Comment by Solar Twin Ltd on EN 12975 solar thermal panel performance and durability tests, in relation to innovative solar thermal technologies. barry@solartwin.com *Please read with document filename "Comment EN 12975 Reliability 10 Jan07" entitled "Request for EN 12975 solar thermal panel standard to be re-examined on the grounds that its durability test is no longer inclusive enough to facilitate a thriving innovative solar thermal market in Europe and the world."*

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				1/ Limited scope assumption on system operating principles, which regard stagnation as a deliberate, normal and routine event. In EN 12975's durability test there is an incorrect presumption of routine and deliberate stagnation as part of normal use. Interestingly, this is not the case with "heat export" designed systems such as Solartwin, for which solar thermal stagnation is neither deliberate nor routine. In a lifetime of say 20 plus years, conventional solar thermal will normally experience at least ten times more hours of stagnation while will be than will Solartwin (which normally does not stagnate and which is usually directly plumbed and continually pumped at high temperatures). This reduction by at least an order of magnitude or even to zero, should reduce the relevance of stagnation-related durability tests. It may also affect the pass / fail requirements of some tests. The large scale of the impact of this issue is worth noting. More than half of the durability tests appear to require re-examination, either in terms of test specification, or in terms of the pass/fail criteria, possibly both. The currently, sometimes inappropriate, stagnation-related emphasis being applied for certain technologies means that it may be necessary to revisit these five tests. 5.2 Internal pressure. The highest pressures that some freeze tolerant, non-stagnating panels are exposed to, are not at stagnation temperatures but in freezing conditions. This should be accommodated (see later in this paper). 5.3 High-temperature resistance. Heat export types of panels are operated in ways that limit their stagnation in lifetime to nil or perhaps 10 or 100 times less frequently than most panels. For them, there may be a case for changing the test, or pass-fail criteria. 5.4 Exposure This done with no circulation, to simulate "operating conditions which are likely to occur in real service". For panels where stagnation is unlikely to occur in real service, circulating a fluid at, say, 90C, is more appropriate. 5.5 External thermal shock. Again, there may be a case for changing the test or its pass-fail criteria.		

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				5.6 Internal thermal shock. Again, there may be a case for changing the test or its pass-fail criteria. So, in the above five durability tests, for non-stagnating panels it may be appropriate to offer modified or alternative tests, refocused away from emphasis on stagnation. Even if some tests remain unchanged, it may still be appropriate to relax some pass/fail criteria if they presume routine deliberate stagnation. Test documentation could then state whether or not the panel is approved for routine and deliberate stagnation. Concerning the incorrect routine stagnation assumption it appears that some fundamentally different but valid operating principles of solar thermal, such as those used by the Solartwin technology, have not been anticipated by this Standard. New technologies such as Solartwin experience major market limitation throughout Europe, as an unfortunate consequence.		
				2/ Limited scope assumption, that peak temperatures and peak pressures in panels always occur at the same time. Such a concurrence is not necessarily the case with innovative technology. For example, in EN 12975's internal pressure durability test 5.2 there is an incorrect assumption that peak temperatures and peak pressures occur at the same time, when in reality, for some technologies, they may occur separately. For the Solartwin technology, which is freeze-tolerant and open vented, the upper temperatures and pressures do not combine in the same event. For example the Solartwin panel stagnates (in abnormal conditions only) at pressures below one bar and at high temperatures, while in winter in low or freezing conditions, it may reach pressures of over 2 bar. However 2 bar and high temperatures do not coincide and it is unreasonable to test a panel, particularly one with an absorber containing polymers such as ours to meet combined high temperature and high pressure eventualities which it will not meet in service. This limited scope and market limiting assumption may need replacement by a broader approach which permits		

