Standardisation and Quality Assurance in Solar Thermal

- Testing and certification -

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TZS

The largest test centre for thermal solar systems in Europe

- Research & development
- Testing & inspection
- Education & knowledge transfer
Content

- Overview on standards for solar thermal components and systems
- Categories of solar products offered on the market
- European Standards
- Certification and certification schemes
- Outlook and conclusions
Testing and Certification

Testing

based on standards
eg. ISO 9806
ISO 9459
EN 12976

Test report

Certification

based on certification program
eg. Solar Keymark

Certificate
Standards for solar thermal products

International Standards (ISO)
e.g. ISO 9806, ISO 9459

European Standards (CEN)
e.g. EN 12975, EN 12976

National Standards (NMX)
e.g. NMX-001 (Collectors), NMX-002 (Terminology)
International Standards (1/2)

ISO 9806 Test methods for solar collectors

- Part 1: Thermal performance of glazed liquid heating collectors including pressured drop

- Part 2: Qualification test procedures

- Part 3: Thermal performance of unglazed liquid heating collectors including pressured drop
International Standards (2/2)

ISO 9459 Solar heating - domestic water heating systems

- Part 1: Performance rating procedure using indoor test methods
- Part 2: Performance test of solar only systems
- Part 3: Performance test of solar plus supplementary systems
- Part 4: System performance characterisation by means of component tests and computer simulation
- Part 5: System performance characterisation by means of whole-system tests and computer simulation
General approach for system testing

- **Testing:**
  - Dynamic short term test of the whole system in an outdoor test facility
- **Parameter determination**
  - by means of a numerical model to determine the parameters characterizing the thermal performance
- **Annual system simulation**
  - by using the same numerical model to predict the annual performance
ISO 9459-2
Performance test of solar only systems

Input-Output Test method

- Whole day test (typically about 6 days at various ambient conditions) to determine the system performance

- Draw off test to determine degree of mixing in the store

- Overnight heat loss test for determination of store (UA)-value
ISO 9459-5
Performance test for all types of solar domestic hot water systems

Dynamic System test (DST-method)

• Sequence $S_{\text{sol}}$ for characterisation of solar collector loop

• Sequence $S_{\text{sto}}$ for determination of (UA)-value (heat loss rate) of store

• Sequence $S_{\text{aux}}$ for determination of auxiliary heated part of the store
Categories of solar products offered on the market

- Solar thermal collectors

- Small domestic hot water systems (factory made systems)

- Solar thermal systems for domestic hot water preparation and/or space heating assembled based on components offered by manufacturers (custom built systems)
European Standards for Solar Thermal Products

EN 12975-1: Solar collectors - Part 1 - General requirements
EN 12975-2: Solar collectors - Part 2 - Test methods

EN 12976-1: Factory made systems - Part 1 - General requirements
EN 12976-2: Factory made systems - Part 2 - Test methods

ENV 12977-1: Custom built systems  
Part 1 - General requirements

ENV 12977-2: Custom built systems  
Part 2 - Test methods

ENV 12977-3: Custom built systems  
Part 3 - Performance characterisation of stores for solar heating systems
European standards for thermal solar collectors

EN 12975, Part 1:
Solar thermal systems and components, collectors
General requirements
e.g. materials, mounting, documentation, safety aspects

EN 12975, Part 2:
Solar thermal systems and components, collectors
Test methods
- thermal performance (different test methods)
- durability and reliability
e.g. internal and external thermal shock, mechanical strength
collectors - durability and reliability testing

rain penetration test  
internal thermal shock
collectors - durability and reliability testing

positive pressure test of transparent collector cover
Performance testing of solar collectors
- steady state test method (indoor and outdoor)
- quasi dynamic test method (outdoor)

Presentation of results by means of a power-curve

Power curve for $G^* = 1000 \text{ W/m}^2$
European Standards for Solar Thermal Products

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ENV 12977-1: Custom built systems
    Part 1 - General requirements
ENV 12977-2: Custom build systems
    Part 2 - Test methods
ENV 12977-3: Custom build systems
    Part 3 - Performance characterisation of stores for solar heating systems
## Classification of systems

