

# Latest developments in the field of Solar Thermal standardisation

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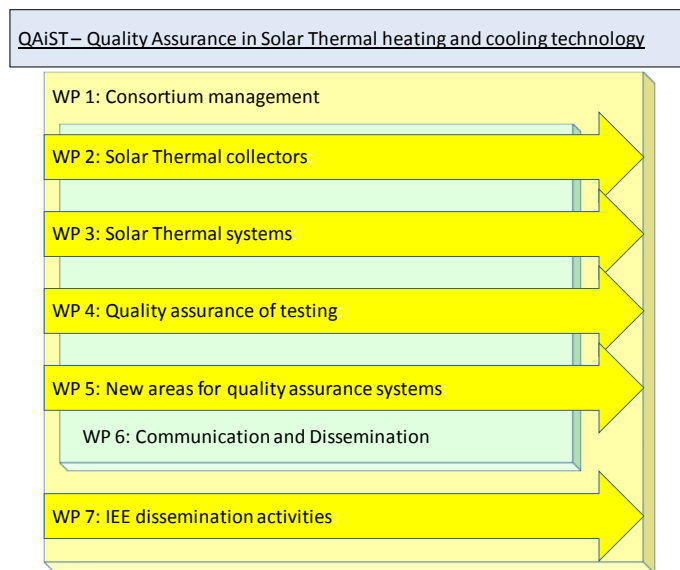
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## Introduction

The European project QAISt-“Quality Assurance in Solar Thermal Heating and Cooling Technology” 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



**Figure 1:** Structure of the QAISt project.

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 IEA SH&C task 43.

The QAISt project is subdivided in 7 work packages

(WP) see Figure 1, however this paper focuses the work packages 2, 3, 4 and 5.

## Solar Thermal Collectors

Work package 2 is dedicated to the Solar Thermal Collectors. The main objectives are:

- Contributions to the revision of EN 12975 Standard (1), (2);
- Global harmonization of collector test standards;
- Development of a calculation tool for collector energy output calculation;
- Development of a guideline to the EN 12975 standard, partly targeting manufacturers, partly test laboratories;

- Developing the framework for CE-marking of collectors in the framework of the European Construction Product Directive according to EC Mandate M369 for “Energy capturing appliances”.

At half way of the QAISt project the progress on these topics is the following:

- A revised EN 12975-1 and 2 has been finalized and is now circulated in a CEN inquiry. Expected date of publication is late 2012. Even though it is not in the scope of the QAISt project, it should be mentioned here that a major contribution to the revision of the EN 12975 standard in the field of air collector testing has been made by Fraunhofer ISE. Until now, air collectors were not at all represented in the standard;
- A new standard for collector materials and components, prEN 12975-3, has been drafted and is now circulated in a CEN inquiry. So far only one part, prEN12975-3-1 “Qualification of solar absorber surface durability” (3) is available, but it is expected that other parts will follow, e.g. durability testing of solar collector heat pipes;
- A revision of the current ISO standard for collector testing, ISO 9806, to be based on the prEN 12975-2 Test methods has been approved by ISO TC 180. Expected date of publication is late 2012;
- The collector energy output calculation tool has been included as an informative part of the prEN 12975-2 and is about to be introduced in the Solar Keymark scheme rules. Annual performance figures for a set of reference locations will thus form part of the Solar Keymark datasheets;
- The EN 12975 guideline is about to be finalized, comprising a small brochure targeting the industry and a more comprehensive PDF document directed to test institutes and laboratories;
- The prEN 12975-1 is about to become a harmonized standard through the introduction of an Annex ZA which will enable CE marking of solar thermal collectors on the basis of the Construction Product Directive (CPD).

## **Solar Thermal Systems**

Work package 3 is dedicated to the Solar Thermal Systems. The main objectives are:

- Contributions to the revision of EN 12976 Standard (4), (5) and future EN 12977 Standard (6), (7), (8), (9);
- Development of an extrapolation procedure applicable to Factory Made systems that can be considered as a “family” of systems;
- Contribution to the procedure for Energy Labelling of Solar Thermal Systems, studying the possibility to use test results according to EN 12976 and future EN 12977 Standard for calculation using “EU Tapping Cycles”;
- Contribution to definition and evaluation of Hot Water Comfort for Solar Thermal Systems (Factory or Custom built systems).

At half way on the QAISt project the progress on these topics is the following:

- The first draft of a revised EN 12976-1 and 2 are available for discussion in CEN TC 312 – WG2;
- Some of the proposals for revision of EN 12976-1 and 2 will also contribute to revision of the future EN 12977, specially part 1 and 2 in order that a parallel

structure is considered in both standards for factory made systems and custom built systems;

- The extrapolation procedure for “family” of Factory Made Systems was already presented to Solar Keymark Network and constitutes Annex D of the Solar Keymark Scheme rules;
- Work on the calculations using “EU tapping cycles” is in progress but final results will only be available by beginning of 2012;
- Work on the definition and evaluation of Hot Water Comfort is in progress but final results will only be available by beginning of 2012.

### **Quality assurance in testing**

To ensure and enhance the quality in testing work package 4 is working in two directions. The first one is to keep the Solar Keymark Network, a committee consisting of certification bodies, test laboratories and solar thermal industry, running. The second one is the Round Robin test on solar thermal collectors and solar thermal systems which is carried out during the years 2010 and 2011.

#### **Round Robin test**

For two different collector types, one flat plate collector and one evacuated tubular collector with CPC reflector, thermal performance tests according to EN 12975-2 (2) are carried out by 12 different test institutes throughout Europe. Two different solar thermal systems, one thermosiphon system and one system with forced circulation are subject to a thermal performance test according to EN 12976-2 (5) and are tested by 9 different test institutes.

For the first time Round Robin tests on solar thermal products are evaluated by an independent institute (Institut für Eignungsprüfung) using the acknowledged procedures for the evaluation of proficiency tests.

#### **Evaluation of Round Robin test**

The results of proficiency tests are assessed with the help of a Z-score that is calculated for each laboratory and each test parameter according to equation 1:

$$Z = \frac{MV_{LAB} - X}{\sigma(n_{IQR})} \quad (\text{eq. 1})$$

$MV_{LAB}$ : Median values of all labs

$X$ : Individual lab result

$\sigma(n_{IQR})$ : Standard deviation of all results

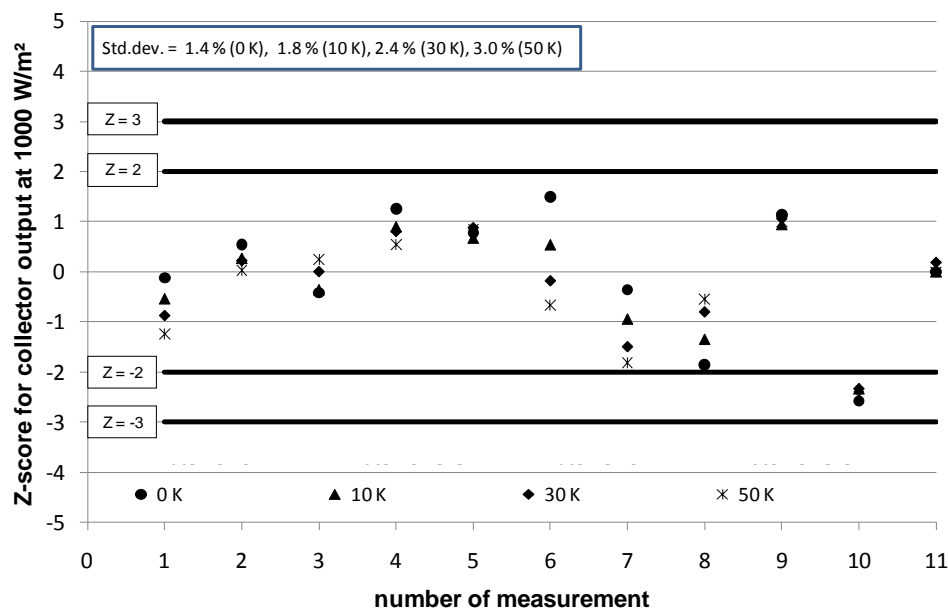
According to ISO/IEC 17043 (10) the following judgements are made:

$|Z| \leq 2$       satisfactory participation

$2 < |Z| < 3$  result questionable

$|Z| \geq 3$       unsatisfactory participation.

Figure 2 shows an example for the presentation of the Z-score.



**Figure 2:** Z-scores of all measurements of the collector output at 1000 W m<sup>-2</sup> for the flat plate collector

At midterm of the ongoing collector Round Robin test the Institut für Eignungsprüfung (IfEP) attested the participants a very good outcome compared to other proficiency tests so far.

