

MEASURING AND TESTING FACILITIES



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BUILDING PHYSICS TESTING

Fraunhofer IBP is focused on research, development and testing in all fields of building physics. Based on the competence of more than 350 scientists, engineers and technicians numerous outstanding testing resources and measuring instruments are available. Knowledge, experience and creativity can be offered as the keys to innovative products and sustainable quality of buildings. Tailored laboratories and software tools are available in the following departments:




- » **ACOUSTICS**
- » **BUILDING CHEMISTRY,**
- » **BUILDING BIOLOGY, HYGIENE**
- » **ENERGY SYSTEMS**
- » **HEAT TECHNOLOGY,**
- » **LIGHTING TECHNOLOGY**
- » **HYGROTHERMICS**
- » **INDOOR CLIMATE**
- » **LIFE CYCLE ENGINEERING**

We carry out complex building physics studies at our efficient and well-equipped laboratories and test centers and at our outdoor testing site in Holzkirchen, which to the best of our knowledge is the largest facility of its kind. Modern laboratory measuring techniques and computational methods help researchers develop and optimize building products for practical applications. We also carry out experiments in environmental test chambers, simulation facilities and existing buildings to assess components and overall systems for new buildings and renovation projects based on the principles of building physics.

Fraunhofer IBP has been approved by the German building inspection authorities as a testing, monitoring and certification center for building materials and building techniques in Germany and the rest of Europe. Four of the institute's test laboratories have been granted flexible accreditation by the German accreditation body Deutsche Akkreditierungsstelle GmbH (DAkkS) in accordance with DIN EN ISO/IEC 17025. This entitles them to develop new test methods and to modify existing methods.

How to use this digest

The easiest way to find the right laboratory or facility is to use the keyword register, which is organized in three different ways:

-  **Measurements in laboratories** (type of measurement or quantity to be measured)
-  **Measurement objects** (or part of a building etc. to be measured)
-  **Standards** (DIN, EN, ISO, VDI, etc.)

For technical reasons, the departments are listed following the given alphabetical order of the German department names.

MEASURING AND TESTING FACILITIES – AN OVERVIEW

ACOUSTICS

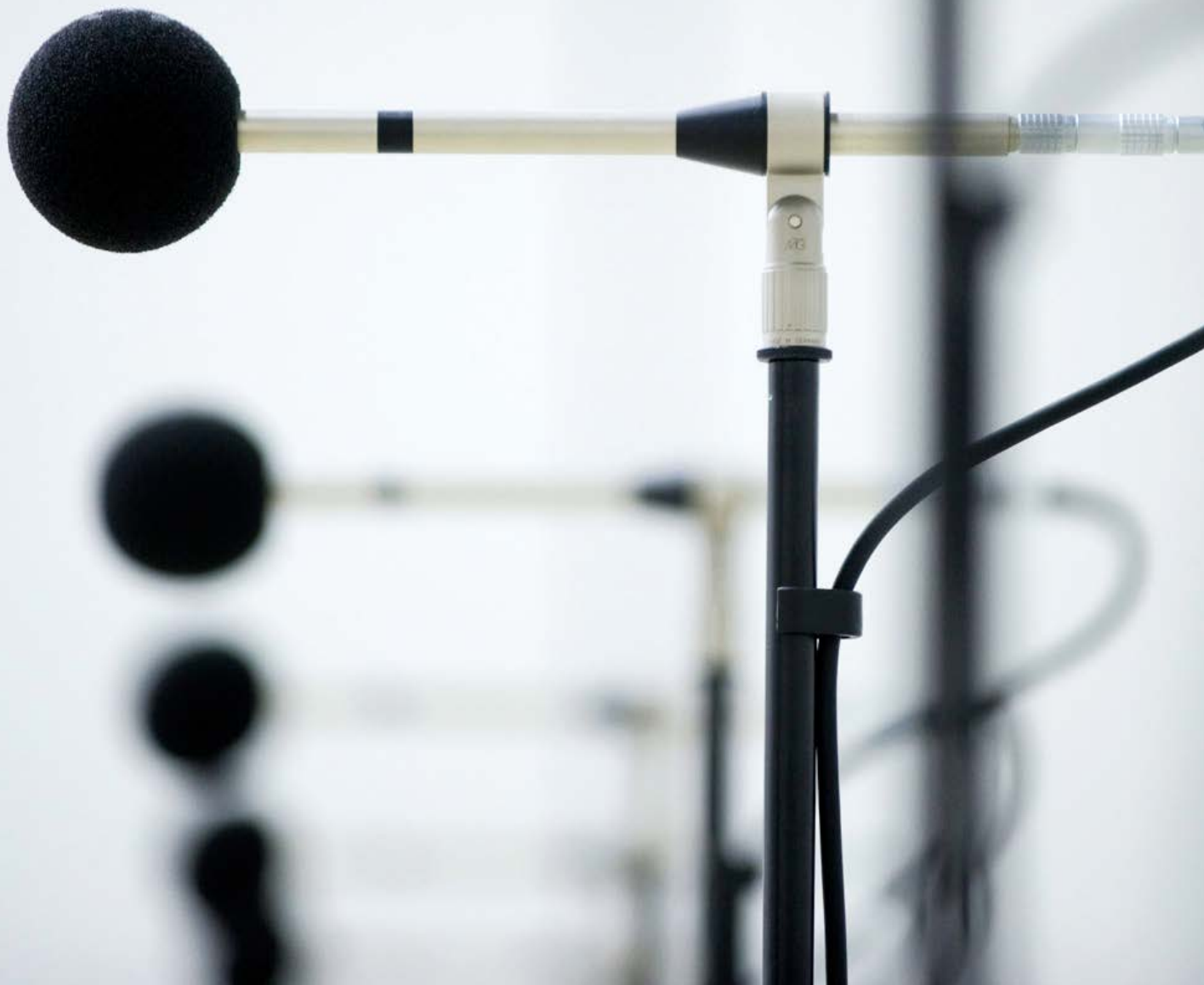
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MEASUREMENT AND TEST RANGE

