

Thermal solar systems and components - Custom built systems - Part 5: Performance test methods for control equipment

This document is a preview generated by EVS

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 12977-5:2012 sisaldab Euroopa standardi EN 12977-5:2012 ingliskeelset teksti.	This Estonian standard EVS-EN 12977-5:2012 consists of the English text of the European standard EN 12977-5:2012.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 04.04.2012.	Date of Availability of the European standard is 04.04.2012.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 27.160

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:
Aru 10, 10317 Tallinn, Eesti; www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:
Aru 10, 10317 Tallinn, Estonia; www.evs.ee; phone 605 5050; e-mail info@evs.ee

English Version

**Thermal solar systems and components - Custom built systems
- Part 5: Performance test methods for control equipment**

Installations solaires thermiques et leurs composants -
Installations assemblées à façon - Partie 5: Méthodes
d'essai pour chauffe-eau solaires et installations solaires
combinées

Thermische Solaranlagen und ihre Bauteile -
Kundenspezifisch gefertigte Anlagen - Teil 5: Prüfverfahren
für die Regeleinrichtungen

This European Standard was approved by CEN on 19 February 2012.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	4
Introduction	5
1 Scope	6
2 Normative references	7
3 Terms and definitions	8
4 Symbols and abbreviations	9
5 Controller classification (including equipment classification)	9
5.1 Controller	9
5.2 Sensor	10
5.3 Actuator	10
6 Requirements	11
6.1 General requirements	11
6.2 Controllers, system clocks, timers and counters	12
6.3 Sensors	12
6.4 Indicators	15
6.5 Actuators	15
6.6 Initial operation and commissioning	16
6.7 Documentation	16
7 Testing of sensors	17
7.1 General	17
7.2 Testing of temperature sensors	17
7.3 Testing of solar irradiance sensors	21
7.4 Testing of further sensors and measuring equipment	25
8 Testing of system clocks, timers and counters	25
8.1 General	25
8.2 Test equipment	25
8.3 Installation of system clocks, timers and counters	25
8.4 Test procedure	26
8.5 Data processing and evaluation	26
9 Function testing of simple differential thermostats	27
9.1 General	27
9.2 Test equipment	27
9.3 Installation of differential thermostats and/or sensors	29
9.4 Test procedure	29
10 Function testing of multi-function controllers	31
10.1 General	31
10.2 Principle of multi-function controller testing	32
10.3 Intellectual property of the manufacturer	32
10.4 Test facility for multi-function controller testing	32
10.5 Preliminary steps when using a test facility provided with an input/output emulator	34
10.6 Test procedure	37
10.7 Data acquisition and processing	39
11 Testing of actuators and additional control equipment	40
11.1 General	40
11.2 Determination of the electric power consumption of actuators and further components	40
11.3 Measuring the electric power of pumps with varying power consumption	40

12	Documentation	40
12.1	General	40
12.2	General information	40
12.3	Marking	40
12.4	Information for the installer, assembly and installation	41
12.5	Information for the user, operation and maintenance	41
13	Test report	42
Annex A	(informative) Testing the electrical supply voltage dependence of control equipment	43
A.1	General	43
A.2	Test equipment	43
A.3	Test procedure	43
A.4	Data processing	44
	Bibliography	45

Figures

Figure 1	— Elevation of an oven-arrangement to test temperature sensor accuracy, high-temperature resistance and differential thermostat functions	18
Figure 2	— Example of a simulation box for testing differential thermostats of solar heating systems	28
Figure 3	— Schematic of a controller test facility including an input/output emulator	34
Figure 4	— Flow chart of steps when using a test facility provided with an input/output emulator according to Figure 3	35

Tables

Table 1	— Classification of controllers for solar heating systems	9
Table 2	— Common sensors for solar heating systems	10
Table 3	— Most common actuators for solar heating systems	10
Table 4	— Accuracy of system clocks, timers and counters	12
Table 5	— Accuracy requirements of temperature sensors for solar heating systems	13
Table 6	— Requirements of high-temperature resistance of temperature sensors	13
Table 7	— Climate test conditions for solar irradiance sensors capability to resist to high irradiance	14
Table 8	— Climate test conditions for solar irradiance sensors capability to resist to high surrounding temperatures	14
Table 9	— Accuracy requirements for solar irradiance sensors	14
Table 10	— Total maximum electrical power of the pump(s)	15
Table 11	— Temperatures to be used for the accuracy test	20
Table 12	— Minimum climate test conditions for exposure and for external shock test	23
Table 13	— Irradiance levels to test the accuracy of solar irradiance sensors	24
Table 14	— Examples of control algorithms and corresponding test sequences for multi-function controllers	38

Foreword

This document (EN 12977-5:2012) has been prepared by Technical Committee CEN/TC 312 “Thermal solar systems and components”, the secretariat of which is held by ELOT.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.

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 CEN/TS 12977-5:2010.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: 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, Turkey and the United Kingdom.

