Acoustic Test Facilities

A complete solution to all types
of acoustic test facilities

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making the world a quieter place

IAC Acoustics

Making the world a Quieter Place

Founded on an unrivalled history of engineering with some of the most pioneering discoveries in the industry, the IAC Acoustics brand is synonymous with technological innovation.

From controlling noise at a power station to tuning the sound in a TV or radio studio, IAC Acoustics has had a positive impact on society and helped to shape what can be achieved to make speech more intelligible, music more enjoyable, reduce the impact of industrial noise and protect people's sense of hearing.

The continual success of our products and services over the decades has brought the brand a reputation for quality and reliability among customers, whether they are multinational corporations or independent family businesses. This is supported by the expertise and passion of our workforce, the people behind the products, including designers, engineers and industry specialists.

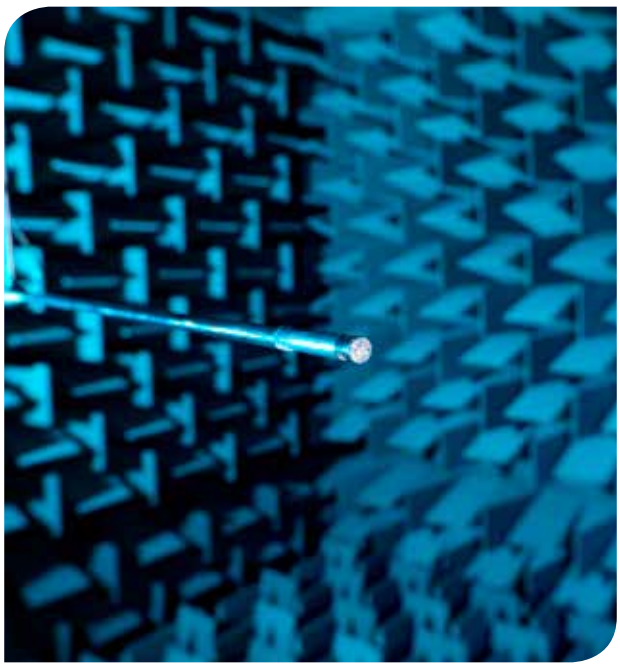
To face the ever increasing noise reduction demands of the future, we will strive to further enhance our ability to reduce excessive noise. We aim to focus on developing tomorrow's solution today, innovating faster and delivering solutions that meet the requirements of the next generation. In doing so, we will stay true to our key values and founding philosophy to make the world a quieter place.

making the world a quieter place

Turnkey complete acoustic test facility for Cummins Power Generation in Fridley, Minnesota

Leading Supplier of Acoustic Test Chambers

IAC Acoustics is one of the largest suppliers of acoustic test chambers and facilities in the world, with hundreds of installations worldwide. As the world's largest manufacturer of noise control products, IAC is able to utilise its expertise and bring together many different products for use in an acoustic test facility. Being able to supply a complete package reduces overall project spend and minimises the number of required suppliers. All IAC products have an individual acoustic rating and when accompanied by a laboratory certificate, give peace of mind about the overall performance of a completed facility. With such a detailed knowledge of acoustics, IAC is capable of tailoring solutions to meet the exact requirements of the client without compromising performance.



Fully anechoic chamber at the National Physical Laboratory (NPL) in London, UK
Image Courtesy of NPL

Acoustic Test Facilities for Manufacturers of:

- Motor cars
- Motorcycles
- Industrial engines
- Diesel generators
- Mechanical plant equipment
- Home appliances
- Office machines
- Electronic components
- Computers
- Mobile phones
- Hi-fi equipment

IAC Acoustics has also supplied facilities to academic research organisations, government agencies and independent test houses.

Turnkey Suppliers

IAC Acoustics has successfully carried out a number of turnkey acoustic test facility projects around the world. As a turnkey supplier, everything from the initial concept design through to the final commissioning is carried out by IAC. As part of the turnkey process, IAC will also be involved in:

- Planning applications with local authorities
- Noise surveys and acoustic mapping
- Architectural design of buildings
- Mechanical and electrical installation design
- Appointing reputable sub-contractors

By opting for a turnkey solution, costs can be consolidated via one single supplier, reducing overall spend and minimising administrative input. This is particularly effective if many different acoustic facilities are being installed at one location or if a complete building is required.

Hemi-anechoic chamber for Dana Trucks, USA

IAC's Capabilities

Since 1949, IAC Acoustics has designed and constructed thousands of acoustic test facilities including several hundred small anechoic and reverberation chambers.

These controlled environments encompass a wide range of performance specifications – from simple quality control requirements to elaborate high precision acoustic measurements.

IAC's design engineers and research physicists bring a wealth of experience to provide data for an informed discussion on how to select free-field anechoic chambers and diffuse-field reverberation rooms.

What is an Anechoic Chamber?

An anechoic chamber can be considered similar to a precision acoustical measurement instrument, providing a free-field environment without noise interference or sound reflection.

In an ideal free-field environment, the inverse square law would function perfectly. This means that the sound level from a spherically radiating sound source decreases by 6dB for each doubling of distance from the source.

For a free field to exist with perfect inverse square law characteristics, room boundaries must have a sound absorption coefficient of unity at all angles of incidence. In practice this is usually not quite perfect and deviations from the inverse square law are to be expected.

Table 1 highlights the maximum allowable deviations from the inverse square law as set out by ISO 3745 which states that "an anechoic room provides the preferred environment for measurements with the smallest uncertainty."

Type of Room	1/3 Octave Band Centre Frequency, Hz	Allowable Difference, dB
Fully Anechoic (Free-Field)	<630 800 to 5,000 >6300	± 1.5 ± 1.0 ± 1.5
Hemi-Anechoic (Simulated Free-Field)	<630 800 to 5,000 >6300	± 2.5 ± 2.0 ± 3.0

Table 1 – Maximum allowable difference between the measured and theoretical levels

Construction of Anechoic Rooms

For anechoic rooms to function well, a number of acoustic, mechanical, electrical and aerodynamic considerations apply. These will include some, or all, of the following:

- Anechoic treatment selection
- Cut-off frequency
- Internal acoustic ambient noise level
- Noise reduction
- Vibration isolation
- Silenced ventilation systems
- Acoustic doors – operation and sizing
- Interior floors – cables and / or gratings
- Lighting and electrical systems
- Overall structural design considerations
- RF shielding requirements

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Noise & Vibration Isolation Characteristics

A well constructed room must provide good sound isolation against external noise so that resulting internal noise will not invalidate acoustic measurements. This may require the use of single or double-wall construction with appropriately designed vibration isolation to adequately reduce air – and / or structure-borne noise transmission.

For best results, anechoic facilities should be individual structures, separate from any host building walls.

Anechoic Wedges

One practical well proven method to achieve a free-field is to shape sound absorbing material into wedge configurations for mounting on to the interior surfaces.

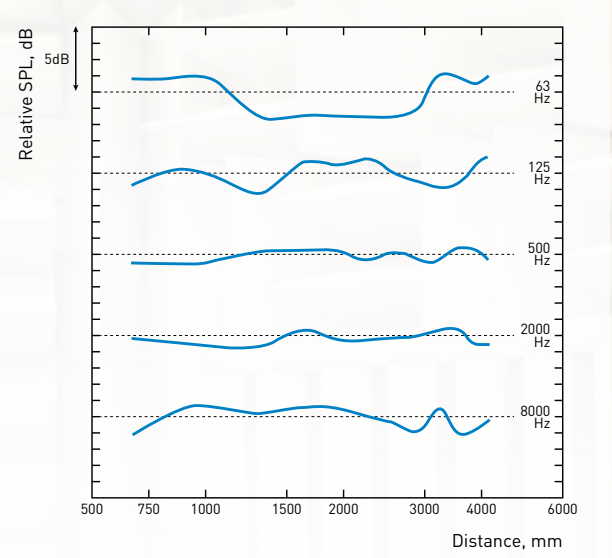
The wedge shaped geometry ensures a gradual change in the acoustic impedance of the transmission media, ensuring that sound waves are absorbed by the material, rather than reflected at an interface.

