Analysis of Local and International Standards

Scope of the working group

The scope of the Working Group is to investigate component testing, with a view to adopt international standards or develop a standards methodology for component testing suited to local conditions.
The tasks should include the following:

1) Research current local standards and international standards with a view to either adopt the most appropriate methodology for South African Standards or develop new methodology that would suit South African requirements
   These standards could include:
   SANS 1307 series of standards including SANS 1307, SANS 6210, SANS 6211-1, SANS 6211-2 and SANS 10106
   ISO 9806 collector standard
   ISO 9459 series of standards including ISO 9459-1, 9459-2, 9459-4 and 9459-5 for system testing
   EN 12976 series of standards for complete system testing of factory built systems
   EN 12977 series of standards for custom built systems
   Standard 100 and Standard 300 from SRCC (American certification)
   AS 2712 Australian standard.
2) Propose a methodology for adoption in South African Solar Standards
3) Provide recommendations on the adoption of International standards (with local requirements) that would suit this methodology or define the requirements of a new local standards series that will suit the methodology
4) Research how the standards can be used to interact with the CPA to provide protection for the consumer with particular regard to warranty.
5) Research currently available testing facilities to ensure testing to the methodology is possible
6) Research the availability of a certification body that will register tested system configurations and be able to provide incentive schemes, registered inspection bodies, auditing bodies and local municipalities with system details for evaluation.

Local Standards

Within the local standards, the following concerns exist:

1) The application of the warranty on the part of the consumer is not clear. While warranty is a commercial consideration and has no place in a technical standard, The standard can be used to clarify some of the areas of responsibility. This stems from the fact that
   a) there is no clear ownership of the warranty resting with the component supplier, the system integrator or the installer,
   b) the test information with build information (as tested parts) is confidential between the test house and the system integrator,
   c) there is no statutory body to apportion blame (component, system or installation). IOPSA, PIRB, SESSA and ESKOM all play a role, but have no legal standing for enforcement.
   d) he consumer rights are diluted by who the purchaser is, the rebate scheme, the insurance company, the government or metro grants etc
2) The consideration of adding a collector maximum temperature test be considered as a measure of the temperatures required for the design of the connector loop components.
3) Overheating by poor design, installer incorrect sizing or changes in usage patterns is highlighted by low storage capacity; the current testing does not highlight this as there is always a daily full capacity draw-off. An extended low daily draw-off test (wet stagnation test) could overcome this.

4) There is no requirement for environmental suitability of system installation. As the systems are installed where they are exposed to the full environmental conditions, some guidance on environmental considerations for solar insolation, impact of moisture on durability, corrosion of internal and external parts, information on angle of incidence and tilt on monthly performance should be introduced.
5) Possibility of providing guidelines on calculation of yearly hot water usage and meeting the needs of SANS 10400 XA
6) Possibility of providing various draw-off scenarios with guidelines on calculation of the solar fraction (solar vs auxiliary power inputs)

Some of these concerns will be addressed by WG 1 and WG 2 as prescribed by TC 1057

International Standards

ISO 9806 has become the norm internationally for the testing of solar thermal collectors. A more in depth investigation of the test methods and the prescribed requirements should be conducted on this standard with a view to replacing the mechanical test standard SANS 6210 with this standard. The ISO 9459 series provides only a test method standard. The trend internationally is to use standard test methods for any system or component testing to ensure consistent methods. The only reason to adopt any of these standards would be if the test method is used in any adopted or developed standard and we want to maintain a consistent test method.

The European EN standards provide the best methodology for testing. They categorise by factory built systems and by custom built systems in the EN 12976 series and EN 12977 series respectively. This provides an option for standard systems and for non-standard systems and large systems to be included in the solar standards portfolio. Within the SABS environment, the current standards con be adapted to become the factory built standards, and a range of standards like EN 12977 could be introduced to allow for both custom and large systems, and also to introduce component testing. Adoption of the EN 12977 series would also solve the lack of evaluation of pumps, heat exchangers and control circuits in the current SANS 1307 series as the EN 12977 applicable standard can be referred to in the local standard. There is the concern that the referenced documents in the EN standard would present conflicting problems. This could be overcome by writing a local Part 1 document (as the EN standards have) that will override any conflict between established local documents and requirements and the EN documents. There is also the possibility that conflicts can be overcome with careful use of the standard forward and additional Annexes to the EN adopted document.

