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S.R. CEN/TS 12977-2:2010

Thermal solar systems and components - Custom built systems - Part 2: Test methods for solar water heaters and combisystems

S.R. CEN/TS 12977-2:2010

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English Version

**Thermal solar systems and components - Custom built systems
- Part 2: Test methods for solar water heaters and
combisystems**

Installations solaires thermiques et leurs composants -
Installations personnalisées - Partie 2: Méthodes d'essai
pour chauffe-eau solaires et installations mixtes

Thermische Solaranlagen und ihre Bauteile -
Kundenspezifisch gefertigte Anlagen - Teil 2: Prüfverfahren
für Solaranlagen zur Trinkwassererwärmung und solare
Kombianlagen

This Technical Specification (CEN/TS) was approved by CEN on 9 September 2008 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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Foreword

This document (CEN/TS 12977-2:2010) has been prepared by Technical Committee CEN/TC 312 “Thermal solar systems and components”, the secretariat of which is held by ELOT.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes ENV 12977-2:2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

a) Drinking water quality

In respect of potential adverse effects on the quality of water intended for human consumption caused by the product covered by this document, it should be noted that:

- 1) this document provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;
- 2) while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

b) Factory Made and Custom Built solar heating systems

EN 12976-1, EN 12976-2 and CEN/TS 12977-1 to -5 distinguish two categories of solar heating systems:

- 1) Factory Made solar heating systems; and
- 2) Custom Built solar heating systems.

The classification of a system as Factory Made or Custom Built is a choice of the final supplier, in accordance to the following definitions:

- 3) Factory Made solar heating systems are batch products with one trade name, sold as complete and ready to install kits, with fixed configurations. Systems of this category are considered as a single product and assessed as a whole.

If a Factory Made Solar Heating System is modified by changing its configuration or by changing one or more of its components, the modified system is considered as a new system. Requirements and test methods for Factory Made solar heating systems are given in EN 12976-1 and EN 12976-2.

- 4) Custom Built solar heating systems are either uniquely built, or assembled by choosing from an assortment of components. Systems of this category are regarded as a set of components. The components are separately tested and test results are integrated to an assessment of the whole system. Requirements for Custom Built solar heating systems are given in CEN/TS 12977-1, test methods are specified in CEN/TS 12977-2 to -5. Custom Built solar heating systems are subdivided into two categories:
 - i) Large Custom Built systems are uniquely designed for a specific situation. In general they are designed by HVAC engineers, manufacturers or other experts;
 - ii) Small Custom Built systems offered by a company are described in a so-called assortment file, in which all components and possible system configurations, marketed by the company, are specified. Each possible combination of a system configuration with components from the assortment is considered as one Custom Built system.

Table 1 shows the division for different system types.

Table 1 — Division for factory made and custom built solar heating systems

Factory Made solar heating systems (EN 12976-1, -2)	Custom built solar heating systems (CEN/TS 12977-1, -2, -4, -5 and EN 12977-3)
Integral collector-storage systems for domestic hot water preparation	Forced-circulation systems for hot water preparation and/or space heating/cooling, assembled using components and configurations described in a documentation file (mostly small systems)
Thermosiphon systems for domestic hot water preparation	
Forced-circulation systems as batch product with fixed configuration for domestic hot water preparation	Uniquely designed and assembled systems for hot water preparation and/or space heating/cooling (mostly large systems)

NOTE 1 Forced circulation systems can be classified either as Factory Made or as Custom Built, depending on the market approach chosen by the final supplier.

NOTE 2 Both Factory Made and Custom Built systems are performance tested under the same set of basic reference conditions as specified in EN 12976-2:2006, Annex B and in CEN/TS 12977-2:2010, Annex A. In practice, the installation conditions may differ from these reference conditions.

c) Test methods and procedures for the analysis of large custom built solar heating systems

Quality assurance is of primary importance for large custom built systems. The total investment cost for such systems is higher than for smaller ones, although the specific investment cost (i.e., per m² collector area) is lower. In several European countries, the potential of large custom built systems from the point of view of conventional energy savings is much larger than for smaller ones. Moreover, the return-on-investment is in many cases more favorable for large systems than for small ones. Hence, both the purchasers of large custom built systems and the governments are interested in efficient, reliable and durable systems, the thermal performance of which may be accurately predicted, checked and supervised.