The effectiveness of the absorption depends on the geometry and materials used.

The lowest frequency at which the absorption is effective (cut-off frequency) is inversely proportional to the depth of the wedge.

IAC's own impedance tube is used for critical adjustment of wedge dimensions before finalising each design.

Due to variations in material characteristics, statistical quality control measures are employed during wedge production to ensure specified acoustic performance.



Inverse square law curves for a hemi-anechoic room with Metadyne® wedges fall well within acceptable ISO tolerance standards. Inside clear dimensions: 6426 x 9500 x 3607mm cut off frequency 60Hz

IAC Metadyne® Wedges

Metadyne® anechoic and hemi-anechoic test rooms have been chosen by the world's leading companies for the many unique advantages they have over rooms built using other materials, such as glass fibre or foam.

Metadyne® wedges were developed by IAC Acoustics as a solution to some of the problems associated with using 100% foam or glass fibre. IAC Acoustics was the first manufacturer to provide acoustic performance of the highest standard with a range of wedges which are entirely encased in perforated metallic casings.

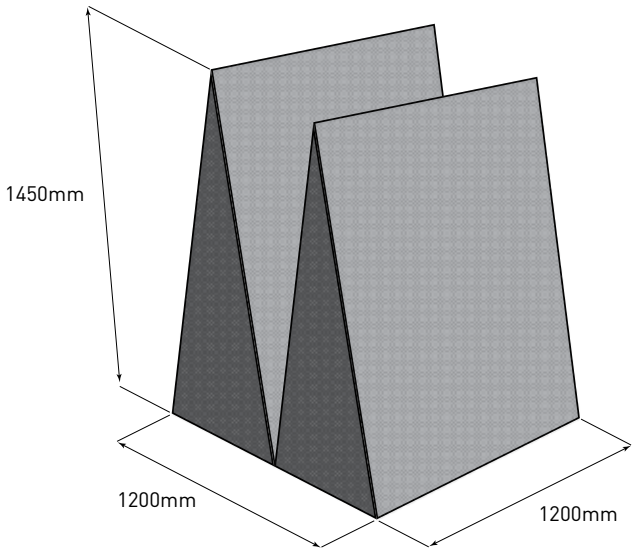
Metadyne® wedges are ideal for large facilities which require low frequencies to be absorbed for testing products such as cars or engines. The rugged wedge construction and their long life span offer advantages to laboratories working with heavy equipment and / or flammable materials.

All Metadyne® wedges are manufactured in IAC factories across the globe to set standards and tolerances. This means a consistent finish can be achieved on large global projects and also ensures the acoustic performance of each wedge.

Metadyne® metal-faced anechoic wedges offer:

- Guaranteed acoustic performance, with very low cut-off frequencies
- Compliance with international test standards, including ISO 3745, ISO 3744, ISO 26101
- Superior fire and impact resistance
- Greater durability and a longer lifespan than any other wedge type
- Ease of cleaning to ensure an "as new" appearance throughout their working life
- A bright, healthy and safe working environment for test personnel
- Bespoke paint options available to match corporate colours

50Hz Metadyne® LF Wedge



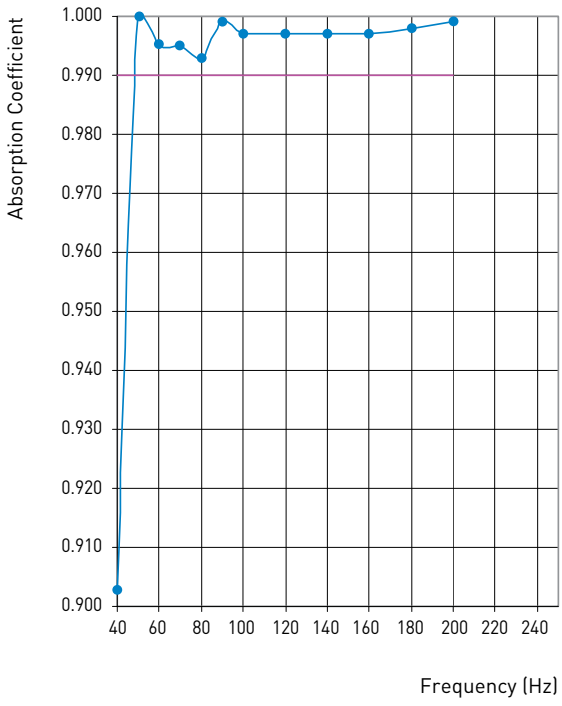
IAC 50Hz Metadyne® LF Wedge Test Report

Test Report Number: 04036-119
Module Size: 1200mm x 1200mm x 1450mm

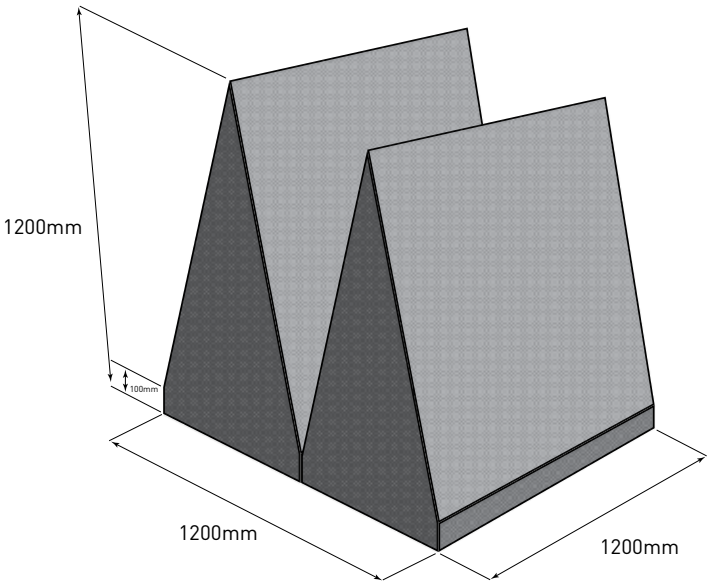
Tested in accordance with ISO 10534-1:1996 Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 1: Method using standing wave ratio.

Cut off frequency to ISO 10534 : 50Hz

Frequency, Hz	Sound Absorption Coefficient
40	0.903
50	1.000
60	0.995
70	0.995
80	0.993
90	0.999
100	0.997
120	0.997
140	0.997
160	0.997
180	0.998
200	0.999



63Hz Metadyne® LF Wedge



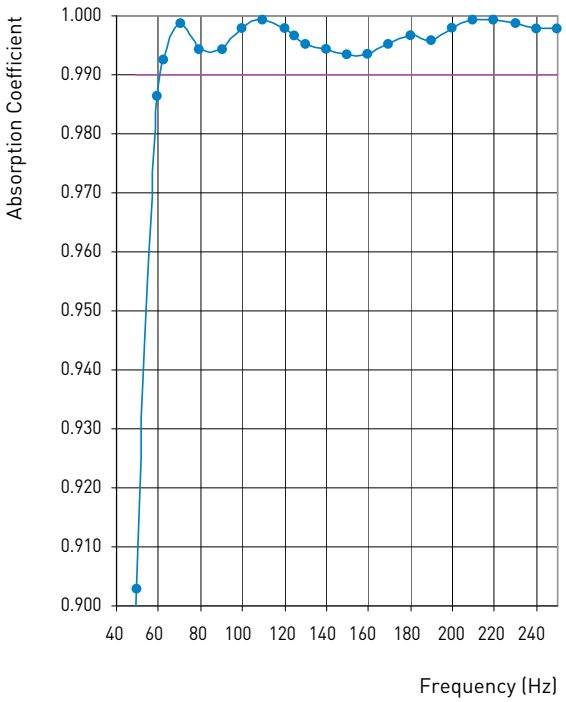
IAC 63Hz Metadyne® LF Wedge Test Report

Test Report Number: 020508-3
Module Size: 1200mm x 1200mm x 1200mm

Tested in accordance with ISO 10534-1:1996 Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 1: Method using standing wave ratio.

