Acoustic Test Facilities

A Complete Range of Microdyne® Anechoic & Macrodyne® Reverberation Chambers

Acoustic Test Facilities for Manufacturers of:

- Vehicles
- Engines
- Motorcycles
- Diesel Generators
- Mechanical Plant Equipment
- Home Appliances
- Office Machines
- Electronic Components
- Computers
- Mobile Phones
- Hi-Fi Equipment

iac acoustics

Acoustic Test Facilities

Microdyne® Anechoic & Macrodyne® Reverberation Chambers

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 Acoustics' 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.

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 Acoustics. As part of the turnkey process, IAC Acoustics 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 minimizing administrative input. This is particularly effective if many different acoustic facilities are being installed at one location or if a complete building is required.

IAC Acoustics offers a complete solution to all types of acoustic test facilities



What is an Anechoic Chamber?

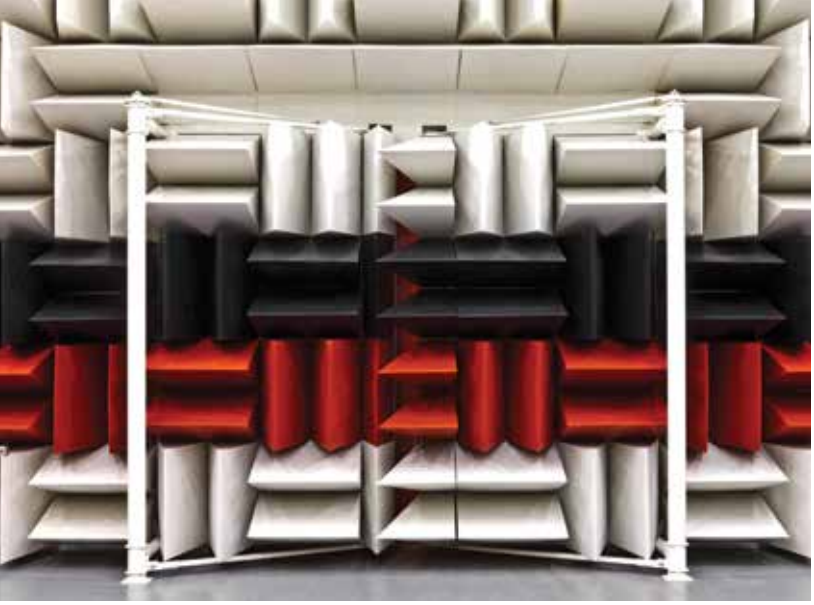
An anechoic chamber can be considered similar to a precision acoustical measurement instrument, providing a free-field environment without noise interference or sound reflection. In an ideal free-field environment, the inverse square law would function perfectly. This means that the sound level from a spherically radiating sound source decreases by 6 dB 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.

The below table 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

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 system
- Acoustic doors — operating & sizing
- Interior floors — cables and/or gratings
- Lighting & electrical systems
- Overall structural design considerations
- RF shielding requirements

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.

Standard Features

Microdyne anechoic rooms come with the following standard features:

- Anechoic wedges (foam, fiberglass or IAC Acoustics Metadyne®) with the required low-frequency cut-offs
- Double or single wall and ceiling construction
- IAC Acoustics standard ventilation system coupled to the building supply
- Lighting (interior) minimally acoustically reflective
- Tubular cable ports
- For full anechoic chambers, interior non-reflective cable floor system above the floor wedges with a nylon catch net below
- IAC Acoustics Noise-Lock® wedge acoustic doors
- IAC Acoustics Acousti-flote™ floor system with vibration isolators

Options

- Floor grating for full anechoic chambers which will house heavy items
- Additional or larger Noise-Lock® acoustic doors
- Access panels for equipment and test openings
- Double Acousti-flote™ floor for Double Wall STC 70 Microdyne Chambers
- Air mounts, springs or other types of vibration isolators
- Independent ventilation system
- RF shielding

Floors

Fully anechoic chambers pose a challenge when people need to enter the facility in order to place items under test. IAC Acoustics has developed a range of floor solutions to minimize reflective sound. Typical installations utilize a grid-based system to maximize the absorption of the floor wedges. IAC Acoustics also uses a range of cable floors to support people and heavy test objects.

