Fraunhofer
IBP

FRAUNHOFER INSTITUTE FOR BUILDING PHYSICS IBP

MEASURING AND TESTING FACILITIES

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)
DIN **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

MEASUREMENT AND TEST RANGE

ACOUSTICS

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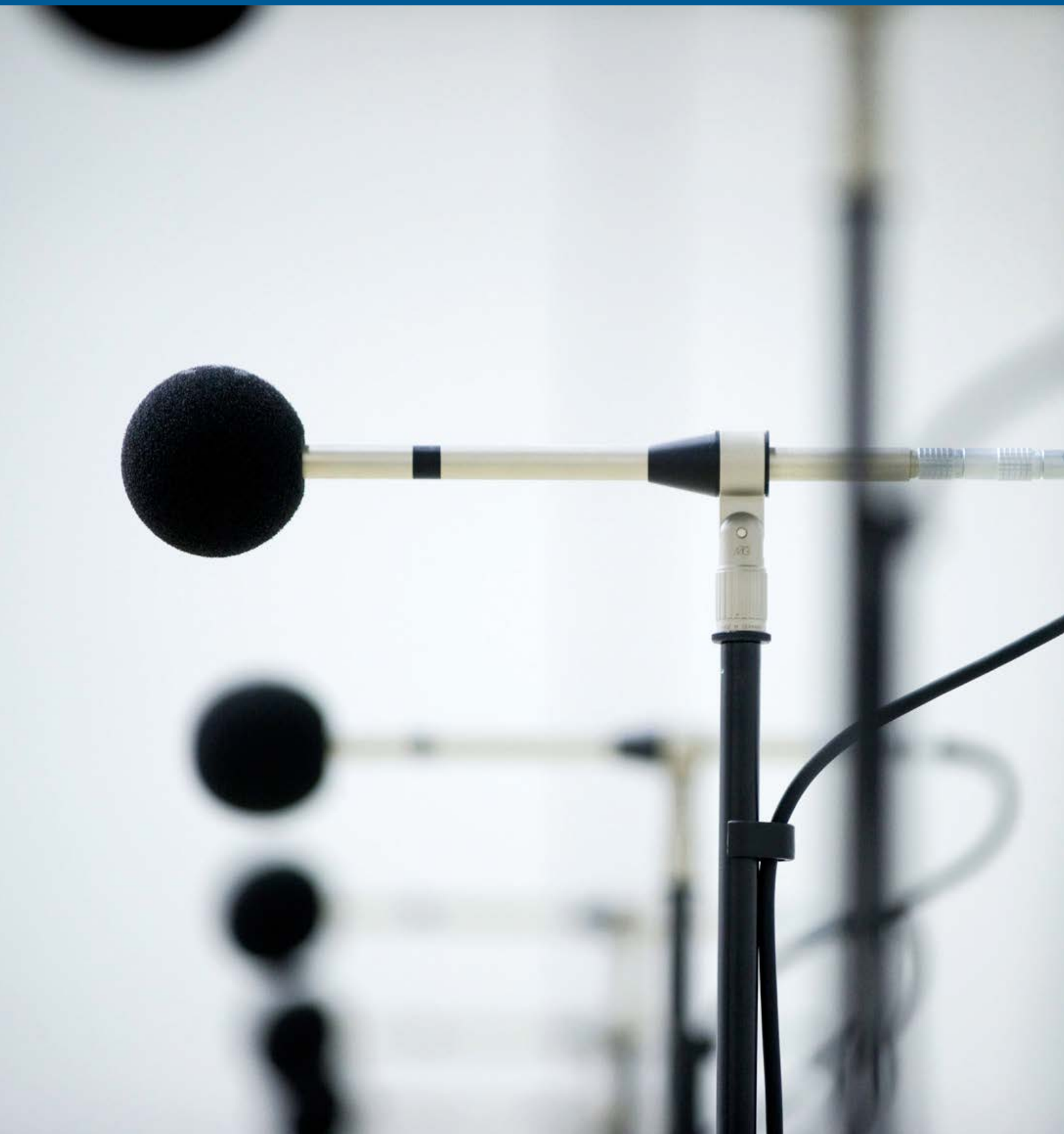


SOUND ABSORPTION IN A REVERBERATION ROOM

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 m²
Room volume	392 m³
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 m² and 2.4 m²
Room volume (2 rooms)	71 m³ and 87 m³
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 m² and 18 m²
Room volume (2 rooms)	67 m³ and 57 m³
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

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 m² and 17.7 m²
Room volume (2 rooms)	62 m³ and 54 m³
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

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 11, 14, 16).

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 m² and 24 m²
Room volume (2 rooms)	66 m³ and 76 m³
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 dB

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 m² and 24 m²
Room volume (2 rooms)	66 m³ and 76 m³
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

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 m² and 20.89 m²
Room volume (2 rooms)	50.82 m³ and 62.64 m³
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

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 m² and 20 m²
Room volume (2 rooms)	62 m³ and 70 m³
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

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 m³ and 54 m³
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.

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 m² and 20 m²
Room volume (2 rooms)	70 m³ and 61 m³
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)

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 m³
Size of test wall	11.7 m²
Length of test pipe	8.1 m
Flow pressure	0.3 MPa or 0.5 MPa

SPECIAL FEATURE

Min. noise level	Lp = 5 dB(A)

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 m³ and 52.6 m³ (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)

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 m² and 23.32 m²
Room volume (2 rooms)	55.2 m³ and 72.7 m³
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

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 m³ and 50 m³
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 m²
Room volume (2 rooms)	70.6 m³ and 50.0 m³
Entrance doors (H × W)	2.18 × 0.83 m and 2.02 × 1.95 m
Size of test samples	20 m², 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.

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 m²
Room volume (2 rooms)	70.6 m³ and 50.0 m³
Entrance doors (H × W)	2.18 × 0.83 m and 2.02 × 1.95 m
Size of test samples	20 m², variable height

SPECIAL FEATURE

Max. sound reduction (related to the size of test sample)	R'max,w = 69 dB

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 m²
Room volume (2 rooms)	70.6 m³ and 50.0 m³
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

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 m² (total)
Room volume (4 rooms)	276.6 m³ (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)	Rw,max = 81 to 83 dB (depending on transmission path)

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 m³
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 m²
Room volume	392 m³
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 m³/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

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 m³
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/m² loading capacity

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 m³/s, pressure difference ≤ 2500 Pa
Max. size of test samples (L × H)	6.000 × 0.498 m

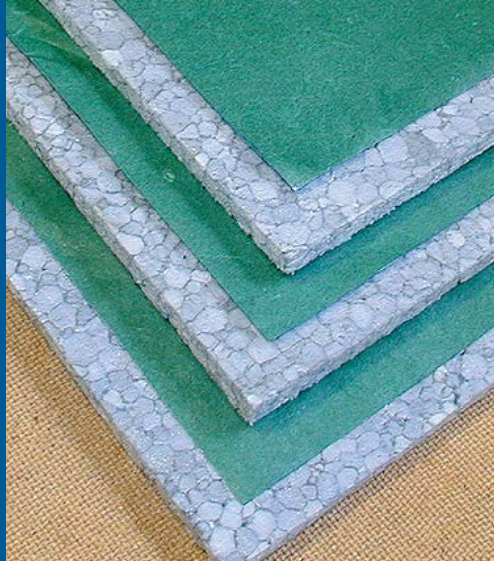
SPECIAL FEATURE

Type of test facility	Wind tunnel with closed loop ventilation duct

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/m³

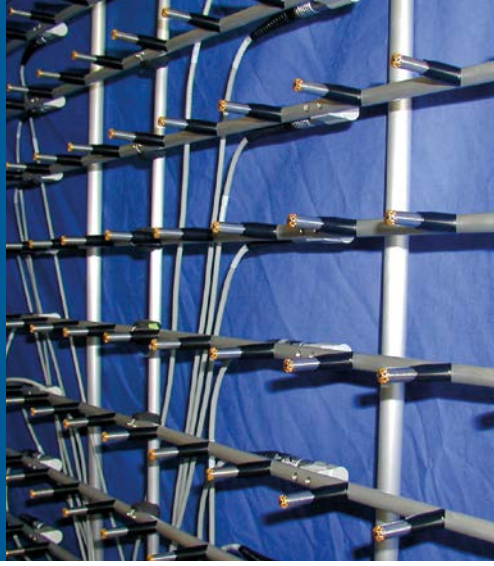
SPECIAL FEATURE

Range of surface load	0.4 Pa to 4 kPa

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 (λ = 633 nm)
Frequency range	0 to 40 kHz
Measuring range	0.5 µm/s to 2.5 m/s (vibration velocity)

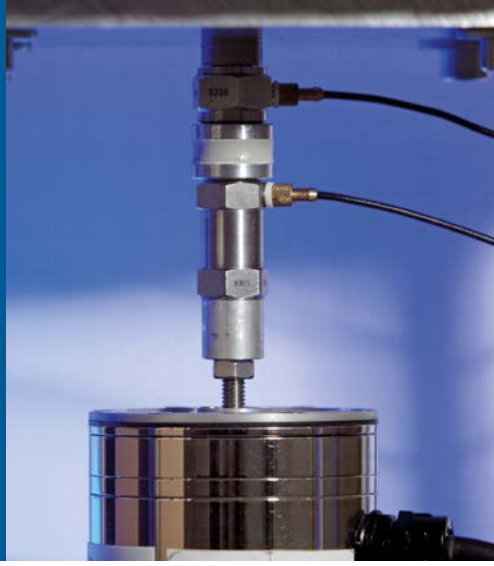
SPECIAL FEATURES

- 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.

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 m³
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	Room acoustics: variable reverberation time by using removable absorptive ceiling and linings 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
Light	Daylight: light wall for sunlight simulation in front of the façade (luminance up to 10 000 cd/m^2, colour temperature between 3000 and 6500 K) Inside: highly variable artificial lighting with DALI bus system, e.g. for adaptive light management
Ventilation	Ventilation rate 300 to 1800 m^3/h Room temperature between +18 and +30 °C

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 m³
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 ≤ 450 m³/h
Heater battery	Power 2 kW, max. temperature in the duct +130 °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

MEASUREMENT AND TEST RANGE

BUILDING CHEMISTRY, BUILDING BIOLOGY, HYGIENE

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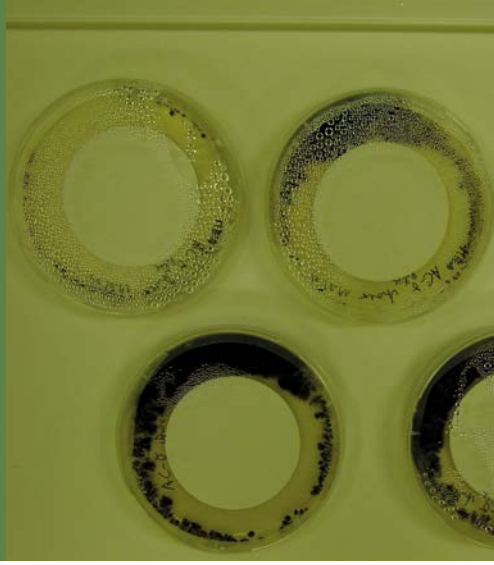
EFFICACY OF BIOCIDAL EQUIPPED COATINGS AGAINST ALGAE OR FUNGI



Measurement	Testing the efficacy of biocidal equipped coatings against algae or fungi
Standards	DIN EN 15458:2007-10 (D), DIN EN 15457:2007-10 (D)
Measurement object	Special designed specimen (diameter 5 cm) with coating (e.g., plaster, paints, varnish), not biocidal equipped reference probe necessary

TECHNICAL DATA

Area of test specimen	Approx. 20 cm²
Thickness of test specimen	Varies according to type of coating from 0.5 to approx. 20 mm
Processing	According to given requirements
Number of specimen	For each tested variant 15 specimen
Test duration	4 to 8 weeks

SPECIAL FEATURES

Test strains	According to relevant standards, on request also further test strains from own collection
Conditioning	On request also special conditioning possible: accelerated carbonation, watering, etc.

MORE INFORMATION

Further tests in context:

- testing on photo-catalytic efficacy
- analysis of surface growth
- testing of biocidal activity on the surface

PRODUCT-SPECIFIC ISOPLETH RANGES

Measurement	Acquisition of the natural resistance of a product against infestation by microorganisms (mould and mildew) through assessment of the product specific isopleth ranges
Standard	Own testing method, published
Measurement object	Special designed specimen (dimension 5 × 5 cm, for loose material filling into special wire frames), 36 specimen shall be provided

TECHNICAL DATA

Area of test specimen	25 cm²
Thickness of test specimen	Typically 1 to 3 cm
Processing	According to given requirements
Test climate	For 100 days, 12 different combinations of temperature and relative humidity (adjustable ranges from +8 to +40 °C and 50 to 98 % r.h.)
Test duration	14 weeks

SPECIAL FEATURES

Test strains	According to material/application "typical" test strains from own collection, apart from fungi also bacteria or algae (light source available) possible
Conditioning	On request also special conditioning possible: accelerated carbonation, watering, etc.