The SRCC provides comprehensive characteristic requirements that are needed in any solar system. They do not however define the pass/fail details in the standard. First impressions are that the testing can be subject to bias, something that will not be tolerated in local evaluations.

First impressions of Australian standards are that they are disjointed, but this may be because the all standards were not available for review. The collector standard appears to use the older methodology found in the previous version of ISO 9806, and the system standard uses a combined standard to evaluate both heat pumps and solar thermal systems. In the NSZ 4613 and NZS 4614 standards, there is a clearer solar thermal specification and installation specification respectively. These standards are however dated at 1986, and could be outdated.

It is not the intention of this document to provide a recommendation, but rather to propose alternatives for consideration by the WG. A more detailed comparison breakdown will further assist the decision process.

Local SABS Standards

Solar Thermal Standards

The Solar Thermal Standards are maintained by SABS TC 1057. The TC National Chairperson is Sanj Lutchman (sanj.lutchman@sabs.co.za) and the National Secretary is Anna Maepa (anna.maepa@sabs.co.za) The detailed information on the TC can be obtained here. At a meeting of the TC held on 26 March 2015, it was agreed that WG 1 be formed to revise SANS 6210 to include a "wet" stagnation test, WG 2 be formed to work on component testing standards, WG 3 be established to work on external corrosion protection in SANS 1307.

Published standards

SANS Number	Title
SANS 9488:2013/ISO 9488:1999	Solar Energy – Vocabulary
SANS 1307:2014	Domestic storage water heating systems
SANS 6210:2013	Domestic solar water heaters – Mechanical qualification tests
SANS 6211-1:2012	Domestic solar water heaters Part 1 – Thermal performance using an outdoor test method
SANS 6211-2:2003	Domestic solar water heaters Part 2 – Thermal performance using an indoor test method
SANS 10106:2014	The installation, maintenance, repair and replacement of domestic solar water heating systems

Referenced documents include

Document	Title
SANS 151:2012	Fixed Electric storage water heaters
Pressure Vessels Regulations	Pressure Regulations 32395 of 15 July 2009 Volume 529 No 9119
VC 9004	Solar water heating Systems and Collectors (not yet published)
VC 9006	Compulsory specification for hot water storage tanks
SANS 10400 XA	Building Regulations Part XA

Standard Methodology

The standards deal only with domestic solar water heaters.

SANS 9488:2013/ISO 9488:1999 is a republication of the international standard on vocabulary.

The two main standards are SANS 1307:2014 that deals with the technical requirements of the system, using test methods in SANS 6210 and 6211-1 to prove compliance and SANS 10106:2014 that deals with the installation of systems that comply with SANS 1307. SANS 1307 requires the storage to comply with SANS 151 in full if it gas an electrical element, and most of the other requirements if no element is fitted.

SANS 6210:2013 is a test method specification that deals with the mechanical tests conducted on the collector and storage container. The tests include:

a) A dry stagnation test (essentially an exposure test to solar radiation)
b) A pressure test, vacuum test and fatigue cyclic pressure
c) A rain penetration test
d) A system freeze test
e) Material test for dezincification
f) Test for water absorption of composite and plastic materials
g) Test for resistance to corrosion

SANS 6211-1:2012 deals with whole system performance testing of the system to obtain the parameters required to express the system performance as

$$Q = a_1H + a_2 (T_a\text{-}T_c) + a_3$$

This parameter is used to provide a comparison of system output and by the National Rebate Scheme under the control of the DOE to assign a rebate value to the system. The equation can also be used with regional solar input to provide the yearly system output for confirming compliance with SANS 10400 XA hot water requirement.

