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'APPLIANCE NOISE'

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Noise from Ventilating and Air Conditioning Equipment.

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The sources of noise in ventilating and air conditioning systems generally fall into one of the following categories,

Equipment noise, generally fans.

Noise generated by flow through ducting systems.

Noise generated by room terminal equipment.

Fans.

The sources of noise within a fan are either,

(i) generated by fluctuating lift forces on the impeller blades and by turbulent flow over other surfaces

(ii) generated by mechanical drives.

For a machine well maintained and running at an efficient speed (i) tends to be the dominant noise source and is aerodynamic in character. Because of this fan noise tends to be predictable for given types and duty conditions [1,2]. The unpredictable factor is the generation of strong tones normally associated with the passage of blades past fixed obstructions.

Typical centrifugal and axial fan noise spectra are shown in Fig. 1. A general rule is that the most efficient fan for a given duty is the quietest.

System Noise.

Noise generated by air flow past obstructions in ducts has recently given rise to more concern because of the trend for economical duct velocities to rise. The noise source is aerodynamic and arises through flow seperation from a surface and the high level of turbulence this generates. Generally the sound power generated can be quantified by the equation

$$\text{Sound power} = f\,(A.V^6.\ \text{Re No.})$$

$$\text{or sound power level} = k + 10\log A + 60\log V + 10\log f(\text{Re No})$$

Where k = constant
A = area
V = velocity
f (Re No) = function of Reynolds Number.

Experimental work we have carried out on turning vanes in bends, dampers and grilles has shown that this equation can be used[3]. A correlation of damper noise is shown in Fig. 2. In this case the sound power level generated is given by

$$Lw = Lwo + 30\log d + 50\log V + 10\log . \frac{\Delta f}{\Delta f_{63}}$$

where Lwo = spectrum base level
d = duct side
V = velocity through damper
$\frac{\Delta f}{\Delta f_{63}}$ = factor to correct data to octave bands.

The change in the V factor from 60 to 50 is thought to arise from the Re No. effect.

Terminal Equipment.

Unitary terminal equipment differs little from other appliancies, normally it is a cased fan/heat exchanger unit.

In high velocity systems terminal equipment is used to perform flow and temperature regulation functions, examples are induction units, mixing boxes, variable volume controllers. Flow control is normally achieved by dissipating flow energy, this creates intense turbulence within the units and noise is generated which is radiated through ducting or the casing. The units also can attenuate by reflection or absorption. The noise generated is similar to system noise but is a function of the design of the unit.

Noise Rating of Equipment

A standard for rating the broad band sound generated by fans has existed for some years (BS B48 : Part 2). The measurements lead to sound power levels in octave bands and diffuse field, free field and in-duct methods are included.

Recently a standard has been published for rating the performance of packaged attenuators (BS 4718) which is complimentary to the fan standard in that is covers broad band sound in octave bands.

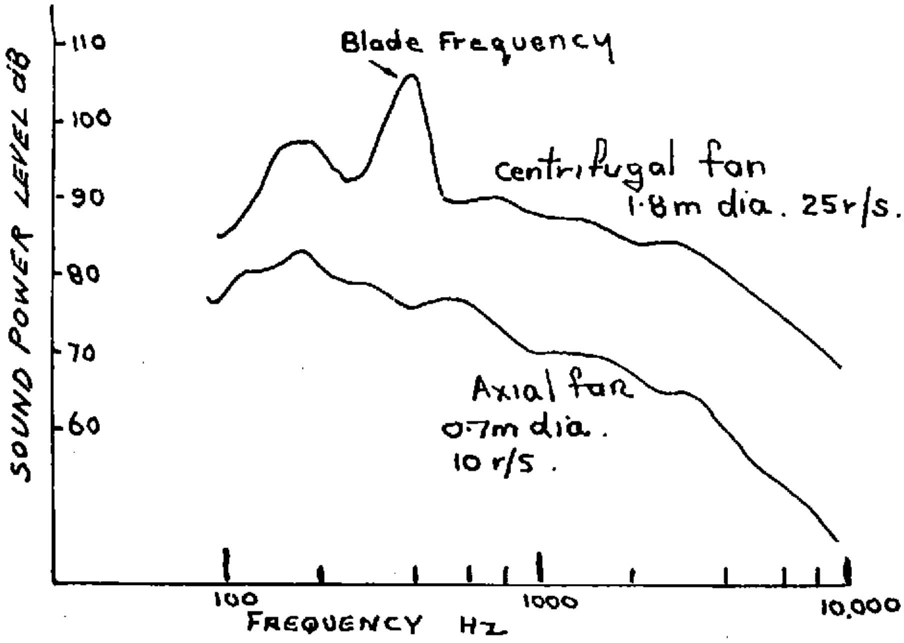
At present a generic standard is being considered for a noise measurement of a wide range of proprietary air conditioning equipment that is installed in or near rooms. The present draft lays out a diffuse field test method for rating broad band sound in octave bands. It also includes a test to identify the presence of any significant tones in the spectra. It does not include a method for measuring and rating such tones.

References.

1. ASHRAE Guide and Data Book, Systems, 1970

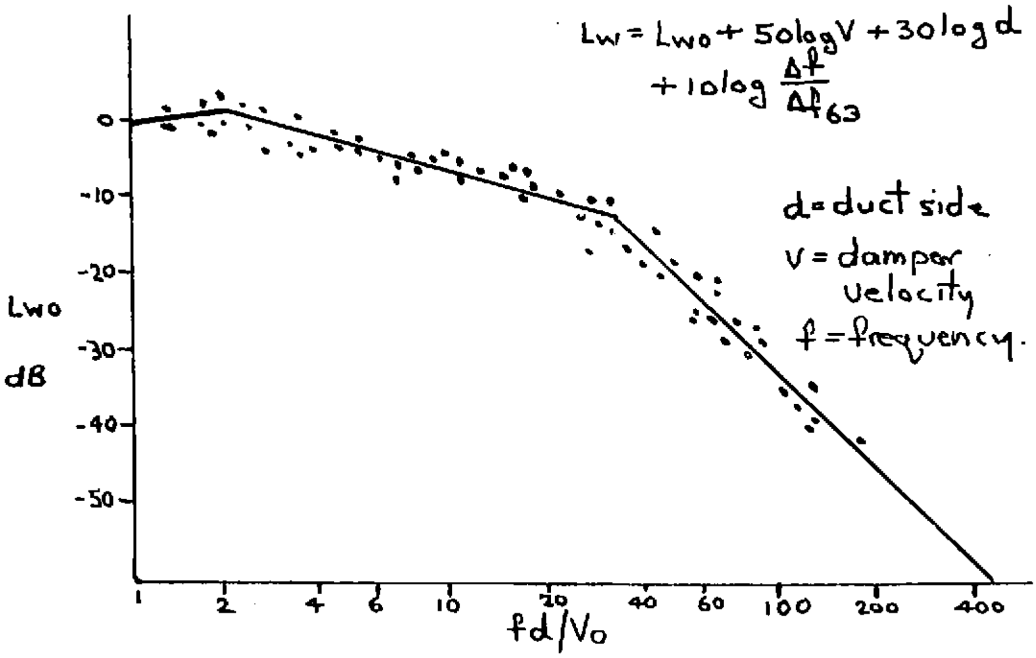
2. IHVE Guide, 1965.

3. HVRA Laboratory Report No. 75. (in print)



TYPICAL FAN SPECTRUM.

FIG 1.



DAMPER NOISE SPECTRUM

FIG 2