MORE INFORMATION

Result presentation as so called "isopleth traffic light"
Further tests in context:

- testing on photo-catalytic efficacy
- testing of biocidal activity on the surface

PHOTO-CATALYTIC EFFICACY OF COATINGS AGAINST MICROORGANISMS

Measurement	Testing of the photo-catalytic efficacy of a correspondingly equipped coating formulation
Standard	Own testing method, published
Measurement object	Special designed specimen (e.g., tiles, dimension from 5 × 5 cm² to 10 × 10 cm²) with coating (e.g., plaster, paint, varnish); non photo-catalytically equipped reference probe necessary

TECHNICAL DATA

Area of test specimen	25 cm² or 100 cm²
Thickness of test specimen	Varies according to type of coating from 4 to approx. 20 mm
Processing	According to given requirements
Number of specimen	For each tested variant 15 specimen
Test duration	2 to 6 weeks

SPECIAL FEATURES

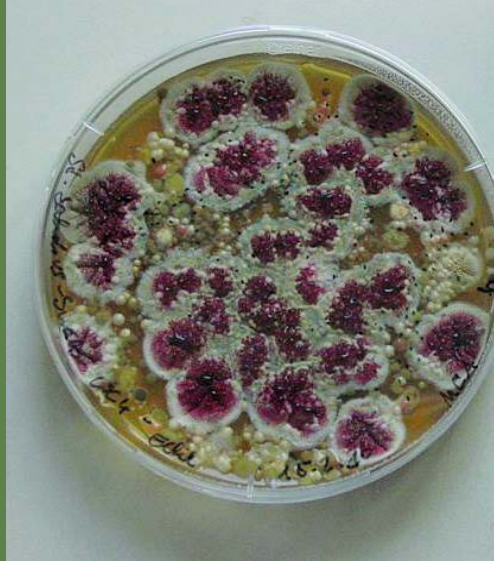
Test strains	According to application "typical" test strains from own collection; for bacteria, fungi or algae in each case separate testing
Conditioning	On request also special conditioning possible: accelerated carbonation, watering, etc.

MORE INFORMATION

Further tests in context:

- testing on efficacy of biocidal equipped coatings against algae or fungi
- analysis of surface growth
- testing of biocidal activity on the surface

INDOOR AIR HYGIENE



Measurement	Survey of airborne germs of indoor air by filtration in comparison to outdoor air
Standards	DIN ISO 16000-16, DIN ISO 16000-17, DIN ISO 16000-18, DIN ISO 16000-19, VDI 4300-10
Measurement object	Indoor air in comparison to outdoor air

TECHNICAL DATA

Test volume	For short-term measurement typically 50 L for each filter
Test duration	Nine-fold measurement, approx. 30 min for each reading point
Processing	Preparation of the measured rooms according to VDI 4300-10
Evaluation	According to UBA guide, counting of germs growing after 3, 7 and 10 days

SPECIAL FEATURES

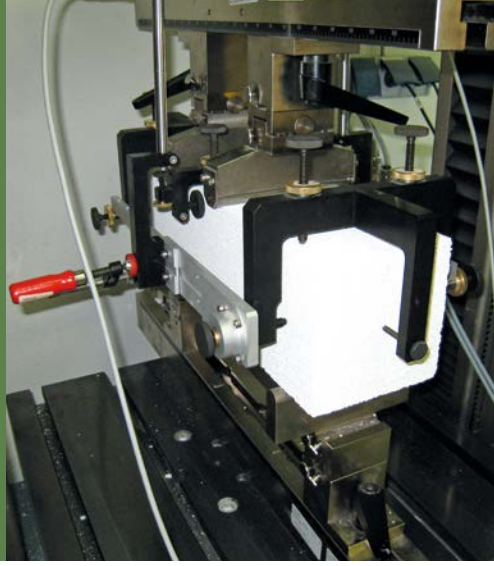
Culture media	Use of microbiological culture media for mesophilic and xerotolerant fungi and airborne bacteria as a matter of routine
Flexibility	Use of gelatine filters allows also the application of a dilution series, apart from direct cultivation – depending on the expected germ load of the investigated air

MORE INFORMATION

Further tests in context:

- orienting rapid test of AQA company
- long term measurement of air germs, impaction or filtration
- microbial analysis of materials (e.g. floor insulation)

FLEXURAL STRENGTH



Measurement	Flexural strength in N/mm²
Standards	DIN 12390-5 (concrete), DIN EN 196-1 (mortar), DIN EN 1351 (autoclaved aerated concrete, AAC)
Measurement object	Concrete, mortar, autoclaved aerated concrete, fibre reinforced concrete

SPECIAL FEATURE

Test specimen dimensions	Concrete prisms 150 × 700 × 150 mm Mortar prisms 40 × 160 × 40 mm AAC prisms 400 × 100 × 100 mm

MORE INFORMATION

Measurement of 3- or 4-point flexural strength possible

COMPRESSIVE STRENGTH

Measurement	Cube compressive strength in N/mm²
Standards	DIN EN 13791 (concrete), DIN EN 196-1 (mortar), DIN EN 679 (autoclaved aerated concrete), DIN EN 772-1 (autoclaved aerated concrete), DIN EN 771-4 (autoclaved aerated concrete)
Measurement object	Concrete, mortar, autoclaved aerated concrete, fibre reinforced concrete

SPECIAL FEATURE

Test specimen dimensions	Concrete cube 100 × 100 × 100 mm Mortar cube 40 × 40 × 40 mm AAC cube 100 × 100 × 100 mm

MORE INFORMATION

Loading capacity max. 100 kN

E-MODULUS

Measurement	Static and dynamic modulus of elasticity in N/mm²
Standards	DIN 1048-5 (concrete), DIN EN 1352 (autoclaved aerated concrete)
Measurement object	Concrete, autoclaved aerated concrete, fibre reinforced concrete

SPECIAL FEATURE

Test specimen dimensions	Concrete prisms 100 × 100 × 300 mm AAC prisms 100 × 100 × 300 mm

MORE INFORMATION

- Measurements of Poisson ratio
- Possibility to measure under different moisture conditions

VOC EMISSIONS FROM CONSTRUCTION PRODUCTS

Measurement	Volatile organic compounds (VOC) concentration in an emission test chamber atmosphere
Standards	DIN EN ISO 16000-9, DIN ISO 16000-3, DIN ISO 16000-6, DIN CEN/TS 16516
Measurement object	Construction products for indoor use

SPECIAL FEATURE

Volume of the emission test chambers	0.2 m³, 0.225 m³ and 1 m³

MORE INFORMATION

Measurement and evaluation according to:

- German AgBB scheme
- evaluation principles of the Deutsches Institut für Bautechnik (DIBt)
- Blue Angel
- French VOC regulation
- Belgian VOC regulation

INDOOR AIR QUALITY

Measurement	Concentrations of VOCs indoors
Standards	DIN EN ISO 16000-2, DIN EN ISO 16000-5, DIN ISO 16000-3, DIN ISO 16000-6
Measurement object	Residential rooms, offices, nursery schools, kindergartens, class rooms

SPECIAL FEATURES

- Active air sampling on appropriate adsorbent tubes
- Determination and quantitation of VVOCs, VOCs, SVOCs, volatile organic amines, selected aldehydes and ketones
- Analysis by thermal desorption GC/MS, HPLC/DAD and LC/MS-MS

MORE INFORMATION

Evaluation according to national and international guidelines, recommendations and regulations

DETERMINATION OF ODOR EMISSIONS FROM CONSTRUCTION MATERIALS AND ODOR EVALUATION OF INDOOR AIR

Measurement	Determination of odor emissions from building products using test chambers, sensory testing of indoor air
Standards	DIN ISO 16000-28, DIN ISO 16000-30
Measurement object	Construction products Indoor air of residential rooms with and without sampling

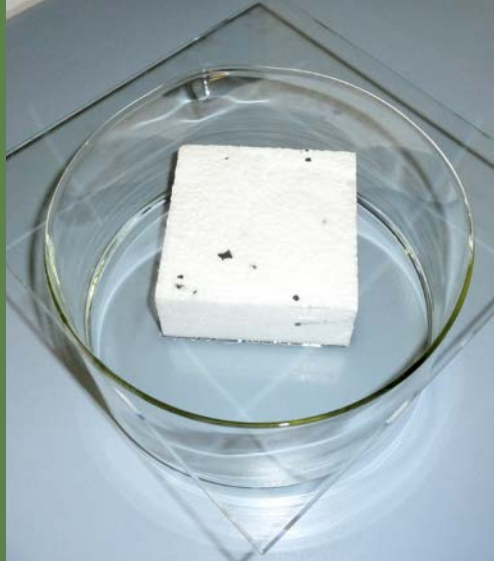
SPECIAL FEATURE

Determination of odor intensity with and without a comparative scale by a trained panel, hedonic tone and acceptability by an untrained panel

MORE INFORMATION

Evaluation according to national (Blue Angel, German AgBB scheme) and international guidelines and recommendations

DETERMINATION OF SUBSTANCE RELEASE FROM IRRIGATED CONSTRUCTION MATERIALS



Measurement	Determination of substance release from construction products into water, determination of sum parameters and individual substances
Standards	Draft standard (Dynamic Surface Leaching Test) according to FprCEN/TS 16637-2, DIN EN 16105
Measurement object	Irrigated construction products for outdoor use like plasters, mortars, paints and roofing material

SPECIAL FEATURES

Chemical analysis of the leachates depending on the products and their properties:

- 64-day Dynamic surface leaching test (DSLT) according to FprCEN/TS 16637-2
- 21-day intermittent leaching test according to DIN EN 16105

MORE INFORMATION

Evaluation according to national guidelines, recommendations and regulations

ENVIRONMENTAL IMPACT OF BUILDING PRODUCTS

Measurement	Weathering experiment, release of compounds by influence of driving rain
Standards	Chemical analyses according to or based on DIN EN 1484, DIN 38404-5, DIN EN 27888, DIN EN ISO 10304, DIN EN ISO 17294-2, DIN EN ISO 14911, DIN EN ISO 10301, DIN EN 16691, DIN 38047-35, own testing method
Measurement object	Draining rain water from roofing membranes, façade coatings and façade parts

TECHNICAL DATA

Sample size	30 × 35 cm up to 100 × 50 cm Other sizes after consultation Complete façade elements (e.g., windows, exterior doors) Miniature houses with a façade area of 300 × 245 cm
Weathering experiment	Investigation of discrete plaster layers, complete plaster systems or complete ETICS on the miniature houses Orientation towards west (test specimen) or towards all four geographic directions (miniature houses)
Measured variables	In drained rain water determination of: – sum parameters (pH-value, electric conductivity, Redox potential, TOC, Phenol index, etc.) – inorganic anions – alkali and earth alkali cations – trace elements and heavy metals – biocides – volatile organic halogen-hydrocarbons, benzene and alkyl benzenes (BTXE), styrene – polycyclic aromatic hydrocarbons and other parameters upon request Determination of the biocide contents in coatings in dependence of exposure time

EVALUATION OF MICROBIAL GROWTH DEVELOPMENT ON WEATHERED SURFACES

Measurement	Weathering experiment, durability, microbial susceptibility
Standard	Own testing method and published evaluation scheme
Measurement object	Complete walls/wall parts of test houses or special designed test specimen

TECHNICAL DATA

Sample size	Per variant at least a 1.20 m wide and 2.80 m high wall area or test specimen with an area of approx. 30 × 30 cm
Weathering experiment	Integration of a wall construction into a test house or setting up of test specimen Orientation towards west and/or east or based on consultation
Measured variables	Biological behavior of external construction materials/exterior building parts/façade systems, etc. under the influence of natural climatic conditions Determination of microbial growth development Exact documentation to the point Determination of the risk of complaints

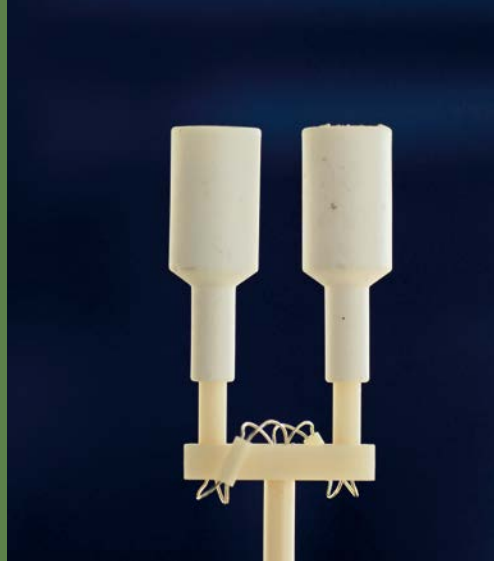
SPECIAL FEATURES

- After consultation other test sites possible (climate variation)
- Measurement at least quarterly, better monthly; seasonal course

MORE INFORMATION

Test duration at least 12 months up to several years. Parallel investigation of the composition of the microbial growth allows a better growth management, concrete statements regarding prevention strategies.