Legal Considerations

The danger of explosion of a heated pressure vessel is a serious risk to life and property, and a number of steps are taken to reduce this risk. The controlling legislation is contained in the Pressure Vessels Regulations. These regulations allow leniency if compliance with SANS 10252, SANS 151 and SANS 10254 are complied with. These provide a “deemed to satisfy” arrangement of controls and safety devices that provide layered protection against malfunction. Compulsory specification VC 9006 also makes it illegal to trade in a hot water storage tank that does not comply with the requirements of SANS 151, including SANS 60335-2-21 for safety of household appliances. Most local authority building regulations also require compliance with SANS 10252, SANS 151 and SANS 10254 although the compulsory standard is easier to legally enforce at a import or manufacture level.

This legal compliance will need to be continued through to any new standards implemented. This should be inherent in the compulsory standard, but a note in the national forward or an additional annex can be used to reinforce the requirement.

Recommendations

Stemming from discussions at the TC meeting, and also from the methodology of other standards bodies, the following items could be considered immediately (Some of this work has been allocated to WG 1 and WG 3) in revision of local standards:

7) The application of the warranty on the part of the consumer is not clear. While warranty is a commercial consideration and has no place in a technical standard, The standard can be used to clarify some of the areas of responsibility. This stems from the fact that
    e) there is no clear ownership of the warranty resting with the component supplier, the system integrator or the installer,
    f) the test information with build information (as tested parts) is confidential between the test house and the system integrator,
    g) there is no statutory body to apportion blame (component, system or installation). IOPSA, PIRB, SESSA and ESKOM all play a role, but have no legal standing for enforcement.
    h) he consumer rights are diluted by who the purchaser is, the rebate scheme, the insurance company, the government or metro grants etc
8) The consideration of adding a collector maximum temperature test be considered as a measure of the temperatures required for the design of the connector loop components.
9) Overheating by poor design, installer incorrect sizing or changes in usage patterns is highlighted by low storage capacity; the current testing does not highlight this as there is always a daily full capacity draw-off. An extended low daily draw-off test (wet stagnation test) could overcome this.
10) There is no requirement for environmental suitability of system installation. As the systems are installed where they are exposed to the full environmental conditions, some guidance on environmental considerations for solar insolation, impact of moisture on durability, corrosion of

internal and external parts, information on angle of incidence and tilt on monthly performance should be introduced.

11) Possibility of providing guidelines on calculation of yearly hot water usage and meeting the needs of SANS 10400 XA
12) Possibility of providing various draw-off scenarios with guidelines on calculation of the solar fraction (solar vs auxiliary power inputs)

International ISO Standards

Solar Thermal Standards

The Solar Thermal Standards are maintained by ISO TC 180. South Africa is a member of ISO, and also has P-member status on TC 180, allowing it full participation on the committee and full voting rights on any proposals by the committee. The current secretariat with Standards Australia (SA), with Ken Guthrie as Chairperson and Erandi Chandrasekare as Secretary. There are 30 P-member countries and 37 O-member countries. There are 16 standards under the direct responsibility of the TC and its SC's.

Published standards (main ones only)

ISO Number	Title
ISO 9488:1999	Solar Energy – Vocabulary
ISO 9459-1:1993	Solar heating -- Domestic water heating systems -- Part 1: Performance rating procedure using indoor test methods
ISO 9459-2:1995	Domestic water heating systems -- Part 2: Outdoor test methods for system performance characterization and yearly performance prediction of solar-only systems
ISO 9459-4:2013	Solar heating -- Domestic water heating systems -- Part 4: System performance characterization by means of component tests and computer simulation
ISO 9459-5:2007	Solar heating -- Domestic water heating systems -- Part 5: System performance characterization by means of whole-system tests and computer simulation
ISO 9806:2013	Solar energy -- Solar thermal collectors -- Test methods

Referenced or lesser documents include documents relating to solar spectral irradiance, measurement and calibration of solar insulation devices and some durability standards for absorber surface durability, internal corrosion of collector materials, rubber seals and elastomeric materials for absorbers, connecting pipes and fittings. The majority of these standards are older than 20 years and may be of little relevance.

