VLA

Vereniging Fabrieken van Luchttechnische Apparaten

Postbus 190 - NL-2700 AD ZOETERMEER

Tel. 31/79/531100 - Fax : 31/79/531365 - Tx 32157

PORTUGAL

APIRAC

Associaçao portuguesa de refrigeraçao e ar condicionadc

R.Viriato, 5-1° - P-1000 LISBOA

Tel. 351/1/530259 - Fax : 351/1/530259 - Tx 18862

SWEDEN

The Swedish Association of Air Handling Industries

P.O. Box 55 06 - S-11485 STOCKHOLM

Tel. 46/8/7838000 - Fax : 46/8/6603378 - Tx 19990

FINLAND

AFMAHE

The Association of Finnish Manufacturers of Air Handling Equipment

Eteläranta 10 - SF-00130 HELSINKI

Tel : 358/0/19231 - Fax : 358/0/624462 - Tx 124997

LIST OF THE MEMBER ASSOCIATIONS

BELGIUM
FABRIMETAL
21 rue des Drapiers -
B-1050 BRUXELLES
Tel. 32/2/5102518 - Fax : 32/2/5102563

GERMANY
FG ALT im VDMA
Postfach 710864 - D-60498 FRANKFURT/MAIN
Tel. 49/69/66031227 - Fax : 9/69/66031218

SPAIN
AFEC
Francisco Silvela, 69-1°C - E-28028 MADRID
Tel. 34/1/4027383 - Fax : 34/1/4027638

FINLAND
AFMAHE
Etäläranta 10 - FIN-00130 HELSINKI
Tel. 358/9/19231 - Fax : 358/9/624462

FINLAND
FREA
PL 37
FIN-00801 HELSINKI
Tel : 358/9/759 11 66 - Fax : 358/9/755 72 46

FRANCE
UNICLIMA (Syndicat du Matériel Frigorifique, Syndicat de l'Aéraulique)
Cedex 72 -
F-92038 PARIS LA DEFENSE
Tél : 33/1/47176292 - Fax : 33/1/47176427

GREAT BRITAIN
FETA (HEVAC and BRA)
Sterling House - 6 Furlong Road - Bourne End
GB-BUCKS SL 8 5DG
Tel : 44/1628/531186 or 7 -
Fax : 44/1628/810423

ITALY
ANIMA - CO.AER
Via Battistotti Sassi, 11 - I-20133 MILANO
Tel : 39/2/73971 - Fax : 39/2/7397316

NETHERLANDS
NKI
Postbus 190 - NL-2700 AD ZOETERMEER
Tel : 31/79/3531258 - Fax : 31/79/3531365

NETHERLANDS
VLA
Postbus 190 - NL-2700 AD ZOETERMEER
Tel. 31/79/3531258 - Fax : 31/79/3531365

NORWAY
NVEF
P.O.Box 850 Sentrum - N-0104 OSLO
Tel. 47/2/413445 - Fax : 47/2/2202875

SWEDEN
KTG
P.O. Box 5510 - S-11485 STOCKHOLM
Tel. 46/8/7820800 - Fax : 46/8/6603378

SWEDEN
SWEDVENT
P.O. Box 17537 - S-11891 STOCKHOLM
Tel : 46/8/6160400 - Fax : 46/8/6681180

TURKEY
ISKID
Büyükdere Cad. No: 108 Kat.
10 Oyal Ishani Esentepe - ISTANBUL
Tel + Fax : 90/212 272 30 07