THERMAL ANALYSIS



Measurement	Determination of melting point and crystallization temperature, enthalpy of fusion and enthalpy of crystallization, specific heat, glass transition temperature
Standards	DIN EN ISO 11357-1, DIN EN ISO 11357-2, DIN EN ISO 11357-3, DIN EN ISO 11357-4
Measurement object	Components and materials

TECHNICAL DATA

Temperature range	–200 to +500 °C Ambient temperature to +1500 °C

THERMO-MECHANICAL ANALYSIS OF COMPONENTS

Measurement	Determination of thermal expansion coefficient, glass transition temperature
Standards	ISO 11359-1, ISO 11359-2
Measurement object	Components and materials

TECHNICAL DATA

Temperature range	–200 to +500 °C Ambient temperature to +1500 °C

POWDER X-RAY DIFFRACTION

Measurement	Qualitative phase analysis, quantitative phase analysis by Rietveld method, determination of amorphous phase by internal or external standards
Measurement object	Powdered samples or little solid samples: minerals, rocks, cements, slag, ceramics, mineral building materials, concrete, mortars

TECHNICAL DATA

Diffractometer	D2 phaser
X-ray tube	Cu-radiation (30 kV, 10 mA), Ni filter
Goniometer radius	141.1 mm
Detector	LynxEye (1D detector)
Measurement range	+5 to +140° 2Theta

SPECIAL FEATURES

LynxEye detector	The one-dimensional detector allows fast measurements with high accuracy.
External standard	The application of an external standard allows the determination of the amorphous phase without contamination of the sample.

MORE INFORMATION

For the preparation of the samples a micronizing mill (McCrone mill) is used.

X-RAY FLUORESCENCE ANALYSIS

Measurement	Determination of the chemical composition, elemental analysis
Measurement object	Solids, pressed powders, loose powders, liquids, filters, bulk material

TECHNICAL DATA

Spectrometer	Epsilon 3 XL
X-ray source	Rh-radiation (9 W), Be-windows
Type of spectrometer	Energy dispersive spectrometer
Detector	Silicon-drift detector (high resolution)
Measurement range	Fluorine to uranium
Accuracy	ppm – %
Number of samples	10-fold sample changer

SPECIAL FEATURES

Massive samples	Measurement of massive samples with a maximum height of 10 cm possible
Measurement in cups	The measurement in cups allows the investigation of fluids and loose powders.
Helium atmosphere	The measurement in helium atmosphere allows the determination of light elements (e.g., fluorine).
Standardless analysis	A special software enables to achieve the best possible analysis without dedicated methods or certified standards.

MEASUREMENT AND TEST RANGE

ENERGY SYSTEMS

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TEST FACILITY FOR ENERGETIC AND INDOOR ENVIRONMENT INVESTIGATIONS (VERU)

Measurement	Evaluation of façades performance regarding the energy efficiency, durability and quality of thermal and visual comfort
Measurement object	Glass and metal façades, double skin façades, ventilated façades, (switchable) glazing, sun and glare protection systems, daylight redirection systems, façade integrated HVAC components, building integrated PV, solar thermal absorbers, general HVAC components and their integral interaction with the façade, decentralized storage systems, technical mock-ups for complete room concepts

TECHNICAL DATA

Height between floors	3.8 m
Façade surface area	21 × 15 m² (for each test field)
Test cell area (W × D)	4 × 4 m up to 8 × 12 m

SPECIAL FEATURES

Field measurements of façade and room concepts	Short- and long-term experiments with real climate conditions
1:1 full scale evaluations in step with real usage situations	Integral consideration of façade, room and building service equipment allow a realistic evaluation of the energy consumption and the visual and thermal comfort.

MORE INFORMATION

Extensive basic equipment of measurement and control systems and building services:

- central supply for heating and chilled water
- supply air preconditioning by heating, cooling, humidification and dehumidification
- freely programmable logic controller, providing among others time-controlled internal heat and moisture sources for simulating usage profiles
- central measurement data acquisition with a web-based analyzing tool (IMEDAS™)
- web browser access to all functionalities (process visualization, database, evaluation templates, measurement channel lists, etc.)

ENERGETIC TWIN ROOMS

Measurement	Comparative measurements of the thermal, visual and energetic performance of building components, building service components and control strategies
Standard	Test cell geometry according to EN ISO 13791
Measurement object	Glass and metal façades, double skin façades, ventilated façades, (switchable) glazing, sun and glare protection systems, daylight redirection systems, façade integrated HVAC components, building integrated PV, solar thermal absorbers, general HVAC components and their integral interaction with the façade, decentralized storage systems and control strategies

TECHNICAL DATA

Clear height	2.8 m
Façade surface area	2 × 15 m² (on each test field)
Test cell area (W × D)	3.6 × 5.5 m

SPECIAL FEATURES

Adiabatic envelop	Featured by highly insulated and temperature-controlled building envelops it is possible to minimize the heat flow through internal partitions that are not relevant for the current experiment. This allows the calculation of an extremely precise energy balance for each room.
1:1 full scale evaluations in step with real usage and climate situations	The two identical equipped office rooms provide the possibility for comparing investigations of different office concepts regarding their energy efficiency and the thermal and visual comfort in step with real usage conditions.

MORE INFORMATION

Extensive basic equipment of measurement and control systems and building services:

- freely programmable, time-controlled ventilation system with heating and cooling functionality
- electrical room heating
- freely programmable logic controller, providing among others time-controlled internal heat and moisture sources for simulating usage profiles
- central measurement data acquisition with a web-based analyzing tool (IMEDAS™)
- web browser access to all functionalities (process visualization, database, evaluation templates, measurement channel lists, etc.)

TWIN HOUSES

Measurement	Comparative measurements of different building and heating systems under real weather conditions with emphasis on residential buildings
Measurement object	Insulation systems, set ups of walls, windows and roofs, radiators and underfloor heating systems, component and control concepts, intelligent control concepts in smart grids, demand-based ventilation systems, sun protection systems, heating systems

TECHNICAL DATA

Floor area	82 m² (each floor)
Layout	Ground floor: 6 rooms Attic: 2 rooms
Roof pitch	30° (orientation south and north)

SPECIAL FEATURES

Full size research under real climate boundary conditions	Two structural identical single family houses for comparative examination of different concepts concerning energy efficiency, thermal and visual comfort
Flexible façade design	The structure of the houses has been engineered to admit the replacement of all exterior components on the ground floor.

MORE INFORMATION

Comprehensive building service installation including measuring and regulating systems:

- freely programmable, time-controlled ventilation system with definable heat recovery
- gas condensing boiler, radiator and underfloor heating
- cooling
- photovoltaic modules (1kW$_P$)
- freely programmable, time-controlled internal heat- and moisture sources to simulate user profiles
- central measurement data acquisition including web-based evaluation tools (IMEDAS™)
- web browser access to all functionalities (process visualization, database access, evaluation templates, measurement channels, etc.)

CALORIMETRIC FAÇADE AND ROOF TEST FACILITY

Measurement	Determination of the energetic and visual performance of (transparent) large-scale façade and roof elements under real climate conditions
Measurement object	Membrane elements, glass and metal façades, double skin façades, (switchable) façades, skylights, light-band, sun and glare protection systems and daylight redirection systems

TECHNICAL DATA

Max. specimen size	3.2 × 2.3 m
Slope	0 to 90°
Orientation	Approx. 360°

SPECIAL FEATURES

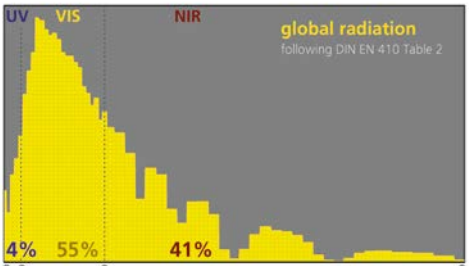
Calorimetric measurement concept	For heating and cooling the internal surfaces of the test chamber are equipped with highly effective water bearing absorbers. From the amount of thermal energy required to keep a certain internal temperature the energetic performance of the specimen can be determined. The SHGC as an example.
3D robot	To investigate specific aspects of local temperatures, air speeds, heat transfer resistances, and lighting and glare evaluations, the facility is equipped with a three-dimensional robot which can be used to position measurement sensors at any point inside the test chamber. By constantly moving this mobile sensor platform it is possible to determine multi-dimensional properties like the areal resolved solar or visual transmissions.

MORE INFORMATION

Focus of investigation:

- field determination of the solar factor (g-value/SHGC) and the heat transfer coefficient (U value) of full scale façade and roof elements under realistic installation conditions
- determination of angle dependent solar factors/properties
- analysis of the light transmission properties of transparent building elements
- evaluation of the users glare risk due to sun shades
- development of test and valuation procedures for novel building elements

UV/VIS/NIR SPECTROMETER



Measurement	UV-, light- and solar direct transmittance, light- and solar direct reflectance, diffuse reflectance, solar direct absorptance, total solar energy transmittance (solar factor), color rendering index
Standards	DIN EN 410, DIN 6169, DIN 5033, DIN EN 13363
Measurement object	Glass, sun shade, glare protection, fabric, synthetic, foil, membrane, metal, plaster, paint coating, concrete surface, coatings

TECHNICAL DATA

Measuring range	300 to 2500 nm (UV/Vis/NIR-range)
Accessory	Integrating sphere (150 mm)
Size of test samples	5 × 5 cm other sizes on request

SPECIAL FEATURE

Measurement and evaluation according to international standards

MORE INFORMATION

The measurement takes place in the testing laboratory for "moisture, mortar, radiation and emissions", which has got the flexible accreditation by the Deutsche Akkreditierungsstelle (DAkkS). Therefore it is authorized – in addition to employing standard test methods – to develop new or modify and improve existing test methods.

FOURIER SPECTROMETER

Measurement	Emissivity (direct-hemispherical)
Standards	DIN EN 12898, DIN EN 673
Measurement object	Glass, sun shade, glare protection, fabric, synthetics, foil, membrane, metal, plaster, paint coating, concrete surface, coatings

TECHNICAL DATA

Measuring range	2.5 to 25 µm (MIR range)
Accessory	Integrating sphere (75 mm)
Size of test samples	Width max. 150 mm, thickness max. 9 mm other sizes on request

SPECIAL FEATURE

Measurement and evaluation according to international standards

MORE INFORMATION

The measurement takes place in the testing laboratory for "moisture, mortar, radiation and emissions", which has got the flexible accreditation by the Deutsche Akkreditierungsstelle (DAkkS). Therefore it is authorized – in addition to employing standard test methods – to develop new or modify and improve existing test methods.

ATTIC FLOOR TEST FACILITY

Measurement	Comparative measurements of different building and heating systems under real weather conditions with emphasis on lightweight building and attic floors
Measurement object	Insulation systems, set ups of walls, windows and roofs, underfloor heating systems, component and control concepts, sun protection systems, thermal storage systems, e.g., on the basis of PCM (Phase Change Materials), air-to-water heat pumps

TECHNICAL DATA

Floor area (per test room)	12 m²
Roof area (per test room)	6.64 m² with each having one window
Number of test rooms	3

TECHNICAL DATA (AIR-TO-WATER HEAT PUMP)

Net-heating capacity (A2/W25)	5.6 kW
Net-cooling capacity (A35/W7)	8.8 kW

SPECIAL FEATURE

Full size research under real climate boundary conditions	Three identical living rooms for comparative, close to practise investigations of divers building concepts with respect to energy efficiency, thermal and visual comfort

MORE INFORMATION

- Comprehensive building service installation including measuring and regulating systems
- Heat pump system for defined heating and cooling of the test rooms
- Controllable shading system

