



Photo: TÜV Rheinland

The PV+Test program, by TÜV Rheinland and Solarpraxis AG, enters the second round.

## New module on top

**Module test:** Two modules went through PV+Test in September. Solon Blue 230/07 now leads the list of holders of the TÜV Rheinland and Solarpraxis AG seal of quality, while the other clearly showed everything that could go wrong.

Tests separate the wheat from the chaff, and that's especially exhibited by the two modules examined for PV+Test in September. One, the Solon Blue 230/07, gleaned enough points to put it at the head of the PV+Test list, with the score of "excellent." The other ended up in mid-field, scoring "satisfactory." Its manufacturer declined to have the results published, so it has to remain anonymous.

More than 25 parameters checked by TÜV Rheinland's testing engineers are summarized in the PV+Test score. A glance at the detailed results documented on our website (see [www.pv-magazine.com/pv-test](http://www.pv-magazine.com/pv-test)) shows the strengths and weaknesses of these products.

If a solar array is to live up to its promises, a module must produce the output shown on the data sheet. To test this out, the PV+Test experts measured output from all five modules of the type tested, which they had bought any-

mously. All the values measured on the two modules tested here lay within the stated output tolerances, so they live up to the specifications. But that's only part of the story. Another important point is how much they deviate from the nominal figure. The mean value for the Solon module is 1.7 watts above nominal, and all five test samples lie within a window 1.03 watts wide. Here we see the benefit of Solon's extra grading process: you get at least nominal power from these modules, or just a little less if we remember the measurement uncertainty of plus or minus two percent. In contrast, the module rated "satisfactory" had a tolerance of plus or minus three percent, resulting in a mean output 0.9 percent below nominal. Variation between modules was somewhat greater here, however; the weakest and most powerful modules lie 2.2 watts apart. A striking fact is that the output from all five modules measured below

nominal value. These differences in measured output are not sufficient, however, to account for the difference in the overall scores for the two modules.

### Visible differences

The "satisfactory" module scored considerably worse than the module from Solon partly because of its aging resistance. High initial output from a module is of little use if it doesn't last very long. For this very reason, PV+Test (the only independent testing program that runs regularly, incidentally) includes requirements that go beyond those of the IEC 61215 standard, such as climatic chamber tests and tests of mechanical loading. A temperature cycling test and two damp heat tests are among the climatic chamber tests. The first damp heat test is carried out over 1,000 hours in accordance with the guidelines, followed by a second test lasting a further 500 hours. The



output from both types of module only slightly degraded in these tests, so they were both awarded almost the full number of points in these categories.

Differences showed up visually and, as a consequence, in the measurements of insulation resistance as well. There's nothing to say against the Solon module in this respect – in these categories, too, it achieved almost the maximum number of points. During the damp heat test, however, one of the test samples of the “satisfactory” module developed a number of conspicuous bubbles, five to ten centimeters in diameter, visible as delamination of the embedding material (EVA, ethylene vinyl acetate) on both the back and front of the module. As the module does not satisfy the criterion of IEC norms 61215/61730 here, it gets zero points for the visual inspection, so its total score falls by five points. That's no trifling matter. “If the bubbles reach the rim of the module, moisture may penetrate, allowing leakage currents to flow,” explains Andreas Cox of TÜV Rheinland. “First of all, this is a safety problem. Then, the array's inverters may turn off for safety reasons.” Indeed, the insulation resistance of the dry module also suffered a 95-percent collapse, though in its unaged condition it was high enough for the resulting 1.8 gigaohms not to present any electrical hazard. Nevertheless, this heavy loss of relative resistance following the humid heat test negatively influenced the score for its insulating properties. Furthermore, blistering indicates that the manufacturer does not have the

lamination process under control. If just one of the test samples forms blisters, it's quite possible for the same effect to occur in other modules of the same series, impairing their durability.

### Similar under pressure

Another important criterion for assessing the aging resistance of photovoltaic modules is checked with mechanical loading tests. Accordingly, following the intensified damp heat test, PV+Test carries out two different tests, one with a load of 2,400 pascals and another with 5,400 pascals. Under the IEC standard, a maximum relative degradation of efficiency of up to five percent is permissible after the loading tests. After the conclusion of both loading tests, the modules tested in September remain within the permitted maximum deviation, though the Solon Blue with a performance degradation of -1.5 percent fares a lot better than the other module, with a degradation of -3.9 percent.

What was striking in the aging tests was how robust the Solon Blue seemed to be. Although it's a glass-film module, it displayed better performance than the previous test winner, the Schott Poly 290 glass-glass module by Schott Solar. “It's interesting that we can achieve this with a glass-film module,” says Dirk König, who's responsible for product certification at Solon. König says his colleagues can do this mainly by strict selection of material. “The process of approving materials is a fundamentally important tool in being able to build decent modules,” he

says, and it's also important “constantly to check processes and improve them.” The Solon Blue is also said to be very stable, thanks to both its hollow frame and its front glass. “We use solar glass four millimeters thick,” says König. That also has disadvantages: at 23 kilograms, Solon Blue is the second heaviest of the modules tested, which is reflected slightly negatively by PV+Test in the category of handling and ease of installation.

