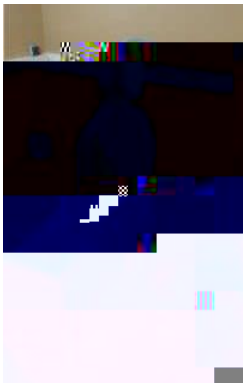
Acoustics laboratory facilities

1. **Hearing protection test facilities (fixtures and facility compliant with AS/NZS 1270)**

The Acoustics Research Group has developed a test facility for the assessment of hearing protection devices (HPDs) in accordance with the method for real-ear attenuation at threshold (REAT) as defined in AS/NZS 1270:2002, to enable research, development and testing of HPDs. The REAT method is a subjective HPD method based on the assessment of a participants' hearing threshold with (occluded) and without HPDs fitted (open-ear). Hearing thresholds are assessed using individual one-third octave bands of pink noise with octave band centre frequencies from 125 to 8000 Hz. The difference in hearing thresholds between the occluded and open-ear conditions represents the attenuation of the HPD at each centre frequency. The individual attenuations can then be used to determine the class of the HPD, which is common to end users of HPDs. The facility and test procedure has been accredited by IANZ.

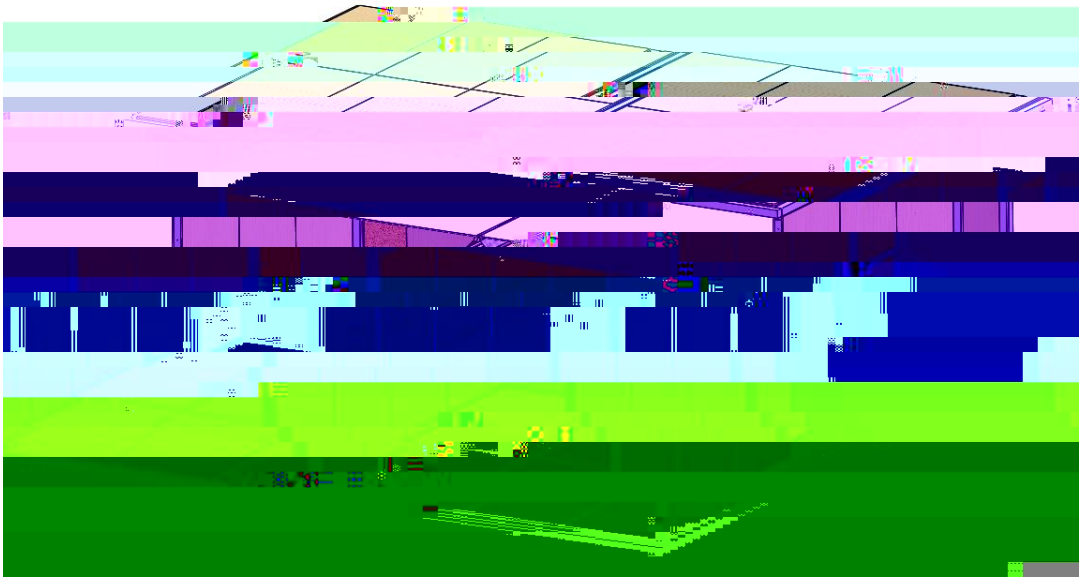


Head and torso simulator in hearing testing facility

2. Ceiling flanking noise facility compliant with ASTM E1414

The Department of Mechanical Engineering has constructed a facility for the study of noise transmission through suspended ceiling systems, as shown below. The test facility is capable of determining the acoustic performance of suspended ceiling systems as well as the effect of in-plenum acoustic treatments. The facility has been designed in accordance with ASTM 1414 and consists of two adjoining rectangular rooms that are structurally isolated from each other. Each room is 3.6 m high, 3.6 m long and 4.8 m wide with a separating wall between the two rooms being 760 mm lower than the roof of the rooms. The suspended ceiling is constructed on the top of the separating wall to create a common plenum between the two rooms. The performance of the suspended ceiling is obtained by placing a continuous noise source (that produces sound between 125 Hz and 4000 Hz) within one of the two rooms and measuring the response in the other room. Microphones are placed in each of the rooms to measure the sound pressure levels.

The acoustic performance of suspended ceilings is important for reducing noise transmitted between rooms that share a common plenum and from services that are commonly installed within the ceiling plenum (air conditioning and ventilation ducts, and pipework for example).