MEASUREMENT AND TEST RANGE

HYGROTHERMICS

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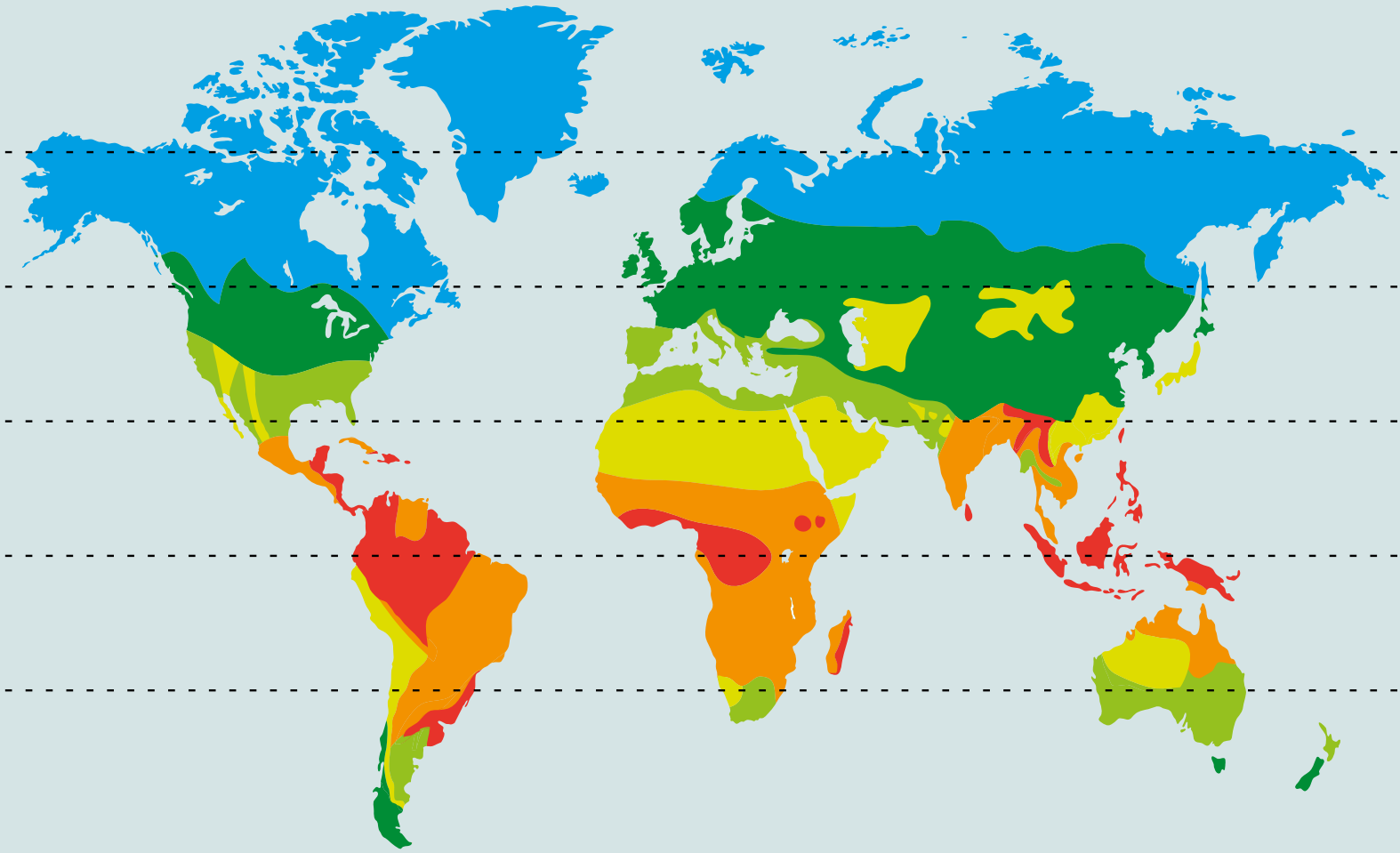

THERMAL CONDUCTIVITY BY THE GUARDED HOT PLATE APPARATUS

Measurement	Thermal conductivity λ, thermal resistance R, and thermal transmittance U
Standards	DIN EN 12664, DIN EN 12667, DIN EN 674, DIN 52612
Measurement object	Homogenous plates, inhomogeneous test specimens: porous, fibrous or granular materials, components laminated, profile plates, glazing elements, sections of building bricks

TECHNICAL DATA

Measuring surface	120 × 120 mm, 150 × 150 mm and 500 × 500 mm
Test specimen dimensions	Square specimens with side lengths between 120 and 900 mm and thicknesses between 5 and 300 mm
Mean specimen temperature	–160 up to +250 °C, depending on the equipment
Measuring range	Thermal conductivity between 0.01 and 2.0 W/(m·K)

SPECIAL FEATURES

Measuring setup	Horizontal and vertical direction
Ambient conditions	Measurements in vacuum or in a protective atmosphere possible

RECOGNITIONS

The test laboratory is recognized by the Deutsches Institut für Bautechnik (DIBt) as a testing facility under applicable building regulations LBO No. BWU10 and as a Notified Body No. 1004 to the terms of the Regulation of Construction Products (EU-BauPVO). It has been granted flexible accreditation under DIN EN ISO/IEC 17025 by the Deutsche Akkreditierungsstelle GmbH (DAkkS) under accreditation No. D-PL-11140-11-04.

AIR PERMEABILITY BY TEST FACILITY FOR IMPERMEABILITY

Measurement	Air permeability
Standards	DIN EN 1026, DIN EN 12207, DIN EN 12427, DIN EN 12426, DIN EN 12153, DIN EN 12152, DIN EN 12114, DIN EN 12835, DIN EN 13141
Measurement object	Windows, doors, gates, curtain walls façades, roof or wall elements (conservatories, glazing elements with integrated sun blinds), foils, adhesive tapes

TECHNICAL DATA

Test specimen dimensions	Height and width up to 4000 mm each, thickness: layers up to 400 mm, roofs up to 8 m length
Measuring range	Air pressure up to 5000 Pa
Air pressure	Static, alternating load (pressure-suction), pulsating
Temperature	–20 up to +70 °C

SPECIAL FEATURES

Specific testing	According to a defined test program
Leakage detection	By means of a fog machine and flow probes

RECOGNITIONS

The test laboratory is recognized by the Deutsches Institut für Bautechnik (DIBt) as a testing facility under applicable building regulations LBO No. BWU10 and as a Notified Body No. 1004 to the terms of the Regulation of Construction Products (EU-BauPVO). It has been granted flexible accreditation under DIN EN ISO/IEC 17025 by the Deutsche Akkreditierungsstelle GmbH (DAkkS) under accreditation No. D-PL-11140-11-04.

WATER TIGHTNESS AGAINST DRIVING RAIN BY TEST FACILITY FOR IMPERMEABILITY

Measurement	Water tightness against driving rain
Standards	DIN EN 1027, DIN EN 12208, DIN EN 12489, DIN EN 12425, DIN EN 12155, DIN EN 12154, DIN EN 12865
Measurement object	Windows, doors, gates, curtain walls façades, roof or wall elements (conservatories, glazing elements with integrated sun blinds), foils, adhesive tapes

TECHNICAL DATA

Test specimen dimensions	Height and width up to 4000 mm each, thickness: layers up to 400 mm, roofs up to 8 m length
Driving rain	e.g., 2L/min/m² at a simultaneous pressure of more than 1000 Pa
Temperature	–20 up to +70 °C

SPECIAL FEATURE

Specific testing	According to a defined test program: Performance under thermal and hygric load Performance under freeze-thaw cycling

RECOGNITIONS

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RESISTANCE TO WIND LOAD BY TEST FACILITY FOR IMPERMEABILITY

Measurement	Resistance to wind load
Standards	DIN EN 12211, DIN EN 1221, DIN EN 12444, DIN EN 12424, DIN EN 12179, DIN EN 13166
Measurement object	Windows, doors, gates, curtain walls façades, roof or wall elements (conservatories, glazing elements with integrated sun blinds), foils, adhesive tapes

TECHNICAL DATA

Test specimen dimensions	Height and width up to 4000 mm each, thickness: layers up to 400 mm, roofs up to 8 m length
Measuring range	Air pressure up to 5000 Pa
Air pressure	Static, alternating load (pressure-suction), pulsating
Temperature	–20 up to +70 °C

SPECIAL FEATURES

Specific testing	According to a defined test program
Leakage detection	By means of a fog machine and flow probes

RECOGNITIONS

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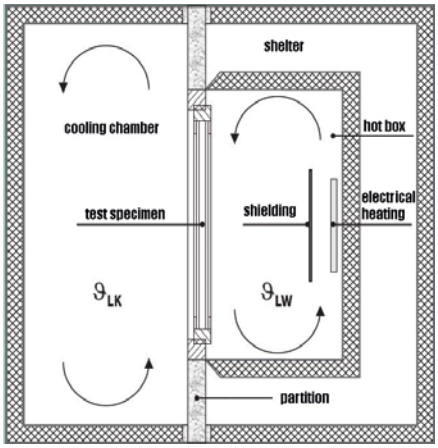
THERMAL RESISTANCE AND THERMAL TRANSMITTANCE IN THE HOT BOX



Measurement	Thermal resistance R and thermal transmittance U
Standards	DIN EN ISO 12567-1, DIN EN ISO 12567-2, DIN EN 12412-2, DIN EN 12412-4, DIN EN ISO 8990
Measurement object	Windows (frame and glazing), profiles, skylights, doors, roller shutter casings, roof elements, façade elements, walls

TECHNICAL DATA

Test opening, test specimen dimensions (W × H)	1230 × 1480 mm 1400 × 1600 mm 1100 × 1600 mm 1600 × 2000 mm
Small specimens	From approx. 1.5 m², measurements can be conducted by means of masks made of insulating material
Larger specimens	Measurement in the climate simulator

RECOGNITIONS

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CLIMATE SIMULATION IN THE BIG CLIMATE SIMULATOR

Measurement	Protection against heat and against cold, moisture proofing, weather proofing, HVAC analyses, sun simulation, rain simulation, durability testing
Measurement object	Building components, complete building elements, prefabricated house elements, façade elements, walls, ceilings, roof constructions, flat roof systems, design of insulation materials, sandwich constructions, windows, doors, components with thermal bridges, shutter systems, skylights, components for the renovation of building elements, etc.

TECHNICAL DATA

Internal size (L × W × H)	7.0 × 6.0 × 5.8 m
Temperature range	–15 to +55 °C
Humidity range	Dew-point temperature +2 to +27 °C Relative humidity 35 to 85 %

SPECIAL FEATURES

Equipment for temperature control of test specimens	Temperature range –15 up to +55 °C Air circulation 1000 to 6000 m³/h
Programmable climate control	Examination of stationary and transient heat and moisture transfer mechanism

MORE INFORMATION

- Door opening (W × H) 2.00 × 3.20 m
- Thermal cycling (without load), cooling rate 15 K/h, heating rate 15 K/h
- Air circulation (laminar or turbulent) 7000 to 30,000 m³/h
- Max. thermal load 76 kW
- Max. point load 20,000 N
- Max. total load 150,000 N

CLIMATE SIMULATION IN THE THREE-CHAMBER CLIMATE SIMULATOR

Measurement	Stationary and transient processes of thermal conductivity and humidity penetration, U-value, storage properties of building components, alternating climate loads, thermal bridges, condensation, cavity convection, vapor diffusion processes, day/night simulation
Measurement object	Large façade and roof elements, prefabricated house elements, door and window elements, thermal insulation by means of external shutters, roller blinds, etc., composite constructions with thermal bridges, multi-layer building components with cavities, charging and discharging cycles of heat storage facilities, equipment for ventilation, heat recovery installations, absorber elements

TECHNICAL DATA

Internal size (L × W × H)	Chamber 1 and 2 2.0 × 4.0 × 2.7 m Chamber 3 2.4 × 4.0 × 2.9 m
Temperature range (chamber 1 and 2/chamber 3)	–30 up to +80 °C
Humidity range (chamber 1 and 2/chamber 3)	Dew-point temperature +2.5 to +58 °C Relative humidity 10 to 95 %

SPECIAL FEATURES

Applications	Up to three simultaneous stationary investigations, programmable alternating climate in each chamber, time lapse investigations, rapid change of temperature
Chambers can be moved	Chamber 1 is stable, chambers 2 and 3 can be moved

MORE INFORMATION

Alternating climate control: (without load), cooling-off rate 50 K/h, heating rate 85 K/h

CLIMATE SIMULATION IN CLIMATE CHAMBERS AND CLIMATE CABINETS

Measurement	Temperature and relative humidity changes, freeze-thaw resistance, durability, aging, air-conditioned storing
Standard	DIN EN 12091
Measurement object	Small-sized building components and building materials, thermal insulating products for building applications

TECHNICAL DATA

Volume of space	Climate chambers approx. 4.6 m³ and 7 m³ climate cabinets 0.35 m³ and 1.50 m³
Temperature range	Climate chambers +10 to +60 °C climate cabinets –70 to +180 °C
Relative humidity	Climate chambers 20 to 90 % climate cabinets 10 to 98 %

THERMAL CONDUCTIVITY OF CONCENTRIC PIPE INSULATION

Measurement	Thermal conductivity
Standards	DIN EN ISO 8497, EN 14313, EN 14303, EN 14305
Measurement object	Concentric pipe insulation, tubular homogeneous and approximately homogeneous as well as layered test specimens (hollow cylinders, half shells, segments)

TECHNICAL DATA

Measurement section	1.5 m
Test specimen dimensions	Length 3 m, external diameter up to 500 mm
Carrier pipe diameters	From 15 to 87 mm; special dimensions on request
Mean specimen temperature	Within a range of approx. –20 to +90 °C
Measurement range	Smaller than 1 W/m·K

RECOGNITIONS

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MORE INFORMATION

- Determination of energy savings, prevention of condensation, corrosion protection, service temperature, values for CE marking
- Pipe insulation, e.g., made of PE cellular plastics, PIR rigid foam, mineral wool, PU cellular plastics, foam glass, vinyl rubber, PS rigid foam in hoses, half shells, wound strands

CALCULATION OF THERMAL PARAMETERS BY COMPUTER-AIDED THERMAL ANALYSIS OF BUILDING COMPONENTS

Measurement	Thermal transmittance U, linear thermal transmittance ψ, thermal resistance R, equivalent thermal conductivities, temperatures and temperature gradients, dew-point temperatures, heat flow and heat flow densities
Standards	DIN EN ISO 10211, DIN EN ISO 10077
Measurement object	Window profiles, frame profiles, glass edge bond, spacers of laminated insulation glazing units, shutter boxes, masonry units, masonry, roof and façade elements with thermal bridges, cavities, fixing elements

TECHNICAL DATA

Calculation program	STATWL, PHYSIBEL
Data of specimens	Completely dimensioned drawings, e.g., CAD drawing in DXF format, material properties (thermal conductivity, transient also density ρ, specific heat capacity c_p),

SPECIAL FEATURES

Variety of calculation	Transient and stationary temperature, two- and three-dimensional,
Presentation	Parameters, graphic presentation of the results

RECOGNITIONS

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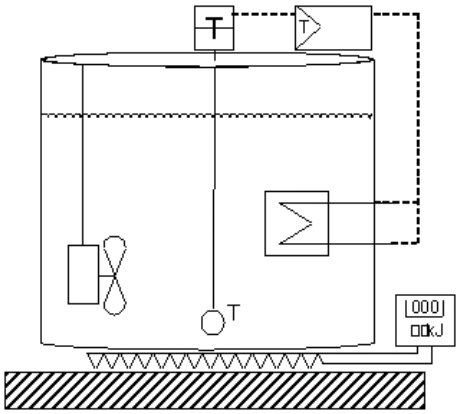
HEAT DISSIPATION OF FLOORS



Measurement	Heat dissipation of floors
Standard	DIN 52614 (withdrawn)
Measurement object	Homogeneous and approximately homogeneous as well as layered floor structures and coverings such as PVC, cork, parquet, linoleum, textile fibers, tiles, industrial floor coverings, polyester resin sheets, etc.