Cut off frequency to ISO 10534 : 63Hz

Frequency, Hz	Sound Absorption Coefficient
40	0.726
50	0.903
63	0.993
80	0.994
100	0.998
125	0.997
160	0.994
200	0.998
250	0.998



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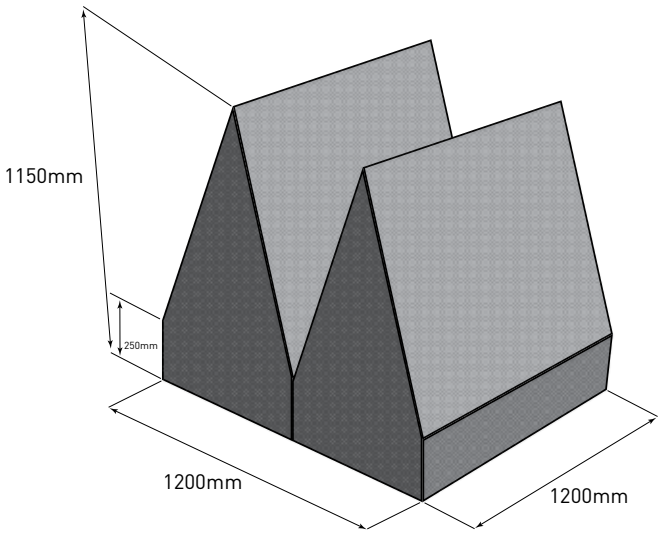
70Hz Metadyne® LF Wedge



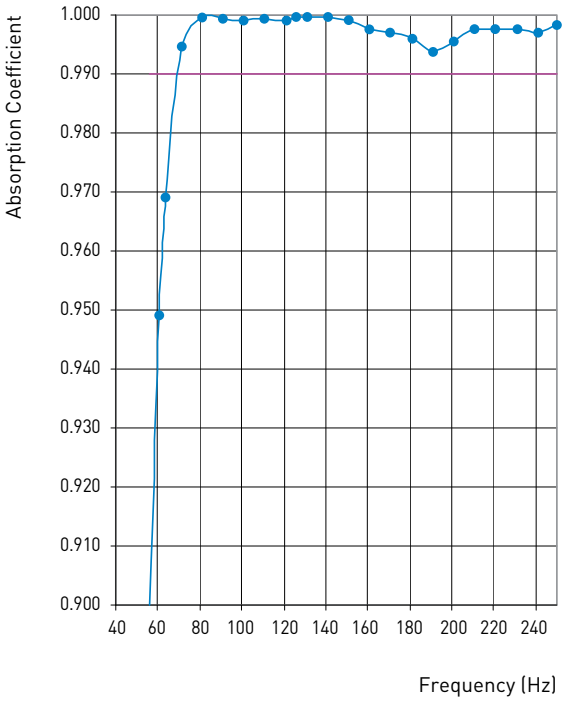
IAC 70Hz Metadyne® LF Wedge Test Report

Test Report Number: 160408-1
Module Size: 1200mm x 1200mm x 1150mm

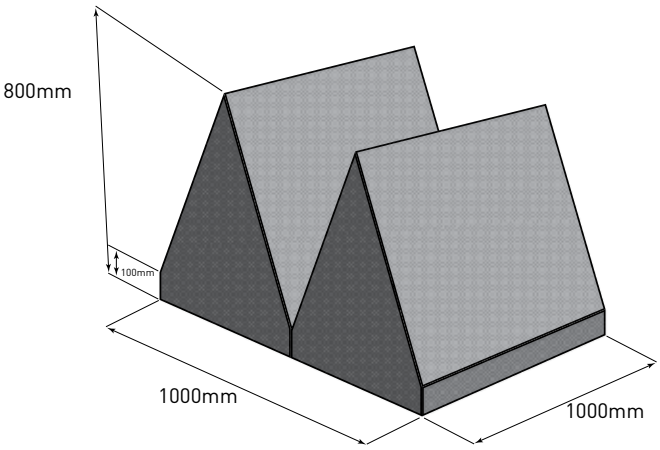
Tested in accordance with ISO 10534-1:1996 Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 1: Method using standing wave ratio.

Cut off frequency to ISO 10534 : 70Hz

Frequency, Hz	Sound Absorption Coefficient
40	0.721
50	0.838
63	0.969
80	0.999
100	0.999
125	0.999
160	0.997
200	0.995
250	0.998



100Hz Metadyne® LF Wedge



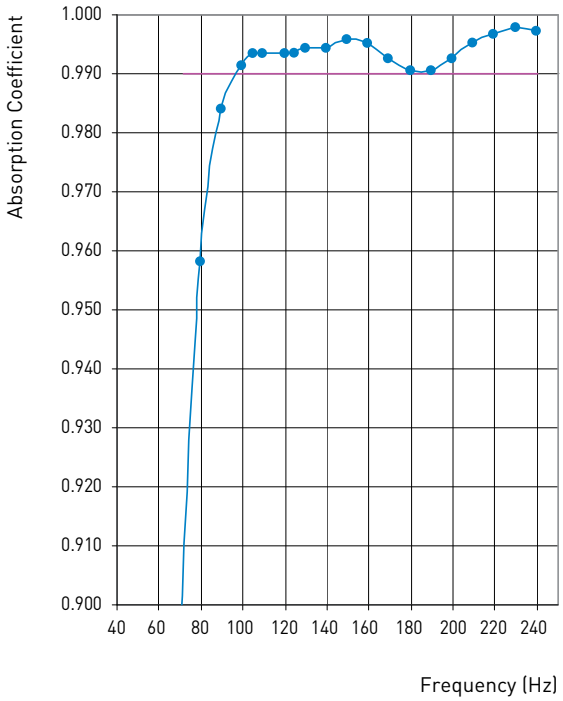
IAC 100Hz Metadyne® LF Wedge Test Report

Test Report Number: 290808
Module Size: 1000mm x 1000mm x 800mm

Tested in accordance with ISO 10534-1:1996 Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 1: Method using standing wave ratio.

Cut off frequency to ISO 10534 : 100Hz

Frequency, Hz	Sound Absorption Coefficient
80	0.958
100	0.992
125	0.994
160	0.995
200	0.993



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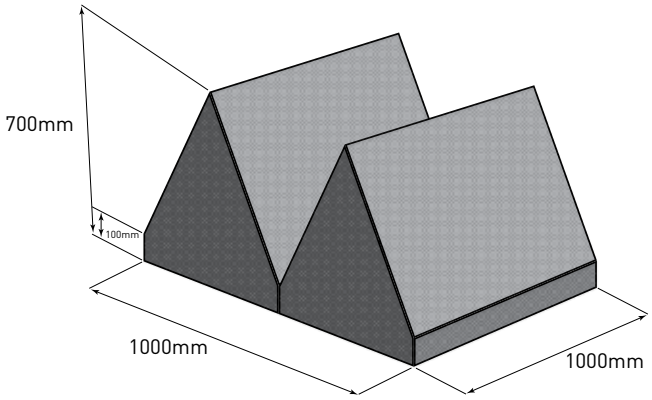
125Hz Metadyne® LF Wedge



