



# Research and Testing Centre for Thermal Solar Systems (TZS)

Institute for Thermodynamics  
and Thermal Engineering (ITW)  
University of Stuttgart



in cooperation with





# Range of Services

## The Institute for Thermodynamics and Thermal Engineering (ITW)

has been working in the field of thermal solar energy since the early 1970s. In 1993 the Research and Testing Centre for Thermal Solar Systems (TZS) was established. Meanwhile, TZS is the largest testing centre for solar thermal components and systems in Europe. TZS has, hence, unique and well-established experience in testing the full spectrum of solar thermal products as well as in conducting research and development projects with partners from research organisations and industry.

**TZS is a testing laboratory**, accredited since 2002 by DAkkS according to DIN EN ISO/IEC 17025. Accreditation applies, amongst others, for testing according to EN ISO 9806 and EN 12975-1 (solar collectors), EN 12976 und EN 12977 (solar thermal systems and solar heat stores). TZS is therefore allowed to carry out tests according to the requirements of the European quality label "Solar Keymark". Furthermore, tests according to the rules of the U.S. certification authority SRCC (Solar Rating and Certification Cooperation) are being performed.

**A qualified, professional and creative team** headed by experienced staff and equipped with state-of-the-art test facilities, equipment and measuring devices provides the framework to carry out numerous R&D projects and tests conforming to international standards.

**The spin-off company SWT** (Solar- und Wärmetechnik Stuttgart / Solar and Heat Technology Stuttgart) extends and complements the range of services provided by TZS. SWT's core activities consist in developing and constructing test facilities for solar collectors and thermal solar systems, as well as consulting, performing studies, elaborating energy concepts and organizing events such as workshops and conferences.



## Solar Collectors

**Tests according to EN ISO 9806, EN 12975-1 and AS/NZS 2712**

- Outdoor and indoor performance tests, durability and reliability tests as well as tests of safety-related requirements
- Detailed examinations related to development activities

### Outdoor test facilities

- 6 test rigs for collectors up to a maximum area of 6 m<sup>2</sup>
- Test rig including a solar tracker for collectors with a maximum area of 5 m<sup>2</sup>
- Test units for special tests (e.g. solar facade and roof integrated collectors) up to a maximum area of 20 m<sup>2</sup>

### Indoor test facility

- 2 solar simulators, max. area about 10 m<sup>2</sup>, max. irradiation intensity 1200 W/m<sup>2</sup>

### Test report

- Test reports including technical data, efficiency curves and pressure losses, e.g. as a basis for Solar Keymark Certification
- Certification according to German BMWi regulations and RAL-UZ 73 (blue angel)
- Performance predictions for European locations with the calculation software SCEnOCalc

## Solar Heat Stores

**Thermal tests of hot water stores according to EN 12977-3**

**Thermal tests of combistores according to EN 12977-4**

- Determination of store parameters required for specific mathematical models
- Verification of the determined parameters by means of dynamic test sequences and comparison of calculated and measured results
- Detailed examinations related to development activities
- 2 test facilities located in climate-controlled test laboratories

### Test report

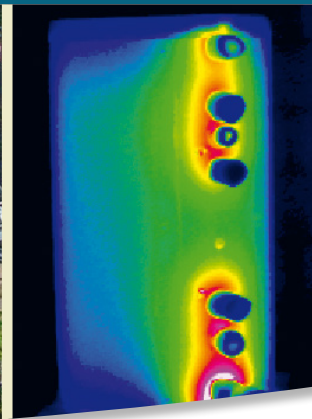
Test reports as e.g. basis for Solar Keymark Certification with the following information:

- Thermal store parameters
- Temperature profiles for different operating conditions
- Characteristic performance charts for domestic hot water preparation
- Input data for simulation programs
- Detection of thermal bridges by means of infrared thermography
- Heat loss rate as a basis for European energy labelling

## Solar Chillers

- Performance test of thermal driven chillers and heat pumps
- Simulation of the thermal behaviour of complete systems according to EN 12977-2





## Solar Domestic Hot Water Systems

Tests corresponding to EN 12976-2 according to ISO 9459-5 using the DST-method (Dynamic System Test) and ISO 9459-2 using the CSTG-method

Test according to EN 12977-2 using the CTSS-method (Component Testing - System Simulation)

### 4 Outdoor test facilities

- Collector locations on tiled roof (roof adjustment south, roof inclination 48,8°) also suitable for thermosiphon and ICS systems
- Stores located inside a fully climate-controlled test facility

### Indoor test facility

- Dynamic solar simulator with an illuminated area of about 10 m<sup>2</sup>, max. irradiation intensity 1200 W/m<sup>2</sup>

### Test report

- Test reports including technical data and results of performance test, e.g. as a basis for Solar Keymark Certification
- Calculation of the annual energy output for European reference locations and climate data

## Solar Combisystems

Tests according to EN 12977-2 using the CTSS-method (Component Testing - System Simulation)

Detailed tests of single components:

- Collector: Performance test, outdoors or indoors using a solar simulator
- Combi-store: Test for detailed characterisation of thermal behaviour
- Controller: Functional testing in laboratory
- Simulation of thermal behaviour of the complete combisystem using the simulation program TRNSYS

### Test report

- Data and parameters of the different components and of the whole system
- Results of the performance tests e.g. as a basis for Solar Keymark certification and energy labelling
- Calculation of the annual energy output for different heating loads and locations

## Heat Pumps

- Determination of COP (coefficient of performance) of heat pumps
- Investigation of the dynamic behaviour of heat pumps and their interaction with the thermal solar system

## Special Tests

### Ageing behaviour of solar collectors

- Accelerated ageing tests using corrosion test chambers for combined exposure to solar and UV radiation, humidity and temperatures in the range of -50 °C to +100 °C