Standard Methodology

The methodology of the body is to write only a test methods specification that is acceptable worldwide in order to unify testing of solar systems. The Standards Organisation adopting the standard will write a requirement specification to meet their environmental conditions. It is guided by other standards bodies and certification bodies that recommend the need for international consistency in a test method, to allow for a uniform test method for systems and components and allow for a register of tested items. International bodies such as EIA-SHC task groups and the European Solar Key Mark (ESTiF) recommend needs for standards.

ISO 9806, the standard for collectors was adopted via the Vienna Agreement, to introduce a common standard across the world for the testing of collectors. This standard was revised from the EN 12975

European standard written by the CEN TC 312. It is currently under revision by CEN TC 312 by agreement from the ISO TC 180. The standard is widely used internationally by all European countries, Briton, China and USA via the SRCC, covering more than 80% of installed systems.

ISO 9459-1 is a performance test only that uses an array of lamps to simulate the solar input, but also allows for a heat source to be placed downstream of the collector to simulate the solar input. It provides a simple “one day” simulation test, which has a specific irradiance input onto the collector, and a simple draw-off of the full system volume in 5 equal draws throughout the day. The test requires a stabilisation period of up to 5 days with the same input and draw. A rating is calculated based on the energy output of the system. If the system is fitted with an auxiliary heat source, a solar factor is calculated based on the auxiliary power and parasitic (pumps etc) power and the output power. Flaws in the method are the collimation (“parallelness”) of the solar simulation irradiation being transported across to vacuum tube collectors, the collector loss in heat input simulators in the collector loop for non-irradiated collectors, and the fixed irradiation simulation not allowing for a yearly performance calculation. No mechanical stress or durability tests are performed. It is intended to provide a quick one day rating test for comparison of systems.

ISO 9459-2 is also a performance test only that uses an outdoor test, 5 days of tests at different irradiation and different input temperatures to provide inputs for a regression analysis to provide the equation

$$Q = a_1H + a_2 (T_a\text{-}T_c) + a_3$$

This test method is extremely similar to that used by SABS in the SANS 6211-1 standard. Note that this test method uses a single draw-off and does not allow for auxiliary heater input. Again in the ISO standard, no mechanical, stress or durability tests are performed. It is purely a performance test. There are guidelines to calculate the yearly performance output, and with a draw-off, a solar fraction (solar vs auxiliary) can be derived.

ISO 9459-4 uses a mathematical model to assess the annual energy performance of a system. The application is restricted only to the availability of a suitable mathematical model. It currently covers:

a) Flat plat, concentrating and tubular solar collectors
b) Thermosiphon and forced circulation through the collectors
c) Collector loop heat exchangers
d) Domestic hot water and space heating (combisystems)
e) Integral collector storage
f) Horizontal and vertical storage tanks
g) One or more electrical heating elements
h) Gas backup heaters
i) Solar preheaters with instantaneous water heaters
j) Solar systems with combined heat pumps

Individual components are evaluated using:
ISO 9806 for collectors
EN12977-3 or Annex B for storage tanks with electrical backup
AS 4552 for storage tanks with gas backup, raised level gas backup and gas instantaneous gas water heaters
Flow rates are determined either by model construction and measurement or by calculation using specified pipe details
EN12976 or annex C is used for integral systems
EN12977-3 or annex F for heat exchangers

EN12977-5 for controllers
Water draw-off data is given, per hour. The older version also gave monthly correction values.
Data is collected as per Annex A
The simulation programme (typically Transys) will consider Weather data, thermal draw-offs, standing losses, cold water temperature, flow information, controllers, heat exchangers, loop piping and insulation, freeze protection losses (including dump valve), over-temperature controls, downstream instantaneous heaters, etc.
There are also guidelines for the equipment supplier and also for the certification body.