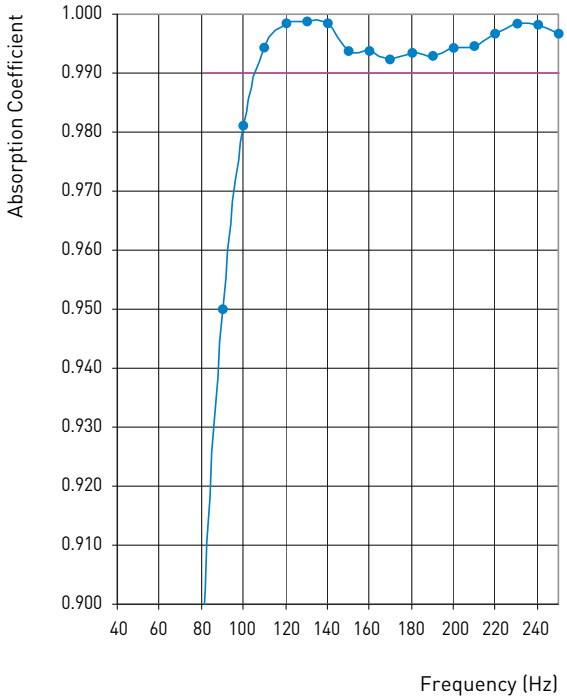
IAC 125Hz Metadyne® LF Wedge Test Report

Test Report Number: 160408-1
Module Size: 1000mm x 1000mm x 700mm

Tested in accordance with ISO 10534-1:1996 Acoustics — Determination of sound absorption coefficient and impedance in impedance tubes — Part 1: Method using standing wave ratio.

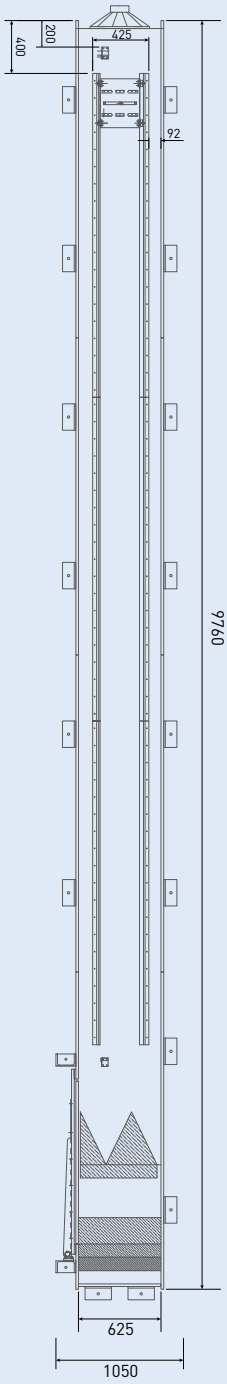
Cut off frequency to ISO 10534 : 125Hz

Frequency, Hz	Sound Absorption Coefficient
80	0.893
100	0.981
125	0.998
160	0.994
200	0.995
250	0.997



Wedge Testing – The Impedance Tube Method

If an anechoic chamber is to meet the free-field criteria of ISO 3745, the wall lining is required to have a normal incidence absorption coefficient α of no less than 0.99 when tested in an impedance tube (plane wave absorption). The cut-off frequency of the wedge is the lowest frequency at which this criterion is met. IAC has a strict testing regime ensuring that all anechoic wedges are designed and verified at full scale within our impedance tube.



Impedance Tube Features

- The impedance tube is designed using the guidance set out in ISO 10534-1 'Acoustics – Determination of sound absorption coefficient and impedance in impedance tubes – Part 1 Method using standing wave ratio', and ASTM C 384-98
- Walls constructed from 20mm plate with 140mm thick concrete and a 100mm air gap to ensure minimal losses and increase the accuracy of measurements
- The tube length limits the lowest measurement frequency (40Hz), and its cross-sectional dimensions limit the upper frequency limit (264Hz)
- The tube cross-section is big enough to test full size wedges

Background Theory

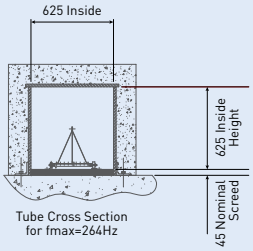
The equipment is very straightforward, the only required measurements are the sound pressure levels at multiple positions along the tube. For each frequency of interest, a speaker outputs a pure tone which creates a standing wave within the tube and a trolley mounted microphone automatically traverses this sound field and measures the sound pressure level at each point, recording the maximum and minimum values.

The absorption coefficient is determined from the ratio of the maximum to the minimum sound pressure level in the tube.

Wedge Testing in Reverberation Chamber

In addition to the impedance tube method, IAC anechoic wedges are also tested in independent laboratories to ISO 354, "Measurement of sound absorption in a reverberation room." By carrying out these additional tests, IAC ensures that each wedge design exhibits excellent absorption characteristics at frequencies above the upper limit of the impedance tube.

Proving the adequacy of the room absorption prior to installation is the best method for ensuring a guaranteed chamber performance.



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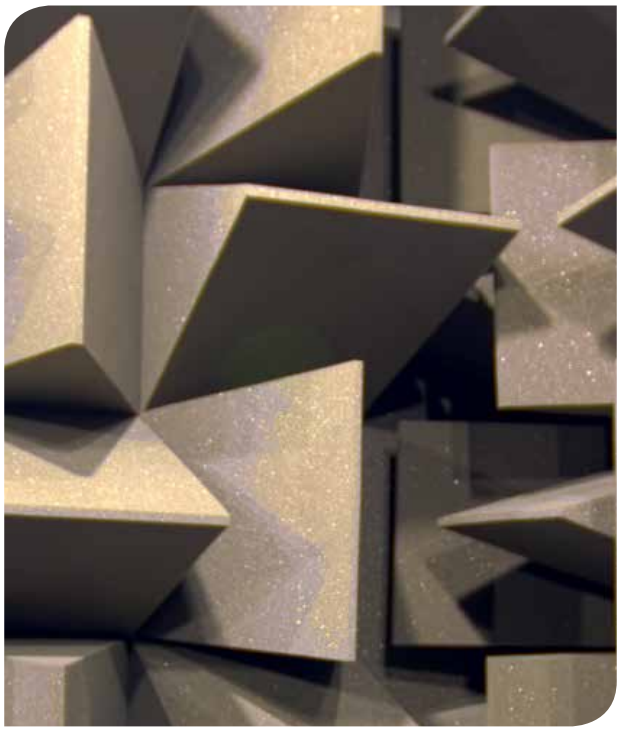
Data Acquisition

IAC's own system captures all of the data and manages all subsequent data reductions, providing repeatable results on a straightforward and user friendly sheet. To capture the amount of data manually would not be time effective, in fact, a single wedge test takes less than 30 minutes to complete. This fast testing method allows IAC Acoustics to make changes to the profile of anechoic wedges and optimise the material configuration.



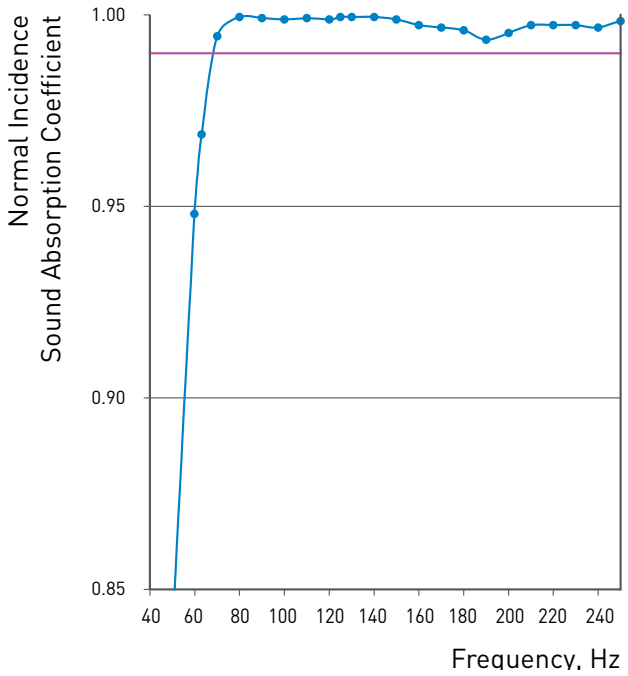
Typical view of IAC's data acquisition system for impedance tube testing

Wedge Test Results

A wedge will be considered suitable if the results show a normal incidence sound absorption coefficient greater than 0.99 at and above the required cut-off frequency.