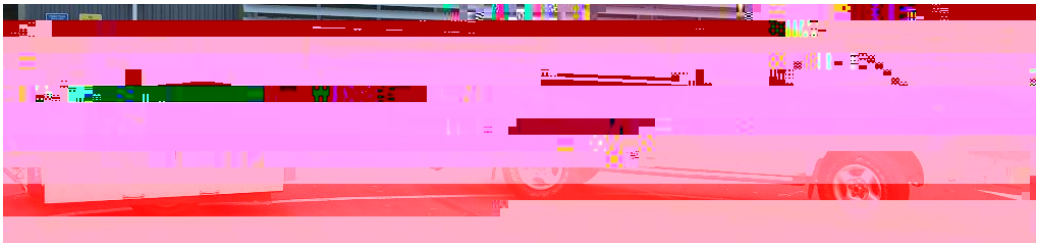


The facility: consisting of two rooms each with a single access door

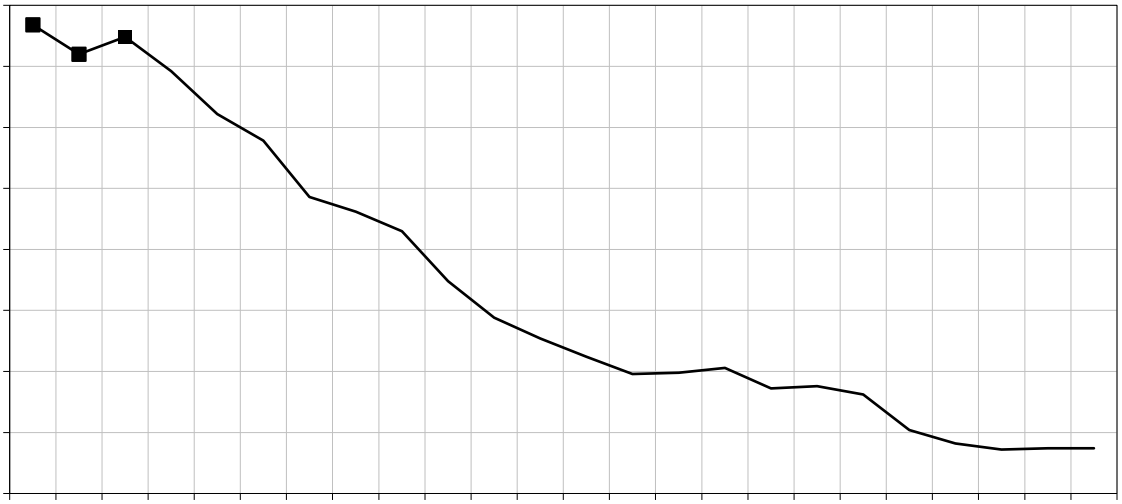
Dimensions of the test facility

3. Tyre-road noise measuring system

The Acoustics Research Group, in collaboration with the New Zealand Transport Agency (NZTA), has constructed and commissioned a close-proximity (CPX) trailer to measure road surface noise generated by vehicle tyre interaction. The trailer meets the requirements of the draft standard ISO/DIS 11819-2. The CPX trailer is towed along a selected section of road at a steady reference speed of 80 km/h. Two microphones continuously measure noise at a position close to where the road is in contact with a reference tyre on the nearside wheel of the trailer. The microphone system is enclosed in an acoustically lined box. An on-board computer calculates the average noise levels over each 20 metre length of the road being tested. The measurement runs are repeated a number of times and the results averaged. The data gives a complete picture of how surface noise varies along the length of road, and how that compares to other roads.



Tyre road noise measurement trailer and towing vehicle



Plot of sound pressure level in one-third octave bands: —△— Noise produced by a NACA0024 aerofoil submersed in a 28m/s airflow with the microphone positioned 350mm directly below the trailing edge, —■— wind tunnel background noise with a 28m/s airflow

7. Duct noise test facility

Measuring Noise in Ducts

The 'Duct Noise Test Facility' in the Department of Mechanical Engineering is used to measure the insertion loss of ducts, duct linings, and other sound attenuating devices that may be placed in a duct.

The facility meets the requirement of ISO 7235: *Measurement procedures for ducted silencers - Insertion loss, flow noise and total pressure loss*. The method of calculating the insertion loss is based on measurements of the sound pressure level before and after the test specimen has been inserted.