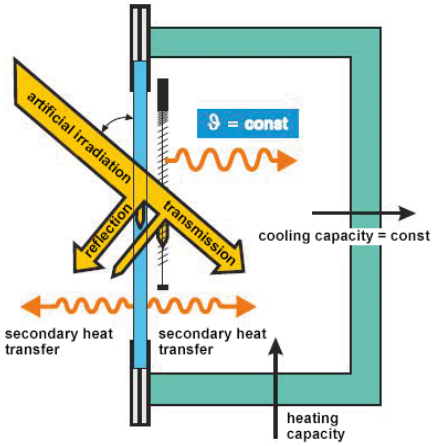
TECHNICAL DATA

Test specimen dimensions	500 × 500 mm

MORE INFORMATION

- Even as the standard is withdrawn, this measuring method is still used because of the significance of the results
- Heat dissipation levels from "not sufficiently warm to the feet" (level I) over "sufficiently warm to the feet" (level II) up to "particularly warm to the feet" (level III)

SOLAR HEAT GAIN COEFFICIENT (SHGC) BY CALORIMETER METHOD



Measurement	Solar heat gain coefficient (SHGC), g-value
Standards	In addition to DIN EN 410 and DIN EN 13363-2
Measurement object	Glazings with shading systems or with more than 3 panes, high-scattering glazing, special components with integrated sun protection, domed building components (domed roof lights, membrane constructions), transparent specimens, vehicle constructions, screen printing or three-dimensional fabrics

TECHNICAL DATA

Standard size and area of aperture	1 m², minimum of 0.5 m²
Test specimen dimensions	Minimum edge length 0.6 m, maximum of 2.9 m depending on construction

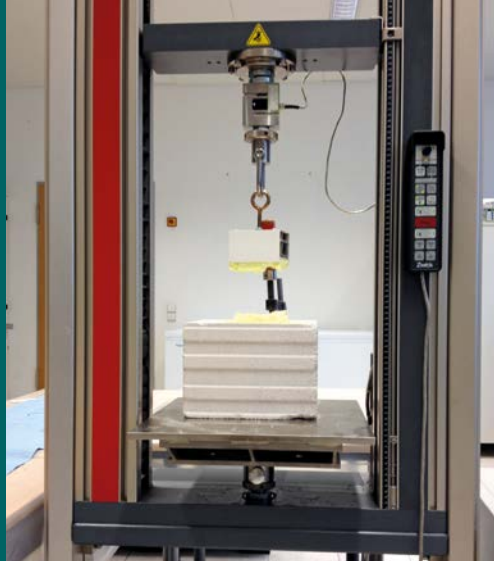
SPECIAL FEATURE

Test method	Nondestructive test method on special components, which are not included in above mentioned standards. This method is according to the latest state of technology but no normative standard yet. The specimen is exposed to artificial solar radiation in the range 300 to 900 W/m². Then an energy balance is performed for the Hot Box behind the sample for defined environmental conditions.

MORE INFORMATION

Additional method for above mentioned standards if optical parameters, gas fill rates or emission coefficients are missing or not available. A common application is the determination of g-values for glazings in existing buildings or for the acceptance of construction.

TESTING MACHINE FOR MECHANICAL MATERIAL AND COMPONENT CHARAC-TERISTICS



Measurement	Compressive stress, bending stress, tension/e-modulus, cyclic loading, nail tensile test, T-peel test, shear strength, bond strength
Standards	DIN EN 826, DIN EN 13163, DIN EN 12310-1, DIN EN ISO 11339
Measurement object	Insulation materials, textiles, plastics, building materials, concrete samples, adhesions, air-tightness-layers, roof underlays

TECHNICAL DATA

Maximum loads (compressive stress/tension)	a) 20 kN (compressive stress, shearing, bending, tension) b) 400 kN (compressive stress)	
Max. size of test samples	Compressive stress	a) 300 × 300 mm b) 420 × 520 mm
	Bending stress	350 × 450 mm
	Tension test	500 × 80 × 10 mm
Max. lift	a) 900 mm b) 50 mm	
Temperature	Standard: room temperature. Pre-tempering of the specimen between –40 to +300 °C possible	

SPECIAL FEATURE

Universal usage	Force or distance controlled load types possible, a number of standard test methods are via database quickly available, custom test methods possible, generation of dynamic loads

RECOGNITIONS

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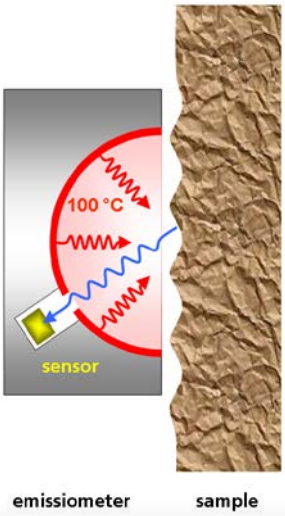
EMISSION COEFFICIENT



Measurement	Thermal emission coefficient and reflection coefficient
Standards	DIN EN 16012 (attachment D), alternative method for DIN EN 12898 and DIN EN 673
Measurement object	Glass including functional layers, insulation materials, roofing underlays or coverings, building panels, façades, floor coverings, concrete, asphalt, IR-reflecting films and almost all surfaces and structures with roughness up to 10 mm, opaque to IR radiation, varnishes and paints on substrate

TECHNICAL DATA

Spectral range	2.5 to 40 µm
Measurement range	0.02 to 0.99 %
Test specimen dimensions	Optional, minimum size 100 × 100 mm

SPECIAL FEATURE

Scope of application	Nondestructive method, investigation of already existing building products, quality control during production

MORE INFORMATION

- Surfaces preferably mounted in vertical position (±30°)
- In-situ measurements under appropriate conditions possible

TEST FACILITY FOR SOLAR REFLECTANCE INDEX (SRI)

Measurement	Solar Reflectance Index (SRI), warming potential under high irradiation
Standards	ASTM E 1980, further procedures ASTM E 1918, ASTM E 903, DIN EN 410, LEED rating
Measurement object	Roofing, tiles, façade sheeting, varnishes and paints, precast concrete parts, asphalt, pavers, parking area, streets, terrace slabs as well as other thin layers of building material layers, which are used in façades, roofs or other parts of building envelope or traffic areas

TECHNICAL DATA

Boundary conditions	1000 W/m², T_{amb} = 37 °C h_c = 5, 12, 30 W/(m²K)
Measurement range	SRI 0 to 100
Input characteristics	Solar reflectance and thermal emissivity
Size of test samples	Any type as long as minimum size within 100 × 100 mm for closed surfaces, minimum size of 16 m² for bulk materials are considered.

SPECIAL FEATURES

Universal usage	Nondestructive method to determine the warming potential of building surfaces, investigations for existing constructions possible, with a variety of auxiliary methods it can also be used on surfaces with structure and for bulk materials, e.g., gravel on roofs
Method	Relative procedure for the determination of the warming potential of a surface in comparison with a black and a white surface

MORE INFORMATION

In-situ measurements available under appropriate conditions

SPECTROPHOTOMETER

Measurement	Absorbance, transmittance and reflectance (UV/VIS/NIR), radiation and optical technical parameters preferably in the solar spectrum
Standards	DIN EN 410, ASTM E 903, DIN EN 13363-2
Measurement object	Organic and mineral glasses, functional layers, varnishes and paints, plastics, concrete, wood-based materials, building boards, metal sheets, light-directing building components and other transparent, translucent or opaque building materials

TECHNICAL DATA

Measurement range	185 to 3300 nm
Resolution	UV/VIS < 0.05 nm, NIR < 0.2 nm
Integrating sphere	150 mm diameter
Size of test samples (W x B x L)	Preferably 50 × 50 × < 10 mm For reflection measurements special sizes up to 0.5 m² and thicknesses up to 100 mm possible

SPECIAL FEATURES

- Testing facility for determination of optical input parameters for calculation methods as DIN EN 410 and DIN EN 13363-2
- Nondestructive laboratory procedure, short measuring time, high reproducibility

MORE INFORMATION

A combination of Tungsten and Deuterium light sources enables a big variety of the measuring range.

SOLAR SIMULATOR FOR LARGE BUILDING COMPONENTS

Measurement	Thermal load tests, spontaneous failure, temperature of building components, g-value (SHGC/total energy transmittance), fitness for purpose, aging behavior, thermal expansion, fogging of closed glass façades
Standards	Alternative method to DIN EN 410, DIN EN 13363-2, DIN EN 4892
Measurement object	Façades and roof components with opaque, translucent or transparent partial areas, transparent building components with light-directing elements, sun protection or shading facilities, also in interspace between the panes, glazing with integrated photovoltaics

TECHNICAL DATA

Irradiated area	1 to 8 m²
Effective irradiance	500 to 1200 W/m²
Sun elevation angle	0 to 90°
Quality of radiation	Solar-near spectrum, mainly parallel beams, variable diffuse component up to 100 % possible
Installation of the specimens	Wall to roof (0 to 90° continuously)

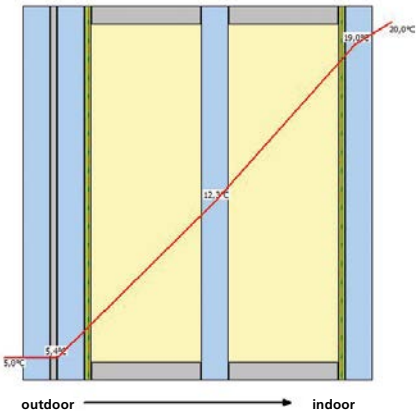
SPECIAL FEATURES

- The solar simulator reproduces almost all global radiation loads on building components in their original size and original mounting position. Smaller specimen can be irradiated with higher intensity, e.g., aviation
- Weather-independent test facility with reproducible boundary conditions

MORE INFORMATION

For long-term weathering testing and thermal load tests additional solar simulation facilities for sizes between 180 × 260 mm and 4 m² are available.

TEST FACILITY FOR DETERMINATION OF U_g ESPECIALLY FOR EXISTING GLAZINGS



Measurement	U_g according to DIN EN 673 (thermal transmittance coefficient), based on analysis of filling gas or residual oxygen, thermal emissivity, construction of glazing
Standard	DIN EN 673 (alternative procedure to DIN EN 674, DIN EN 675)
Measurement object	multiple glazing with 2 to 5 individual panes, thermal insulation glazing, solar control glazing, post-control of already existing glazings

TECHNICAL DATA

Test specimen dimensions	Any dimensions
Analysis of filling gas	Determination of air, argon and krypton in the gap between the panes (0 to 100 %) by means of analysis of residual oxygen and thermal conductivity detector
Emissivity	0.02 to 0.99 %
U_g	0.3 to 3.0 W/(m²K)

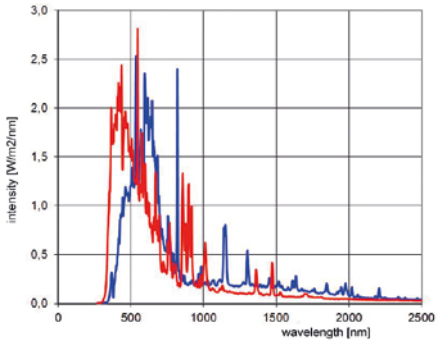
SPECIAL FEATURES

Special dimensions	This procedure is particularly suitable for glazings, which doesn't comply to standard parameters of measuring in the Hot Plate Apparatus or Hot Box
Installation	Due to the combination of calculation and measuring, the real mounting position can be considered by the calculation
Acceptance testing	Verification of the actual glazing quality during acceptance of construction

MORE INFORMATION

Besides the analysis of filling gas, a filling operation with noble gases for multiple glazing is also available.
Any gas filling rates can be performed, e.g., for additional examinations of prototypes.