The results opposite are those for a wedge with a cut-off frequency of 70Hz.

The software allows any individual frequency to be tested within the limits of the tube.



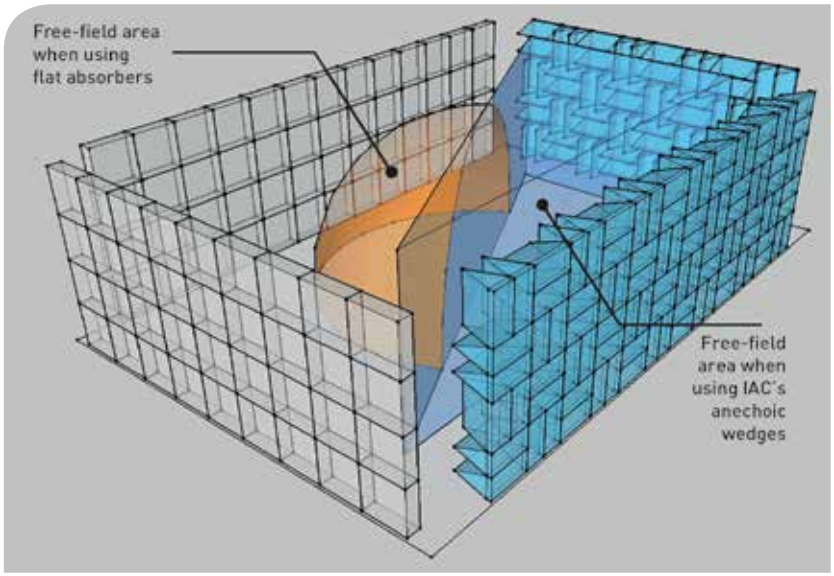
Wedge vs. Flat Anechoic Linings

Flat acoustic absorber panels can be used in a chamber to create a lower grade free-field, anechoic space. These panels are typically used if space is limited as they take up less room than a chamber lined with wedges. IAC's flat anechoic absorption range, Planarchoic™ can be tuned to deal with certain frequencies in the same way as our range of Metadyne® wedges.

Although Planarchoic™ lined chambers have the benefit of increasing the available floor space for testing, the free-field area is reduced (as seen in the diagram below).

Planarchoic™ free field rooms are always hemi-anechoic, usually large in size and can be placed on a hard floor in the absence of structurally transmitted vibration and noise. Planarchoic™ rooms are suitable for sound measurements of cars, lorries, fork-lifts, transformers and other industrial equipment.

Special care must be taken in the relationship of Planarchoic™ room volume to test object dimensions to assure a free-field environment, due to the reduced area for taking viable measurements.



Free-field area inside a hemi-anechoic chamber comparison between surfaces lined with flat absorbers and wedges

Due to flat surfaces creating even a small amount of sound wave reflection, despite being acoustically treated, their performance is typically not as great as anechoic wedges.

Better acoustical measurements can be taken and relied upon using a chamber lined with wedges. All IAC chambers with wedge linings are certified to ISO 3745 for the determination of precision acoustic power levels (Grade 1). Chambers with flat absorbers applied to surfaces typically only qualify for ISO 3744 which is for non-precision acoustic power level measurements (Grade 2).

Hemi-anechoic room showing flat absorbers on the walls with wedges in the roof to increase the amount of absorption

IAC Noise-lock® High Performance Acoustic Doors

IAC Acoustics is a leading supplier of high performance acoustic doors with over fifty years experience in door design and manufacture. IAC offers a wide range of standard models, or can design and make doors to suit specific applications.

Over 1,000,000 IAC acoustic doorsets have been installed in industrial and commercial buildings throughout the world. They have been used in many applications in addition to acoustic test facilities and offer a high performance solution to situations where sound must be contained within or excluded from a room or building.

All IAC Noise-lock® doors and frames are designed to be acoustically compatible with rooms in terms of sound transmission loss. Hinges can either be cam-lift or level swing, depending on the requirements and double magnetic seals assure acoustic performance. Threshold compression seals can be provided with or without a sill.

IAC Noise-lock® Acoustic Doors for Anechoic Facilities

Specialist doors are required for anechoic facilities in order to maintain the same level of absorption as other walls and surfaces.

Anechoic wedges can either be attached directly to the inner face of Noise-lock® acoustic doors, or a separate 'basket' style arrangement can be used.

IAC Wedge Basket Doors

To maintain an absorbent wedge finish on all walls, entrances to an anechoic facility can solely utilise basket doors, or be used in conjunction with IAC's Noise-lock® range of high performance acoustic doors.

Depending on the available space and the type of wedge used, IAC Acoustics can offer a cost effective solution to accommodate basket doors for any situation.

Reverberation Rooms

What is a reverberation room?

A reverberation room can be considered the opposite of a an anechoic chamber because its boundaries reflect, rather than absorb sound energy. Reverberation rooms are designed for the determination of sound power output of noise sources, transmission loss of partitions, insertion loss of silencers, response characteristics of microphones and random incidence absorption coefficients of materials. They are also used for high-intensity noise-level fatigue testing of aircraft, space vehicles and other equipment.

The purpose of a reverberation room is to create a highly diffused acoustic measurement environment, defined as a sound field in which acoustic energy flows equally in all directions.

A reverberation room must provide sound isolation against extraneous noises and an environment which can be temperature, pressure and humidity controlled.

IAC Acoustics has installed many field-proven reverberation rooms in different configurations. With more than 60 years experience, IAC is the pioneer and leading company in the design, construction and commissioning of modular reverberation chambers.

Construction of Reverberation Rooms

For a reverberation room to perform correctly, careful consideration must be given to a number of factors which include:

- Test standard or method
- Interior volume
- Room dimensions in relation to test object size
- Interior working space
- Lowest frequency band of interest
- Internal acoustic ambient noise level
- Noise reduction
- Vibration isolation
- Silenced ventilation systems
- Doors and access
- Lighting and electrical systems
- Overall structural requirements

Standard Features

IAC reverberation rooms come fully equipped with the following features:

- IAC Hardliner™ panel construction
- Double / single wall and ceiling construction
- IAC ventilation system coupled to building supply
- Interior lighting and power
- A standard size IAC Noise-lock® acoustic door
- Complete certification and commissioning tests

Options

- Self-contained air handling/ ventilation system
- Additional/larger door
- Access panels for equipment and test openings
- Air mounts, or other types of vibration isolation
- RF shielding
- Turning vanes and/or diffusers

IAC Ventilation Systems

A ventilation system must provide adequate air circulation at sound pressure levels below design criterion. IAC Quiet-vent® silencing systems are designed to provide approximately 15 air changes per hour in a typical anechoic facility. If specialist heating/cooling needs are required, then IAC Acoustics can custom-design a system to meet your needs.

IAC Acoustics is an industry leader in the design and construction of silencing devices for air/gas flow systems. These range from minimal air changes to large elaborate intake and exhaust silencing systems to accommodate engine research within an acoustic test facility.

IAC has designed and manufactured hundreds of thousands of silencers for soundproof rooms, HVAC systems, industrial machinery, power plants, engine test cells and gas turbines.

Climatic Chambers

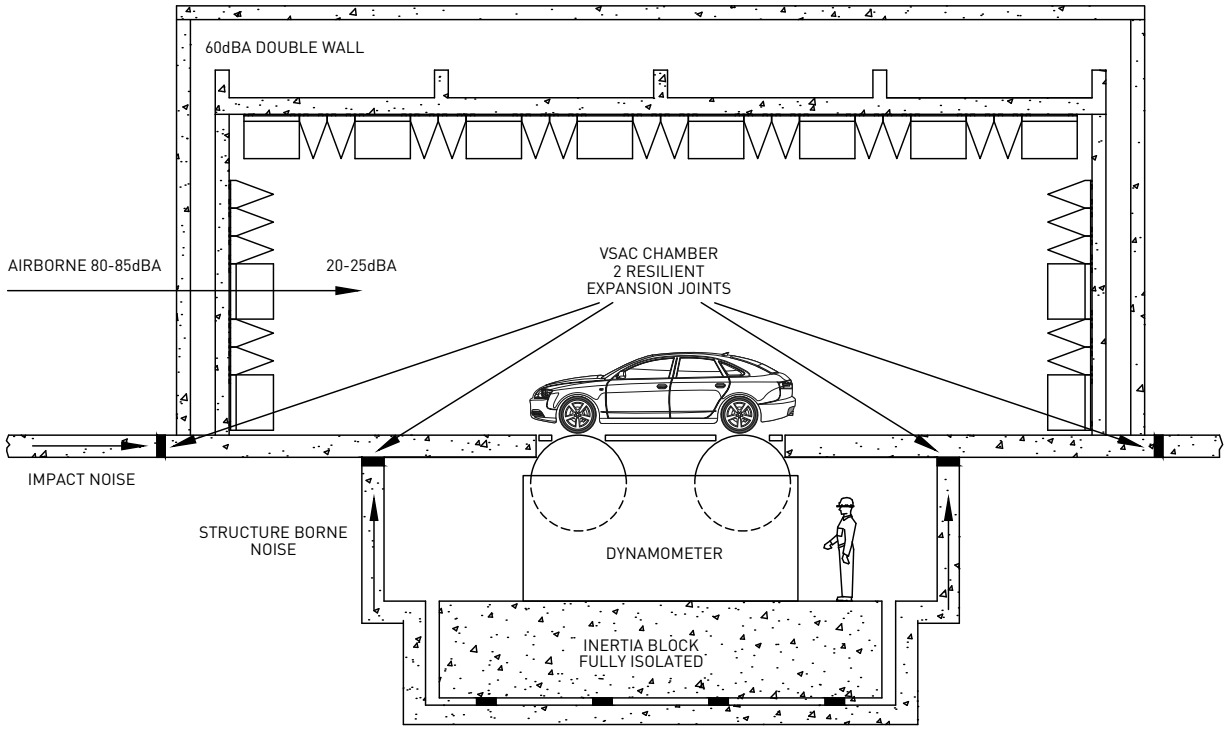
IAC Acoustics can enhance ventilation systems to cover a wider range of temperatures within the chamber. IAC Metadyne® wedges are able to withstand high and low extremes without degradation, provided that the temperature cycling is controlled for condensation.

Areas of potential complication are frequent room calibration for differing temperatures, structural design for very low temperature, personnel safety, test equipment durability and operation.

Should extreme temperature testing be required including fluctuations in humidity, IAC Acoustics can work with clients to achieve the best possible results.

Isolation

With regard to chamber isolation, at design budget stage, there is usually insufficient information to confirm whether structural isolation of the floor slab is or is not required. IAC Acoustics would review proposed site layouts, Geotech reports and space planning to analyse what may affect the chamber performance based on surrounding facilities. IAC has found through experience, that other than in extreme cases, with good isolation of the dynamometer and plant room equipment, an expansion joint 'break' in the floor slab would be enough to eliminate most problems for general NVH.



Spring mounts being installed for floating floor system

Ancillary Equipment

In addition to core acoustic products, IAC Acoustics is also able to offer full integration of other ancillary equipment within facilities, including electrical items (lighting, alarms, sensors, CCTV etc) and mechanical plant and equipment (chassis dynamometer, instrumentation, chillers etc).

Cranes, Hoists & Vehicle lifts

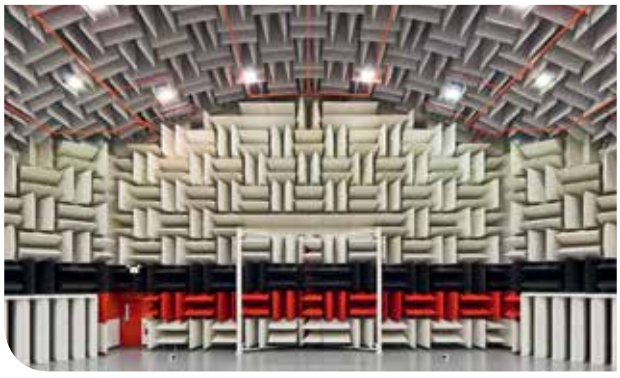
IAC Acoustics has supplied many different types of systems ranging between 2 post lifts, 4 post lifts, recessed floor systems, overhead cranes and runway beam cranes.

Lighting

IAC supplies the latest LED-based lighting system that is designed to provide a diffused light field. IAC also include emergency lighting as necessary. The lighting provided ensures that horizontal luminance in the working area at 1m above the floor is no less than 600lux and their lifespan rated at no less than 75,000 hours. The lights are selected to achieve the lowest possible background noise levels and ambient temperatures.

Plant & Test Equipment

Air cooled external chillers with buffer vessels and pump systems for chilled water cooling, chassis and engine dynamometers.



Hemi-anechoic room highlighting IAC's chosen lighting system alongside the client's preferred fire suppression system

Plant room for turnkey acoustic testing facility

Below is an example of a project for Volvo Cars where the facility was completely overhauled by IAC to include new wall linings, acoustic doors and a silent ventilation system.

Before

After

Refurbishment

The last two decades have seen an explosion in acoustic testing by automotive manufacturers, component suppliers, engineering institutions and educational organisations together with a rapid growth in the construction of new acoustic test facilities.

Many older facilities have become tired and may contain materials that are now considered unsuitable and hazardous. IAC Acoustics can provide your facility with a much needed upgrade complying with current day standards and utilising state of the art robust materials and technology. All IAC products are rigorously tested and the new materials permit "corporate styling" and high aesthetics to suit each customers' individual requirements.

Upgrade products include:

- Survey and design
- Existing chamber strip-out
- Replacement wedges
- Replacement doors
- Replacement ventilation
- Replacement lighting and electrics

Refurbished anechoic pass-by chamber facility with foam and IAC Metadyne® wedges

IAC Curved Roof for Turnkey Hemi-Anechoic Chambers

Main contractors sometimes struggle to provide a smooth, flat and level surface to the underside of concrete roofs or walls, to allow the installation of IAC's wedge support structure. Because of the spans, the concrete thickness tends to escalate where the roof load can easily exceed 500 tonnes (all of which needs supporting). A builder's solution, normally, is to install deeper steel beams and hollow-pot type ceiling, however, this is not acceptable physically or acoustically for the wedge system.

This heavy design also increases the steel tonnage, foundations, costs and at the end there may be no acoustic guarantees from the builder. For the same size, with a guarantee, IAC can supply a flat or curved roof system that will only weigh a fraction of an equivalent concrete solution at 30 tonnes.

Please refer to the adjacent photos of IAC's 'curved' panel ceilings. The curve also has the added benefit of improving the anechoic performance inside the chamber and the reduced wall height reduces cost and allows space for return air ductwork above the rooms.