ACOUSTICS

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SOUND ABSORPTION IN A REVERBERATION ROOM



Measurement	Sound absorption coefficient (random sound incidence)
Standard	DIN EN ISO 354
Measurement object	Sound absorbers, suspended ceilings, wall linings, office screens, furniture, seats, panels, textiles, fabrics, noise barriers

TECHNICAL DATA

Floor area	60 m ²
Room volume	392 m ³
Entrance door (H × W)	2.40 × 2.19 m

SPECIAL FEATURES

Connection to a semi-anechoic room	Measurement of sound insulation and sound absorption of elements between reverberation and anechoic room
Size of the connecting door (measuring surface)	3.80 × 2.35 m

MORE INFORMATION

- Area of the test object between 12 m² and max. 18 m², aspect ratio between 0.7 and 1
- Low vibration doors with high sound reduction
- Suppressed excitation of structure-borne sound of the walls due to a special basement

SOUND ABSORPTION IN AN IMPEDANCE TUBE



Measurement	Sound absorption coefficient (normal sound incidence)
Standard	DIN EN ISO 10534
Measurement object	Sound absorbers, suspended ceilings, wall linings, panels, fabrics, textiles, granular materials, active material systems

TECHNICAL DATA

Size of test samples	198 × 198 mm and diameter 100 mm
Thickness of test samples	max. 250 mm (including rear wall distance)
Further tubes and sizes	248 × 248 mm and diameter 30 mm

SPECIAL FEATURES

Horizontal and vertical installation	Sound absorption measurement of granular materials in lying position
Anechoic termination (measuring surface)	248 × 248 mm

MORE INFORMATION

- Measurement of acoustic impedance, reflection factor and sound absorption coefficient
- Measurement with a static pressure difference between front and back side
- Different frequency resolutions (extended frequency range by using microphone array)

SOUND INSULATION IN A FAÇADE TEST LABORATORY



Measurement	Sound insulation and flanking sound transmission
Standards	DIN EN ISO 10848, DIN EN ISO 140-5
Measurement object	Façade elements and prototypes including installations, noise barriers (gabions, etc.), exterior building elements

TECHNICAL DATA

Floor area (2 rooms)	18.4 m ² and 2.4 m ²
Room volume (2 rooms)	71 m ³ and 87 m ³
Doors (H × W)	1.99 × 0.86 m and 2.02 × 0.95 m
Outward opening (H × W)	10.30 × 3.52 m

SPECIAL FEATURES

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 71$ dB
Vibrational isolation of the test rooms	Supressed external influences

MORE INFORMATION

- Delivery and direct installation of large test samples via truck-mounted crane
- Rolling gate to close the test opening (weather protection)

SOUND INSULATION IN A WINDOW TEST LABORATORY



Measurement	Sound insulation
Standard	DIN EN ISO 10140
Measurement object	Windows, glazings, shutters, ventilation elements, panels, joint sealings, small-sized elements

TECHNICAL DATA

Floor area (2 rooms)	22 m ² and 18 m ²
Room volume (2 rooms)	67 m ³ and 57 m ³
Entrance doors (H × W)	2.0 × 0.85 m and 2.04 × 1.90 m
Size of test samples (H × W)	1.23 × 1.48 m or 1.35 × 1.54 m

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 72$ dB
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MORE INFORMATION

- Installation of elements in the test opening by using butt joint or stop bar.
- Elements with smaller size will be framed by a multi-layer panel construction with high sound insulation.
- Heavy elements can be sited by a crane.

