This is a free page sample. Access the full version online.

NSAI Standards

Irish Standard
I.S. EN 12977-4:2012

Thermal solar systems and components - Custom built systems - Part 4: Performance test methods for solar combistores

© NSAI 2012 No copying without NSAI permission except as permitted by copyright law.

This is a free page sample. Access the full version online.

I.S. EN 12977-4:2012

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard – national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation - recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces:
CEN/TS 12977-4:2010

This document is based on:
EN 12977-4:2012

Published:
12 April, 2012

This document was published under the authority of the NSAI and comes into effect on:

12 April, 2012

ICS number:

27.160

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie

W **NSAI.ie**

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

This is a free page sample. Access the full version online.

I.S. EN 12977-4:2012

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12977-4

April 2012

ICS 27.160

Supersedes CEN/TS 12977-4:2010

English Version

Thermal solar systems and components - Custom built systems - Part 4: Performance test methods for solar combistores

Installations solaires thermiques et leurs composants - Installations assemblées à façon - Partie 4: Méthodes d'essai por chauffe-eau solaires et installations solaires combinés

Thermische Solaranlagen und ihre Bauteile - Kundenspezifisch gefertigte Anlagen - Teil 4: Leistungsprüfung von Warmwasserspeichern für Solaranlagen zur Trinkwassererwärmung und Raumheizung (Kombispeicher)

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

© 2012 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN 12977-4:2012: E

This is a free page sample. Access the full version online.

Contents

Page

Foreword 3

Introduction 4

1 Scope 5

2 Normative references 5

3 Terms and definitions 5

4 Symbols and abbreviations 5

5 Store classification 5

6 Laboratory store testing 6
6.1 Requirements on the testing stand 6
6.1.1 General 6
6.1.2 Measuring data and measuring procedure 6
6.2 Installation of the store 6
6.2.1 Mounting 6
6.2.2 Connection 7
6.3 Test and evaluation procedures 7
6.3.1 General 7
6.3.2 Test sequences 8
6.3.3 Data processing of the test sequences 12

7 Test report 13
7.1 General 13
7.2 Description of the store 14
7.3 Test results 15
7.4 Parameters for the simulation 16

Annex A (normative) **Store model benchmark tests** 17

Annex B (normative) **Verification of store test results** 18

Annex C (normative) **Benchmarks for the parameter identification** 19

Annex D (informative) **Requirements for the numerical store model** 20

Annex E (informative) **Determination of hot water comfort** 21

Bibliography 22

Tables

Table 1 — Classification of combistores 6

Table 2 — Flow rates and store inlet temperatures for Test CD 9

Table 3 — Flow rates and store inlet temperatures for Test CI 10

Table 4 — Flow rates and store inlet temperatures for Test DD 11

Table 5 — Flow rates and store inlet temperatures for Test DI 11

This is a free page sample. Access the full version online.

Foreword

This document (EN 12977-4:2012) has been prepared by Technical Committee CEN/TC 312 “Thermal sorla 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 12977-1:2010.

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.

This is a free page sample. Access the full version online.

Introduction

The test methods for stores of solar heating systems as described in this document are required for the determination of the thermal performance of small custom built systems for combined domestic hot water preparation and space heating, so-called solar combisystems, as specified in EN 12977-1.

These test methods deliver parameters, which are needed for the simulation of the thermal behaviour of a store being part of a small custom built system.

NOTE 1 With the test methods for stores given in EN 12897 only a few parameters are determined in order to characterise the thermal behaviour of a store. These few parameters are not sufficient for the determination of the thermal performance of small custom built systems as described in EN 12977-2.

NOTE 2 The already existing test methods for stores of conventional heating systems are not sufficient with regard to thermal solar systems. This is due to the fact that the performance of thermal solar systems depends much more on the thermal behaviour of the store (e.g. stratification, heat losses), as conventional systems do. Hence, this separate document for the performance characterisation of stores for solar heating systems is needed.

NOTE 3 For additional information about the test methods for the performance characterisation of stores see EN 12977-3 and [1] in Bibliography.

This is a free page sample. Access the full version online.

1 Scope

This European Standard specifies test methods for the performance characterization of stores which are intended for use in small custom built systems as specified in EN 12977-1.

Stores tested according to this document are commonly used in solar combisystems. However, the thermal performance of all other thermal stores with water as a storage medium (e.g. for heat pump systems) can be also assessed according to the test methods specified in this document.

This document applies to combistores with a nominal volume up to 3 000 l and without integrated burner.

NOTE This document is extensively based on references to EN 12977-3:2012.

