

# Macrodyne® Hardliner™ Reverberation Rooms

A Complete Range of Macrodyne Reverberation Chambers



- Double or single wall construction

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- Hardliner panel construction

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- Silenced ventilation systems

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- Tubular cable and power ports

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- Interior lighting

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- Complete certification and commissioning tests

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- Customization options available





# Macrodyne Hardliner Reverberation Rooms

A reverberation room can be considered the opposite of an anechoic room because its boundaries reflect, rather than absorb, incident 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 acoustical measurement environment, defined as a sound field in which the acoustical 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 rectangular configurations. With more than 70 years experience, IAC Acoustics is the pioneer and leading company in the design, construction, and commissioning of modular reverberation rooms.

IAC Macrodyne Hardliner Reverberation Rooms are designed not only to fully satisfy reverberation requirements, but also meet specific interior acoustic sound levels and other environmental requirements.

## **This is accomplished by:**

- Single-wall & double-wall structures
- Standard & special ventilation systems
- Vibration isolators to supply the required noise reduction



**IAC Acoustics is the pioneer and leading company in the design, construction and commissioning of modular reverberation rooms.**



## Construction of Reverberation Rooms

In order for a reverberation room to perform correctly, careful consideration must be given to a number of factors, including:

- Interior volume
- Room dimensions in relationship to size of test object
- Interior working space
- Lowest frequency band of interest
- Maximum ambient noise level
- Noise reduction
- Vibration isolation
- Silenced ventilation system
- Doors and access plugs
- Lighting and electrical systems
- Overall structural requirements
- Sound transmission loss requirement

IAC's Macrodyne Hardliner reverberation rooms are tailored to provide suitable working spaces, sizes and types of doors, lighting, electrical systems and climate controls appropriate to the work intended.

All of these elements are assembled within an engineered modular structural framework, to assure the overall integrity of the Macrodyne Reverberation Room. With the IAC Moduline® Component System, virtually any size room can be created.



## Room Volume & Frequency Cut-Off

IAC Macrodyne Reverberation Rooms are designed and constructed to meet current standards. These standards generally require that the room be large enough and have low total sound absorption to provide an adequate reverberant sound field for all frequency bands of interest.

For most applications, IAC recommends the preferred minimum volumes, which are a function of the low cut-off frequency (shown in Table 1). It is also recommended that the volume of the test equipment not be larger than 1% of the room volume. Clearly, for large pieces of equipment or low cut-off frequencies, larger rooms are required.

Room proportions should be selected to avoid unequal spacing between the frequencies of the normal modes of the room. To achieve this condition it is recommended that the ratio of any two dimensions does not equal, or closely approximate, an integer (suggested room dimensional ratios are listed in Table 2).

**Table 1: Preferred Minimum Room Volume as a Function of Lowest Frequency Band of Interest**

Lowest Frequency Band of Interest	Room Volume	
	ft <sup>3</sup>	m <sup>3</sup>
125 Hz octave or 100 Hz one-third octave	7062	200
125 Hz one-third octave	5297	150
160 Hz one-third octave	3531	100
250 Hz octave or 200 Hz one-third octave or higher	2472	70

**Table 2: Recommended Alternative Room Dimensional Ratios for Rectangular Rooms**

	1	2	3	4	5
Ly/Lx	0.83	0.83	0.79	0.68	0.70
Lz/Lx	0.47	0.65	0.63	0.42	0.59

# Sound Absorption Characteristics

The sound-absorption coefficients of a reverberation room surface must help insure a satisfactory reverberant field and minimize the effect of source positioning on measurement accuracy. Consistent with current standards, Macrodyne Reverberation Rooms have average sound absorption coefficients of less than 0.06 for each octave band in the frequency range from 125 to 8000 Hz.

However, in a lower frequency range, additional absorption is usually desirable to increase the band-width of the normal modes of the room. The upper limit of this frequency range is given in the following relationship:

$$F = 2000 / V^{1/3*}$$

**V = Volume in cubic meters**

The highest value of the average sound-absorption coefficient within frequency range of interest should not exceed 0.06. Moduline Hardliner Modules meet these desired sound-absorption characteristics (shown in Table 3).

**Table 3: Typical Sound-Absorption Coefficients of Moduline Hardliner Panels**

Octave Band Center Frequency, Hz						
125	250	500	1000	2000	4000	8000
Sound-Absorption Coefficient						
0.045	0.03	0.02	0.02	0.015	0.02	0.03

## Single-Wall Construction

Single-Wall Macrodyne Reverberation Rooms are available with and without IAC vibration isolated Hardliner floors depending on degree of structurally transmitted noise. Room volumes, lowest recommended frequency of interest, dimensions and weights for some configurations are shown in Table 1. Outside dimensions are shown without Acusti-Flote™ Floor; if required, add 7" to overall room height.