ISO 9459-5 provides a procedure for dynamic testing of the system to determine system parameters for a "Dynamic System Testing Program". The intention of the testing is to take into account the variable start conditions of the storage tank, the variable draw conditions and solar irradiation conditions. The procedure caters for different storage volume to collector areas, for systems designed for high storage, low performance to low storage high performance. This is considered in the different draw-off procedures. A series of tests on consecutive days is carried out. Test A is a high draw-off procedure that keeps collector inlet temperatures low (increasing collector efficiencies) and Test B is a low draw-off that keeps tank temperatures high, tests overheating, and storage losses. There are specific requirements on the A/B test sequence, and handling of overheat protection devices and limits on draw-off if the outlet water drops below a set level (under-sized storage) The results are passed through simulation software to predict any condition performance, i.e. Variable solar insolation, variable draws, and auxiliary inputs required to assist the solar input.

Recommendations
With the exception of ISO 9806, all the ISO standards are test method only standards that give no pass fail criteria, only a broad result that can be used as a system rating or to predict the yearly system performance.

ISO 9806 has become the standard of choice worldwide for the testing of collectors. If adopted, comparisons will show that this standard is more through than our best equivalent in SANS 6210, and that we should consider its adoption with the possible phasing out of SABS 6210 over time to allow for suppliers to upgrade to meet these requirements. This standard can act as an additional or more severe requirement to SANS 6210, and a requirement to strive for.

ISO 9459-1 has not been revised since 1993. The procedures are dated. In South Africa, we are seeing very little need from test labs to use an indoor method. The collimation if using solar lamps is an issue particularly with evacuated tube collectors, in the future, with concentrating collectors. Using an upstream heat source also has issues with calibrating the heat source with the collector input (collector performance and efficiency) and with collector loss at elevated temperatures. The result of the test can only be a system rating under benchmark conditions, and gives no real information of the system under operating conditions. The suggestion is that we do not consider the standard.

ISO 9459-2 is the basic routine used in our SANS 6211-1 tests. The only reason to adopt the standard would be to prompt ISO TC180 to continue review of the standard. The suggestion is that we do not consider the standard.

ISO 9459-3 has been withdrawn by ISO TC180.

ISO 9459-4 is a component testing standard that calls on the EN or AS standards for the test procedures for collectors, storage, heat exchangers and control systems. It relies on a Certification Body to specify the test procedure (from the options it provides) and to control and verify the software simulation program. The result of the test and simulation is a yearly solar output, that will satisfy our building regulation requirements. This standard could be adopted as a component testing standard, but it would require the adoption of other standards and would require a Certification Body to control testing and registration.

ISO 9459-5 is a single system black box test that allows for a shortened sequence of tests to be performed on a system, and then allows for computer simulation of all conditions. The tests can be done in a lab, or "on the roof". It provides a good equipment supplier test procedure if they want to fully understand the performance of their systems. This standard can be adopted without interfering with current standards as a supplier standard. Otherwise, suppliers can use the standard directly from ISO.

European EN Standards

Solar Thermal Standards

The Solar Thermal Standards are maintained by CEN TC312. South Africa is outside of Europe, and thus does not participate in TC 312. TC 312 has been responsible for the drafting of ISO 9806, via the Vienna Agreement, and has been tasked again with the revision of ISO 9806 by a vote from the members of ISO TC 180. Via this agreement, CEN TC 312 has invited TC 180 to provide limited participation on TC 312 for this task.

Published standards (main ones only)

EN Number	Title
EN ISO 9488:1999	Solar Energy – Vocabulary
EN ISO 9806:2013	Solar energy -- Solar thermal collectors -- Test methods
EN 12975-1:2006+A1:2010	Thermal solar systems and components - Solar collectors - Part 1: General requirements
EN 12976-1:2012	Thermal solar systems and components - Factory made systems - Part 1: General requirements
EN 12976-2:2012	Thermal solar systems and components - Factory made systems - Part 2: Test methods
EN 12977-1:2012	Thermal solar systems and components - Custom built systems - Part 1: General requirements for solar water heaters and combisystems
EN 12977-2:2012	Thermal solar systems and components - Custom built systems - Part 2: Test methods for solar water heaters and combisystems
EN 12977-3:2012	Thermal solar systems and components - Custom built systems - Part 3: Performance test methods for solar water heater stores
EN 12977-4:2012	Thermal solar systems and components - Custom built systems - Part 4: Performance test methods for solar combistores
EN 12977-5:2012	Thermal solar systems and components - Custom built systems - Part 5: Performance test methods for control equipment
EN 22975-3:2014	Solar energy - Collector components and materials - Part 3: Absorber surface durability (ISO 22975-3:2014)

Standard Methodology

EN probably has the most consistent methodology of all the standards bodies. This is mostly due to the Estif (CEN Keymark Scheme) that has driven for clear standards that can be easily implemented into a Product Certification Scheme. There are standards for collector testing and for system testing. They also have a clear distinction between factory built systems and custom built systems for the system testing.

Factory built systems are batch products sold as a complete ready to install kit with fixed configurations. They are considered as a single system and assessed as a whole. Systems can be integral systems, thermo siphon systems or forced circulation systems. Custom built systems are either uniquely built or assembled by choosing from an assortment of components. Systems are regarded as a set of components, and are separately tested and the test results are integrated into an assessment of the whole system. Systems are forced circulation and allow for configurations built from tested components with documented configurations and also systems that are uniquely designed and assembled (large systems)

Most of the group of standards have a Part 1 document that specifies the requirements. This allows different countries within the European community specify their unique requirements. Where possible these requirements are maintained the same.

EN ISO 9806 covers the collector requirements of all systems. EN 12975:2006+A1:2010 covers specific requirements that relate to the European community. The results of any of the registered test houses are posted on the ESTiF and are publicly available at this link.

EN 12976 (note this information was compiled from the 2006 version of the standard, 2012 is the current version) covers factory built systems. Part 1 covers the requirements, and Part 2 covers Test Methods.

System testing includes:

a) Collector test to ISO 9806 from EN 12976-1 requirement

b) Freeze testing is done mostly by observation rather than a cold room test (antifreeze fluid – by measuring the freeze point, drain-back – by observation, drain-down – by measuring the valve operation, circulation by controls – check the pump start point). A freeze room test is available

c) Over temperature protection is a 4 day test with no fraw-off, with at least 2 days of 20 MJ/m2 insolation.

d) Pressure test is conducted at 1.5x rated on the whole system for 15 minutes.

e) Water contamination is done to EN 1717

f) Lightning protection is checked to IEC 61024-1

g) Safety valves – by inspection of correct positioning and valve type, including safety and expansion lines

h) Labelling to requirements

i) A thermal performance test that can be one of:
   a. A ISO 9459-2 test – the test our SANS 6211-1 is based on
   b. A test in accordance with ISO 9459-5 (see above)

   Both these tests result in a Q value for the system. There is a method to compare the results

j) Ability of solar-plus-supplementary to supply the daily load without solar input. This is a draw-off test at 10 L/m, with water above 45C for 95% of the time.

k) Reverse flow protection via visual inspection.

l) Electrical safety to EN 60335-2-21

EN12977 (Information from the 2010 version) covers custom build systems.

Part 1 covers general requirements,

Part 2 covers test methods for solar water heaters and combisystems,

Part 3 covers performance test methods for solar water heater stores from 50l to 3000l

Part 4 covers performance test methods for solar combisystems

Part 5 covers performance test methods for control equipment

The standard covers both small custom built system for domestic applications and also large systems for commercial applications. The scope excludes integral systems, thermo siphon systems and systems not using water as the storage medium.

Part 1 and Part 2 cover a similar layout, where part 1 will give the requirement, and Part 2 will give the method of evaluation (by inspection, calculation or by test method). Many of the test methods are referred to in other EN or ISO standards.