### Investigations of stores

- Interaction of store and gas burner
- Store with integrated auxiliary heater, e.g. gas or oil burner, heat pump

### Life Cycle Assessment (LCA) and ecological assessment

- Determination of the energy payback time and the total energy savings during the lifetime of thermal solar systems
- Environmental assessment of technical products according to ISO 14040

### Transmittance

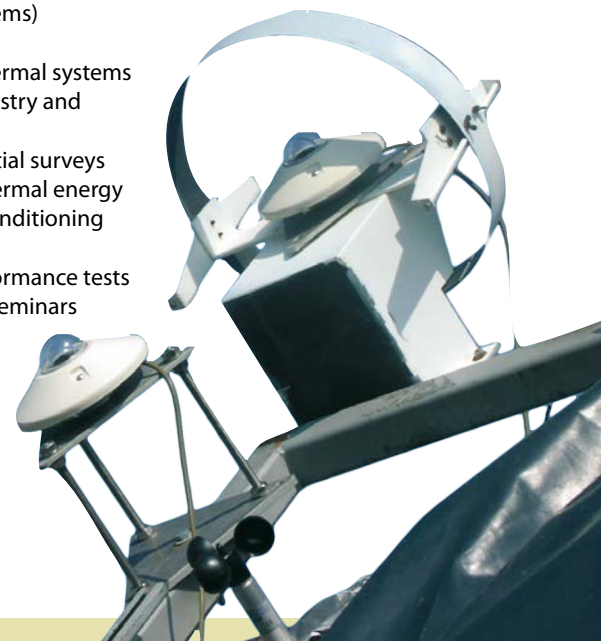
- Determination of the incidence angle modifier of solar collector glazings

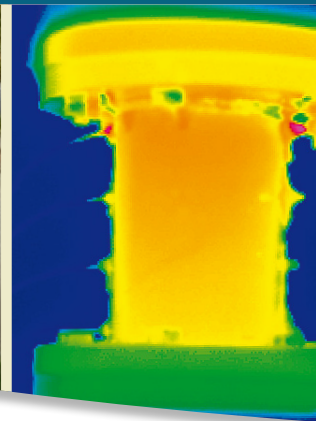
## Simulation Studies

- Simulation studies for solar thermal systems using TRNSYS
- CFD-simulation (Computational Fluid Dynamics) of fluid flow and heat transport phenomena with FLUENT, OpenFOAM and COMSOL

## Other Services

- Development and construction of test facilities for solar thermal products (e.g. solar collectors, heat stores, solar thermal systems)
- Special tests
- Design of solar thermal systems
- Consulting of industry and politics
- Market and potential surveys related to solar thermal energy and heating/air conditioning technology
- Comparative performance tests
- Training courses, seminars
- Project acquisition and management





# Research and Development

## Investigations of ageing behaviour of solar collectors

- Accelerated ageing of solar collectors by means of UV radiation, moisture, high temperature operation and corrosive atmosphere

## Thermochemical heat storage

- Concepts of heat storage with high energy densities and significantly reduced heat losses

## Solar local district heating

- Solar heat supply of housing areas and quarters with solar fractions of more than 50 %

## Seasonal energy storage

- Technologies for the storage of large energy amounts from summer to winter

## Solar buildings

- Development of building concepts with high solar fraction of electricity and heat (up to full solar supply)
- PV driven heating systems
- Design, simulation, measurement analysis

## Development of stores

- Modular storage concepts for improved use of space
- Detailed examinations e.g. of thermal stratifiers by LIF (Laser Induced Fluorescence) and PIV (Particle Image Velocimetry)
- New tank materials, standardisation, cost reduction
- Increased storage capacity by using phase change materials
- Advanced thermal insulation concepts such as vacuum insulation

## Test methods for solar thermal systems and components

- Development of test methods
- Participation in European and international standardisation committees

## Monitoring, measurement and evaluation of large scale systems

- Short term and long term in-situ measurements of installed plants

## Ecological Assessment

- Development of methods for the integral assessment of solar thermal systems throughout their lifetime taking into account ageing effects

## Development of detailed numerical mathematical models

- Application of modern numerical methods, such as CFD-calculations of fluid flow and heat transport phenomena, and validation of results by high resolution measuring techniques

## Energy concepts

- for innovative buildings with low energy consumption
- for the restoration of historical, in some cases even listed buildings

## Participation in committees and working groups

- Conference board »OTTI-Symposium Thermal Solar Energy«
- Intersolar Europe Solar Thermal Conference chairman
- Working group »long term thermal energy storage«
- Solar Keymark Network and Solar Certification Fund
- Global Solar Certification Network
- Network of stakeholders of energetic building renovation
- Standards committee »Thermal solar systems and components«
- Steering committee »Renewable Heating in Germany«
- European standardisation committee CEN TC 312
- International standardisation committee ISO TC 180

## Solar Heating and Cooling Program of the International Energy Agency (IEA SH&C)

- IEA SH&C Task 39 »Polymeric Materials for Solar Thermal Applications«
- IEA SH&C Task 42 »Compact Thermal Energy Storage«
- IEA SH&C Task 43 »Solar Rating and Certification Procedures«
- IEA SH&C Task 44 »Solar and Heat Pump Systems«
- IEA SH&C Task 45 »Large Scale Solar Heating and Cooling Systems«
- IEA SH&C Task 49 »Solar Heat Integration in Industrial Processes«

## Technology platforms

- DSTTP / ESTTP / RHC-TP

Significant contribution to the foundation of the German solar thermal technology platform (DSTTP), the European solar thermal technology platform (ESTTP), the European technology platform for renewable heating and cooling (RHC-TP), participation in the respective steering committees

# Contact

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