Cable Floors

IAC Acoustics fully anechoic chambers are typically provided with a tensioned cable floor, situated approximately 4" above the tips of the floor wedges. Beneath this cable floor is a nylon catch net to prevent debris and small objects falling out of reach.

The cable floor consists of stainless steel cable interwoven in a criss-cross matrix of 2" separation. Each cable is tensioned from an acoustically lagged steel ring beam by turnbuckles at one end and a coil spring at the other. This ensures that the floor is strong with even deformation and spring characteristics.

Double Wall STC 70 Microdyne® Chambers

The IAC Acoustics Double Wall STC 70 Microdyne Chamber is designed for the research physicist or engineer who must make precise sound measurements in a free-field acoustic environment. Double Wall STC 70 Microdyne Chambers provide high sound transmission loss (TL) characteristics and have a completely anechoic wedge lined interior to meet these requirements.

For maximum sound isolation, IAC Acoustics Double Wall STC 70 Microdyne Chambers are designed as a room within a room featuring certified IAC Acoustics Noise-lock® and Moduline™ components. The inner room is set on a vibration isolation system created for the specific weight and frequency cut-off of the room.

Single Wall STC 40-60 Microdyne® Chambers

Single Wall STC 40-60 Microdyne Chambers are designed for applications and locations where the noise reduction characteristics for a single wall and ceiling construction provide adequate noise isolation.

The single wall construction results in smaller overall outside dimensions and is particularly suited to placement in less noisy areas. In every other respect, the Single Wall STC 40-60 Microdyne Chamber is similar to the Double Wall STC 70 Microdyne Chamber series with the same standard features and options available.

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.

An impedance tube is used for critical adjustment of wedge dimensions before finalizing each design. Due to variations in material characteristics, statistical quality control measures are employed during wedge production to ensure specified acoustic performance.

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 fiberglass or foam. Metadyne wedges were developed by IAC Acoustics as a solution to some of the problems associated with using 100% foam or fiberglass. 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.

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
- Many paint options available to match corporate colors

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 Acoustics' 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. 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, trucks, 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. 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 Acoustics 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 engineering grade acoustic power level measurements (Grade 2).

Typical Uses of Anechoic Chambers

Microphone Calibration

- Primary calibration, free-field reciprocity method
- Secondary calibration by the substitution method
- Frequency response & directivity

Sound Level Meter Calibration

- Pattern evaluation
- Frequency response
- Directivity

Psycho-Acoustic Testing

- Sound perception testing is typically used for research and development of products

Sensory Deprivation Testing

- Used for military & educational research

Hearing Research

- Free-field audiometry
- Cochlear implant testing

Speaker Research & Development

- Sound power output measurements
- Physical speaker design
- Distortion & frequency response

Acoustic Science

- PhD projects
- Ultrasound scanning research
- Virtual acoustics — generating auralizations of concert halls, city streets & other spaces

UL Certification

- All machines are required to have a sound power output test carried out prior to being released for sale
- Testing of toys to ensure suitability for hearing in children
- Items such as hearing protectors are required to be tested in an anechoic chamber to measure their effectiveness

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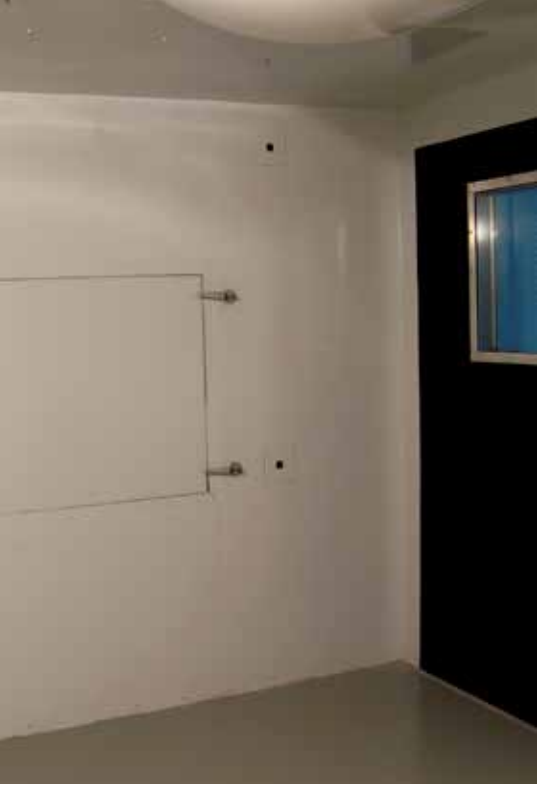
Macrodyne® Reverberation Rooms

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

A reverberation room can be considered the opposite of 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.