SOUND INSULATION IN A DOOR TEST LABORATORY



Measurement	Sound insulation
Standard	DIN EN ISO 10140
Measurement object	Doors, door leaves, framed doors, ventilation elements, panels, joint sealings, elements

TECHNICAL DATA

Floor area (2 rooms)	20 m ² and 17.7 m ²
Room volume (2 rooms)	62 m ³ and 54 m ³
Entrance doors (H × W)	2.04 × 1.92 m and 2.02 × 0.87 m
Size of test samples (H × W)	1.985 × 0.985 m (butt joint)

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 61$ dB
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MORE INFORMATION

- Elements with smaller size will be framed by a multi-layer panel construction with high sound insulation.
- Larger elements can be tested in other facilities (see pages 8, 11, 13).

SOUND INSULATION IN A WALL TEST LABORATORY



Measurement	Sound insulation
Standard	DIN EN ISO 10140
Measurement object	Separating walls with high sound insulation, massive and lightweight wall constructions, walls with additional linings, cinema walls, façades, roofs

TECHNICAL DATA

Floor area (2 rooms)	21 m ² and 24 m ²
Room volume (2 rooms)	66 m ³ and 76 m ³
Entrance doors (H × W)	1.990 × 0.835 m and 2.02 × 1.95 m
Size of test samples (H × W)	3.11 × 4.25 m and 2.95 × 4.25 m

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 89 \text{ dB}$
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MORE INFORMATION

- Wall constructions with high sound insulation at low frequencies, for example separating walls in cinemas, can be tested in this wall test laboratory.
- Height of the walls up to the upper floor or to the lintel below the upper floor

FLANKING SOUND TRANSMISSION OF CAVITY AND RAISED FLOORS



Measurement	Normalized flanking impact sound level, normalized flanking level difference
Standard	DIN EN ISO 10848-2
Measurement object	Cavity and raised floors, floor systems with air terminals, bulkheads (absorbent, boards)

TECHNICAL DATA

Floor area (2 rooms)	21 m ² and 24 m ²
Room volume (2 rooms)	66 m ³ and 76 m ³
Entrance doors (H × W)	1.990 × 0.835 m and 2.02 × 1.95 m
Height of the floor system	Variable

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 89$ dB
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MORE INFORMATION

- The height of the floor system can be varied but will influence the room volume.
- The separating wall above the floor system is made of a multi-layer panel construction with high sound insulation.

SOUND INSULATION IN A WALL TEST LABORATORY



Measurement	Sound insulation
Standards	DIN EN ISO 10140, DIN EN 1793-2
Measurement objects	Movable walls, glass walls, folding partitions, noise barriers and screens

TECHNICAL DATA

Floor area (2 rooms)	16.73 m ² and 20.89 m ²
Room volume (2 rooms)	50.82 m ³ and 62.64 m ³
Entrance doors (H × W)	1.990 × 0.835 m and 2.92 × 4.25 m
Size of test samples (H × W)	2.93 × 3.67 m

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 77$ dB
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MORE INFORMATION

Halfen-rails for quick and easy installation of movable wall systems

SOUND INSULATION OF ROOM-HIGH ELEMENTS



Measurement	Sound insulation
Standard	DIN EN ISO 10140
Measurement object	Façade elements, windows, glazings, panels, gates, doors, large elements

TECHNICAL DATA

Floor area (2 rooms)	17.7 m ² and 20 m ²
Room volume (2 rooms)	62 m ³ and 70 m ³
Entrance doors (H × W)	2.05 × 1.91 m and 2.00 × 0.83 m
Size of test samples (H × W)	3.18 × 1.23 m (butt joint)

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 72$ dB
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MORE INFORMATION

- Elements with smaller size will be framed by a multi-layer panel construction with high sound insulation.
- Larger elements can be tested in other facilities.

IMPACT SOUND INSULATION OF FLOOR COVERINGS



Measurement	Impact sound insulation
Standard	DIN EN ISO 10140
Measurement object	Floor coverings, floating floors, carpets, parquet floors, laminate, stone floors

TECHNICAL DATA

Floor area and object size	4.73 × 3.73 m, variable thickness of floor coverings
Room volume (2 rooms)	62 m ³ and 54 m ³
Entrance doors (H × W)	2.05 × 1.91 m and 2.05 × 1.89 m
Thickness of separating floor	140 mm (reinforced concrete)

SPECIAL FEATURE

Walking sound (walking noise)	Apart from the impact sound the walking sound in the sending room can also be measured and weighted.
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MORE INFORMATION

The surface of the separating floor is especially grinded, in order to apply (laying or sticking) thin resilient floor coverings.