Hemi-anechoic chamber with a curved roof during construction phase

The same site, once the chamber was completed and the wedges installed

Typical building shape from outside a turnkey facility with a curved roof

iac acoustics
making the world a quieter place

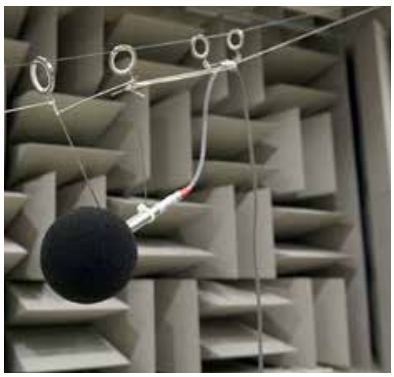
Facility Testing and Final Commissioning

IAC Acoustics offer a comprehensive commissioning service for all acoustic test facilities to ensure the performance criteria is met and an exact frequency cut-off determined.

IAC has been represented on the International Standards Organisation working group to develop a standardised test method for anechoic and hemi-anechoic chambers. The new standard (ISO 26101 – Acoustics — Test methods for the qualification of free-field environments) provides a test method applicable to all free-field environments, as an alternative to the method given in the Annex of ISO 3745 which is primarily for anechoic rooms designed for sound power measurement.

When commissioning a facility, IAC will determine the effectiveness of the chamber by making sound pressure level measurements as a function of distance from a sound source situated in the centre of the chamber, and comparing these with the corresponding values predicted by the inverse square law.

In addition to commissioning the test cell, IAC Acoustics also carries out ambient noise levels (including the ventilation system) and transmission loss, reverberation time and dynamometer noise measurements. As part of the commissioning procedure, IAC also fully tests and commissions the ventilation system in the facility, including air flow balancing.



Automotive Test Facilities

- Hemi-anechoic Chambers
- VSAC
- Pass-by Chambers
- Powertrain NVH Test Laboratories
- Driveline Chambers
- Listening Rooms
- Modal Analysis Facilities
- Shake & Rattle Chambers
- Airbag Test Facilities
- Quiet Rooms

Automotive Acoustic Test Facility International Customer List

Customer	Description	Location
Aberdeen Proving Ground	M H	USA
Airic	M P	Iran
American Axle	M H	USA
Alpine	Mi M	Germany
Arcelic	M H	Turkey
Artc	M H	Taiwan
Arvin	M H	USA
Arvin Muffler	M H	USA
Arvin Muffler	M H	USA
Arvin N.A.	Mi A	USA
Audi	M H	Germany
Audi	M F H	Germany
Audi Ingolstadt	Mi H	Germany
Bajaj Autos	M P	India
Bar F1	M E	UK
BMW	E	UK
Bosch Auto	M H	USA
Bosch Automotive	M H	USA
Bridgestone/Firestone	M V	USA
BYD (Build Your Dreams)	M P V L	China
Burke E. Porter	Mi A	USA
Ceeva	M V	France
Cetecom	Mi A	Germany
Chrysler Motor Corporation	M V	USA
Chrysler Motors	M V	USA
CMI-Ricardo	Mi E	USA
Coltec Automotive	M A	USA
Continental	F V	USA
Creos	M V	France
Daewoo	M H	USA
Dana Corp.	M H	USA
Deere & Company	M H	USA
Deere & Company	M H	USA
Deere & Company	M H	USA
Deere & Company	M H	USA
Deere & Company	M H	USA
Delphi Automotive	Mi A	USA
Delphi Int. Sys.	M H	USA
Delphi Products	M H	Luxembourg
Delphi Products	M A	Luxembourg
Delphi Products	M H	Germany
Dow Automotive	M H	USA
Faital	M H	Italy
FEV Engine Tech	M H	USA
Fiat	M A	Italy
Fisa	M H	Italy
Ford Motor	M A	USA
Ford Motor Company	M V x12	USA

Customer	Description	Location
Ford Motor Company	Mi H	USA
Ford Motor Company	M V T	Australia
Ford Motor Company	M H	USA
Ford Motor Company	M H	USA
Ford Motor Company	Mi H	UK
Ford	Fg H	UK
Ford Rawsonville	M H	USA
Georgia Tech	M A	USA
GIF	M V	Germany
GM Corporation	M H	USA
GM Lansing	M H	USA
GM Truck & Bus	M V	USA
GM Brazil	M V	Brazil
GM Flint	M H	USA
GM Milford	M H	USA
GM Saginaw	M H	USA
Goodyear	M V	Luxembourg
Harley Davidson	M P	USA
Harman Consumer Group	Mi A	USA
Harman International	Mi H	USA
Harman International	M H	USA
Harman Motive	Mi H	USA
Harman OEM Group	M H	USA
Harman Becker UK	Mi A	UK
Honda F1	M E	UK
Honda	F H	USA
Honda America	F H	USA
Honda America	M H	USA
Honda UK	M V	UK
Hyundai Motor	M A	USA
Hyundai Motor	Mi A E	USA
Idiada	M V T	Spain
ITT Automotive	F H	USA
ITT Automotive	F H	USA
ITT Rochester	M A	USA
IMS Morat + Söhne	M H	Germany
Ivensys	R	USA
Jaguar	L	UK
Jaguar	M V T	UK
Katri	M V	Korea
Kampmann	M H	Germany
Karmann	M H	Germany
Kolano & Saha	M A	USA
Kuzoi Motors	M H	Taiwan
Kwang Motors	M H	USA
Lear Corporation	M H	USA
Land Rover	Mi V	UK
Lombard Co.	M H	USA

Customer	Description	Location
Lotus	M H V	UK
Lotus	M H E	UK
Magna Corporation	Mi H	USA
Mando	M H	USA
Massey Ferguson	M H V	France
Maruti Suzuki	M H V L	India
McLaren F1	M H E	UK
Merloni	M H	Italy
Methode Electronics	M	USA
Monroe Auto	Mi A	USA
Monroe Auto Equipment	Mi A	USA
Monroe Auto Equipment	Mi A	USA
Motor Products	Mi A	USA
MTS	M F H	USA
Nissan European Technology Centre	M H V	UK
Nissan European Technology Centre	Mi H V	UK
Nissan	M H E	Spain
Nissan	M H Q	USA
Opel	M H V	Germany
Opel Russelsheim	M H	Germany
Perstorp	M H V	USA
Porsche	M A E	Germany
Porsche	M H V	Germany
Renault	M H V	France
Ricardo	M H E	UK
Ricardo	M H E	USA
Rousch Anatrol	M H V	USA
Rousch Anatrol	M H	USA
Rousch Anatrol	F H	USA
Rover	M H V	UK
Rover	SR	UK
Rolls Royce Motor Cars Ltd	M H SR	UK
Sanden	M H V	France
Schenck Pegasus	M H V	USA
Schenck Pegasus (Ford Motor Co.)	M H	USA
SDRC	M H SQ	USA
Sebring	M H V	Austria
Siemens Corporation	M H	USA
Siemens Corporation	M H V SQ	UK
Siemens Ag, Bad Neustadt	M	Germany
Siemens Munich	M H	Germany
Siemens Kamplintfort	M A	Germany
Siemens Bocholt	M H	Germany
Siemens Ulm	M A	Germany
Siemens Production Technology	M H	Germany
Siemens Beijing	M H	China
Sika Industry	M A	USA
Skoda	M H L SQ	Czech. Rep.