Construction of Macrodyne 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 & access
- Lighting & electrical systems
- Overall structural requirements

Standard Features

IAC Acoustics Reverberation Rooms come fully equipped with the following features:

- IAC Acoustics Hardliner™ panel construction
- Double/single wall & ceiling construction
- IAC Acoustics ventilation system coupled to building supply
- Interior lighting & power
- Standard size Noise-Lock® acoustic door
- Complete certification & commissioning tests

Options

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

Facility Testing & Final Commissioning

IAC Acoustics offers a comprehensive commissioning service for all acoustic test facilities to ensure the performance criteria is met and an exact frequency cutoff determined. IAC Acoustics has been represented on the International Standards Organization working group to develop a standardized 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 Acoustics 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 center 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 Acoustics also fully tests and commissions the ventilation system in the facility, including air flow balancing.

Acoustic Test Facilities for Education & Acoustic Research

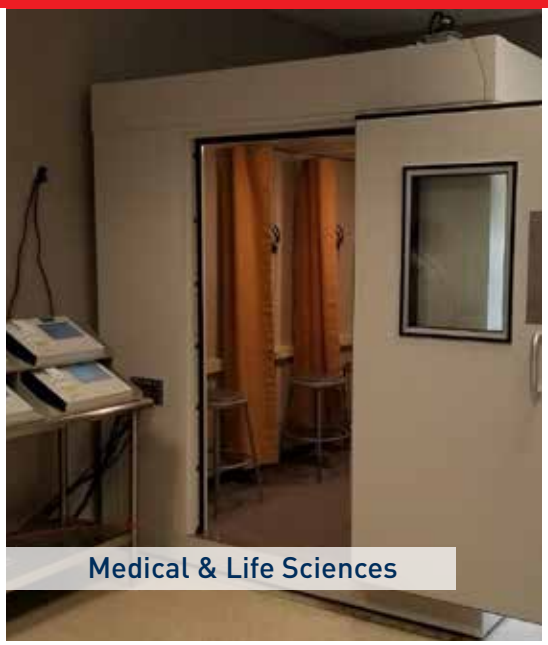
In addition to being the world's largest supplier of noise control solutions to industry, IAC Acoustics is also unique in its ability to provide some of the best acoustic test facilities to colleges, universities and research groups around the globe. Specialist education establishments where cutting edge research is carried out, demand the highest acoustic specifications for their facilities. IAC Acoustics has been privileged to have worked with some of the best organizations worldwide.

Anechoic facilities used by research institutions are typically constructed from IAC Acoustics modular acoustic panels to the configuration of either Single Wall STC 40-60 Microdyne or Double Wall STC 70 Microdyne chambers.

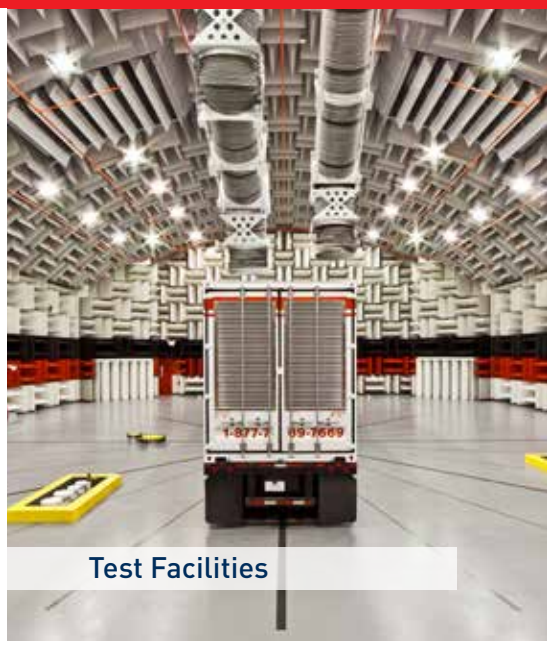
Making the World a Quieter Place

Markets Served by IAC Acoustics

Architectural



Medical & Life Sciences



Test Facilities

Industrial

Dyno Test Rooms

HVAC

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