The tests (in EN 12977-2) cover:

1) Water quality to EN 806-1
2) Water contamination by inspection of design to prevent backflow into the drinking main
3) Freeze resistance by EN 12976-2 (details given above)
4) High-Temperature protection by inspection of the design in providing mixing devices if water temperatures can exceed 60^{o}C and by evaluation of stagnation temperature for the collector loop and maximum temperature based on the system pressure for the other parts
5) Reverse circulation by inspection
6) Pressure resistance by a test at 1.5X manufacturers maximum for 15 minutes performed separately on collector, storage and heat exchangers, and hot pressure tests if the collector contains organic materials
7) Electrical safety tests to EN 60335-1
8) Materials in collector loop checked to ISO/TR 10217
9) Components and pipework
    a. Collector to ISO 9806
    b. Supporting frame to EN 1991-1-3 and EN 1991-1-4
    c. Circulation pump to EN 12977-5 (also EN 1151-1 and EN 809)
    d. Expansion vessels and drain back vessels, confirm volume and position in hydraulic loop and spill lines
10) Heat exchangers tested to EN 307 and also for scaling or availability to clean them. Also for small systems, an estimation of efficiency is required. Allows for loop side and load side heat exchangers.
11) Stores are tested to EN12977-3 for solar only and EN 12977-4 for combisystems
12) Pipework and thermal insulation to ISO/TR10217, EN 806-1 and EN 12828
13) Safety valves per collector loop that can be isolated, to prevent maximum pressure in any part, blowoff lines not to clog, collect flutd or discharge were damage can occur
14) Indicators, flow indicator in collector or in/out temperatures and pressure gauge
15) Lightning to EN62305-1 or EN 12976-2
16) Documentation (based on the older 2010 version)
    a. Assembly, installation and commissioning docs for the installer and operation docs for the user
    b. Technical document describing the proposed **assortment** by the company, including
        i. System configurations and hydraulic and controls
        ii. List of all the components in all of the systems
        iii. Reference of components to test reports
        iv. List of combinations of dimensions within each system
        v. Tables of system performance with assumptions of draw, weather data etc
17) System performance is done by component testing
    a. Collector ISO 9806
    b. Stores by EN 12977-3 or 4 respectively if heater or combistore

c. Controls by 12977-5
d. Simulation by computer model – typically TRANSYS
e. Included are Yearly solar predictions, auxiliary energy on solar plus systems and calculation of solar fraction.

Recommendations
The concept of the Factory built and custom built systems is a good one.

EN12976 series provides a good system testing replacement for our SANS 1307 series or we could revise our SANS 1307 series to be a "Factory Built" standard. There will be a few cross references that would need to be adopted to use EN 12976 as our local standard. These include ISO 9806 to replace the mechanical tests in SANS 6210 and ISO 9459-2 to replace the performance tests in SANS 6211-2. We could also write a Part 1 that could override some of the EN references and replace them with SANS standards, e.g. for pipe work and safety valves.

The EN 12977 series will allow for systems that are built to order (designed on the roof), from a selection of parts. It also allows for systems that fall outside the "Factory Built" type or are large industrial systems. What is not understood is how the industry will apply component testing. There are a few scenarios,

1) A supper supplier manages the assortment files for custom builds and installers purchase kits from them, they are trained by the supper supplier and understand the compliance to documentation of the super supplier. The super supplier manages the warranty
2) Installers each create their own assortment files independently, source the components and manage the warranty
3) Component manufacturers test their components to the requirements, and then offer the results to Kitting houses or installers to create the assortment files and documentation for registration with a certification body who ensure consumer protection is maintained.
4) Other options

To control some of the warranty and consumer protection concerns, it may be necessary to write the specifications in a way that will influence the options are taken up in the industry. This should be an industry decision, and not the decision of the WG.

The best concept is to have a dual steam solution,

1) A group of standards that cover the basic systems with rigid rules on system components, assembly methods and installation but cost effective to test, would provide consistent output and would not require extensive quality checks for the most basic of installations (an almost deemed to satisfy solution)
2) A more complex system that would require some expertise and system knowledge that can be integrated from a set of tested parts to allow for systems outside of the standard system to be implemented as an engineering design.