## Double-Wall Construction

Double-Wall Macrodyne Reverberation Rooms are designed to provide optimum noise isolation with Hardliner Noise-Lock® components. These use double-wall and ceiling construction within the inner room on its own IAC Hardliner vibration isolated floor. The outer room rests on the building floor. However, where more vibration isolation is required, the outer shell can also be supplied with an Acusti-Flote™ Floor.



## Standard Features

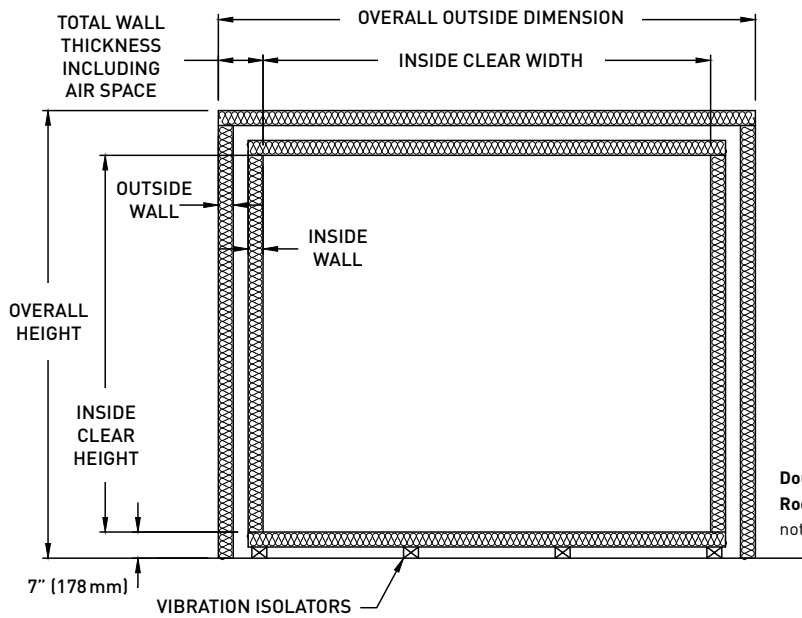
IAC Acoustics Macrodyne Hardliner Reverberation Rooms come fully equipped with the following features:

- Hardliner panel construction
- Double or single wall and ceiling construction
- IAC Tranquil-Aire® Ventilation Systems — coupled to building supply
- Interior lighting
- Tubular cable and power ports
- (1) 36" x 84" clear opening Noise-Lock door
- IAC Acousti-Flote floor
- Rubber-in-shear vibration isolation — 6 ½ Hz
- Complete certification and commissioning tests

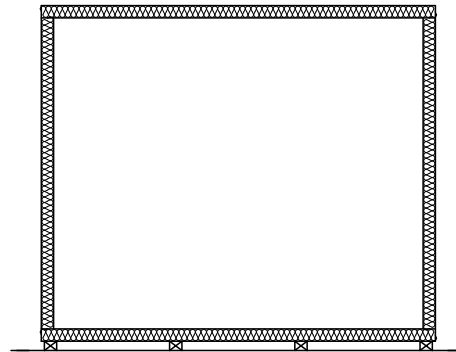
## Options

- Self-contained air handling/ventilation systems
- Additional or larger door
- Access panels for equipment and test openings
- IAC Acousti-Flote floor for single-wall rooms
- Double IAC Acousti-Flote floor for double-wall rooms
- Air mounts, springs or other types of vibration isolation
- Turning vanes and/or diffusers

# Room Layout



**Single Wall Macrodyne Hardliner Reverberation Room** — similar to Double-Wall except outer room & floor eliminated (Acousti-Flote Floor optional).