NOISE OF WATER INSTALLATIONS ON LIGHT WALLS



Measurement	Noise of water installations
Standards	DIN EN ISO 10052, DIN 4109, SIA 181, VDI 4100
Measurement object	Lightweight installation walls, front-wall and in-wall installations

TECHNICAL DATA

Floor area (2 rooms)	20 m ² and 20 m ²
Room volume (2 rooms)	70 m ³ and 61 m ³
Entrance doors (H × W)	2.00 × 0.83 m and 1.99 × 0.84 m
Thickness of separating floor	190 mm (reinforced concrete)

SPECIAL FEATURE

Controllable water supply (water pressure and flow rate)	In both rooms (stacked bathrooms)
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MORE INFORMATION

- Lightweight installation walls are separating each of the stacked rooms.
- Test results can be used to prove compliance with requirements according to the German standard DIN 4109 and to the guideline VDI 4100.
- Test results can be used for classification according to the Swiss standard SIA 181 (noise sensitivity levels).

NOISE OF WATER TAPS AND SUPPLY VALVES



Measurement	Noise of water taps and water supply valves
Standard	DIN EN ISO 3822
Measurement object	Water taps, supply valves, equipment for water installations, fresh water filters, water softening systems

TECHNICAL DATA

Room volume	55.8 m ³
Size of test wall	11.7 m ²
Length of test pipe	8.1 m
Flow pressure	0.3 MPa or 0.5 MPa

SPECIAL FEATURE

Min. noise level	L _p = 5 dB(A)
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MORE INFORMATION

- Flow rate up to 2.0 Liters per second
- Issuing of special certificates, for example "Allgemeine Bauaufsichtliche Prüfzeugnisse (ABP)" as needed in Germany

NOISE OF WATER INSTALLATIONS



Measurement	Noise of water installations and sanitary equipment
Standards	DIN EN ISO 10052, DIN EN 14366, DIN 4109, SIA 181, VDI 4100
Measurement object	Water installations, waste water systems, shower systems, bath tubs, all types of front-wall installations, pipe insulations, pipe clamps, etc.

TECHNICAL DATA

Floor areas	5.00 × 3.45 m (installation room) 5.00 × 4.62 m and 5.00 × 3.45 m
Room volumes	70.4 m ³ and 52.6 m ³ (receiving room)
Entrance door (H × W)	2.05 × 2.00 m (installation room)
Thickness of separating floor	190 mm (reinforced concrete)

SPECIAL FEATURE

Controllable water supply (water pressure and flow rate)	In all rooms (stacked bathrooms)
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MORE INFORMATION

- Massive walls (single layer, 220 kg/m² mass per unit area) are separating each of the stacked rooms.
- Test results can be used to prove compliance with requirements according to the German standard DIN 4109 and to the guideline VDI 4100.
- Test results can be used for classification according to the Swiss standard SIA 181 (noise sensitivity levels).

FLANKING SOUND TRANSMISSION VIA SUSPENDED CEILINGS



Measurement	Normalized flanking level difference
Standard	DIN EN ISO 10848-2
Measurement object	Suspended board ceilings, grid ceilings, metal ceilings, ceilings systems with lights and air terminals, bulkheads (absorbent, boards)

TECHNICAL DATA

Floor area (2 rooms)	18.76 m ² and 23.32 m ²
Room volume (2 rooms)	55.2 m ³ and 72.7 m ³
Entrance doors (H × W)	1.900 × 0.805 m and 1.910 × 1.875 m
Height of the ceiling plenum	Variable between 400 mm and 1150 mm

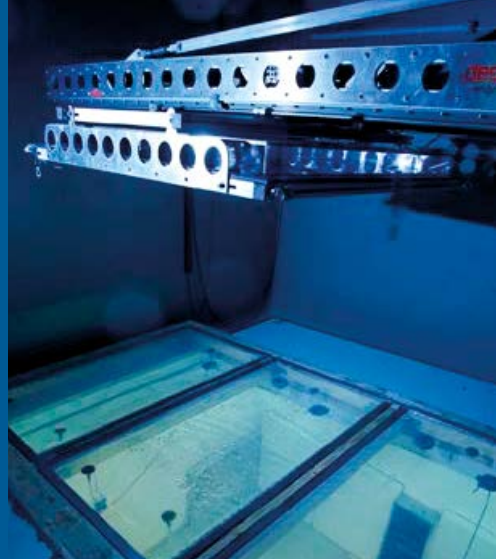
SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 70$ dB
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MORE INFORMATION

- The concrete floor above the suspended ceiling is adjustable in height, so the plenum height can be changed without changing the suspended ceiling.
- Mounting grids available
- The separating wall below the suspended ceiling is made of a multi-layer panel construction with high sound insulation.