SRCC Standards

Solar Thermal Standards
In America, standards are normally fall under ANSI or ASTM. For solar system registration this is done by the SRCC (Standards Registration and Certification Corporation). The SRCC is recognised by the Solar Industry as the Standards Development Body for Solar Collectors and Solar Thermal Systems. They manage their own standards (but these may call up ANSI or ASTM standards.

Published standards

Number	Title
SRCC Standard 100-2014-7	Minimum standards for solar thermal collectors
SRCC Standard 300-2014-7	Minimum standards for solar thermal systems
SRCC TM-1	SDHW System and Component Test Protocols

Standard Methodology

There are three standards, a collector standard and a system requirements standard and the Test Methods standard. The objective of the standards is to prove compliance to be listed on the certified list.

SRCC Standard 100-2014-7 is a requirement standard that calls on ISO 9806 test methods. The standard does also have some additional testing for freeze testing of heat pipe systems in addition to the ISO 9806 tests.

SRCC Standard 300-2014-7 gives requirements for systems. For performance testing SRCC ISO 9806 is used for collectors and TM-1 is used for systems and component test methods.

SRCC Standard 100-2014-7 uses the ISO 9806 test methods standard. See above for tetts.

SRCC Standard 300-2014-7 contains a number of design requirements, reliability and durability requirements, safety requirements, operation and servicing requirements and installation requirements. Many of these requirements are done by inspection and by subjective evaluation (particularly in evaluating the reliability and durability requirements).

SRCC Standard TM-1-2014-7 covers the testing of components to obtain the input values for a TRANSYS analysis of the system. Initial indications are that the TRANSYS simulator uses the time dependent measurement values (e.g. a plot of the output temperature every 5 minutes of purging a tank) to analyse the results. Tests include:

1) Solar collector warm-up and decay tests for clear sky low differential temperature tests and cloudy high differential temperature tests
2) A night time decay heat loss test on the collector
3) Passive collector heat loss and warm-up tests
4) Storage tank pressure tests
5) Storage Tank Capacity test
6) Storage Tank Heat loss test
7) Heat Exchanger pressure tests on both sides
8) Pressure drop tests on the heat exchanger
9) Performance tests on the heat exchanger
10) PV Solar performance map (VI curves at different insolation)
11) DC Pump Performance Map (Flow and head)
12) Inverter efficiency (25%, 50%, 75% and 100% load)

Recommendations

SRCC 100 provides a test method according to ISO 9806, and is consistent with international practice.

SRCC 300 provides a comprehensive list of system requirements. It is left largely up to the SRCC to confirm compliance by observation, as there are few measureable parameters specified as part of the requirement. Also the application of TRANSYS to the model is left mostly in the hands of the SRCC. It is most likely that many of the criteria used in pass fail decisions are provided in internal documentation inside SRCC. For these reasons it would be difficult to adopt any of these standards without either writing the pass fail into the standard as adaptations or creating the internal documentation for our test or certification bodies.

Australian Standards

Solar Thermal Standards
Standards Australia and Standards New Zealand cooperate in creation of most of the standards. The Solar thermal standards seem to be written as an alternative energy type standard, with both solar water heater and heat pump systems combined into the same standard. AS 2717-2007

Published standards

Number	Title
SA/NZS 2535.1:2007	Test methods for solar collectors – Thermal performance of glazed liquid heating collectors including pressure drop
AS 2712-2007	Solar and heat pump water heaters
AS 4445.1:1997 (R2013)	Solar heating – Domestic water heating systems – Performance rating procedure using indoor test methods
AS 4552	Gas fired water heaters
AS 3498	Authorisation requirements
AS/NZS 4692.1	Electric water heaters

Methodology
Without having the standards available, it is difficult to establish the methodology. The collector standard would appear to be based on the old 1999 version of ISO 9806, AS 4445.1 would appear to be based on the 9459-1 standard. No reference could be found for an outdoor system test, and it is assumed to be now part of the AS 2717 standard. These assumptions could be incorrect.