**Double Wall Macrodyne Hardliner Reverberation Room** — door, ventilation system, lighting fixtures not shown.

# Acoustic Performance

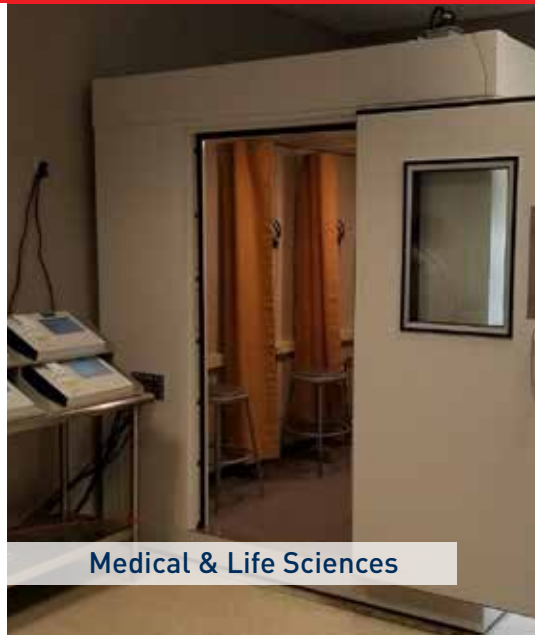
RR Type	Volume ft <sup>3</sup> , m <sup>3</sup>	Lowest 1/3 Octave Band, Hz	Inside Dimensions ft, mm			Outside Dimensions ft, mm						Weight lb, kg		
			Single Wall & Double Wall			Single Wall (no floor)			Double Wall (w/ Inner Floor)			Single Wall w/ Floor	Single Wall no Floor	Double Wall w/ Inner Floor
			L	W	H	L	W	H	L	W	H			
201	2,646 74.49	200	21 6,401	14 4,267	9 2,743	21'-8" 6,604	14'-8" 4,470	9'-4" 2,845	23 7,010	16 4,877	10'-7" 3,226	18,000 8,160	13,500 6,125	34,000 15,420
202	2,736 77.5	200	19 5,791	16 4,877	9 2,743	19'-8" 5,994	16'-8" 5,080	9'-4" 2,845	21 6,401	18 5,486	10'-7" 3,226	18,250 8,280	13,600 6,170	34,500 15,650
203	3,780 107.1	160	21 6,401	18 5,486	10 3,048	21'-8" 6,604	18'-8" 5,690	10'-4" 3,150	23 7,010	20 6,096	11'-7" 3,531	22,500 10,200	17,000 7,710	43,000 19,500
204	3,840 108.8	160	24 7,315	16 4,877	10 3,048	24'-8" 7,518	16'-8" 5,080	10'-4" 3,150	26 7,925	18 5,486	11'-7" 3,531	23,000 10,430	17,000 7,710	44,000 19,960
205	5,544 157.0	125	22 6,706	18 5,486	14 4,267	22'-8" 6,909	18'-8" 5,690	14'-4" 4,369	24 7,315	20 6,096	15'-7" 4,750	28,600 12,970	22,000 9,980	54,000 24,500
206	6,552 185.6	<125	26 7,925	21 6,401	12 3,658	26'-8" 8,128	21'-8" 6,604	12'-4" 3,759	28 8,534	23 7,010	13'-7" 4,140	32,000 14,520	24,000 10,890	61,000 27,670
207	6,612 187.3	<125	29 8,839	19 5,791	12 3,658	29'-8" 9,042	19'-8" 5,994	12'-4" 3,759	31 9,449	21 6,401	13'-7" 4,140	33,000 14,970	25,000 11,340	62,000 28,120
208	7,680 217.5	100	24 7,315	20 6,096	16 4,877	24'-8" 7,518	20'-8" 6,299	16'-4" 4,978	26 7,925	22 6,706	17'-7" 5,359	35,000 15,880	27,500 12,470	68,000 30,840
209	8,208 232.5	<100	27 8,230	19 5,791	16 4,877	27'-8" 8,433	19'-8" 5,994	16'-4" 4,978	29 8,839	21 6,401	17'-7" 5,359	37,000 16,780	29,000 13,150	72,000 32,660
210	10,098 286.0	<100	27 8,230	22 6,706	17 5,182	27'-8" 8,433	22'-8" 6,909	17'-4" 5,283	29 8,839	24 7,315	18'-7" 5,664	42,000 19,050	32,900 14,920	85,000 38,560
211	10,500 297.4	<100	30 9,144	25 7,620	14 4,267	30'-8" 9,347	25'-8" 7,823	14'-4" 4,369	32 9,754	27 8,230	15'-7" 4,750	44,000 19,960	33,000 14,970	85,000 38,560
212	10,626 300.9	<100	33 10,058	23 7,010	14 4,267	33'-8" 10,262	23'-8" 7,214	14'-4" 4,369	35 10,668	25 7,620	15'-7" 4,750	45,000 20,410	33,500 15,200	86,000 39,000

# Making the World a Quieter Place™

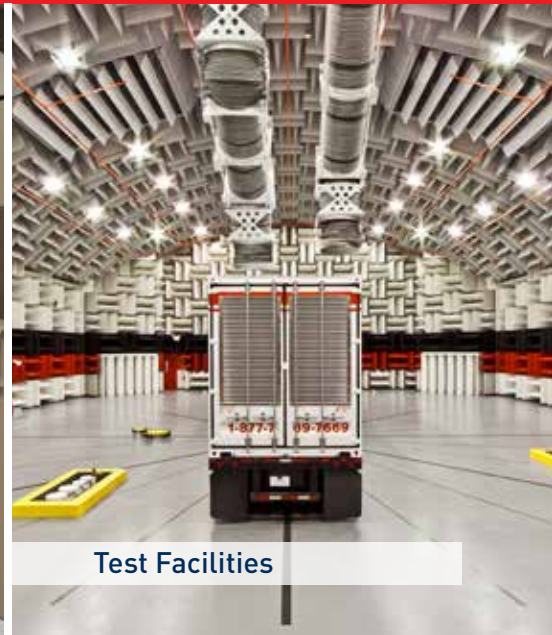
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