### New areas for quality assurance

In recent years, a number of new application areas for solar thermal technology have emerged and/or reached a considerable market presence. Many of them, however, are currently not covered by any standards and thus also lacking a basis for the development and implementation of quality assurance schemes. Within the QAiST project, three such promising application areas were identified:

- Solar thermal and heat pump combined systems;
- Function and yield control for large solar thermal systems;
- Solar cooling systems.

The aim of the work within QAiST Work Package 5 is to prepare a basis for the development of standards and quality assurance methods for these technologies.

*Solar thermal and heat pump systems (SHP):* A number of standards both for heat pumps and for solar thermal systems are readily available. They have been collected for an analysis of possible additions or improvements to satisfy the needs of the combined systems. For that purpose, the information on currently available systems on the market (configuration, intended application and operating condition, used components, etc.) have been collected and analysed. A categorisation of the systems will be elaborated. A proposal for a systematic approach on the performance evaluation figures, as one of the main points in this task, is still under discussion and will be ready until the end of the project. As a number of participants currently develop testing procedures, these will be

described and also used for the evaluation of the standards. All results will be compiled in a publishable deliverable at the end of the project.

*Function and yield control (F&YC) for large solar thermal systems:* The number of installations and the market for large solar thermal systems is developing fast. F&YC can play an important role to ensure a similar trend for the future. However, only a few F&YC products are available on the market at the moment, some are under development. Despite its potential, F&YC as a technology has not yet reached a broad market presence. According to the experts there are two main barriers for the take-up of the technology:

- On the technical level, an effort is still required to push more F&YC concepts from the R&D level to market ready F&YC systems. Building-up of own F&YC experience of all participants involved in that process is needed;
- The needs and views of all stakeholders have to be taken into consideration when developing F&YC systems. The benefits, concerns and workloads with respect to F&YC associated to each player have to be understood and taken into consideration.

Known concepts, both already marketed and under development, have been described in a technical report which will be available as a part of the deliverable at the end of the project. Recently, a proposal for a VDI guideline on “Functional checking and evaluation of gain of solar thermal systems” (11) was published for comments. As the first document of its kind for F&YC technology, it will be discussed within the group as well as the possibility to take it as a basis for future standards. Finally, a workshop aiming at bringing the stakeholders together to discuss the technical and non-technical needs and requirements for a broader usage of F&YC in the large solar thermal systems, as well as existing experiences will be organised. The most important conclusions of the workshop will be collated in a technical report which will also be a part of the final deliverable. Until the end of the project, the aim of initiating the process of making a technology roadmap for F&YC within e.g. RHC platform will be pursued – the output of the workshop will be the basis for future discussions.

*Solar cooling systems:* The goal of the project regarding this technology is to examine the requirements for durability and performance of the installations, whose number is increasing rapidly. For that purpose, technical and operation data were collected for a number of systems, mainly in participating countries. Also data from previous projects were used, such as Solair, IEA SHC Task 38 or FP6 Rococo. The survey yielded first results regarding most common problems in operation. On the basis of this outcome, a structured questionnaire is being developed to address the most critical topics and to try to formulate a set of guidelines for better performance of the systems. These guidelines will take into account the whole lifespan of an installation: planning, commissioning and operation. Further, information about the current activities on the development of testing and rating methods from other activities (UEA SHC Task 38, IEA HPP Annex 34 etc.) will be gathered and summarised in a technical report together with an overview of standards related to solar cooling technologies.

## Conclusion

Within the European QAI-ST project work has been done to revise the existing European Standards EN 12975, EN 12976 and EN 12977. The work done, especially for solar thermal collectors, is a big step towards a global test standard for solar thermal collectors. Hence it is most likely that we will have a joined EN/ISO standard 12975/9806 respectively by the end of 2012. This standard will, apart from general revisions, include solar air collectors. In addition CE-marking according to the Construction Products Directive will be possible.

The quality assurance in testing is enhanced by a well working Solar Keymark network and the ongoing Round Robin test for solar thermal collectors and solar thermal systems. Finally, first steps towards the development of standards and quality assurance methods for emerging solar thermal applications are being undertaken. The outcome of this work will be continued in ongoing (e.g. IEA SHC Task 44 / HPP Annex 38, joint WG of CEN/TC113 and CEN/TC312 for SHP systems) international activities and also activities which are in the definition phase (e.g. IEA SHC Task 48 for solar cooling systems).

## References

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