Joint European efforts on solar thermal collector standardization and certification

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Abstract

The European project QAIST-"Quality Assurance for Solar thermal heating and cooling technologies", funded by the Intelligent Energy Europe program and by the participating countries, gathers 15 participating organizations including the European Solar Thermal Industry Federation ESTIF and major testing and research institutes in Europe. The objective of the project is to enhance the competitiveness of the European Solar thermal industry and further increase consumer confidence through improved standards and certification schemes, harmonization in testing and certification and a wide dissemination of the quality concept throughout Europe. Global harmonization in collector standards and certification is also on the QAIST agenda and has taken a large step forward through CEN/ISO cooperation and a strong European representation in the new IEA SH&C task 43.

1. Introduction

The European project QAIST-"Quality Assurance for Solar thermal heating and cooling technologies" [1], co-funded by the Intelligent Energy Europe program, gathers 15 participating organizations including the European Solar Thermal Industry Federation ESTIF and major testing and research institutes in Europe. The main objectives of the project is to enhance the competitiveness of the European Solar thermal industry and further increase consumer confidence through improved standards and certification schemes, harmonization in testing and certification and a wide dissemination of the quality concept throughout Europe. QAIST addresses both solar thermal systems and solar thermal collectors, however this paper focuses on the solar collectors.

2. Objectives

The QAIST project builds on work carried out during the past ten years, since the European standards for solar thermal products were first introduced. Research on topics to be covered by future standards was carried out in the NEGST project [2] and a massive experience from collector testing has been

gained in several European laboratories. Furthermore, isolated research efforts are continuously undertaken at many institutes. With respect to solar thermal collectors, the introduction of a European certification scheme; The Solar Keymark has been very successful, now surpassing 1000 licences, the large majority (90%) for collectors and the rest for systems. At the same time a range of new products have been introduced, production has become more industrial and competition is increasing which altogether increases the need for flexibility and ability to support innovation in the certification process and in the underlying standards. A prerequisite for the Solar Keymark certification is that the main product requirements rely on a generally accepted European standard.

One of the main objectives of the QAIST project is therefore to work on an extension of the scope of the collector product standard EN 12975 [3] and to clarify and strengthen the standards' requirements related to durability and reliability. Other main objectives are to:

- Raise interest in further development of EN standards and Solar Keymark in the solar thermal industry
- Increase of the share of quality products in the solar thermal market
- Stimulate the introduction of new collector designs and materials
- Enhance quality assurance and harmonization in European collector testing

A long term objective for the work is furthermore to support the development process towards a global standard for solar thermal collectors, harmonized to the revised EN 12975 that will be an output from the QAIST project.

3. Focus areas and achievements so far for QAIST work on collectors

Work package 2 of the QAIST project, devoted to solar thermal collectors, is subdivided into four parts:

1. Tracking and/or concentrating collectors (mid- temperature collectors) under lead of CENER, Spain

2. Durability testing and assessment of collectors and collector components under lead of Fraunhofer ISE, Germany

3. A guideline to the standard EN 12975 under lead of SP, Sweden

4. A collector performance calculation tool under lead of SP, Sweden

1. and 2. are directly connected to upcoming revisions of the EN 12975 standard, the first planned for 2010/2011 and another one by the end of the QAIST project in 2012/2013. Additional important work tasks in QAIST relating to solar thermal collectors are the globalization efforts through cooperation with ISO/TC 180 and IEA SH&C Task 43 [4], work on CE-marking according to EC Mandate M369 for "Energy capturing appliances" and a Round Robin on collector and system testing involving more than ten European laboratories. Each of these topics is further explained in the following.

3.1 Mid temperature collector performance

The main priority of this work is to make the EN 12975 standard generally applicable to performance testing of all types of solar thermal collectors. In its present form, the standard has primarily been developed with the conventional flat plate collector in mind. As concentrating and tracking designs as well as evacuated tubular collectors (ETC) are becoming more common, the standard must also reflect specific features of these products. A challenge is thereby to achieve as far as possible common assessment methods that can apply to the whole range of products. To a large extent however, only minor adjustments to the standard are required. Work is currently carried out on:

- A review of all known performance test methods with respect to definitions and requirements on test conditions and test equipment.

- A revision proposal with respect to tracking/concentrating collectors. In order to reach a fully generalized methodology (low to high concentration ratios), it has been concluded that the ability to distinguish between performance characteristics related to direct and diffuse irradiance is the key issue. At present this can only be done by applying the quasi dynamic test method, but the aim is to have also the steady state test method open for this feature.

- ETCs with heat pipes, in order to reach a better understanding of thermal capacitance effects and tilt angle dependency.

3.2 Durability and reliability of collectors, components and materials

Also when it comes to durability issues, new designs require new or generalized methods. Even though not representing a new technology, ETCs, as a result of its growing presence in the European market, are receiving major attention in this work, where the collective testing experience and research efforts carried out in parallel are “wrapped up” and revision proposals are being prepared. As an example of the work currently carried out, we can highlight:

- A collaborative effort on exposure testing, where 10 laboratories are performing long term (one year) exposure on different collector types, focusing on ETCs, with performance testing before and after the exposure. The objective is to gain more knowledge about the ageing effects and about the general applicability of the current method. A proposal for a thoroughly revised (shortened) exposure test is under discussion.

- ETCs: vacuum, absorber coating and heat pipes durability is being investigated through experimental work and literature reviews.

- Tracker durability and reliability will essentially not be an issue for the EN 12975 and work will focus on identifying other relevant standards for references inclusion.

Trackers are however to be considered as part of a tracking collector to be performance tested, i.e. it shall be delivered as part of the product by the collector manufacturer and it will thus be subject to a limited functional check during the collector performance testing.

- Mechanical load, impact resistance and rain penetration tests are under intense discussion and some major changes to the current approaches are expected:
    - A “class definition approach” is considered for the two former as natural conditions determining these forces vary within a wide range over Europe. This will enable manufacturers to optimize products for certain regions which will result in lower costs. It will also pave the way for a global harmonization of the standard.
    - Results from impact resistance test using steel ball or ice ball should be quantifiable and thus comparable enabling the class definition approach and hopefully ending discussions on their respective appropriateness. The test will be suggested as mandatory in the standard revision.
    - For determining the results of the rain penetration test there are currently three different methods available and none of them is considered fully appropriate. A completely new approach has been discussed in which rain penetration will form part of a revised outdoor exposure test, to be concluded with the disassembling and final examination of the collector.
- Methods for assessment of materials, e.g. absorber coatings, reflectors or polymer components will not form a part of the EN 12975. Nevertheless it is an important topic for the industry and it will be dealt with in the second half of the QAIST project i.e. 2011-2012. This work will, as in the case of the trackers, mainly consist of identification of the relevant standards for inclusion as references in the EN 12975. The option of opening a new work item under CEN/TC 312 with the aim to develop a specific standard for “Solar collector materials” has also been discussed.

3.3 Introducing the EN 12975 to new laboratories and to collector manufacturers

The guideline to the standard EN 12975 should serve several purposes. A “brochure type” guide will mainly target collector manufacturers. It should give them a very light introduction to the standard, mainly explaining the objectives behind it and how essential parts of the standard can be performed by themselves, as part of the product development. A more extensive document will target existing and new laboratories, namely in new EU member states. The added values for these groups will be the option of having a quick introduction to the comprehensive standard, thus making it easier for new laboratories to get on track. Furthermore, basic descriptions guiding on the choice of methods and in the assessment of test results will support a harmonized application of the standard all over Europe.

3.4 Collector performance calculations

In order to strengthen user confidence in the quality assurance of solar thermal products it is essential that performance test results are understandable and comparable, irrespectively of where in Europe the collectors have been tested. Therefore, a harmonized energy output calculation tool for collectors is developed, to be incorporated in the Solar Keymark scheme rules. The annual energy output figures will be presented with a relevant uncertainty band and the collector model will be extended to tracking and unglazed collectors in its second release.

3.5 International harmonization and CE marking

A specific objective of the QAIST project is to work for a wide implementation of the EN 12975 standard and the Solar Keymark certification scheme. In a global perspective this means that these "products" should preferably form the core of the corresponding global products. Two major achievements in this direction are:

- An agreement between ISO/TC 180 and CEN/TC 312 to work towards a common harmonized standard for collector testing. This work is currently ongoing under CEN lead in working group 1 of CEN/TC 312.
- Key participants of the QAIST project have taken part in the definition work and then joined the newly started IEA SH&C project Task 43 on testing and certification of solar thermal products. An outline of a global certification system for solar thermal products in line with Solar Keymark principles has been developed.

Reacting to a mandate from the European commission (M369), ESTIF have proposed to develop a CE marking on the basis of the construction product directive (CPD) for building mounted solar collectors. This should include fire resistance and structural issues in addition to items already covered in the EN 12975. Additional requirements (which might also affect the standard EN 12975) related to mechanical load and rain penetration tests have recently been discussed as a result of the UK MCS scheme where add on requirements to those of the EN standard have been introduced.

3.5 Miscellaneous

In the ongoing revision of the EN 12975 the following items are furthermore addressed:

- Unglazed collectors, where the test method is reviewed in order to improve the accuracy of performance test results. In a second step the collector model will be extended to also include condensation effects which are important for solar-heat pump systems.

- In an attempt to improve the accuracy of the collector stagnation temperature determination some investigations have been made on the option of calculating the stagnation temperature based on performance test results. Preliminary results show that this is feasible for flat plate collectors but not for ETCs, and the measurement method for the latter will therefore instead be further refined.

- In a first step towards integrating PVT collectors in the Solar Keymark scheme, it will be suggested that the thermal part of a PVT can be assessed for performance using the EN 12975.

4. Conclusions

Since the QAIST project started in June 2009, the following main achievements were made with respect to solar thermal collectors:

- The working group 1 under CEN/TC 312 is now active with the revision of the EN 12975 standard, involving some 25 active participants from 15 countries
- An extensive work plan for the further elaboration of the European standard for solar collectors have been developed taking into account industry needs, experiences from test laboratories and ongoing research
- Global harmonization in collector standards and certification has taken a large step forward through CEN/ISO cooperation and a strong European representation in the new IEA SH&C task 43
- A Round robin (inter laboratory comparison) on collector and system testing has been initiated and is now through the first testing season, involving more than ten European test laboratories

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