RAIN NOISE OF ROOF CONSTRUCTIONS



Measurement	Rain noise level
Standard	DIN EN ISO 140
Measurement object	Roofs, roof constructions and elements, skylights, roof and dome lights, membrane roofs, systems for rain noise reduction

TECHNICAL DATA

Room volume (2 rooms)	100 m ³ and 50 m ³
Entrance doors (H × W)	2.05 × 1.91 m
Size of test samples (standardized)	3.71 × 2.71 m (roofs), 1.5 × 1.25 m (skylights)
Slope angle	5° (roofs), 30° (skylights)

SPECIAL FEATURES

- The installation frame can be adapted to arbitrarily shaped test samples.
- Controllable rain intensity and impact velocity of rain drops

MORE INFORMATION

Airborne sound insulation of installed test samples can be determined.

IMPACT SOUND AND IMPACT SOUND INSULATION OF FLOORS AND FLOOR COVERINGS



Measurement	Impact sound and impact sound insulation
Standard	DIN EN ISO 10140
Measurement object	Timber frame and lightweight floor constructions, floating floors and floor coverings, timber joist floors

TECHNICAL DATA

Floor area and object size	20 m ²
Room volume (2 rooms)	70.6 m ³ and 50.0 m ³
Entrance doors (H × W)	2.18 × 0.83 m and 2.02 × 1.95 m
Size of test samples	20 m ² , variable height

SPECIAL FEATURE

Impact sound insulation and walking sound	Apart from the impact sound in the receiving room the noise generated in the sending room (walking sound) can be measured and weighted.
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MORE INFORMATION

- Circumferential bracket to support the separating floor
- Timber joist floor of type 1 according to DIN EN ISO 10140 available

SOUND INSULATION OF FLOORS AND ROOFS



Measurement	Sound insulation
Standard	DIN EN ISO 10140
Measurement object	Timber frame and lightweight floor constructions, floor coverings, roofs and roof constructions

TECHNICAL DATA

Floor area (both rooms)	20 m ²
Room volume (2 rooms)	70.6 m ³ and 50.0 m ³
Entrance doors (H × W)	2.18 × 0.83 m and 2.02 × 1.95 m
Size of test samples	20 m ² , variable height

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	$R'_{\max,w} = 69$ dB
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MORE INFORMATION

- Circumferential panel for the bearing of roof or ceiling units
- Timber joist floor type 1 according to DIN EN ISO 10140 available

FLANKING SOUND TRANSMISSION VIA VENTILATION DUCTS AND SHAFTS



Measurement	Normalized flanking level difference (German "Schachtpegeldifferenz")
Standard	DIN 52210
Measurement object	Ventilation ducts and shafts, exhaust systems, components of ventilation systems

TECHNICAL DATA

Floor area (both rooms)	20 m ²
Room volume (2 rooms)	70.6 m ³ and 50.0 m ³
Entrance doors (H × W)	2.18 × 0.83 m and 2.02 × 1.95 m
Size of mounting place	Variable cross-section of ducts and shafts

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	Dw ≥ 55 dB
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MORE INFORMATION

- Circumferential bracket to support the separating floor
- Variable installation of duct and shaft systems

FLANKING SOUND TRANSMISSION OF WALL CONSTRUCTIONS



Measurement	Normalized flanking level difference, vibration transmission (index) of wall junctions
Standards	DIN EN ISO 10848-2, DIN EN ISO 10848-3
Measurement object	Separating walls (massive, masonry, lightweight), additional linings, internal and external thermal insulation composite systems, wall junctions

TECHNICAL DATA

Floor area (4 rooms)	89.5 m ² (total)
Room volume (4 rooms)	276.6 m ³ (total)
Entrance doors (H × W)	2.00 × 0.83 m and 2.06 × 1.94 m

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	R _{w,max} = 81 to 83 dB (depending on transmission path)
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MORE INFORMATION

- The test facility with concrete walls can be separated in 4 adjacent rooms, which are divided by isolated joints (horizontal, vertical) in order to minimize the flanking sound transmission.
- Reproduction of standard construction situations
- Reduced flanking transmission
- Typical scenarios in buildings can be investigated, considering all horizontal direct and flanking transmission paths of airborne and structure-borne sound.