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 12828, *Heating systems in buildings — Design for water-based heating systems*

EN 12977-3:2012, *Thermal solar systems and components — Custom built systems — Part 3: Performance test methods for solar water heater stores*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12977-3:2012 and EN ISO 9488:1999 apply.

4 Symbols and abbreviations

For symbols and abbreviations, refer to EN 12977-3:2012.

5 Store classification

Solar combistores are classified by distinction between different charge and discharge modes. Five groups are defined as shown in Table 1.

This is a free page sample. Access the full version online.

Table 1 — Classification of combistores

Group	Charge mode	Discharge mode
1	direct	direct
2	indirect	direct
3	direct	indirect
4	indirect	indirect
5	stores that cannot be assigned to groups 1 to 4	

NOTE 1 All stores may have one or more additional electrical heating elements.

NOTE 2 Stores that can be charged or discharged directly and indirectly (e.g. a store of a space heating system with an internal heat exchanger for the preparation of domestic hot water) can belong to more than one group. In this case, the appropriate test procedures or the assignment to one of the groups respectively, should be chosen depending on its mode of operation.

6 Laboratory store testing

6.1 Requirements on the testing stand

6.1.1 General

The hot water store shall be tested separately from the whole solar system on a store-testing stand.

The testing stand configuration shall be determined by the classification of the combistores as described in Clause 5.

An example of a representative hydraulic testing stand configuration is shown in EN 12977-3:2012, Figure 1 and Figure 2. An appropriate test facility consists of two charge loops as shown in EN 12977-3:2012, Figure 1 and two discharge loops as shown in EN 12977-3:2012, Figure 2.

6.1.2 Measuring data and measuring procedure

The requirements specified in EN 12977-3:2012, 6.1.2 shall be fulfilled.

6.2 Installation of the store

6.2.1 Mounting

The store shall be mounted on the testing stand according to the manufacturer's instructions.

The temperature sensors used for measuring the inlet and outlet temperatures of the fluid used for charging and discharging the storage device, shall be placed as near as possible at least 200 mm to the inlet and outlet connections of the storage device. The installation of the temperature sensors inside the pipes shall be done according to approved methods of measuring temperatures.

If there is/are more than one pair of charging and/or discharging inlet or outlet connections, then only one may be connected to the testing stand (at the same time) while the other(s) shall be closed.

The pipes between the store and the temperature sensors shall be insulated according to EN 12828.

This is a free page sample. Access the full version online.

6.2.2 Connection

The way of connecting the storage device to the testing stand depends on the purpose of the thermal tests which shall be performed. Detailed instructions are given in the clauses where the thermal tests are described.

Connections of the store which do not lead to the charge or discharge circuit of the testing stand shall be closed, and not connected heat exchangers shall be filled up with water. All closed connections shall be insulated in the same way as the store.

Since fluid in closed heat exchangers expands with increasing temperature, a pressure relief valve shall be mounted.

NOTE The performance of a solar heating system depends on the individual installation and actual boundary conditions. With regard to the heat losses of the store besides deficits in the thermal insulation, badly designed connections can increase the heat loss capacity rate of the store due to natural convection that occurs internally in the pipe. In order to avoid this effect, the connections of the pipes should be designed in such a way that no natural convection inside the pipe occurs. This can be achieved if the pipe is directly going downwards after leaving the store or by using a heat trap siphon.

6.3 Test and evaluation procedures

6.3.1 General

The aim of store testing as specified in this document is to determine parameters required for the detailed description of the thermal behaviour of a hot water combistore. Therefore, a mathematical computer model for the store is necessary. The basic requirements on suitable models are specified in Annex A and Annex B.

The following parameters shall be known for the simulation of a store being part of a solar system.

a) Stored water:

   1) height;

   2) effective volume respectively effective thermal capacity;

   3) heights of the inlet and outlet connections;

   4) heat loss capacity rate of the entire store;

   5) if the insulation varies for different heights of the store, the distribution of the heat loss capacity rate should be determined for the different parts of the store;

   6) a parameter describing the degradation of thermal stratification during stand-by;

NOTE 1 One possible way to describe this effect in a store model is the use of a vertical thermal conduction. In this case, the corresponding parameter is an effective vertical thermal conductivity.

   7) a parameter describing the characteristic of thermal stratification during direct discharge;

NOTE 2 An additional parameter may be used to describe the influence of different draw-off flow rates on the thermal stratification inside the store, if this effect is relevant.

   8) positions of the temperature sensors (e.g. the sensors of the collector loop and auxiliary heater control).

SAI GLOBAL

This is a free preview. Purchase the entire publication at the link below:

Product Page

Looking for additional Standards? Visit Intertek Inform Infostore

Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation