TASK 43:
Solar Rating and Certification Procedures - Advanced Solar Thermal Testing and Characterization for Certification of Collectors and Systems

Annex Text
July 2009

ANNEX 43
Solar Rating and Certification Procedures - Advanced Solar Thermal Testing and Characterization for Certification of Collectors and Systems

1. Description of Technical Sector

The testing and characterization of solar thermal systems and components have been investigated from the inception of the IEA Solar Heating & Cooling Programme.[1, 2] Performance test procedures and characterization equations were originally developed for typical solar collector types under well-defined standard test conditions. In addition, short-term tests were developed to predict the long-term durability of standard collectors and systems. Presently, national and international test laboratories in many IEA participant countries use these test procedures and characterization equations in order to determine a solar thermal product's performance and compliance with required safety and reliability standards. Based on the test certificates issued by accepted test laboratories the products are certified by certification bodies. In order to assess and compare solar thermal systems and components, appropriate procedures are required. These procedures should account for aspects like thermal performance, the provided comfort and the environmental impact.

However, new and advanced solar thermal products are continually being introduced to the marketplace and are being submitted to national certification bodies. The existing testing and characterization procedures do not always accommodate these new products or allow them to be evaluated in a reasonable and consistent manner. This has caused the manufacturers of some of these advanced products to believe that they are being unfairly barred from participating in certain markets and their related incentive programs.

An additional important point in testing and characterization of solar thermal collectors and systems is the assessment of the environmental impact. Up to now, no uniform methodology for life cycle assessment exists which is acknowledged or used by all countries. As there exists many different assessment criteria (e.g. carbon footprint, global warming potential, cumulative energy demand, energy payback time, energy gain over lifespan...) it is necessary to investigate the most appropriate criteria for solar thermal systems. With these criteria a uniform assessment methodology has to be developed.

A relevant figure in this environmental assessment has proved to be the energy gain during the entire lifespan. However, degradation that reduces energy gain over time must be considered. To determine the performance degradation of solar collectors or systems respectively, accelerated aging tests have to be applied in order to predict performance reduction. A proposed accelerated aging test based on the influence of high temperature has already been developed in IEA-SHC Task X[3]. These tests already form a basis for further development of accelerated aging procedures.

In addition to the treatment of advanced solar thermal products, new qualification test procedures have also been developed for exposure of all types of solar thermal products to

[1] IEA-SHC || Task 01, "Investigation of the Performance of Solar Heating and Cooling Systems," 1977-1983
[2] IEA-SHC || Task 03, "Performance Testing of Solar Collectors," 1977-1987
[3] IEA-SHC || Task X, "Solar Materials R&D," 1985-1991

extreme environmental conditions, e.g., hurricane-force wind loads[4] and hail storms[5]. While these test procedures are useful in some IEA participant countries, they have not yet all been internationally vetted and agreed upon.

An example of another advanced solar thermal testing and characterization issue is unglazed polymer collectors that are now being used in drainback water heating systems. While the unglazed collectors may have been tested according to ISO 9806 – Part 3 or EN 12975-2, the wind dependence of the collector performance is not entirely accounted for in the current characterization equations. This may be of small importance when the unglazed collectors are being used to heat water to swimming pool temperatures, but it becomes a much greater factor when they are being used in domestic water heating systems.

Finally, as more advanced solar thermal products are being submitted for testing and certification, it has been suggested that conventional flat-plate collectors no longer need to be tested, but rather can be characterized by modeling based upon their measured material properties. A variation on this idea is to test only for a limited amount of data (e.g., the optical efficiency), and then model the loss coefficient.[6] While these ideas would certainly relieve some of the burden from testing laboratories, they have yet to be validated empirically and would have to be accepted by certification bodies.

2. Coordination with Other Programmes

The work in this task will be closely coordinated and shared with other groups and organizations involved in testing and certification. Some of the significant areas for coordination include the results of recent CEN/TC 312 meetings which created a resolution regarding revision of EN12975-1 and 2 and implementation of M/369 which recommended:

- work on unglazed collectors to refine performance test conditions and prediction and improve sky temperature measurement;
- requirements and test methods for collector components;
- quality tests for evacuated tubes;
- improved exposure—accelerated ageing tests of collectors;
- annual energy output.

Action on the resolution will be considered in order to avoid duplication of effort and to leverage other work. ISO/TC180 is also considering progress made in Europe over the last decade and their relevance to updating ISO 9806.

Two current IEA SHC tasks are investigating solar thermal testing and characterization procedures that relate directly to their tasks[7, 8]. Their findings on these testing issues and success in harmonizing test procedures internationally will determine the extent to which this task carries on with some of their work. An example of an issue with polymer collectors is the multiple-day exposure requirement for solar collectors which submits polymer-based collectors to dry stagnation, even if the system they are part of would always be operated in a

[4] Florida Building Code, Miami-Dade Product Approval, TAS-202 "Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure"
[5] Standards Australia AS 2712, "Design and Construction," Appendix C, "Hail resistance test"
[6] Klein, S.A. et al, "Alternative Methods for Performance Testing of Solar Thermal Collectors," Proceedings – Solar 2007, American Solar Energy Society, Boulder, Colorado, USA. Background papers at: http://sel.me.wisc.edu/research/coltest.html
[7] IEA SHC Task 35 "PV/Thermal Solar Systems"
[8] IEA-SHC || Task 39 - Polymeric Materials for Solar Thermal Applications

wet condition.[9] Yet a polymer-based thermosiphon system is not typically subjected to dry stagnation, even though it may also contain polymer-based solar collectors.

Task 23, SolarPACES and Task 36 on Solar Resource Knowledge Management also address testing standards and issues in testing and certification that will be incorporated into the work in Task 43.

The New Generation of Solar Thermal Systems (NEGST) group has also offered recommendations and analysis directly related to these subtasks addressing:

- collector components (absorber surface durability, polymeric materials, quality testing of reflector materials and anti-reflective coatings),
- collectors (performance and quality testing of evacuated tubes, exposure testing, flow rate and flow distribution in flat plate collector tests, uncovered collectors, performance testing of air collectors, IAM determination and application of present standards to tracking and concentrating collectors)
- Storage/controller/system standards (parameter identification, principles and concepts to apply in developing store test methods, simulation models and test methods for stores with external heat exchanger, controllers, combi-systems, cooling)
- Solar fluids
- Life-Cycle Assessment

Alanod, a major supplier of materials and components for concentrating systems, convened a meeting on September 11, 2008 to discuss protocols for concentrating solar thermal collector testing. The group identified a set of issues and problems in concentrating collector testing as well as proposed solutions. The members agreed to continue exchanging information and ideas, and to work on a final proposal for modifications in testing protocols that will be as close to existing European standards as possible. This group included:

- ALANOD: Stefan Brändle +Harald Kuester+Wolfang Peters
- DLR: Eckhard Lüpfert + Björn Schirike
- SPF: Stefan Brunold
- ARSENAL Research: Josef Buchinger
- CENER: Enric Mateu Serrats+ Fabienne Sallaberry
- ITW: Stefan Fischer
- ISE Fraunhofer: Stephan Hess
- PSA: Eduardo Zarza
- INETI/AO SOL: Manuel Collares-Pereira
- Other institutions and persons invited and not able to be present
- ISE. Mathias Rommel
- ITC Canarias: Privero
- TUV: Ulrich Fritsch

3. Purpose and Objectives

The task shall focus on research activities and not interfere with standardization bodies. Standardization bodies need the results of research and, under participation of the market actors work out the way the research results shall be applied to products. Communication and dissemination of results will include the legal authorities which define how certification shall be run, for use as they see fit. This proposed international collaboration will research and

[9] http://www.iea-shc.org/task39/newsletters/2007-11.pdf

develop, where needed, new test procedures and characterization methods for addressing the testing of both conventional and advanced solar thermal products. It will leverage the knowledge from existing Tasks/Technical Committees/Certification Groups as a base for the development of work, inviting these groups to participate. By researching testing issues and improved approaches the outputs of this task can help optimize the time and resources companies, laboratories and certification bodies expend on testing and certification; while still assuring consumer protection and providing credible information on solar heating and cooling benefits. The scope of this proposed task includes performance testing and characterization, qualification testing, environmental impact assessment, accelerated aging tests, numerical and analytical modelling, component substitution procedures, and entire system assessment.

4. Means

Two main subtasks are planned for this task, each with more specific activities designed to accomplish the purpose and objectives of the overall task. The main subtasks and their objectives are:

Subtask A: Collectors. The objective of this subtask is to examine existing testing and certification procedures for low-temperature evacuated tube and flat-plate collectors, air heating collectors, medium- to high-temperature concentrating collectors, to identify weaknesses, inconsistencies in application, and significant gaps. The research will result in new or improved tests that can be communicated to ISO/TC 180 for consideration in updating old standards or developing new standards. Results will be promoted to certification bodies when they are relevant for consideration in how product certification is implemented. Methods include round robin tests to refine existing test procedures, in cooperation with researchers, industry and certification bodies involved in these technologies. The task will also establish ongoing information dissemination and communications to provide necessary information and feedback among participants, industry, and certification bodies to promote harmonized standards and coordination among certification bodies.

Subtask B: Systems. The objective of this subtask is to examine existing testing procedures for entire systems and identify weaknesses, inconsistencies in application, and significant gaps. Testing research will investigate component/material substitution issues, including implications for qualification and safety testing. System performance characterization, testing, simulation and modelling and extrapolation will be investigated to help clarify key issues including accelerated aging testing and performance prediction. The research will extend to analyzing how system testing and performance characterization results can be applied to analysis and public dissemination of public benefit indictors, including environmental, economic, energy and occupant comfort indicators for solar thermal systems. Where appropriate, research results that have implications for testing standards will be communicated to ISO/TC 180 and/or certification bodies to consider. Methods will include round robin tests to refine existing test procedures, in cooperation with researchers, industry and testing bodies involved in these technologies. The task will also establish ongoing information dissemination and communications to provide necessary information and feedback among participants, industry, and certification bodies to promote harmonized standards and procedures.

Major Activities for Subtask A: Collectors. The activities in this subtask are intended to produce research results that can inform participants, industry, testing labs and certification bodies with new information on testing that will promote harmonized testing and

certification.

***Activity A.1 – Roadmap of Collector Testing and Certification Issues*:** Develop a roadmap on existing collector testing processes to serve as a guide to how tests and standards are applied and how they relate to certification, and to identify gaps, inconsistencies and weaknesses along with approaches to addressing problems. Develop recommendations for improving the system for emerging technologies where standards and testing are under development, for example by exploring the possibility of "provisional" or "light" certifications based on Technical Specifications rather than final CEN or ISO standards.

Activity A.2 – Low-to-Medium Temperate Collector Test Procedures, Standards and Simulation: Based on priorities and issues developed in Activity 1, this task will analyze current issues in flat plate and evacuated tube collector testing and certification and initiate worldwide round-robin tests to identify variations and problems in procedures. Issues the teams will consider for research will include but not be limited to:

- wind speed dependence and comparability of ratings when tested at different wind speeds,
- whether infrared effects explain some of the variations in outdoor and indoor testing (note that the Germans use a "cold baffle"- two glazings with cool air passing between; this will be very useful to see what the bias is in their testing, versus FSEC/Bodycote that do not attempt to alter the IR flux), and
- how the most recent changes in the EN12975 series of standards apply to these issues. The research will also involve a comparative analysis of how standards are applied in different countries and whether there are inconsistencies or differences that should be resolved to promote harmonization of standards and certification.

Where appropriate researchers will review component test simulation tools to identify any issues in their application to current SHC technology and opportunities to adapt to new applications. CTSS, Dynamic System Test, Input-Output, and recent regression modelling results for using measured data to determine parameters in models will be investigated. Research testing and measurement standards will be considered to identify conditions used in ratings, and share information needed to promote harmonization across participating countries.

Researchers will review current laboratory approaches to qualification and safety testing to identify inconsistencies, gaps, and problems specific to low- to medium-temperature collectors. Research will also examine the implications of component/material substitution on performance and lifetime and characterize key components. Based on the results researchers will develop recommendations for research or improved practices to resolve issues. Topics may include but will not be limited to:

- Hail testing (incident angles, ice vs. steel balls, type/handling of ice [clear, opaque, cracks,…], test to failure approaches) and moisture, differences in testing related to different types of collectors.
- Determining whether quality ratings and degradation estimates are feasible based on tests and their implications for system life, lifetime performance, reliability and warranties.
- Mounting structures; lightning protection, working fluids and other topics raised by growing installations in varied locations, and will address what is appropriately addressed in component and system testing and certification versus building codes and installer responsibility.

- Component and material substitution and how it is addressed in testing and standards, including when substitutions should be considered significant enough to require new testing and standards. For example with change in glass thickness from 4 to 3.2 mm, substituting thicker aluminium for copper on absorber fins, fin bonds going from fused to mechanical. Heat transfer fluids are also an issue, for example in the U.S. heat transfer fluids in systems with single-wall heat exchangers must be certified by the Food and Drug Administration (FDA) as food-grade, while in Europe standards are different.

Activity A.3 – Air Heating Collector Test Procedures, Standards and Simulation: Based on priorities and issues developed in Activity 1, for closed loop collectors this task will examine common practices for testing and certification of existing collectors as applied by Bodycote, Fraunhofer ISE and others (5 collectors already certified by SRCC using ASHRAE, 3 tested by ISE using modified EN12975) to identify issues in ASHRAE 93/96, how collectors are certified by SRCC, Solar Keymark and Australia.

For open loop collectors research will examine common practices for testing and certification of existing collectors as applied by Bodycote and others, and research at NREL and other labs. Work will be coordinated with SRCC to apply results where they are appropriate for equipment certifications which are in process.

Work on both open and close-loop collectors is expected to include but is not limited to:

- Examining how growing markets would benefit from more information on performance and better tests.
- Characterizing issues involved in passive/active building integration of systems.
- Studying test procedures and promoting round-robin tests, recommending changes in requirements and certification schema for different types of collectors as needed.

Where appropriate researchers will review component test simulation tools to identify any issues in their application to current SHC technology and opportunities to adapt to new applications. CTSS, Dynamic System Test, Input-Output, and recent regression modelling results for using measured data to determine parameters in models will be investigated. Research testing and measurement standards will be considered to identify conditions used in ratings, and share information needed to promote harmonization across participating countries.

Researchers will review current laboratory approaches to qualification and safety testing to identify inconsistencies, gaps, and problems specific to air heating collectors. Research will also examine the implications of component/material substitution on performance and lifetime and characterize key components. Based on the results researchers will develop recommendations for research or improved practices to resolve issues. Topics may include but will not be limited to:

- Hail testing (incident angles, ice vs. steel balls, type/handling of ice [clear, opaque, cracks,…], test to failure approaches) and moisture, differences in testing related to different types of collectors.
- Determining whether quality ratings and degradation estimates are feasible based on tests and their implications for system life, lifetime performance, reliability and warranties.
- Mounting structures; lightning protection, working fluids and other topics raised by growing installations in varied locations, and will address what is appropriately

addressed in component and system testing and certification versus building codes and installer responsibility.
- Component and material substitution and how it is addressed in testing and standards, including when substitutions should be considered significant enough to require new testing and standards.

Activity A.4 – Concentrator Collector Test Procedures, Standards and Simulation:
Convene active parties (either virtually or face-to-face) engaged in Alanod meeting, IEA research, and recently formed SRCC standards subcommittee to develop improved methods for measurement, characterization and testing to coordinate efforts, characterize strengths and weaknesses of existing approaches embodied in ASTM905 efficiency test methods.

Research current approaches and develop new procedures and standards as needed for in-situ testing of large collectors, for example placement and calibration of environmental monitoring, time periods for collection, approaches to normalizing and extrapolating data, etc. CEN/TC 312 meetings created a resolution regarding revision of EN12975-1 and 2 and implementation of M/369 recommended clarifying how present standards apply to tracking and/or concentrating collectors. Action on the resolution will be considered in order to avoid duplication of effort and to leverage other work.

Assess applicable research conducted on fresnel, linear, dish, fixed mirror, and other novel configurations (e.g, fixed receiver, either line or point) conducted in Europe, Australia, and U.S. (including for CSP) to determine their applicability to measurement and testing needs of solar thermal products.

Conduct a review of component test simulation tools to identify any issues in their application to current SHC technology and opportunities to adapt to new applications. Research testing and measurement standards to identify conditions used in ratings, and share information needed to promote harmonization across participating countries.

Researchers will review current laboratory approaches to qualification and safety testing to identify inconsistencies, gaps, and problems for concentrating collectors. Research will also examine the implications of component/material substitution on performance and lifetime and characterize key components. Based on the results researchers will develop recommendations for research or improved practices to resolve issues. Topics may include but will not be limited to:
- Hail testing (incident angles, ice vs. steel balls, type/handling of ice [clear, opaque, cracks,…], test to failure approaches) and moisture, differences in testing related to different types of collectors.
- Determining whether quality ratings and degradation estimates are feasible based on tests and their implications for system life, lifetime performance, reliability and warranties.
- Mounting structures; lightning protection, working fluids and other topics raised by growing installations in varied locations, and will address what is appropriately addressed in component and system testing and certification versus building codes and installer responsibility.
- Component and material substitution and how it is addressed in testing and standards, including when substitutions should be considered significant enough to require new testing and standards.

Activity A.5 – Communication and Adoption of Results: In coordination with Subtask B, develop efficient means of communication for the results of the overall task including the Internet, promotion of web conferences and meetings, and other tools identified in the course of the task.

- Identify existing groups working in the subject of technology, testing and standardization and establish links with these groups to engage them in communications and harmonization effort.
- Develop a communication plan for the target audiences that draws on the current IEA-SHC communication plan to further target industry, standards and certification bodies, testing laboratories, and other supporting organizations.
- Prepare and maintain a web page that includes work in progress in addition to final deliverables for projects with implications for testing and standardization, with material open to outside groups or limited to participants as appropriate.
- Establish an alert system for information on relevant data from IEA tasks, TC standardization groups, and certification bodies (Solar Keymark, SRCC, Office of Australian Renewable Energy Regulator) to actively notify interested parties of developments rather than relying on their searching for the information.
- Establish a regular forum for participants and outside persons to pose questions or make suggestions regarding testing processes so that developers of new technologies have an entry point into the testing process, and existing technology practitioners have a place to raise questions or provide input.
- Actively recruit participation from other countries including China and India either as direct participants in research or as observers. Organize joint meetings in conjunction with Solar Keymark networking or other events (Standardization Technical Committee meetings) to promote ongoing action to harmonize standards, testing and certification. Organize more meetings with broad international appeal and dispersed locations like ISES meetings. Work to make standards and testing a distinct track in larger meetings where researchers in this task can be involved as individuals in standards development.

Major Activities for Subtask B Systems Testing and Characterization: The activities and projects in this subtask examine testing and certification procedures for systems. By examining current practices, weaknesses in existing methods can be identified and improved, gaps in existing methods and processes can be identified and redressed, and inconsistencies in the application of existing methods and processes can be reduced by sharing information and promoting harmonization of procedures. One of the objectives will be a more sound, well-documented and widely adopted set of procedures for estimating the environmental, energy and economic impacts of solar thermal systems over their lifetimes. Another objective will be a more sound, well-documented and widely adopted set of procedures for understanding how system design and components interact with buildings and other equipment in delivering reliable and comfortable space conditioning, reliable hot water, energy surety, and other indicators of solar thermal value to end-users.

Activity B.1 – Roadmapping of Systems Issues: Convene a meeting of experts to discuss issues and define research needs in more detail. Conduct research to define the limits/boundaries of solar thermal systems within the context of building integration, what is the solar thermal system in the contexts of storage, cooling, heating. Work will also consider how systems should be defined for incentive programs; characterizing quantity and quality of heat; and appropriate parameters for due diligence assessments for larger custom systems. Investigate ranges of tolerance/acceptable uncertainty in performance and/or define bands of

acceptability for performance. Examine existing performance testing and research applied to systems and promote round robin tests to investigate variations in practices and procedures and their impact on test results, for example for passive systems where there are problems in producing comparable results for separable thermosiphon systems versus ICS and non-separable thermosiphon systems.

Activity B.2 –Component/Material Substitution, Qualification and Safety Testing: Research how component and material substitution should be addressed in testing and standards, including when substitutions should be considered significant enough to require new testing and standards. For example, the substitution of Grundfos pumps for Wilo pumps, or substitutions of different storage components.

Research how to extrapolate changes within a model line. For example, how to treat changes in the size and or number of collectors even though their "construction" is identical, or tank volume changes (with the same stratification devices if any are used). There has been work on procedures that use a complex mapping of solar fraction vs area/volume by simulation, with variations for climate, draw volume, and other factors. Another approach is to "test at extremes" and interpolate. Examining various approaches and determining their strengths and weaknesses will provide laboratories, industry and certification bodies with better, more standardized approaches to deal with sizing issues.

Survey current laboratory approaches to qualification testing and how they relate to systems to identify inconsistencies, gaps, and problems. Develop recommendations for research or improved practices to resolve issues, building on the base of experience developed in collector testing.

Investigate (with input from test laboratories, industry and certification bodies) whether quality ratings and degradation estimates for whole systems are feasible based on tests and their implications for system life, lifetime performance, reliability and warranties. Determine to what extent individual collector and component testing can be aggregated into whole system predictions of lifetime, performance, and reliability.

Survey current practices for safety-related testing and certification to identify issues, including lightning protection, over-temperature protection, and other factors raised by growing installations in varied locations, and address what issues are best considered in component and system testing and certification versus building codes and installer responsibility.

Activity B.3 – Simulation and Modelling: Conduct a review of component test simulation tools to identify any issues in their application to current SHC technology, opportunities to adapt to new applications, and issues in applying them to systems analysis. CTSS, Dynamic System Test, Input-Output, and recent regression modelling results for using measured data to determine parameters in models will be investigated. Research testing and measurement standards applied to combi-systems, identify conditions used in ratings, and share information needed to create/apply common methods across participating countries.

Activity B.4 – Analysis and Public Dissemination of Benefit Indicators: Examine value and application of test results to quantify environmental benefits including carbon footprint, lifecycle disposal and recycling issues, energy payback calculations, and others suggested in the course of research. Recommend further research in areas where benefits estimates are

inadequately supported by testing and characterization efforts, and recommend improvements that could strengthen the technical basis for benefits estimates. Although these benefits measures depend on basic performance information, there are questions concerning how well current measures support these benefits estimates and how the scientific basis for them could be improved to help industry gain public and policy support.

Examine the relation between test and characterization information and consumer perceptions of issues such as "comfort" to identify areas where existing test and measurement data are inadequate for quantifying these factors. An example would be the differences users sense between hydronic, forced-air and radiant space conditioning systems and how solar systems perform in these different applications. Related performance issues that go beyond thermal performance include reliability and security of systems and ability to cover loads.

Activity B.5 – Communication and Outreach Coordination: In coordination with Subtask A, develop efficient means of communication for the results of the overall task including the Internet, promotion of web conferences and meetings, and other tools identified in the course of the task.

- Identify existing groups working in the subject of technology, testing and standardization and establish links with these groups to engage them in communications and harmonization effort.
- Develop a communication plan for the target audiences that draws on the current IEA-SHC communication plan to further target industry, standards and certification bodies, testing laboratories, and other supporting organizations.
- Prepare and maintain a web page that includes work in progress in addition to final deliverables for projects with implications for testing and standardization, with material open to outside groups or limited to participants as appropriate.
- Establish an alert system for information on relevant data from IEA tasks, TC standardization groups, and certification bodies (Solar Keymark, SRCC, Office of Australian Renewable Energy Regulator) to actively notify interested parties of developments rather than relying on their searching for the information.
- Establish a regular forum for participants and outside persons to pose questions or make suggestions regarding testing processes so that developers of new technologies have an entry point into the testing process, and existing technology practitioners have a place to raise questions or provide input.
- Actively recruit participation from other countries including China and India either as direct participants in research or as observers. Organize joint meetings in conjunction with Solar Keymark networking or other events (Standardization Technical Committee meetings) to promote ongoing action to harmonize standards, testing and certification. Organize more meetings with broad international appeal and dispersed locations like ISES meetings. Work to make standards and testing a distinct track in larger meetings where researchers in this task can be involved as individuals in standards development.

5. Expected Results/Deliverables

The products from this Task are for industry, testing laboratories and certification bodies to use in improving and harmonizing testing and certification processes. The improvements that result should benefit consumers and policymakers by providing better information on the performance and benefits of solar thermal technologies. Results will include:

Subtask A, Collectors:

- Task Experts Meeting and conference to develop a roadmap of solar thermal testing and certification issues for collectors, approaches to improve existing systems and harmonize standards and certification. Target Date: 10/2009
- State of the art white papers on testing, measurement and certification issues concerning:
    - Flat-Plate Collectors; (Target Date: 12/2009)
    - Evacuated Tube Collectors; (Target Date: 12/2009)
    - Air Heating Collectors; (Target Date: 12/2009)
    - Concentrating Collectors for Medium to High Temperatures, based on meetings with Alanod, SRCC and other active parties; (Target Date: 12/2009)
- Reports on the results of round-robin tests for:
    - Flat-Plate Collectors; (Target Date: 8/2010)
    - Evacuated Tube Collectors; (Target Date: 8/2010)
    - Air Heating Collectors; (Target Date: 8/2010)
    - Concentrating Collectors for Medium to High Temperatures; (Target Date: 8/2010)
- If deemed appropriate, draft recommendations for revising performance test standards, qualification and safety test standards:
    - Flat-Plate Collectors; (Target Date: 8/2011)
    - Evacuated Tube Collectors; (Target Date: 8/2011)
    - Air Heating Collectors; (Target Date: 8/2011)
    - Concentrating Collectors for Medium to High Temperatures; (Target Date: 8/2011)
- Joint meetings with Solar Keymark, ISO, and other standards groups to discuss testing and certification issues and promote harmonization, distinct technical tracks or sessions on testing and certification at large international meetings, such as ISES. (Target Dates: March 2009, semi-annually thereafter)
- A web page or pages that connect major organizations involved in testing and certification and provide more forward-looking information on work in progress and new initiatives that impact testing and certification. It would also provide a forum for participants and newcomers to pose questions or make suggestions regarding testing and certification processes, particularly for developers of new collector technologies. Target Date: 9/2009.
- A communication plan for reaching the industry, testing and certification bodies concerned with the activities in this task, means of continuing communication and coordination after the task is completed, and more active outreach to alert target audiences of new developments. Target Date: 9/2009

Subtask B, Systems:

- Results of a meeting of experts to discuss solar thermal systems testing and characterization issues and develop detailed research recommendations. (Target Date: 10/2009)
- A report on norms for systems testing and characterization that addresses system boundaries and definitions. (Target Date: 6/2010)
- A report on qualification and safety testing that identifies inconsistencies, gaps and problems and recommends actions to resolve key issues. (Target Date: 9/2010)
- A white paper on simulation and modeling tools that identify strengths, weaknesses, gaps in their capabilities, and inconsistencies in their application or interpretation. (Target Date: 10/2010)

- A white paper detailing the results of research on the effects of component/material substitution and extrapolating size have on actual system performance versus predictions and recommendations on how tests and standards for systems need to be adapted. (Target Date: 12/2010)
- A report examining the relation between test and characterization information and user experience – for example, testing and measurement as it relates to occupant comfort in space conditioning – with recommendations for improvements or new approaches. (Target Date: 5/2010)
- A report examining the connection between solar thermal system testing and measurement and measures of the public benefits of solar thermal systems, with recommendations for making testing, measurement and certification more effective as a foundation for benefits estimates. (Target Date: 1/2010)

6. Time Schedule

This Task will enter into force July 1st, 2009 and remain in force until June 30th, 2012. Within the limits of the term of the Agreement, this Task may be extended by two or more Participants, acting in the Executive Committees, and shall thereafter apply only to those Contracting Parties and Sponsors, if any, which expressed in writing their wish to participate in this Task.

7. Meetings

There will be Experts meetings of the Task at intervals of approximately 6 months. Subtask Leaders may arrange meetings in between or in association with Experts meetings of the Task. Attendance at the Experts Meetings of the Task will be mandatory.

8. Funding

Each country will bear the *costs* of its own participation in the Task, including necessary travel costs. The cost of organising meetings will be borne by the host country.

Level of effort

- The Participants agree on the following funding commitment:
  - Each Participant (country) will contribute to this Task a minimum of 4 person months per year to the overall task, allocated between Subtasks commensurate with effort required.
  - Participation in the Task requires participation in at least one of the Subtasks.
  - The Operating Agent will contribute with a minimum of 0.2 person year per year to the Task,
  - The Subtask leaders will contribute 0.2 person years per year to their subtasks and overall task coordination activities
  - Laboratories will be responsible for securing funds for shipping, testing, reporting and all other costs associated with round-robin testing
  - Industry participants will contribute products for round-robin testing where they choose to participate
- Participation may partly involve *funding already allocated* to a national (or international) activity which is substantially in agreement with the scope of work outlined in this Annex. Aside from providing the resources required for performing the work of the Subtasks in which they are participating, all Participants are required to commit the resources necessary for activities which are specifically collaborative in nature and which would not be part of activities funded by national or international sources. Examples include the preparation for and participation in Task meetings, co-ordination with Subtask Participants, contribution to the documentation and dissemination work and Task related

R&D work which exceeds the R&D work carried out in the framework of the national (or international) activity.

9. Management

Subtask Leaders

The Subtask Leader for each of the foregoing Subtasks will:

- Co-ordinate the work performed under that Subtask;
- Assist the Operating Agent in preparing the detailed programme of work and budget;
- Direct technical workshops and provide the Operating Agent with written summaries of workshop results; and
- Edit technical reports from the Subtask and organise their publication.

Each Subtask Leader shall be a Participant which provides to the Subtask a high level of expertise and undertakes substantial research and development in the field of the Subtask. The Subtask Leaders shall be proposed by the Operating Agent, and designated by the Executive Committee, acting by unanimity of the Participants. Changes in the Subtask Leaders may be agreed to by the Executive Committee, acting by unanimity of the Participants.

Technical Advisory Committee

The Participants shall establish a Technical Advisory Committee consisting of the Subtask Leaders and the Operating Agent. The Technical Advisory Committee shall assist the Operating Agents in the co-ordination of the Task and advise the Operating Agents on the performance of the Task.

Rights and Obligations of Participants

In addition to the obligations enumerated in Article 7 of this Agreement

- Each Participant shall provide the Operating Agents with detailed reports on the results of the work carried out for each Subtask;
- Each Participant shall collect, assess and report to the Operating Agents data on the tests and measurements for comparison among participants; and
- Each Participant shall participate in the editing and review of draft reports of the Task and Subtasks.

Specific Obligations and Responsibilities of the Operating Agent

In addition to the obligations enumerated in Articles 7 and 10 of this Agreement, the Operating Agents shall:

- Prepare and distribute the results of the task;
- At the request of the Executive Committee organise workshops, seminars, conferences and other meetings;
- Prepare the detailed Programme of Work for the Task in consultation with the Subtask Leaders and the Participants and submit the Programme of Work for approval

to the Executive Committee;
- Provide semi-annually, periodic reports to the Executive Committee on the progress and the results of the work performed under the Programme of Work;
- Provide to the Executive Committee, within six months after completion of all work under the Task, a final report for its approval and transmittal to the Agency;
- In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programmes and projects implemented by or under the auspices of the Agency or by other competent bodies;
- Provide the Participants with the necessary guidelines for the work they carry out with minimum duplication; and
- Perform such additional services and actions as may be decided by the Executive Committee, acting by unanimity.
- The Operating Agent shall be responsible for any damage to persons or property and for all legal liabilities, actions, claims, costs and expenses connected therewith to the extent described in Article 8 (c) of this Annex.

10. Information and Intellectual Property

For purposes of this Annex, in case of conflict with the provisions set forth in Article 7 of the Agreement, the following provisions shall prevail.

For arising information regarding inventions the following rules shall apply:

- Arising information regarding inventions shall be owned in all countries by the inventing Participant. The inventing Participant shall promptly identify and report to the Executive Committee any such information along with an indication whether and in which countries the inventing Participant intends to file patent applications;
- Information regarding inventions on which the inventing Participant intends to obtain a patent protection shall not be published or publicly disclosed by the Operating Agent or the other Participants until a patent has been filed, provided, however, that this restriction on publication or disclosure shall not extend beyond twelve months from the date of reporting of the invention. It shall be the responsibility of the inventing Participants to appropriately mark Task reports which disclose inventions that have not been appropriately protected by filing a patent application.

The inventing Participant shall license proprietary information arising from the Task for non-exclusive use as follows:
- To Participants in the Task:
- On the most favourable terms and conditions for use by the participants in their own country; and
- On favourable terms and conditions for the purpose of sub-licensing others for use in their own country.
- Subject to sub-paragraph above, to each participant in the Task for use in all countries, on reasonable terms and conditions; and
- To the government of any Agency Member country and nationals designated by it, for use in such country in order to meet its energy needs.

Royalties, if any, under licenses pursuant to this paragraph shall be the property of the inventing Participant.

11. Participants in this Task

- Australia:
  - Sustainability Victoria, Standards Australia Committee CS028, Ken Guthrie, (ExCo member and ISO TC180)
  - Australian Office of the Renewable Energy Regulator
- Austria:
  - Arsenal research, Roland Sterrer, Hubert Fechner and Josef Buchinger
- Canada:
  - Natural Resources Canada, Doug McClenahan, (ExCo Chair)
  - Bodycote Solar Test Facility, Alfred Brunger, Canada
- Germany:
  - ITW University of Stuttgart , Harald Drueck (Subtask Leader) and Elke Streicher,
  - Fraunhofer ISE, Stefan Mehnert, Korbinian Kramer
  - ISFH Hannover, Nele Rumler
- Italy:
  - ENEA, Vinood Sharma
- Portugal:
  - INETI, Maria Joao Carvalho
- Spain:
  - Centro Nacional de Energias Renovables, (Fabienne Sallaberry, Lourdes Ramirez Santigosa, Enric Mateu Serrats (Subtask Leader))
- Sweden:
  - SP Sweden, Peter Kovacs
- United States:
  - U.S. Department of Energy, Robert Hassett (ExCo member)
  - Solar Rating and Certification Corporation Les Nelson (North American Co-Operating Agent), Mark Thornbloom, and Stephen Still
  - Florida Solar Energy Center, James Huggins
  - National Renewable Energy Laboratory, Tim Merrigan
  - University of Wisconsin Solar Energy Laboratory, Sandy Klein
- Private Sector/Non-Governmental:
  - ESTIF/Solar Keymark, Jan Erik Nielsen, (European Co-Operating Agent)
  - Kingspan Renewables, Richard Pelan, United Kingdom
  - Bosch Portugal, Tiago Mateus, Portugal
  - Solar Twin, Ltd, Barry Johnson, United Kingdom
  - Lumicum, Joakim Bystrom, Sweden