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				whatever number of separate temperature and pressure tests are required by innovative technologies.		
				3/ Pass / fail criteria should be functional, not absolute. In EN 12975's durability test there are problems with pass/fail criteria being absolute instead of functional. For example, the pass fail criterion referring to interpretation of permanent deformation is absolute (no deformation), when our view is that the criterion should be functional (none which significantly affects what the panel does, in terms of durability, safety or performance). The Standard's approach may once been appropriate for traditional metal and glass panels but it is no longer, It is market limiting against those which make greater use of polymers. For example, polymer glazing or polymer absorbers may be able to deform permanently, with no significant functional consequence. The standard should accommodate polymers adequately and allow functional pass/fail criteria, and, for example, could state that deformation should not significantly affect performance, durability, safety, or performance.		
				4/ Limited scope assumption, that all polymers or elastomers are organic materials. Strictly speaking, the Solartwin panel does not exist as a solar panel at all under EN 12975, because the Standard's scope excludes silicone rubber, from which Solartwin's water channels are made. Silicone rubber has been in common use for longer than EN 12975. Silicone rubber is not organic, but an inorganic elastomer (an elastic polymer). But the Standard only acknowledges the existence of organic polymers. For seven years, the innovative Solartwin panel has been using silicone rubber in its absorber. Inorganic polymers need to be included and durability tests for elastomers should include inorganic rubbers. This market limiting exclusion needs amending, to facilitate innovations using inorganic elastomers. (A further amendment required is the apparent exclusion of innovations involving composite, ie multi-material absorbers from the scope of the Standard which is only scoped for single materials. Solartwin, which contains both silicone rubber and aluminium is again not covered under this limited scope.)		

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				We now move from four issues concerning the durability test to two concerning the performance test. **5/ Limited scope on temperature sensor position penalises low flow panels.** In EN 12975's performance test, low flow panels are penalised by an over-prescriptive temperature sensing arrangement. The effect is an under-representation of performance for such technologies with the inaccuracy increasing as the flow rate decreases. The problem is caused by having only one temperature sensor and by having it positioned towards the top of the panel, two thirds up it. Having, say, several sensors spaced out from top to bottom would better represent the performance of ultra-low flow technology such as Solartwin (which uses a 2.88 sqm panel with a variable speed water flow of no more than 60 litres / hr and typically 40 litres /hr or less). In full sunlight, such low flow rates in this panel can give inlet-outlet temperature differences of several tens of degrees. In such a case, where the heat transfer fluid is entering at the bottom of the panel, it will therefore exhibit a widely varying range of efficiencies, with them typically declining, non-linearly, as one rises from the bottom to the top of the absorber. So a more accurate approach should be permitted. This could allow for sensing of multiple temperatures (or even energy delivery) from which performance can be extrapolated. Several ways forward could be explored. Here are three. One is to allow low flow systems to use high flows during testing but only to the extent that that the temperature across the panel does not exceed a certain amount for any given irradiance, for example, 5C. A second approach could be to allow multiple sensors for example five, spaced at 10%, 30%, 50% 70% and 90% up the collector and to change the efficiency derivation calculation into 5 slices which are then combined in an appropriate way. A third approach would be to allow performance data from heat metering based on measured increases in temperature against volume as the heat transfer enters and leaves the collector. Following on from this last point, it is of note that is is always best to measure what one wants to measure and something else. However the standard does not measure the most effective parameter which really should be measured, energy output. Instead it measures a more distant and less representative parameter, panel temperature two thirds up, which already introduces error. It then seeks to derive performance from this, with the risk of introducing further error.		

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				Reliance on the "2/3 up temperature measurement method" means market limitation against innovations such as the Solartwin technology because it may be assessed by the Standard as being less efficient than it really is. There may also be a relative performance exaggeration (and thereby market) bias towards high flow systems as well as some evacuated tube technology, that which uses heat exchangers at the absorbers.		
				6/ Limited scope quadratic equation mathematical assumption. EN 12975's performance test constrains innovation, because of this assumption. This is because its performance test is only appropriate for panels which do not have a "temperature step change" in their performance. Here follows a brief explanation. Panels which, say, use thermotropic materials, such as GE's proposed new polycarbonate glazing which goes opaque when it gets hot, or panels with a thermostatic air vent in them, both have temperature steps in their performance. The effect of this is that performance will drop above a certain temperature, because, for example, the glazing turns cloudy, or perhaps air vents open at a certain temperature. Such panels will not be properly represented by the mathematical assumptions behind this test. This is because the quadratic equation which the standard assumes only allows for one point of inflection (ie only one bend). But panels with step changes will have at least two points of inflection on their performance curve: the first where performance drops off suddenly and the second where the curve levels off somewhat afterwards. A quadratic equation cannot approximate to an accurate performance function in cases which have a thermal step change (typically a reduction) in performance at a certain temperature. The Standard's "quadratic equation best fit assumption" will not correctly characterise some panels which have a thermal step change in them. A better, probably mathematical, representation can prevent market limitation.		

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