Testing process heat collectors – an overview on methodologies and categories

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Abstract

The paper sums up the latest developments in the standardization work on concentrating solar thermal collectors, especially focused on the CEN technical committee 312 working group 1 (CEN/TC 312 WG 1) [2]. Also the ongoing work with Standard 600 [1] for concentrating collectors on the North-American side is discussed. The paper sorts the workflow towards a solution for concentrating collectors so far and shows differences is the structural approaches. The paper does not discuss in detail the differences in different technical methodologies to characterize the thermal performance of collectors. Finally it opens up the discussion for the categorization and the differentiation which could be a possible sound solution.

Keywords: Testing, concentrating collectors, labeling, certification, standards

1. Introduction

Testing concentrating collectors is more and more in the focus of professionals in the solar thermal community, both the low temperature part and the high temperature part (e.g. concentrating solar power, CSP). The basic problem is, that there is not a detailed definition how to test products which are different from standard collectors, for which well established test procedures are available for years. So the question is what are these differences all about? Can the existing standards be applied to these kinds of products? If not what different methodology could be applied? How to categorize these products?

To answer those questions for a technology many aspects have to be taken into consideration. Economic perspectives, the perspective of quality assurance and labeling, the technical point of view and even a macro-economic view are relevant for the complete interacting design of regulations, rules, certificates, standards and maybe policy instruments.

The following paper will not be able to clarify all these questions and for sure not to discuss all the different points of view, but it will raise questions and tries to give the status quo in regards with standardization work and labeling schemes and maybe also can help to identify who could be the ones to bring forward a sound solution to the problems and market barriers of these kind of collector systems.

2. The existing standards for solar thermal testing

Important if one talks about testing is surly that testing and better characterising is not limited to performance criteria at all. A very important part is the reliable function of the products in every situation and the long-life durability. So the following table provides an overview on different standards, the status they are in and the testing they comprise.

Tab. 1: Overview on testing standards dealing with concentrating collectors or not.[1]

State	Title	Performance Test	Function Tests
Published April 2010	SRCC Standard 600	According to EN 12975 quasi-dynamic method (QDM)	
Published 2011	EN 12975-1,2:2006 +A1:2010	Testing of concentrating collectors possible	
Public inquiry in 2011	EN 12975-1,2:2012, will become most likely an CEN/ISO standard	Applicable, Annex defines extra guidelines for testing of concentrating and tracking collectors	
Published 2007	AS/NZS 2712:2007 AS/NZS 2535.1:2007	AS/NZS 2535.1:2007 includes reference to ISO 9806:1994 (**not** applicable for concentrating collectors)	AS/NZS 2712:2007 Basically applicable for tracking systems 
Public inquiry until 02/2011	CSA F378.1	Applicable if $\vartheta > 60°$ otherwise ISO 9806:1994 valid (**not** applicable for concentrating collectors)	
Ongoing work	AENOR (Spanish standardization institute)	Component testing (e.g. mirror properties)	Component testing (e.g. mechanical strength)
Request	New work item, request handed in at DKE		
Future ~2014	CEN-ISO	Strongly influenced by EN	Combination of different international standards

2.1. Standard 600

The standard 600 is developed by a group of professionals from mostly the north-American region to test concentrating solar collectors. It cites the quasi-dynamic method from EN 12975 (2006) for the efficiency parameters [1]. It also adds some of the durability test actually based on ISO 9806 (1995).

2.2. EN 12975

The standard EN 12975 has been revised in the recent times several times, always to be adapted to the latest developments in both collector technologies and testing procedures and achievable accuracies. Besides that it is still under revision, it had an amendment accepted just in 2011. The amendment opened up the possibility to apply as far as possible the standard procedures to concentrating collectors. Still of course a lot of things could not be taken into account with this amendment, but will be with the revision of the standard which will be published in 2012 eventually. The idea behind is to do not let fall apart all different solar thermal technologies by generating several side-by-side standards, because this will open up the marked for confusion, impossibility of inter-comparison and the never-ending arguing of what is the right choice of testing conditions. Most likely later on or maybe even simultaneously a definition process for quality or

[1] The icons used are explained in chapter 6

energy labels will take place. There is of course already a very well established quality label for solar thermal products and components – the Solar Keymark, but for sure new questions rising with including these new kind of products will be to solve. In the revision of EN 12975 the gap for especially collectors to produce heat for low, or medium or medium-high temperatures is covered. It includes air as a heat transfer fluid as well as water, and basically also other fluids. It will have three parts:

Part 1: Requirements for solar thermal collectors

Part 2: Testing methods for solar thermal collectors

Part 3: Testing methods for solar thermal components

Part 3.1. Testing methods for solar absorber coatings

So the structure is provided to enlarge the component part of the standard with every new revision as soon as the industrial group of each of those is ready with it.

There is of course one very special need for bigger installations like parabolic thoughts or dish or linear Fresnel collectors, where a testing as a complete collector at a testing institute is not reasonable. For these kind of collectors an in-situ methodology may be a sound solution. This has to be developed carefully to have results from these tests which are comparable and reliable. Of course all the needs from the point of view of accreditation and quality assurance of the equipment, then used locally at the collectors site have to be adjusted. So there is still a lot to clarify and define, but this would fit perfectly in the work of CEN/TC 312 WG 1 and could be part 4 of EN 12975.

The work on the revision of EN 12975 is not only limited to the European countries. Because of the joint idea of a common global standard which applies the same methodologies and varies the conditions to fulfill local requirements, there has been established an IEA Task 43 “Global Rating and Certification for Solar thermal Products”. This group is working towards a global certification scheme based on an international standard, the mentioned CEN/ISO standard. The other standards mentioned above do not include concentrating collectors yet.