SOUND POWER IN A SEMI-ANECHOIC CHAMBER



Measurement	Sound power (enveloping measurement surface), sound intensity, localization of sound sources
Standards	DIN EN ISO 3745, DIN EN ISO 3744
Measurement object	Machinery and equipment, for example of ventilation and air-conditioning systems, and other noise sources

TECHNICAL DATA

Free room size (L × W × H)	19.43 × 5.25 × 6.17 m
Room volume	629 m ³
Entrance door (H × W)	1.90 × 2.37 m

SPECIAL FEATURES

Connection to a reverberation room	Measurement of sound insulation and sound absorption of elements between reverberation and anechoic room
Size of the connecting door (measuring surface)	3.80 × 2.35 m

MORE INFORMATION

- Ventilation system (flow rate max. 4000 m³/h)
- Vibrational isolation by using “Omega Clamps” to suppress influence due to structure-borne sound
- Lower cut-off frequency 125 Hz (according to standard)

SOUND POWER IN A REVERBERATION ROOM



Measurement	Sound power
Standard	DIN EN ISO 3741
Measurement object	Machinery and equipment, for example of ventilation and air-conditioning systems, air terminals and other noise sources

TECHNICAL DATA

Floor area	60 m ²
Room volume	392 m ³
Entrance door (H × W)	1.9 × 2.4 m

SPECIAL FEATURES

Connection to a semi-anechoic room	Measurement of sound insulation and sound absorption of elements between reverberation and anechoic room
Size of the connecting door (measuring surface)	3.80 × 2.35 m

MORE INFORMATION

- Controllable air-condition system for the adjustment of temperature and humidity
- Low vibration doors with high sound reduction
- Suppressed excitation of structure-borne sound of the walls due to a special basement

SOUND POWER IN A WIND TUNNEL



Measurement	Sound power, wind and flow noise
Standard	DIN EN ISO 7235
Measurement object	Façades, façade elements, fans, other components of HVAC systems (filters, heat exchangers, gratings, throttles, etc.)

TECHNICAL DATA

Test duct (L × H)	12.0 × 0.5 m
Width of the test duct	500 to 1300 mm (50 mm steps)
Fan	Flow rate ≤ 35 m ³ /s, pressure difference ≤ 2500 Pa
Max. size of test samples (L × H)	6.000 × 0.498 m

SPECIAL FEATURE

Type of test facility	Wind tunnel with closed loop ventilation duct
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MORE INFORMATION

- Continuously adjustable air flow speed
- Uniform and noiseless air flow
- Sound power measurement in the receiving room out of the air flow
- Stationary measuring system for static and dynamic pressure

SOUND POWER IN AN ANECHOIC CHAMBER



Measurement	Sound power (enveloping measurement surface), sound intensity, localization of sound sources
Standard	DIN EN ISO 3745
Measurement object	Machinery and equipment, for example of ventilation and air-conditioning systems, and other noise sources

TECHNICAL DATA

Free room size (L × W × H)	9.3 × 10.4 × 10.3 m
Room volume	1090 m ³
Entrance door (H × W)	1.89 × 2.34 m

SPECIAL FEATURE

Removable assembly grating as working area	4.0 × 4.0 m area, 5000 N/m ² loading capacity
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MORE INFORMATION

- Room-in-room construction with very low background noise
- Vibrational isolation by using separate basement and steel springs
- Lower cut-off frequency 80 Hz (according to standard)
- Ventilation system

INSERTION LOSS, PRESSURE LOSS, FLOW NOISE OF SILENCERS AND MUFFLERS



Measurement	Insertion loss, sound power, pressure loss
Standard	DIN EN ISO 7235
Measurement object	Silencers as splitters, ducted silencers, special construction of silencers, ventilation and air-conditioning components, (filters, heat exchangers, etc.)

TECHNICAL DATA

Test duct (L × H)	12.0 × 0.5 m
Width of the test duct	500 to 1300 mm (50 mm steps)
Fan	Flow rate ≤ 35 m ³ /s, pressure difference ≤ 2500 Pa
Max. size of test samples (L × H)	6.000 × 0.498 m

SPECIAL FEATURE

Type of test facility	Wind tunnel with closed loop ventilation duct
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MORE INFORMATION

- Special sound source (loudspeaker wall, 2800 W) for uniform radiation into the test duct
- Continuously adjustable air flow speed
- Uniform and noiseless air flow
- Sound power measurement in the receiving room out of the air flow
- Stationary measuring system for static and dynamic pressure

DYNAMIC STIFFNESS



Measurement	Dynamic stiffness
Standard	DIN 29052
Measurement object	All types of elastic and damping layers of floating floors and floor coverings, elastic and damping materials for other applications

TECHNICAL DATA

Size of test samples	200 × 200 mm
Thickness of test samples	10 to 50 mm
Static load	8 kg
Measuring range	Approx. 5 to 100 MN/m ³