The test methods in this document provide a means of verifying the compliance of large custom built systems with the requirements in CEN/TS 12977-1.

NOTE Within the framework of the EU ALTENER Programme the project "Guaranteed Solar Results" (GSR) was addressing similar objectives in respect of quality assurance (see [7], [8]). Similar procedures and monitoring equipment were used as described in Annexes C and D. It might be necessary to update Annexes C and D later on in a revision of this document when more experience is available.

As large custom built systems are by definition unique systems, only general procedures on how to check and supervise them may be given. An additional difficulty in the formulation of procedures is the fact that they have to be adapted to the dimension of the large custom built system considered, which may vary from typically 30 m² to 30 000 m² of collector area. Therefore, several possible levels of analysis are included (Annexes C and D).

The objective of the two short-term system tests presented in Annex C is the characterization of system performance and/or the estimation of the ability of the system to deliver the energy claimed by the designer. In principle, two approaches for short-term system testing are referred to in this Technical Specification:

- 1) A simplified check of short-term system performance, carried out by intercomparison of the measured solar system heat gain with the one predicted by simulation, using the actual weather and operating conditions as measured during the short-term test.
- 2) A short-term test for long-term system performance prediction. The performance of the most relevant components of the solar heating system is measured for a certain time period while the system is in normal operation. More detailed measurements encompass:

- i) energy gain of collector array(s); and
- ii) energy balance over storage vessel(s).

Intercomparison of the observed and simulated energy quantities provides the indirect validation of collector and storage design parameters. The measured data within the collector array are also used for direct identification of the collector array parameters. As far the component parameters are verified, the long-term prediction of the system gain as well as the detection of possible sources of system malfunctioning are possible.

Annex D describes a procedure for long-term monitoring as a part of the supervision of a large custom built solar heating system. The objectives of supervision may be:

- 3) the early recognition of possible failures of system components, in order to get the maximum benefit from the initial solar investment as well as to minimize the consumption of non-solar energy and the resulting environmental impact;
- 4) the measurement of system performance (solar gains or other system indicators), if requested by a contractual clause, e.g. guaranteed results.

The long-term monitoring in Annex D is limited to the solar energy specific aspects, especially to the determination of the solar contribution to the total heat load. Instrumentation used in the long-term monitoring should be an integrating part of the system, a part included from the very beginning of the design process. If adequately foreseen, it may also be used for system adjustment at start time.

1 Scope

This Technical Specification applies to small and large custom built solar heating systems with liquid heat transfer medium for residential buildings and similar applications, and gives test methods for verification of the requirements specified in CEN/TS 12977-1.

This document also includes a method for thermal performance characterization and system performance prediction of small custom built systems by means of component testing and system simulation.

Furthermore, this document contains methods for thermal performance characterization and system performance prediction of large custom built systems.

This document applies to the following types of small custom built solar heating systems:

- systems for domestic hot water preparation only;
- systems for space heating only;
- systems for domestic hot water preparation and space heating;
- others (e.g. including cooling).

This document applies to large custom built solar heating systems, primarily to solar preheat systems, with one or more storage vessels, heat exchangers, piping and automatic controls and with collector array(s) with forced circulation of fluid in the collector loop.

This document does not apply to:

- systems with a store medium other than water (e.g. phase-change materials);
- thermosiphon systems;
- integral collector-storage (ICS) systems.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 307, *Heat exchangers — Guidelines to prepare installation, operating and maintenance instructions required to maintain the performance of each type of heat exchangers*

EN 806-1, *Specifications for installations inside buildings conveying water for human consumption — Part 1: General*

EN 809, *Pumps and pump units for liquids — Common safety requirements*

EN 1151-1, *Pumps — Rotodynamic pumps — Circulation pumps having a rated power input not exceeding 200 W for heating installations and domestic hot water installations — Part 1: Non-automatic circulation pumps, requirements, testing, marking*

EN 1991-1-3, *Eurocode 1: Actions on structures — Part 1-3: General actions — Snow loads*

EN 1991-1-4, *Eurocode 1: Actions on structures — Part 1-4: General actions — Wind actions*

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