SPECTRORADIOMETER



Measurement	Spectrum of emitted radiation from light sources, transmission, absorption and reflection, evaluation of solar simulation equipment, spectral analysis of daylight, integral and wavelength-dependent irradiance
Standards	Additional/special procedure for DIN EN 410, generation of spectral match reports for measuring class, performance as per IEC 60904, ASTM E 927, colorimetry CIE 1931 and CIE 1964
Measurement object	Light sources of any type, solar simulation facilities, glazing façades, roof and wall building components

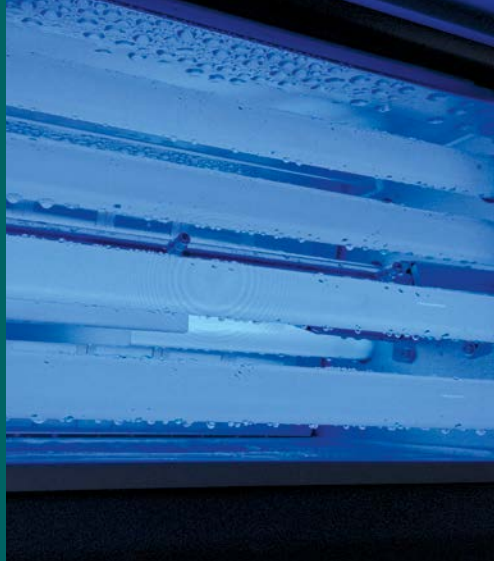
TECHNICAL DATA

Test specimen dimensions	Any dimensions
Integration time	5 to 10 s
Resolution	Wavelength-dependent 1 to 10 nm
Viewing angle	150°
Installation of the specimens	Wall to roof (0 to 90° continously variable)

SPECIAL FEATURES

Building dimensions	Due to the compact size, the spectroradiometer is portable and can be used locally during customer visits. A 3 m long glass fibre disconnects the sensor head from the spectrometer. Therefore measurement is independent on location and can be operated in narrow spaces.
Temperature range	Sensor head –30 to +70 °C, noncondensing
Intensity of irradiation	Integration can be done very fast on a wide variety of bandwidths within the measurement range
Calibration	Traceable to NIST

ARTIFICIAL AGEING BY COMBINED EXPOSURE TO RADIATION, HUMIDITY AND TEMPERATURE



Measurement	Change of material and component properties, e.g. strength, hardness, embrittlement, chalking, fading, transmittance, emissivity, yellowing, geometry
Standards	DIN EN 927-6, DIN EN 1297, DIN EN 1898, DIN EN 12224, DIN EN 12543-4, DIN EN 13523-10, DIN EN 75220, DIN EN ISO 4892-1, DIN EN ISO 4892-2, DIN EN ISO 4892-3, DIN EN ISO 11507, DIN EN ISO 11895, DIN EN ISO 11997-2, ASTM D 3424, ASTM D 4329, ASTM D 4587, ASTM D 4799, ASTM D 5071, ASTM D 5208, ASTM D 6695, ASTM G 151, ASTM G 154, ASTM G 155, SAE J 2020, prEN 1062-4
Measurement object	Organic glasses, films, coatings, paints, plastics, gaskets, sealants, roof linings, bitumen and elastomer roofing sheets, vehicle and façade components

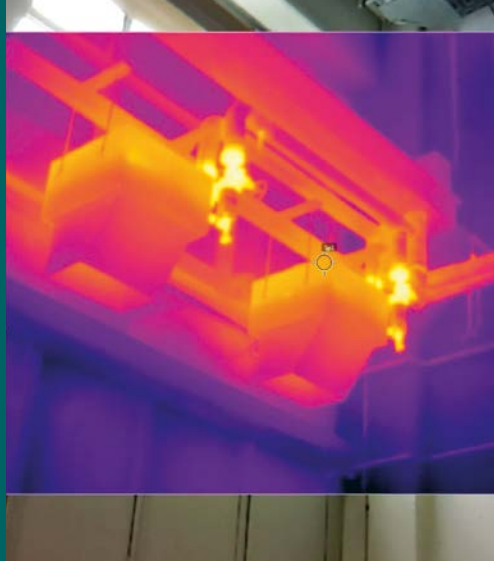
TECHNICAL DATA OF INDIVIDUAL SPECTRAL RANGES

UV-A (fluorescent tubes)	Spectral range Irradiation Humidity (cyclic) Sample size	300 to 400 nm, max. 340 nm 0.35 to 1.65 W/m² at +35 to +80 °C condensing or spraying 76 × 152 mm (48 pieces) to 488 × 311 × 25 mm (4 pieces)
Solar, Device A (Xenon lamps)	Spectral range Irradiation Humidity Max. sample size	300 to 800 nm 250 to 765 W/m² at +35 to +100 °C cyclic underwater storage 190 × 280 mm
Solar, Device B (metal halide lamps)	Spectral range Irradiation Humidity Max. sample size	280 to 3000 nm 800 to 1200 W/m² at –40 to +120 °C rel. humidity 20 to 80 % 900 × 1500 mm, height by arrangement

SPECIAL FEATURES

Reduced testing periods	By reducing or omitting dark phases and consistently high irradiances typical load durations are 1 to 8 weeks. The testing periods are thus shorter than in outdoor exposure.
Reproducibility	Reduced number of variables, therefore, they can be better monitored. Artificial ageing is more reproducible than natural weathering. Thus, comparisons between different products are easier possible.
Calibration	Yes. Traceable reference standards are available.

INFRARED (IR) LABORATORY



Measurement	Thermal radiation, temperatures, temperature distributions by thermography
Standards	DIN EN 13187, DIN 54190, ISO 18434-1
Measurement object	Technical building equipment, fireplaces, exhaust systems, façades and roof structures, thermal bridging, moisture retention, location of supply lines under plaster, vehicles, temperature analysis of larger surfaces and components, visualization of transient temperature behavior

TECHNICAL DATA OF INDIVIDUAL DETECTORS

Thermographic camera	Spectral range	7.8 to 14 µm
	Temperature range	–40 to +2000 °C, resolution 0.04 K
	IR image	frequency 30 Hz, 640 × 480 pixel
	Lenses	wide-angle 45°, 1.23 mrad
	Integrated digital camera, continuous superposition possible	
IR-video camera	Spectral range	7.5 to 13 µm
	Temperature range	–20 to +900 °C, resolution 0.1 K
	IR image	frequency 100 Hz, 120 × 160 pixel
	Lenses	standard, wide-angle, telephoto
IR temperature sensors (special applications)	Spectral range	a) 2.3 µm b) 8 to 14 µm
	Temperature range	a) +50 to +400 °C, resolution 0.2 K b) –40 to +900 °C, resolution 0.1 K

SPECIAL FEATURES

Emissivity	Adjustable (afterwards) 0.1 to 1.0
Formats (camera dependent)	In addition to radiometric images also fully radiometric video can be created. There will also be saved all temperature information.
Recording	Trigger and timed recordings are possible.
Calibration	A precision Infrared Calibrator for the temperature range +35 to +500° C, emissivity = 0.95 is available as a reference standard.

WATER VAPOR TRANSMISSION PROPERTIES

Measurement	Water vapor resistance factor, diffusion equivalent air layer thickness
Standards	DIN EN ISO 12572, DIN EN 12086, DIN EN ISO 7783-2, DIN 1931, DIN 53122-1, ASTM E 96-95
Measurement object	Mineral materials like brick, lime stone, sandstone, concrete, plasters and renders, insulation materials, flexible sheets for waterproofing, roof underlays, etc.

TECHNICAL DATA

Sample size, circular	Diameter 90 mm, 100 mm, 200 mm
Sample size, rectangular (L × W)	100 × 100 mm 200 × 100 mm 180 × 130 mm Special dimensions possible
Test condition	Dry cup: +23 °C, 0 to 50 % r.h. Wet cup: +23 °C, 50 to 93 % r.h. Special conditions available

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test reports can be issued

MORE INFORMATION

The water vapor transmission of building materials is one of the most important characteristics to estimate moisture behavior of constructions. In particular prevention of condensation and the drying of constructions are controlled by the water vapor transmission properties.

WATER ABSORPTION

Measurement	Capillary water absorption, a-value
Standards	DIN EN ISO 15148, DIN EN 1015-18, DIN EN 12087
Measurement object	Mineral materials like brick, lime stone, sandstone, concrete, plasters and renders, insulation materials, coatings, etc.

TECHNICAL DATA

Sample size, circular	Diameter 90 mm, 100 mm, 200 mm
Sample size, rectangular (L × W)	100 × 100 mm 200 × 100 mm 180 × 130 mm
Sample size, prism (L × W × H)	40 × 40 × 40 mm
	Irregular surface areas are possible as well, minimum area 50 cm²

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test reports can be issued.

MORE INFORMATION

- The water absorption coefficient is used to evaluate the capillary water uptake of building materials and an important data to estimate moisture protection of constructions.
- With the knowledge of the water absorption coefficient the calculation of the capillary transport coefficients for the water uptake is possible. These coefficients are used in simulations with WUFI®.

MOISTURE STORAGE, SORPTION

Measurement	Water content in % by volume, % by weight
Standard	DIN EN ISO 12571
Measurement object	Brick, lime stone, sandstone, concrete, plasters and renders, insulation materials, wooden materials, etc.

TECHNICAL DATA

Sample size	Any shape (bigger samples need more time to reach equilibrium)
Test conditions at +23 °C	50 % r.h. 65 % r.h. 80 % r.h. 93 % r.h. 97 % r.h. further conditions possible
Test method	Adsorption curve: equlibrium with increasing moisture content Desorption curve: equilibrium with decreasing moisture content

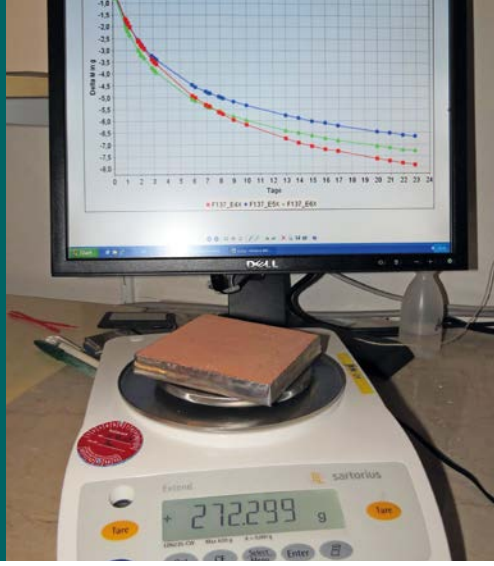
SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test reports can be issued

MORE INFORMATION

- Sorption of moisture means the exchange of water vapor between a material and the surrounding air until an equilibrium is reached.
- The sorption isotherm is used to determine the moisture storage function for a material specific WUFI® data set.

DRYING CURVE, DRYING OUT



Measurement	Mass change per time unit
Standard	Own testing method
Measurement object	Brick, lime stone, sandstone, concrete, plasters and renders, insulation materials, wooden materials, etc.

TECHNICAL DATA

Sample size, circular	Diameter 100 mm, 200 mm
Sample size, rectangular (L × W)	100 × 100 mm 200 × 100 mm
Basic conditions	Climate chamber +23 °C, 50 % r.h.

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test report can be issued

MORE INFORMATION

– A test specimen is saturated with water by immersion in water. The saturated specimen is sealed on the sides with aluminium foil and if necessary insulated. Then the drying out over the top face is measured in the climate chamber at +23 °C and 50 % r.h. The measured drying curve can be divided in a first drying period, which only relates to the test conditions (temperature, moisture, air velocity) and a second period, which is material dependent.
– Simple method for determination of the transport coefficients for the drying to be used in WUFI® material data set.

POROSITY, TRUE DENSITY

Measurement	Pore volume
Standard	DIN EN 1936
Measurement object	Porous materials like brick, lime stone, sandstone, concrete, plasters and renders, insulation materials, etc.

TECHNICAL DATA

Sample size	Max. 1 cm^3
Apparatus	Heliumpycnometer AccuPyc II 1340 from Micromeretics

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test report can be issued

MORE INFORMATION

- The true density of a material is defined as the mass of the dry material related to the volume of the solid matrix, which means minus the free accessible pore volume. The pore volume of the material sample is measured the heliumpycnometer. Helium is a inert gas and has a very small diameter, though all accessible pores of the material can be reached.
- The porosity of a material can be calculated by knowing the bulk and true density.

MOISTURE DISTRIBUTION, NMR

Measurement	Moisture distribution, moisture profile, penetration depth
Measurement object	Building materials, drilling core, insulation materials, etc.

TECHNICAL DATA

Sample size	Prisms with a max. width of 50 mm Drilling cores with a max. diameter of 50 mm
Apparatus	NMR spectroscopy

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test reports can be issued

MORE INFORMATION

- The contribution of weakly bounded protons in a material can be determined with this method. Therefore the moisture distribution at a certain time in materials or a combination of materials can be determined. Also the changes of the profiles, e.g., during a water uptake experiment or during a drying experiment, can be determined.
- The procedure can be used to determine the penetration depth of hydrophobic agents, impregnations or stone strengthening agents.

CAPILLARY ACTIVITY OF INTERIOR INSULATION MATERIALS

Measurement	Moisture content, moisture distribution
Standard	Own testing method
Measurement object	Insulation materials, etc.