3. DKE TC - a new approach

Very recently a new work item was applied for by a subcommittee of DKE (German Electricity Community on Standardization). This application is still under approval, as it might interfere with the work items of existing standardization committees. This would be most in-efficient of course and is therefor blocked with in the exchange of DIN and DKE. So right now it is not exactly clear if there will be a new group working in parallel on the issues of standardization adjustment or the new experts from behind this group join forces with the DIN, CEN or ISO committees for solar thermal energy. This will be surly clarified within the next months.

4. Related Project

Different projects are recently paving the way to realize this enormous goal. One of the most important is the project QAiST (Quality Assurance in Solar Thermal Heating and Cooling Technology) founded by the IEE. The project deals with a wide range and variety of new products and up-coming technologies and normative questions how to include them into the existing structures. More interesting information can be found on www.qaist.org. A new IEA Task on the topics of industrial process heat collectors will be established soon as well, which will provide more and more elaborated knowledge on the testing issues for concentrating collectors. The Solar Paces as well has worked on this issue for quite a while and this information could be included as well.

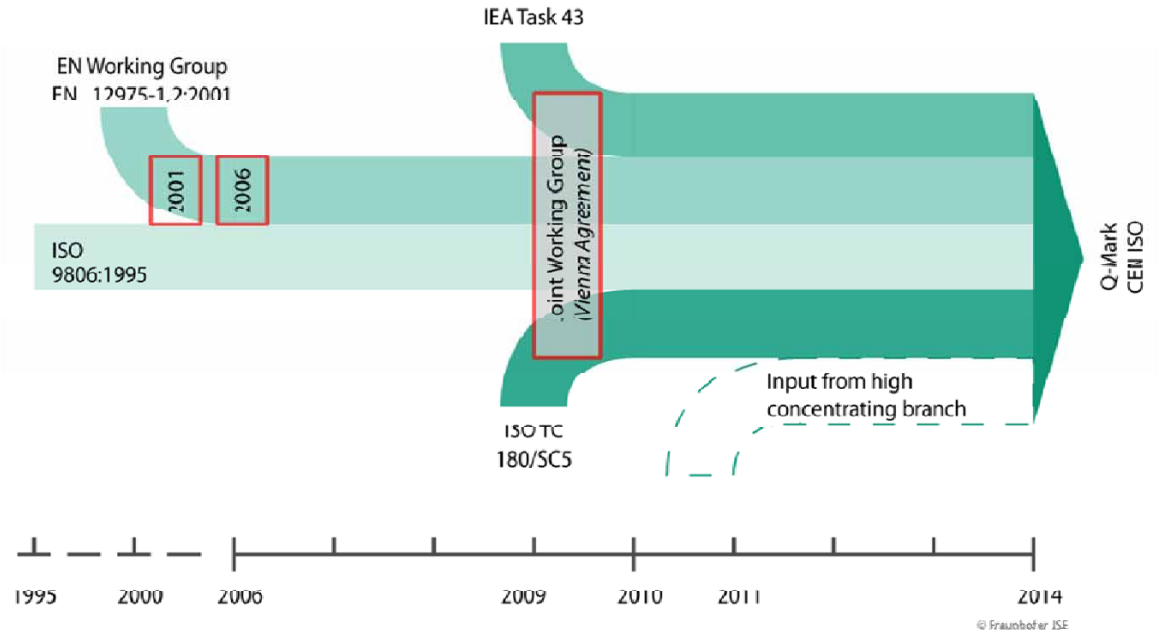

Fig. 1: Streams of information coming together for the CEN-ISO standard

5. Conclusion

There are still more efforts needed to find a sound solution to all these aspects. The theme is one of the most important for the solar thermal branch because it will define the starting point of technology characterization. All judgments, all rent ability calculations all intra industrial inter-comparisons will be based on the efficiency results of this standard methodology.

On the other hand it is as well a big chance to bring together experiences from labeling, certification and testing and standards-design from the low-temperature solar thermal group and the experiences with big single projects and financial invest from the CSP group.

Bridging the gap from no standard to applying the existing standards wisely, can help to show the potential of concentrating solar collectors until a perfect suited solution also for the big installations is available.

6. Used Icons and their meaning

Table 1; Overview and explanation of the used icons ©Fraunhofer ISE.

Icon	Name of the test	Description
	Time Constant	Measured determination of the time constant of the collector describing the inert time the collector has after applying a thermal impulse
	Static Pressure test	Pass/Fail test on the resistance of the collectors hydraulic layout against 1.5 times the maximum operation pressure

	Heat Resistance test	Visual check, if any deformations damage or aging appears after a defined radiation/temperature set-up procedure
	Exposure test	Visual check, if any deformations damage or aging appears after a defined exposition
	External thermal Shock test	Pass/Fail test on the resistance of a hot collector towards a sudden cold water spray
	Internal Thermal Shock test	Pass/Fail test on the resistance of a hot collector towards a sudden cold water flux
	Rain Resistance test	Pass/Fail test on the ability of a collector to handle humidity caused by rain
	Mechanical load test	Pass/Fail test on the resistance of mechanical loads (wind/snow)
	Frost Resistance test	Pass/Fail test on the resistance of a collector against damage caused by frost
	Stagnation temperature	Determination of the so called stagnation temperature, defined as maximum temperature under specific test conditions
	Impact Resistance test	Pass/Fail test on the resistance of a collector against damage caused by impact (hail, tools, birds…)
	Pressure drop	Determination of the pressure drop over the complete collectors hydraulic layout
	Final inspection	Visual Chek-up on material damage, deformation other functional failures by opening up the collector, findings documented and rated

7. References

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