Introduction

One purpose of this document is to define how to check that a controller is behaving as it is intended when in combination with associated equipment (e.g. sensors, pumps and other actuators). In addition, function testing of differential thermostats and so-called "multi-function" controllers are described in order to determine switch on and switch off temperature differentials as well as control algorithms where dependent on temperature differences, temperature levels or operating conditions of the system. For all functions and operations, it should be tested and documented, whether the controller and control equipment comply with the manufacturer's guidance.

In addition, the capability for all sensors to resist extreme operating conditions and to determine any significant drift in accuracy caused by this should be tested. The energy consumption of the controller and the associated control equipment should be documented, e.g. actuators. If the electrical supply is different from the mains supply this should be documented, e.g. PV powered pumps.

Performance predictions for the associated system that the control equipment belongs to are considered. For the determination of the component parameters according to the CTSS method, as specified in EN 12977-2, a detailed investigation of all relevant algorithms, features and parameters controlling the system is relevant.

NOTE The most widely used control equipment for solar heating systems is described in EN 12977-5. For control equipment not widely used in solar heating systems or auxiliary heaters, if part of the system, accompanying standards should be applied if available.

In respect of potential adverse effects to human health or life (e.g. drinking water quality) caused by the products covered by EN 12977-5 it should be noted that:

- 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;
- while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

EN 12976-1, EN 12976-2 as well as EN 12977-1, EN 12977-2, EN 12977-3, and EN 12977-4 distinguish two categories of solar heating systems:

- 1) factory made solar heating systems;
- 2) custom built solar heating systems.

As defined in EN 12977-1, the classification of a system as factory made or custom built is a choice of the final supplier.

Custom built solar heating systems are subdivided into two categories:

- i) large custom built systems are uniquely designed for a specific situation.
- 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;

1 Scope

This European Standard specifies performance test methods for control equipment. Furthermore, this document contains requirements on accuracy, durability and reliability of control equipment.

The tests described in this document are limited to electrically activated components delivered with or for the system by the final supplier. For the purposes of this document controller and control equipment for solar heating systems and auxiliary heaters, if part of the system, are restricted to the following:

- a) Controllers as:
 - 1) system clocks, timers and counters;
 - 2) differential thermostats;
 - 3) multi-function controllers.
- b) Sensors as:
 - 1) temperature sensors;
 - 2) irradiance sensors (for short wave radiation);
 - 3) pressure sensors;
 - 4) level sensors;
 - 5) flow meters;
 - 6) heat meters.
- c) Actuators as:
 - 1) pumps;
 - 2) solenoid and motor valves;
 - 3) relays.
- d) Combinations of controllers, sensors and actuators listed above.

An additional objective of the procedures described in this document is to verify control algorithms and, together with the accuracy of sensors, to determine control parameters. In addition to verifying the functioning of a controller, its equipment and actuators, the determined parameters may be used for numerical system simulations.

Typically, electrical anodes are not part of the control equipment and are not controlled by the control equipment. However, because they are electrical appliances, electrical anodes are included in this document.

This document is valid for control equipment of solar heating systems for the purpose of hot water preparation and/or space heating. If the solar system is connected to or part of a conventional heating system, the validity is extended to the entire system. In combination with the standards EN 12976-1, EN 12976-2 as well as EN 12977-1, EN 12977-2, EN 12977-3 and EN 12977-4, this document is valid for

- e) factory made solar heating systems,
- f) small custom built solar heating systems,
- g) large custom built solar heating systems,
- h) auxiliary heater equipment used in connection with e), f) and g).

2 Normative references

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

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 12975-2, *Thermal solar systems and components — Solar collectors — Part 2: Test methods*

EN 12976-1:2006, *Thermal solar systems and components — Factory made systems — Part 1: General requirements*

EN 12977-1:2012, *Thermal solar systems and components — Custom built systems — Part 1: General requirements for solar water heaters and combisystems*

EN 60038, *CENELEC standard voltages (IEC 60038)*

EN 60255 (all parts), *Measuring relays and protection equipment (IEC 60255, all parts)*

EN 60335-1, *Household and similar electrical appliances — Safety — Part 1: General requirements (IEC 60335-1)*

EN 60335-2-21, *Household and similar electrical appliances — Safety — Part 2-21: Particular requirements for storage water heaters (IEC 60335-2-21)*

EN 60730 (all parts), *Automatic electrical controls for household and similar use (IEC 60730, all parts)*

EN 62305-3, *Protection against lightning — Part 3: Physical damage to structures and life hazard (IEC 62305-3)*

EN ISO 4413, *Hydraulic fluid power - General rules and safety requirements for systems and their components (ISO 4413)*

EN ISO 9488:1999, *Solar energy — Vocabulary (ISO 9488:1999)*

ISO 9060, *Solar energy — Specification and classification of instruments for measuring hemispherical solar and direct solar radiation*

ISO/TR 9901, *Solar energy — Field pyranometers — Recommended practice for use*

ISO 15218, *Pneumatic fluid power — 3/2 solenoid valves — Mounting interface surfaces*