TECHNICAL DATA

Sample size	Prisms with a max. width of 50 mm Drilling cores with a max. diameter of 50 mm
Apparatus	NMR spectroscopy
Equipment	Special experimental setup in the climate chamber

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test reports can be issued

MORE INFORMATION

A sample of the insulation material with the dimensions 45 × 45 mm × material thickness is laterally sealed with an epoxy resin. The back side of the specimen is attached to a cooling device to manage a dew-point undercut. The front side is exposed to the climatic conditions in the climate chamber with +23 °C and 65 % r.h. This produces a gradient of temperature and partial pressure, and consequently vapor diffusion into the material. The adsorbed moisture is condensing at the sealed back side of the material, where it causes an increase of relative humidity; hence, the moisture content inside the material sample is rising. Due to the increasing gradient of relative humidity, a liquid transport back to the front of the material sets in. Eventually, the opposing moisture fluxes will reach a dynamic equilibrium. To reveal the hygrothermal behavior of the material samples during testing, two modes of measuring are taken. Through periodic gravimetrical measurements, the moisture gain is analyzed and documented for the test period. The moisture distribution in the sample's cross-section is measured periodically by using nuclear magnetic resonance spectroscopy (NMR). The test results are reproduced by numerical simulation to determine and adapt the transport coefficients.

TENSILE STRENGTH, E-MODULUS

Measurement	Force and elongation, e-modulus
Standards	DIN EN ISO 8339 (sealing material), DIN EN 12311 (elastomer film), DIN 53457 (plastics), EN 1607 (insulation materials)
Measurement object	Sealing materials, elastomer films, fibrous insulation materials

TECHNICAL DATA

Sample size	Variable, depending on material
Apparatus	Zwick universal testing machine
	2 measuring ranges: up to 2 kN and up to 20 kN

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test reports can be issued

MORE INFORMATION

– The stress-strain curve of different materials can be determined
– Durabitiy and lifetime test of mechanical material properties after outdoor or artificial weathering

AIR-CONDITIONED TEST HALL

Measurement	Total water content, driving rain load
Standard	Own testing method
Measurement object	Wall elements in air-conditioned test hall exposed at the exterior to natural climate conditions

TECHNICAL DATA

Sample size	Wooden frame 50 × 50 cm, width: 20 cm or 40 cm
Field investigation	Wall with different composition
	Outdoor climate exposure to the west or east

SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test reports can be issued
	The wall elements can be removed from the test hall façade with a fork lift and weighed. Changes in weight of the wall elements can be determined, which are in correlation with the total water content.

MORE INFORMATION

Determination of moisture absorption or release to small-format wall elements, which are exposed to a controled interior climate in the winter and to natural weathering on the outside. This method is meant to compare for example different external coatings or insulation systems. Moisture content, temperature profiles and heat fluxes can be measured.

DURABILITY WITH DRIVING RAIN IMPACT

Measurement	Weathering, field experiments, durability
Measurement object	Whole wall segments on a building facing towards east or west

TECHNICAL DATA

Sample size	Individual wall segments have a width of 1.20 m and height of 2.80 m
Field test	Installation of a wall construction in a test building
	Orientation to east and/or west
Measured variables	Weathering of fibrous insulation materials under natural conditions by: Determination of pull-off strength Determination of dirt collection Dilatation tests Protection against driving rain

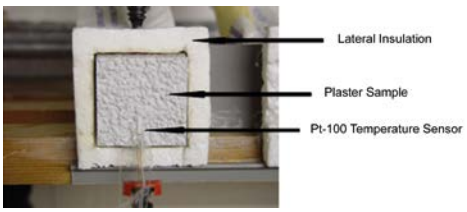
SPECIAL FEATURES

Accredited by DAkkS **D-PL-11140-11-02**	The laboratory has a flexible accreditation according to DIN EN ISO/IEC 17025 Test laboratory moisture, mortar, radiation, emmissions
	Test report can be issued

MORE INFORMATION

At a test building on the test field whole wall segments can be torn down and reconstructed. The building is air-conditioned in winter to an indoor climate of +20 °C and 50 % r.h. Test duration is at least a period of 6 month up to several years. Temperature and moisture measurements on the wall sequence can be used for validation of WUFI® simulations.

DETERMINATION OF DEW WATER ON THE SURFACE



Measurement	Determination of dew water on the surface of exterior finishes caused by nocturnal long-wave radiation
Standard	Own testing method
Measurement object	Outside coatings like plaster or paint

TECHNICAL DATA

Sample size (H × W)	50 × 50 mm
Indoor climate	+20 °C, 65 % r.h.
Dew-point temperature undercut	Typically 1.5 K

SPECIAL FEATURES

- Determination of dew water on the surface by dabbing and weighing
- Dew-point temperature corresponding to the situation of outer walls in clear nights

MORE INFORMATION

- Course of the surface water during a condensation period of several hours is decisive for the risk of microbial manifestation
- Typical testing time: 2 to 8 hours (without preparation)

ACCELERATED TEST TO ASSESS THE MICROBIAL GROWTH RESISTANCE OF EXTERIOR FINISHES

Measurement	Sensitivity of coatings to microbial infestation
Standard	Own testing method
Measurement object	Outside coatings like plaster or paint

TECHNICAL DATA

Specimen size (H × W)	Typically 100 × 100 mm
Room volume	Approx. 2 m³
Entrance door (H × W)	1.60 × 1.40 m
Number of specimen	Max. 70 (at 100 × 100 mm)

SPECIAL FEATURES

- Acceleration of microbial growth with a factor of 10 or more
- Natural transient climatic conditions in a daily course
- Autumn climate with weekly rain
- Simulation of the nocturnal undercooling by backside cooling below dew-point temperature
- Inoculation with a cocktail of microbial primary coloniser

MORE INFORMATION

- Left and right side separate individual undercooling possible
- Typical test time: 100 days

FLEXIBLE TEST FACILITY FOR FLAT AND PITCHED ROOF

Measurement object	Pitched roof constructions with between and top rafter insulation or combinations: solutions for gableboard or eaves, solar systems

TECHNICAL DATA

Ground area	42 m²
Number of test rooms	4 test rooms, thereof 2 northern-oriented and 2 southern-oriented
Room volume/Floor area	Per test room 6 m³ room volume with 7.45 m² floor area
Net test area (L × W)	Pitched roof areas: each 2.5 × 2.5 m Fixed flat roof: 4.0 × 5.5 m

SPECIAL FEATURES

Flexible slope of the roof	Adjustable between 22 and 50° with steps of 1° without replacing the roof construction
HVAC	Heating and ventilation system for floor and room heating, local humidification to enable daily moisture load profiles
Measurement equipment	Networked data logging, optionally external access, basic metrological equipment; upgrading depending on requirements possible using existing subdistribution panels

MORE INFORMATION

Backfitting of a cooling system prepared

MEASUREMENT AND TEST RANGE

INDOOR CLIMATE

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CLIMATE-MEASURING SYSTEM DRESSMAN

Measurement	Equivalent temperature
Standard	DIN EN ISO 14505
Measurement object	Indoor environments, cabin compartments of aircrafts and vehicles, cockpit

TECHNICAL DATA

Equivalent temperature	–10 up to +50 °C
Air temperature	–10 up to +60 °C
Air velocity	0 to 1 m/s and 0 to 10 m/s
Supply voltage	12 V

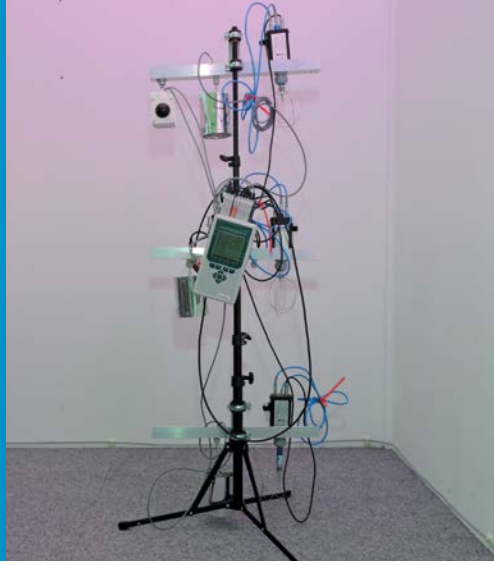
SPECIAL FEATURES

Optional sensors	Prepared for integration of additional sensors measuring local air temperature and velocity
Local climatic conditions	Measurement of the environmental climatic conditions at up to 16 different body parts for assessment of overall thermal comfort

MORE INFORMATION

- The equivalent temperature sensors are heated with a selected power output.
- Local effects of air temperature, air velocity and radiation are integrated into a single numerical value, which enables different climatic conditions to be compared and evaluated.
- Empirical studies yield good correlations between measured equivalent temperatures and the comfort assessment from test subjects.

MEASUREMENT DEVICE FOR INDOOR ENVIRONMENTAL COMFORT COMPONENTS



Measurement	Air temperature, air velocity, air humidity, globe temperature, global solar radiation, carbon dioxide
Standard	DIN EN ISO 7730
Measurement object	Offices, conference and living rooms, automotive, aviation, rail-bound vehicles

TECHNICAL DATA

Air temperature	–10 up to +60 °C
Air velocity	0 to 1 m/s, 0 to 5 m/s
Air humidity	5 to 98 % r.h.
Globe temperature	–10 up to +60 °C
Global solar radiation	0 to 1300 W/m²
Carbon dioxide	0 to 10 000 ppm

SPECIAL FEATURE

Measurements simultaneously	Temperature measurement radiation shielded. Air temperature and air velocity at three heights, measuring heights between 0.1 and 1.8 m

MORE INFORMATION

- Measurement device on lockable rolls for sliding to different test sites
- Measurement device telescoping to 0,85 m for transport
- Data logger included

PARTICLE IMAGE VELOCIMETRY (PIV)

Measurement	Time-varying flow field of a fluid
Measurement object	Air flow, buoyancy flow, convection, turbulence, flow around

TECHNICAL DATA

Nd:YAG double pulse laser	Pulse energy	200 mJ at a wavelength of 532 nm
	Repetition rate	0 to 15 Hz with a pulse duration between 6 and 9 ns
	Beam diameter	6.5 mm
	Beam divergence	<3 mrad
4 sCMOS cameras	Resolution	2560 pixel × 2160 pixel
	Readout noise	<3 electrons (50 frames/s)
	Pixel size	6.5 µm × 6.5 µm
	Minimum image distance	2 µs
Evaluation system	Workstation with 2x Quad Core with 1.8 TB of storage and 12 GB of memory, including special software for parallel computing on NVIDIA graphics cards	

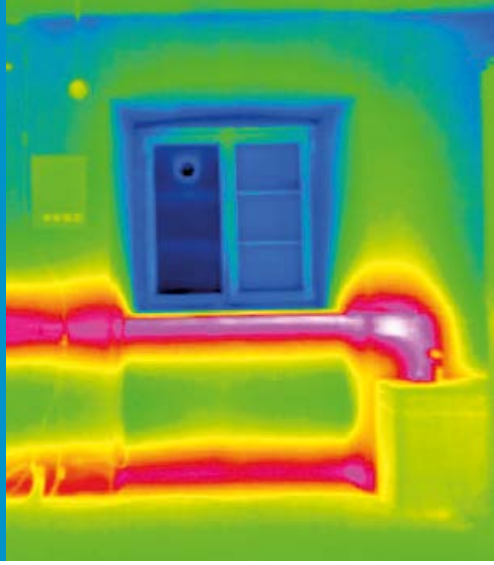
SPECIAL FEATURES

Tomographic PIV	Enhancements for measurement of 3D velocity fields in a maximum volume of 0.64 dm³ (requires 3 or 4 cameras)
Particle Tracking Velocimetry (PTV)	Conversion to methods for tracking particles through a fluid in the measuring area

MORE INFORMATION

- Any additional devices: helium bubble generator, compressed air bottle to spray (for seeding) to operate, 5 tripods, each 4 wide-angle and macro lenses, 4 Scheimpflug adapters, 5 goggles, light sheet optics for laser
- Seeding: di-ethyl-hexyl-sebacate (DEHS) or helium bubbles
- Black theatrical material with high absorption and protection available to blackout

INFRARED THERMOGRAPHY



Measurement	Infrared radiation 7.5 to 14 µm wave length
Standards	DIN 54190, DIN EN 13187
Measurement object	Building envelopes: outer and inner walls of commercial and residential buildings, particularly historic buildings Building services: heating and cooling equipment in buildings, particularly museums, and their local effects on adjacent building elements or works of art

TECHNICAL DATA

Detector size	600 × 480 infrared pixel
Thermal sensitivity	0.030 Kelvin at +23 °C (low noise detector)
Measurement and accuracy	Infrared spectrum 7.5 to 14 µm wave length at ±1.5 Kelvin and ±2 % of measurement reading
Wide-angle lens 12,5 mm	65 × 51° (complete walls indoors, even in small rooms)
Telephoto lens 50 mm	18 × 14°

SOFTWARE

HighEnd Software IRBIS plus	Editing of digital thermogram with several editing functions, e.g., temperature profiles along any lines and across any measured areas
Image and data export	Temperatures for each measuring point (pixel)
Emissivity coefficient	Different emissivity coeffecients are adjustable
AVI generator	Set up of video sequences in real-time or in time sceduled sequences