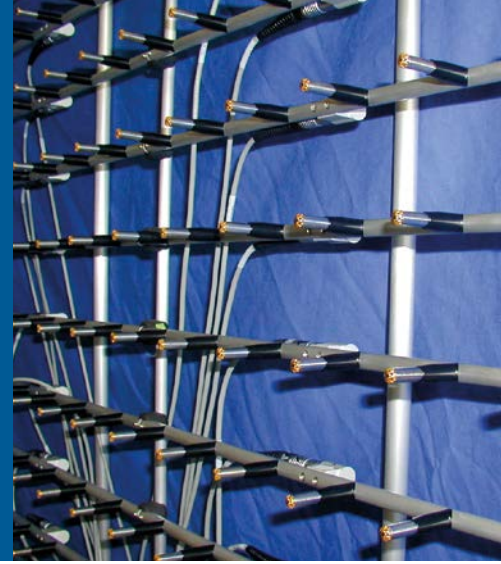
SPECIAL FEATURE

Range of surface load	0.4 Pa to 4 kPa
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MORE INFORMATION

The resonance frequency of the system (test sample and mechanically loading element) is determined by using swept sine excitation at different forces.

ACOUSTIC CAMERA BY USING A MICROPHONE ARRAY



Measurement	Sound radiation, directional pattern, sound, sound particle velocity, sound intensity, sound power
Measurement object	Machinery, equipment, tools, components, building services, fans, vehicles, etc.

TECHNICAL DATA

Number of microphones	96 (holography), 56 (beamforming)
Array geometry	Rectangular, circular, logarithmic spiral
Distance between microphones	30, 75, 150 mm (holography)

SPECIAL FEATURES

Acoustic nearfield holography	Analysis in the nearfield of sound sources, stationary and transient sound
Beamforming	Analysis in the farfield of sound sources, static and moving test objects

MORE INFORMATION

- Combination with a high-speed camera
- Laboratory and in-situ measurements

VIBRATION ANALYSIS BY LASER SCANNING VIBROMETRY



Measurements	Vibration velocity and displacement, vibration and modal analysis
Measurement object	Machinery, equipment, installations, tools, components, panels, shells, etc.

TECHNICAL DATA

Laser	Helium-neon laser ($\lambda = 633 \text{ nm}$)
Frequency range	0 to 40 kHz
Measuring range	0.5 $\mu\text{m/s}$ to 2.5 m/s (vibration velocity)

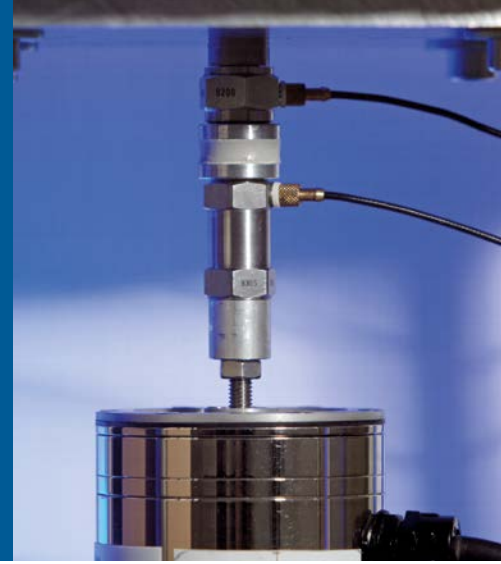
SPECIAL FEATURES

- Contact-free measurement of vibrating objects and surfaces
- Automatic scanning of a free definable point grid on the surface
- Visualization (graph or film) of vibration modes of the measuring objects

MORE INFORMATION

- Locating of zones with maximum vibration in case of real or ideal excitation
- Optimization of the vibration characteristics of components
- Combination with acoustic near-field holography for determination of radiation factor
- Data export to other software for refined analysis

ELASTIC MODULUS, MECHANICAL LOSS FACTOR



Measurement	Elastic (Young's) modulus, mechanical loss factor
Standard	Based on ISO 6721-4
Measurement object	All types of elastomers (plastic and foamed materials), sealing compounds (silicone, acrylic, etc.), elastic adhesives

TECHNICAL DATA

Size of material samples	Diameter 20 mm (cylindrical slices)
Thickness of material samples	3 to 5 mm
Shape function	The influence of geometry is considered by using a shape function.
Frequency range	50 to approx. 3000 Hz (upper limit depends on the sample)

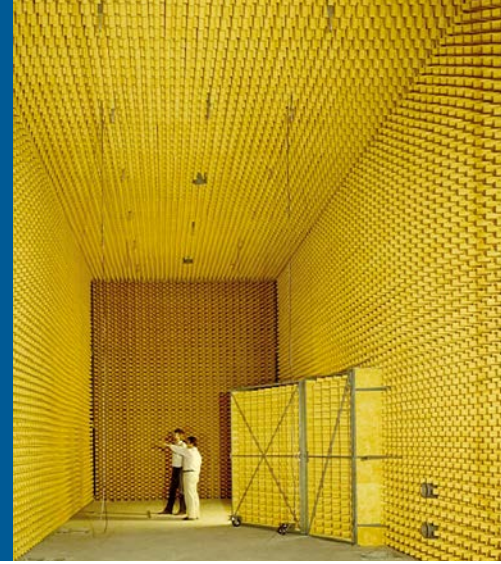
SPECIAL FEATURE

Sample preparation	Preparation and hardening of the sample is carried out outside of the test system. Afterwards the sample is installed with adapters on both sides.
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MORE INFORMATION

