

MEASURING AND TESTING FACILITIES



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BUILDING PHYSICS TESTING

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




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

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

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

How to use this digest

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

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

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

MEASURING AND TESTING FACILITIES – AN OVERVIEW

INDOOR CLIMATE

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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/m ²
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
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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	

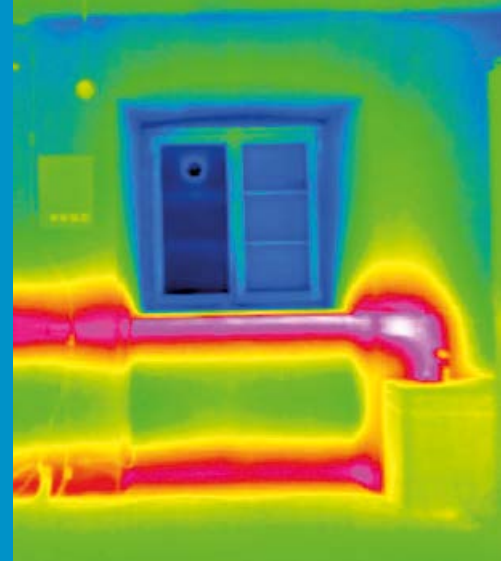
SPECIAL FEATURES

Tomographic PIV	Enhancements for measurement of 3D velocity fields in a maximum volume of 0.64 dm ³ (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	<p>Building envelopes: outer and inner walls of commercial and residential buildings, particularly historic buildings</p> <p>Building services: heating and cooling equipment in buildings, particularly museums, and their local effects on adjacent building elements or works of art</p>

TECHNICAL DATA

Detector size	600 \times 480 infrared pixel
Thermal sensitivity	0.030 Kelvin at +23 $^{\circ}\text{C}$ (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 \times 51 $^{\circ}$ (complete walls indoors, even in small rooms)
Telephoto lens 50 mm	18 \times 14 $^{\circ}$

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 coefficients are adjustable
AVI generator	Set up of video sequences in real-time or in time scheduled 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 Schöfflerei 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

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