INDOOR CLIMATE MONITORING AND CONTROL IN FOUR HISTORIC ROOMS

Measurement	Air temperature, globe temperature, relative humidity, surface temperature, heat flux, heating water flow rate, electric power, air velocity
Standards	DIN EN 60751, DIN EN ISO 7726
Measurement object	Four historic rooms in the Alte Schäfflerei Benediktbeuern Monastery
Aim	Examination and comparison of different heating systems in combination with internal and external wall insulation

MONITORING OF TEMPERATURE, RELATIVE HUMIDITY AND HEAT TRANSPORT

Air temperature	In 10, 60, 110, 170 and 255 cm height above ground with radiation blocked PT 100 sensors
Surface temperature	On all walls in 0, 10, 170, 255 and 260 cm height above ground as well as on floor and roof in the room center
Globe temperature	In the center of the room in 170 cm height
Relative humidity	In the center of the room in 170 cm height
Heat flux	On the outer walls in 170 cm height

CONTROL OF TEMPERATURE, RELATIVE HUMIDITY AND AIR EXCHANGE

Measurements	PT 100, capacitive r.h. sensor, anemometer, heat flux
Control system	DESIGO™
Control variables	Supply water temperature and water flow rate, air dehumidification and humidification, air supply flow, electric power

MEASUREMENT AND TEST RANGE

HEAT TECHNOLOGY, LIGHTING TECHNOLOGY

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“IN-SITU” MEASUREMENT OF PHOTOMETRIC CHARACTER-ISTICS OF STREET PAVEMENT

Measurement	Reflection characteristic of street pavement: Level of mirroring S, mirroring factor κ_P and luminance coefficients q_0, q_d thereby classification of the R class and C class
Standards	DIN EN 13201, CIE 144:2001
Measurement object	Measurement of street pavement layers on site

TECHNICAL DATA

Light source	Actively controllable luminance screen to provide the necessary diffuse and direct light components
Sensor system	Luminance meter grade A
Measuring angle	Measuring the street pavement at 1° and 2.29°

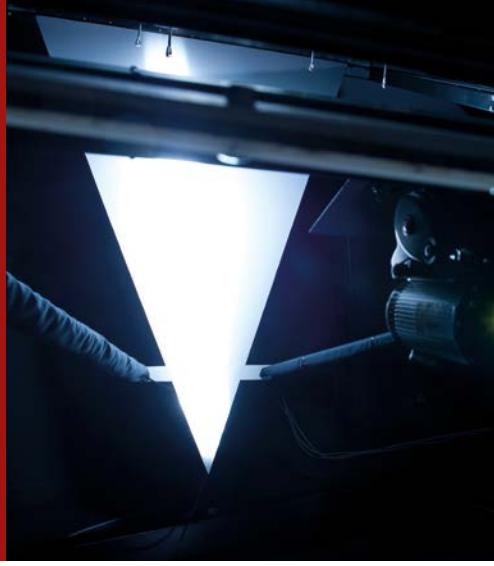
SPECIAL FEATURES

On-site measurement	On-site measurement of built in street pavement avoiding core abstractions and artificial aging of samples
Time-efficient measurement	Compact, lightweight device Automatic control of the measurement

MORE INFORMATION

IBP Research News 36 (2009), Nr. 494

LIGHT TRANSMISSION AND REFLECTION OF FAÇADES



Measurement	Directed-directional light transmission and light reflectance (luminance coefficients, BRTDF), directional-hemispherical light transmittance and reflectance
Standards	DIN EN 410, DIN EN 13363, DIN EN 14500, DIN EN 14501, DIN V 18599-4
Measurement object	Glass, Complex Fenestration Systems (CFS) like functional glass types (e.g. printed glass, glass for light control), blinds, textile sun protection, glass-sun protection composites, systems for skylights

TECHNICAL DATA

Light source	D65 spectrum, opening angle 0.34° Exposure to sample: elevation angle of 0° up to 84° Azimuth angle: 0 to 360°
Sensor system	Spatially resolved measurements by luminance camera (2°) Monochromatic, 3 color channels, circadian action spectrum c(λ)
Sample size (L × W × H)	1.23 × 1.48 × 0.30 m

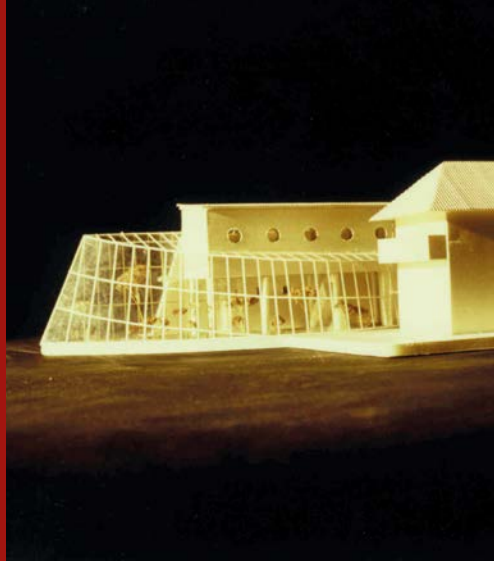
SPECIAL FEATURES

Automatic sample positioning	Highly automated measuring device. Inter alia louvre angle of blinds can be set automatically.
Further use of the data in planning	Software-based data analysis. The recorded data may inter alia directly be used in light simulation programs such as DIALux to evaluate the façades photometrically and energetically.

MORE INFORMATION

IBP Research News 36 (2009), Nr. 499

ARTIFICIAL SUN FOR DAY-LIGHTING EVALUATION OF BUILDING MODELS



Measurement	Exposition and shading studies of buildings and settlement models, daylight system evaluation and optimization
Standard	DIN 5034
Measurement object	Models of buildings or settlements

TECHNICAL DATA

Light source	85 halogen spotlights
Model table	Diameter 1.20 m; distance to specimen 6 m, gimbal mounted

SPECIAL FEATURES

Direct radiation	Narrow beam of lamps and filtering with honeycomb material lead to an almost parallel insolation on the model table (2° angle).
Automatic control	Software-based control of the relative angle of the model to the artificial sun to set any positions of the sun and diurnal cycles

MORE INFORMATION

IBP Research News 20 (1993), Nr. 237

ARTIFICIAL SKY FOR DAY-LIGHTING EVALUATION OF BUILDING MODELS

Measurement	Illuminance distributions in building models, daylight factor measurement according to DIN 5034, daylight system evaluation and optimization
Standard	DIN 5034
Measurement object	Models of buildings

TECHNICAL DATA

Light source	85 hemispherically over a model plane placed halogen lamps with 38° beam angle
Measurement	Illuminance in the interior of models and outside the model with miniature photometers. From this e.g. determination of the daylight factor

SPECIAL FEATURE

Desired luminance distributions	All spotlights are individually dimmable, so that different luminance distributions of the covered and clear sky can be set.

MORE INFORMATION

IBP Research News 20 (1993), Nr. 237

ARTIFICIAL WINDOW FOR A DETAILED ANALYSIS OF DAYLIGHT CONDITIONS

Measurement	Weather-independent investigation of daylight conditions in interior spaces, precisely controllable interaction between artificial and natural light for studies on user behavior and performance (e.g. at computer workstations), focused studies of light management systems such as daylight-responsive light control, specific tests of sun and glare protection systems under controlled conditions, studies on novel approaches such as artificial windows
Measurement object	Test group studies, computer workstations, light management systems, sun and glare protection systems, novel approaches such as artificial windows

TECHNICAL DATA

Light field	108 spotlights on 3 × 4 m, mobile in front of façade
Lamp power	30 kW in total, fully dimmable, electronically and by mechanical shutter
Direct light	Altitude angle: 0° to 60° Façade azimuth: –60° to +60°
Diffuse light	Luminance up to 10 000 cd/m²
Color temperature	2500 K to 9300 K

SPECIAL FEATURES

View out	Interchangeable scene foil
Light scenes	Computer-controlled, for example daily and annual cycles, alternating between direct and diffuse light. Variable luminance distributions on the façade
Connected laboratory	Highly flexible artificial lighting system with daylight-dependent light management. Integration into laboratory concept which makes integral indoor climate, lighting and acoustic investigations possible

LIGHT LABORATORIES FOR EXPERIMENTAL STUDIES ON THE PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF LIGHT

Measurement	Performance and user acceptance studies on the physiological and psychological effects of light, testing new lighting concepts, such as context-sensitive lighting, integral investigations of indoor climate, lighting and acoustics
Measurement object	Test group studies, computer workstations, light management systems, lighting systems

TECHNICAL DATA

Lighting system	Efficient LED lighting of the entire room, subdivided into several separately controllable zones Algorithm-supported choice of the color point or color of light taking the color rendering into account
Illuminance	Up to 2000 lux, directly and indirectly
Color of light	RGB saturated colors or white from 2000 K to over 15,000 K, CRI 90 at white light

SPECIAL FEATURES

Light control	Real-time consideration of numerous user-related factors (position in space, direction of view, activity, age, preferences) and environmental variables (daylight, time of day)
Interfaces	PC software for lighting control, as well as gesture and voice control. Sensors for the detection of selected user-related factors.
Conditioning of laboratory	Embedded in a laboratory concept which enables researchers to perform integral investigations of indoor climate, lighting and acoustics.

VIRTUAL WINDOW FOR WINDOWLESS INTERIORS

Measurement	Psychological studies on the effect of light in windowless environments
Measurement object	Test group studies (e.g. performance tests)

TECHNICAL DATA

Size	3 screens, each with 165 cm (65”) diagonal
Resolution	3240 pixel × 1920 pixel
Brightness	Up to 500 cd/m²
Mappable viewing angle	160°
Footage	Motifs with 15 447 pixel × 9154 pixel, any images and videos
Position tracking	IR depth image sensor, capturing the viewpoint and the view direction relative to the virtual window

SPECIAL FEATURES

Image projection	Automatic adjustment of the image, taking the viewpoint and view direction into account
Twin rooms	Next to the room with virtual window is a identical twin room, but with a real window. By directly uploading the outside world to the virtual window real and virtual situations can be directly compared with each other.

EYE TRACKING GLASSES FOR AN ANALYSIS OF VISUAL BEHAVIOR

Measurement	Binocular eye tracking data, capturing the eye movements to study cognitive and decision making factors
Measurement object	Consumer behavior, social interactions

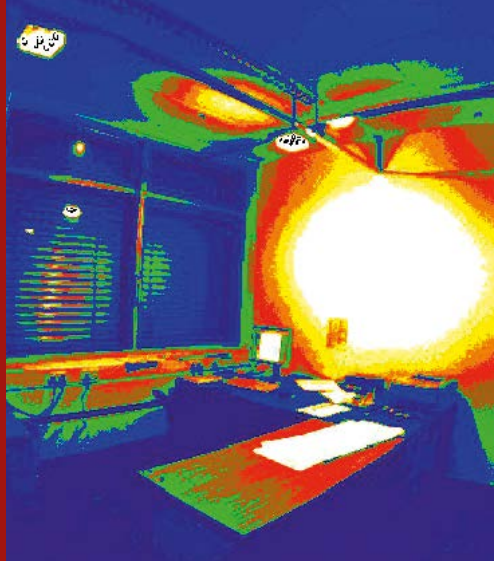
TECHNICAL DATA

Eye tracking principle	Binocular eye tracking with automatic parallax compensation
Temporal resolution	60 Hz
Gaze tracking range	80° horizontal, 60° vertical
HD scene camera	Resolution: 1280 pixel × 960 pixel at 24 frames per second (fps); 960 pixel × 720 pixel at 30 fps, video format: H.264, field of view: 60° horizontal, 46° vertical
Human interface design	Noninvasive video-based glasses-type eye tracker
Gaze position accuracy	0,5° over all distances, parallax compensation

SPECIAL FEATURES

Eyewear compatibility	Works with contact lenses
Audio	Integrated microphone
Real-time capturing	Online scene video with gaze position, pupil diameter/position, tracking status, eye image online interfacing via SDK
Calibration	Instant calibration with fully mobile use
Analysis	Quantification and visualization of eye tracking data using specific software

LUMINANCE MEASURING CAMERA FOR A SPATIALLY RESOLVED ANALYSIS OF LUMINANCE DISTRIBUTIONS



Measurement	Spatial luminance distribution of indoor and outdoor environments, photometric image analysis
Standard	DIN 5032
Measurement object	Luminous and illuminated surfaces covering a wide range of visual environments from VDT to daylight situations

TECHNICAL DATA

Camera	1.4 megapixel CCD detector, photopic spectral correction
Typical luminance range	0.015 to 50,000 cd/m² (with filter up to 5×10^9 cd/m²)
Lenses	Wide angle, fish eye

SPECIAL FEATURES

Filter	Neutral density filter with transmission of 1 and 0.01 % to raise the maximum measurable luminance
Analysis	Using the software luminance values can be measured over a series of measuring points or as complete surfaces.

MEASUREMENTS IN LABORATORIES

MEASUREMENT OBJECTS

DIN STANDARDS

NOTES

NOTES

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