Electroluminescence imaging is intended to provide additional information about the quality of the cells. The Solon reference module already displayed a microcrack during goods-inward inspection, but this did not have a negative effect on output measurements.

### Parameters for greater yield

Although aging resistance tests can tell something about whether a module functioning well at the time of purchase will still work well after 10 or 15 years, its low-light characteristic and temperature coefficient give an indirect indication of how much yield can be expected per kilowatt of nominal power. So these, too, are decisive in simulation programs that calculate the yield to be expected at a given location. This is especially true for countries like Germany, where insolation is normally much less than the 1,000 watts per square meter specified in the standard conditions for testing nominal power. In these latitudes, this value is only reached on very sunny days. When there's less sunlight, a good low-light characteristic is advantageous. Even on such days, the midday module temperature can lie between 40 and 60 degrees, so a good temperature coefficient is important.

The efficiency of the “satisfactory” module falls by a relative 11.68 percent at an ambient temperature of 50 degrees Celsius. The Solon Blue 230/07 drops by 11.18 percent. Clearly, both modules lose points. These values put them in midfield as compared with other modules tested previously. The module with the worst score so far in this category is the Sovello SV-X-195-fa1, with a relative efficiency reduction of 12.28 percent, and the best is the Conergy PowerPlus 225P, with a reduction of 10.48 percent.

Differences in low-light performance are even clearer. At an insolation of 200 watts per square meter, the efficiency of the Solon Blue even measured slightly higher than under standard test condi-

## **i** TESTED: SOLON BLUE 230/07

The Solon Blue 230/07 is a polycrystalline module. Besides the 230-watt power class tested, it's also available in power classes from 225 to 260 watts. It has a hollow frame, and the front glass consists of solar glass four millimeters thick. This, Solon says, makes the module very stable. The high quality of the module is quoted as justifying its slightly higher price. It is therefore vaunted as a typical module for residential buildings. The firm adds that project developers also install it frequently on large industrial roofs and, to some extent, in ground-mounted solar installations.

This module has been available on the European market since April 2009. Since then, modules with a total output of approximately 200 megawatts have been produced. For the U.S. market, Solon offers a variant with a UL-certified junction box. The module has also held an MCS (Microgeneration Certification Scheme) certificate for the British market since February 2010. Solon says this module is the company's best-selling product. It is also obtainable in a monocrystalline version under the name Solon Black 230/07.



tions, while that of the other module was worse by a relative 4.6 percent. This puts the Solon module at the top of the test field in this category, displacing the previous leader in low-light performance, the Sovello SV-X-195-fa1 module, which displayed a relative efficiency loss of 0.5 percent.

### Safe edges

The difference between the two modules tested shows up in other points as well. The documentation, data sheet and type plate of the Solon are faultless, apart from minor defects. Grounding instructions are inadequate, however, and no wiring instructions are provided. The data sheet for the other module omits information about, for example, reverse current loading capability and low-light performance. The information about the plug used is, moreover, misleading. The data sheet praises MC4 connectors as though they were the ones used, but the plug connector is actually from Yukita. It's doubtful whether this plug can be connected to MC4 plugs from Multi-Contact without problems. Multi-Contact certainly advises against it. The data sheet therefore only gets seven out of ten possible points for its individual score, and a further point is deducted in the overall score for the incorrect plug designation.

### Certification is lacking

Another serious problem is that this module has no valid certification under the technical safety standard IEC 61730. "Strictly speaking, these modules should not be on sale here in Europe," says Andreas Cox of TÜV Rheinland. His colleague Willi Vaaßen adds that, "To get the CE marking for [their] product, the manufacturer must declare its conformity with the relevant EU Directive. If the basic tests are not performed, that's of course difficult." He mentions, however, that manufacturers can perform the appropriate tests in-house and – if the results are OK – get CE conformity by declaring compliance with IEC 61730 on their own authority. Customers may, however, put more trust in a certified statement. So, zero points out of ten are awarded in the individual score for this absence of IEC certification, and five points are once more deducted from the overall score. In addition, information about protection class and important safety notes are missing from the name plate.


There are also differences regarding a criterion that's particularly significant for installers: the nature of the module edges. The "satisfactory" module has sharp edges and corners that could easily give bloody fingers to an installer working without gloves. With the Solon Blue 230/07, on the other hand, everything was beautifully rounded. ♦

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#### TEST RESULTS AND CONTACT

PV+Test test results are documented on the **pv magazine** website:

 [www.pv-magazine.com/pv-test](http://www.pv-magazine.com/pv-test)

and on the PV+Test homepage:

 [www.pvtest.de/index\\_en.html](http://www.pvtest.de/index_en.html)

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