<table>
<thead>
<tr>
<th>Factory made solar heating systems</th>
<th>Custom built solar heating systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integral collector-storage systems for domestic hot water preparation</td>
<td>Forced-circulation systems for hot water preparation and/or space heating, assembled using components and configurations described in a documentation file <em>(mostly small systems)</em></td>
</tr>
<tr>
<td>Thermosiphon systems for domestic hot water preparation</td>
<td>Uniquely designed and assembled systems for hot water preparation and/or space heating <em>(mostly large systems)</em></td>
</tr>
<tr>
<td>Forced-circulation systems as batch product with fixed configuration for domestic hot water preparation</td>
<td></td>
</tr>
</tbody>
</table>
## Performance testing of systems

<table>
<thead>
<tr>
<th>Factory made systems</th>
<th>Custom built systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>(domestic hot water preparation)</td>
<td>(domestic hot water preparation and/or space heating)</td>
</tr>
<tr>
<td>performance testing required</td>
<td>performance testing optional</td>
</tr>
</tbody>
</table>

### Systems without auxiliary heating
- **CSTG method** acc. ISO 9459-2

### Systems with or without auxiliary heating
- **DST method** acc. ISO 9459-5

### Small systems
- **CTSS method** acc. ENV 12977

### Large systems
- initial inspection, short term system testing, long-term monitoring
Testing of **factory made** systems acc. EN 12976

**Performance test of the whole system**

DST-method (ISO 9459-5) or **CSTG-method (ISO 9459-2)**

CSTG test facility from SWT-Technologie
European Standards for Solar Thermal Products

EN 12975-1: Solar collectors - Part 1 - General requirements
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EN 12976-1: Factory made systems - Part 1 - General requirements
EN 12976-2: Factory made systems - Part 2 - Test methods

ENV 12977-1: Custom built systems
  Part 1 - General requirements

ENV 12977-2: Custom build systems
  Part 2 - Test methods

ENV 12977-3: Custom build systems
  Part 3 - Performance characterisation of stores
  for solar heating systems

* replaced by new structure

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New structure of EN 12977 series

*Thermal solar systems and components - Custom built systems*

EN 12977-1:
General requirements for solar water heaters and combisystems

EN 12977-2:
Test methods for solar water heaters and combisystems

EN 12977-3:
Performance test methods for solar water heater stores

EN 12977-4:
Performance test methods for solar combistores

EN 12977-5:
Performance test methods for control equipment
Testing of custom built systems acc. EN 12977 series

CTSS-Method: Component Testing - System Simulation
Testing and Certification

Testing

based on standards
eg. ISO 9806
ISO 9459
EN 12976

Test report

Certification

based on certification programm
eg.
Solar Keymark

Certificate
Example of relevant certification programs for solar thermal products

Golden Sun (China)
China General Certification Center

SRCC (US)
Solar Rating and Certification Corporation

Solar Keymark (Europe)
Approved national certification bodies

Others: E.g. Australian REC
Golden Sun (China)

Available for
- solar collectors
- solar domestic hot water systems

Standards
Certification programs (national standards) include:
- GB/T 19141-2003 Specification of domestic solar water heating system,
- GB/T 17049-2005 All glass evacuated solar collector tube,
- GB/T 6424-1997 Specification for flat plate solar collectors,
- GB/T 17581-1998 Evacuated tube solar collector
SRCC (US)

Available for
- solar collectors
- solar domestic hot water systems

Standards (collectors):
Certification program (OG 100) include:
- **ISO 9806-1**: 1994, Test methods for solar collectors
  Part 1: Thermal performance of glazed liquid heating collectors
- **ISO 9806-2**: 1995, Test Methods for solar collectors
  Part 2: Qualification test procedure
- **ISO 9806-3**: 1995, Test methods for solar collectors
  Part 3: Thermal performance of unglazed liquid heating collectors
SRCC (US), contd.