- Excitation by using forced vibrations (swept sine) generated by an electrodynamic shaker
- Detection of input force and resulting displacement with piezoelectric force transducer and accelerometer including the phase difference between force and displacement

SOUND PRESSURE LEVEL IN A SEMI-ANECHOIC CHAMBER



Measurement	Sound pressure level (averaged values and statistical analysis), directional pattern of sound sources
Measurement object	Machinery and equipment, ventilation and air-conditioning systems, especially large measuring objects

TECHNICAL DATA

Free room size (L × W × H)	19.43 × 5.25 × 6.17 m
Room volume	629 m ³
Entrance door (H × W)	1.90 × 2.37 m

SPECIAL FEATURES

Connection to a reverberation room	Measurement of sound insulation and sound absorption of elements between reverberation and anechoic room
Size of the connecting door (measuring surface)	3.8 × 2.35 m

MORE INFORMATION

- Vibrational isolation by using “Omega Clamps” to suppress influence due to structure-borne sound
- Lower cut-off frequency 125 Hz (according to standard)
- Ventilation system (flow rate max. 4000 m³/h)

SOUND IMPACT, SOUND QUALITY



Measurement	Sound impact, sound quality (e.g. loudness, annoyance, performance)
Standards	ISO/TS 15666, ISO 16832, etc.
Methods	Interviews, perception and performance tests (users, affected people, test persons)

TECHNICAL DATA

Floor area	44 m ²
Room volume	132 m ³

SPECIAL FEATURES

Acoustics	<p>Room acoustics: variable reverberation time by using removable absorptive ceiling and linings</p> <p>Electroacoustic system: 64 channel sound field system (IOSONO) comprising 412 loudspeakers for realistic presentation of acoustic scenarios, laboratory and software for production of sound files, studio for 4 test persons</p>
Light	<p>Daylight: light wall for sunlight simulation in front of the façade (luminance up to 10 000 cd/m², colour temperature between 3000 and 6500 K)</p> <p>Inside: highly variable artificial lighting with DALI bus system, e.g. for adaptive light management</p>
Ventilation	<p>Ventilation rate 300 to 1800 m³/h</p> <p>Room temperature between +18 and +30 °C</p>

MORE INFORMATION

- Identification of sound impact and optimization of sound quality of products or components in buildings, e.g., building service systems and installations
- Investigation of use-related room scenarios, e.g. offices, meeting rooms and classrooms, with test persons in order to quantify room influences on well-being and performance

SOUND PROPAGATION IN A SEMI-ANECHOIC CHAMBER



Measurement	Sound propagation, sound shielding and attenuation
Measurement object	Scale models of constructions, buildings and landscapes, for example sound screens and noise barriers

TECHNICAL DATA

Free room size (inside liner) (L × W × H)	19.43 × 5.25 × 6.17 m
Room volume	629 m ³
Entrance door (H × W)	1.90 × 2.37 m

SPECIAL FEATURES

Connection to a reverberation room	Measurement of sound insulation and sound absorption of elements between reverberation and anechoic room
Size of the connecting door (measuring surface)	3.80 × 2.35 m

MORE INFORMATION

- Scale model measurements (on a scale 1: 40), including rooms
- Determination of sound propagation in scale model landscapes and urban scenarios, for example emission and shielding of buildings, sound screens and noise barriers
- Ventilation system (flow rate max. 4000 m³/h)
- Vibrational isolation by using “Omega Clamps” to suppress influence due to structure-borne sound
- Lower cut-off frequency 125 Hz (according to standard)

INSERTION LOSS AT HIGH TEMPERATURES



Measurement	Insertion loss, sound power
Standard	DIN EN ISO 7235
Measurement object	Exhaust gas silencers, components of exhaust gas systems, silencers in duct systems with high temperature

TECHNICAL DATA

Test duct	2 m length, connection 200 mm diameter
Fan	Flow rate $\leq 450 \text{ m}^3/\text{h}$
Heater battery	Power 2 kW, max. temperature in the duct $+130 \text{ }^\circ\text{C}$
Size of test samples	Max. 1.8 m length, max. 400 mm diameter

SPECIAL FEATURES

Type of test facility	Closed loop duct system
Measuring duct	Sound source, anechoic terminations

MORE INFORMATION

- Continuously adjustable air flow speed
- Uniform and noiseless air flow

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