Customer	Description	Location
Sverdrup Technology Inc.	M	USA
Tennex Industries	M H V ★	UK
Toyota	M H V	USA
TRW	M H Q	Germany
US Army	M H	USA
Valeo	M H Q	USA
Valeo	M H Q	USA
Valeo Wiper Systems	M H Q	USA
Valeo	M H Q	France
Visteon (Ford)	Mi A	UK
VW Wolfsburg	Mi A	Germany
Volvo	M H V	Sweden
Volvo	M H E	Sweden
Volvo	M H V	Sweden
Volvo Penta	M H E	Sweden

Key

- M — Metadyne® Wedges
- Mi — Microdyne® Foam Wedges
- Fg — Microdyne® Fiberglass Wedges
- F — Planarchoic™ (flat) Panels
- A — Full Anechoic Chamber
- H — Hemi-anechoic Chamber
- V — Vehicle Semi-anechoic Chamber (VSAC)
- E — Engine Semi-anechoic Chamber (ESAC)
- P — Pass-by Chamber
- L — Listening Room
- Q — Quiet Room
- SR — Shake & Rattle Facility
- SQ — Sound Quality Room
- R — Reverberation Chamber
- ★ — Turnkey Project

Industrial & OEM Facilities


Power
Generation
1-877-769-7669
www.cummspower.com/rental

Industrial & OEM Acoustic Test Facility International Customer List

Customer	Description	Location
AMD	M H	USA
AP Products	M M M M	USA
Apple Computers	Mi H M M	USA
Arcelic	M H M M	Turkey
Artc		Taiwan
AT & T	Mi H	USA
Autophon (UK) Ltd.	Mi H	UK
AWA/Aisin		USA
Bafam (Berlin Germany)		Germany
Becton Dickinson		USA
Blachford		USA
BPB America/Celotex		USA
British Telecom	Mi A	UK
Bristol Compressors		USA
Bureau of Mines		USA
Burke E. Porter		USA
C. Iber & Sons		USA
Canon Virginia		USA
Cemoter	M H	Italy
Cidco Inc.		USA
Conner Peripherals		USA
Copeland Corp.		USA
Cosi		USA
Cummins	M H x2 T	USA
Defiance		USA
Delco Electronics		USA
Dell Computer	Mi H	USA
Deutsche Telekom Ag (Steinfurt)	Fg A	Germany
Dunn Construction		USA
Eaton Technologies Inc.		USA
Environetics		USA
Ericsson	Mi H	UK
Fachhochschule (Kiel Germany)		Germany
FG Wilson Ltd.	M H R T	UK
Faital	M A	Italy
FBI		USA
FEV Engine Tech	M H	USA
Firma Cetecom		Germany
GE Appliances	R	USA
GHSP		USA
Goodmans Loud Speakers	Mi A	UK
Grundfos	M H	Denmark
Grundig	Mi A	Germany
Harman Consumer Group	M H	USA
Harris Corp.		USA
Hewlett Packard	Mi H	USA
HLFU (Germany)		Germany
Honeywell Inc.		USA

Customer	Description	Location
Hull City Council	Mi H	UK
IA & A Acoustics		USA
IBM Corp.	Mi H	USA
Inalfa Roof		USA
Ingersoll Rand		USA
Intel	Mi H	USA
ITT Telecom	Mi H	USA
Jabil Circuit		USA
Kelley & Associates		USA
Ketchum & Walton		USA
Kokusai Electric		USA
Lectron Products		USA
Mabe		USA
Magna Corporation		USA
Mando Machinery	M H	USA
Matsushita Electric	Mi H	USA
Maxtor Corp.	Mi A	USA
Mayo Clinic		USA
Merloni		Italy
Meyer Sound		USA
Microsoft		USA
Ministry of Defence	Mi H A	UK
Miracle Ear/Dahlberg		USA
MIT	M H	USA
MOD	M H	Israel
Motorola	Mi H	USA
MTD Products		USA
Nacco		USA
Nastech		USA
NEC America	Mi A	USA
Neuroscience	Mi A	USA
Newman Technology		USA
Nidec Corp.		USA
NIST		USA
Nokia UK	Mi A	UK
Nokia Bochum	Mi A	Germany
Nokia Copenhagen	Mi A	Denmark
Northern Telecom	Mi A	USA
Northrop Electro		USA
Nytt Rikshospital	Mi A	Norway
Oeler Industries/Polymics		USA
Ohio State University	Mi A M M	USA
OKI Telecom	Mi H	USA
Owens Corning	Mi H	USA
Oxford Speaker Company		USA
Panasonic	Mi A	UK
Penn Ventilators		USA
Phonak Gmbh	Mi A	Germany

Customer	Description	Location
Pioneer Speakers Inc.	Mi A M M	USA
Pitney Bowes	Mi H M M	USA
Prince Corporation		USA
Q-Tran		USA
Ransco	Mi H	USA
Resound Corp.	M H	USA
Robert Bosch	M H M M	USA
Rockwell International		USA
Rolm Systems		USA
Rudolph Libbe		USA
Samsung	Mi H	UK
Sanitherm Engineering		USA
SCJ Associates		USA
SDRC	M H	USA
Seagate Technologies	Mi H	USA
Shure Brothers		USA
SIAC	M H	Singapore
Simpson		USA
Singer Controls		USA
Smith Corona Corp.		USA
Standard Telecommunication Lab.	Mi A	UK
STC Telecommunications Ltd.	Mi A	UK
Sunbeam Oster		USA
Sverdrup Technology Inc.		USA
Systems Mat'l Handling		USA
Tokai Rika		USA
Tokia Rubber		USA
US Army		USA
US Dept. of Labor		USA
USA Medical Research	Mi A	USA
VDE	H	
Veridian Veda Operations		USA
Vertu	Mi A	UK
W.E. O'Neil		USA
Western Digital		USA
Walbridge Aldiner		USA
Walker		USA
Whirlpool Singapore	M H	USA
Xerox Corporation	M H T	USA
Yazaki Eds Eng		USA
Yazaki N.A.		USA
York International	H T	UK
Yosemite Trading		USA

Key

- M Metadyne® Wedges
- Mi Microdyne® Foam Wedges
- Fg Microdyne® Fiberglass Wedges
- F Planarchoic™ (flat) Panels
- A Full Anechoic Chamber
- H Hemi-anechoic Chamber
- L Listening Room
- R Reverberation Chamber
- T Turnkey Project

High Performance Acoustic Test Facilities

For education and acoustic research organisations

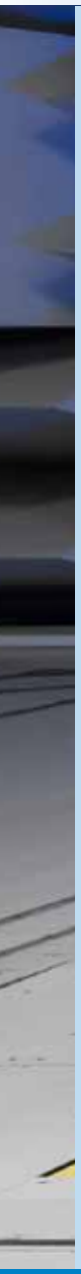
Academic & Research Acoustic Test Facility International Customer List

Customer	Description	Location
Aberystwyth University	L	UK
BSI	Mi A	UK
CEM	Mi A Pu	Spain
Department of Science		USA
Edinburgh University	M H Mi A L	UK
Goodmans Hi-Fi	Mi A Pu	UK
Harman Becker	Mi A Pu	UK
HSL Buxton	Mi A H	UK
Imperial College London	Mi H	UK
Institute of Sound & Vibration Research (ISVR)	Fg A	UK
Lorent	R	UK
McQuarie University	Fg A	Australia
MIT	M H	USA
MOD Aquilla	Mi A	UK
National Physical Laboratory (NPL)	Mi A Pu	UK
Neuroscience Department		USA
Ohio State University	Mi A	USA
Oxford University	Mi A	UK
Portsmouth University	Mi H	UK
Qinetic	Mi A H	UK
Salford University	M H Mi A L	UK
SATRA	Mi H	UK
Southbank University	Mi A	UK
Southampton Solent University	Mi	UK
Strathclyde University	L	UK
University College London	Mi H	UK
University College Northampton	L	UK
University of Southampton	Mi H	UK
US Army		USA
US Dept. of Labor		USA
USA Medical Research		USA
Warwick University	L	UK

Key

- M — Metadyne® Wedges
- Mi — Microdyne® Foam Wedges
- Fg — Microdyne® Fiberglass Wedges
- Pu — Pure-tone Certified
- A — Full Anechoic Chamber
- H — Hemi-anechoic Chamber
- L — Listening Room
- R — Reverberation Chamber
- Turnkey Project


TANNOY



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