Available for
- solar collectors
- solar domestic hot water systems

Standards (systems):
Certification program (OG 300) include:
- **ANSI Z21.10.1-2004/CSA 4.1-2004** Gas Water Heaters Volume 1, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less
- **ANSI Z21.10.3-2004/CSA 4.3-2004** Gas Water Heaters - Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous.
- SRCC Standard and Documents, such as e.g. OG 100
European Certification - The Keymark

- thermal insulation products
- fire extinguisher
- coffee machines
- ....
- ....
- solar thermal collectors and factory made solar thermal systems (Solar Keymark)

The aims:
- One test valid for whole Europe
- Providing a minimum product quality
Solar Keymark

Available for
- solar collectors
- factory made solar domestic hot water systems

Standards for collectors (referenced in the Solar Keymark scheme rules)
- EN 12975-1: Solar thermal systems and components, collectors
  General requirements
- EN 12975-2: Solar thermal systems and components, collectors
  Test methods

Standards for systems (referenced in the Solar Keymark scheme rules)
- EN 12976-1: Solar thermal systems and components, factory made systems, General requirements
- EN 12976-2: Solar thermal systems and components, factory made systems, Test methods
The 4 elements of Solar Keymark Certification

1. Audit of the manufacturer’s management system by an independent inspector
2. Inspection of the factory production and picking of the test samples by an independent inspector
3. Complete test of the product according to EN 12975 (collectors) or EN 12976 (domestic hot water systems)
4. Periodic surveillance
   - Bi-annual audit of the quality management system and the production
   - Physical inspection of the product
Actors - Solar Keymark Certification

- CEN (European Committee for Standardisation) owns the legal right on the Keymark label
- Certification bodies (e.g. DIN Certco, Certif, SP ...)
- Accredited test laboratories (e.g. arsenal, ITW, INETI, SPF)
- Independent inspectors / auditors
Solar Keymark Highlights (1/2)

- A large number of solar collectors is already Solar Keymark certified.

- Solar Keymark is accepted nearly all over Europe as a basis for subsidies.

- The product to be tested is picked from manufacturer’s production or from the stock.
Solar Keymark Highlights (2/2)

- the collector is completely tested acc. to EN 12975
- the system is completely tested acc. to EN 12976
- complete documentation of the product required
- periodical supervision of production
  - annual check of the QM-system
  - biannual check of the products and production
- test laboratories shall be accredited
What in needed in the near future?

- Harmonisation of standards and certification programs
- Mutual acceptance of different certification marks / labels
- Extension of certification to other products e.g.
  - solar air collectors, PVT collectors, concentrating collectors
  - solar combisystems, solar cooling systems, solar+heatpump sys
- Acceptable costs for
  - product testing (appropriate test effort)
  - for certification

--> IEA SH&C Task 43 (Solar Rating and Certification Procedures
  - Advanced Solar Thermal Testing and Characterization for Certification
  of Collectors and Systems) Internet: www.iea-shc.org/task43/
provides excellent basis to achieve these goals
IEA Task 43

Solar Rating and Certification Procedures
Advanced Solar Thermal Testing and Characterization for Certification of Collectors and Systems
July 1, 2009 - June 30, 2012
Internet: www.iea-shc.org/task43/

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IEA Task 43

Overall Goal:
Harmonisation of Testing and Certification procedures

• push the ISO and CEN work on international standardisation aiming at - as much as possible - harmonized ISO and EN standards for solar thermal collectors and systems

• possibilities for establishing a common worldwide certification scheme for solar thermal collectors will be investigated.
Key Elements required for the development of a sustainable solar thermal market

- standards
- certification programs
- promotion
- test labs
- Industry
Conclusions: Co-ordinated actions and efforts lead to success

- **promotion**
  by campaigns and political measures
  e.g. INFONAVIT

- **certification programs**
  for products and installers

- **Industry**
  for manufacturing and installing products

- **standards**
  for components and systems
  containing requirements & test methods

- **test labs**
  for testing products and further development of technology
Conclusions: Co-ordinated actions and efforts needed

- **promotion** by campaigns and political measures
- **certification programs** for products and installers
- **standards** for components and systems containing requirements & test methods
- **test labs** for testing products and further development of technology

Thank you for your attention.