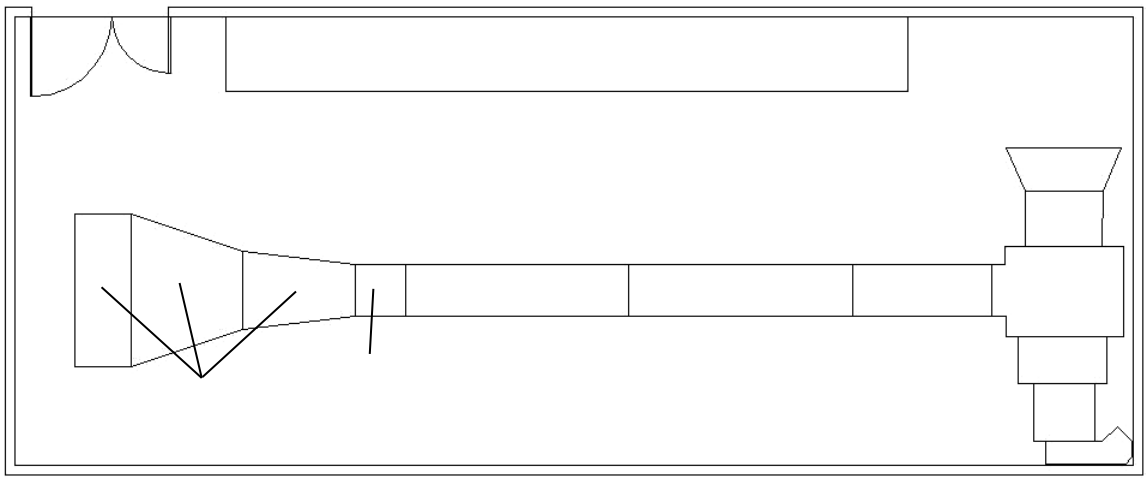
Measuring Pressure Loss in Ducts

The facility allows the measurement of pressure loss due to a test specimen in the duct. This is measured by taking the difference in pressure loss across a test section, with and without the test specimen.

Test Facilities

Apparatus

A schematic of the facility is shown below.



Schematic of Duct Noise Test Facility

A centrifugal fan provides a mean flow for testing. The fan has an impeller diameter of 690 mm consisting of 11 backwards inclined laminar (straight) blades. The volume flow rate is controlled by varying the fan speed via a variable speed AC drive unit connected to the 15 HP three-phase motor. A maximum volume flow rate of 4 m^3s^{-1} can be achieved.

Ducts

There are two duct sizes available for testing. Each duct size has a number of configurations available for testing.

540 x 300 mm

- 25 mm lined on top and bottom
- 50 mm lined on top and bottom
- 75 mm lined on top and bottom
- 25 mm lined on 4 sides

- substitution duct allowing absorption without an expansion in duct size

270 x 300 mm

- 25 mm lined on top and bottom
- 25 mm lined on 4 sides
- substitution duct allowing absorption without an expansion in duct size

The test facilities is shown below.

Duct Noise Test Rig

8. Sound intensity systems

Introduction

The Acoustics Research Group has two sound intensity measurement systems, one for use with hand-held Bruel & Kjaer dual channel sound level meters (type B&K 2260 or B&K 2270 systems) and one for use with a Bruel & Kjaer Pulse system. These systems find wide application in measuring the sound power in a variety of applications. The relationship of sound power to sound pressure is addressed below and a typical application discussed in terms of locating and quantifying noise sources.

Sound Power of a Machine and Locating Sources of Noise

So

Source location and radiation patterns using sound intensity

Sound intensity is a *vector quantity*, since it is concerned with the energy flowing through an area. This means there is a direction associated with a sound intensity measurement. Because measured sound intensity gives a measure of direction as well as magnitude it can be used to locate sources of sound. This applies to locating the machines emitting the most noise, and also locating the components of a machine that are the nosiest.

9. Environmental noise measurement and analysis facilities

The Acoustics Research Group has a Bruel &Kjaer outdoor sound measurement kit including Bruel and Kjaer sound level meters equipped with logging software for the measurements of environmental noise.

The Group also has environmental noise modelling software for predicting noise levels in the environment due to variety of sources.

10. Fan noise test facility