


|   |  |  |                        |  |                                    |   |  |                           |             |             |             |  |
|---|--|--|------------------------|--|------------------------------------|---|--|---------------------------|-------------|-------------|-------------|--|
| <b>Summary of EN 12975 Test Results,</b>  |  |  |                        |  |                                    | <b>Licence Number</b>   |  | <b>011-7S2313 F</b>       |             |             |             |  |
| <b>annex to Solar KEYMARK Certificate</b>   |  |  |                        |  |                                    | <b>Issued</b>   |  | <b>2014-09-19</b>         |             |             |             |  |
| <b>Company holding the</b>  |  | <b>Solimpeks Solar Energy Corp.</b>                    |                        |  |                                    | <b>Country</b>  |  | <b>TURKEY</b>             |             |             |             |  |
| <b>Brand (optional)</b>   |  | <b>--</b>  |                        |  |                                    | <b>Website</b>  |  | <b>www.solimpeks.com</b>  |             |             |             |  |
| <b>Street, street number</b>  |  | <b>Fevzi Cakmak Mah. 10753 SOK. NO: 3</b>              |                        |  |                                    | <b>E-mail</b>   |  | <b>info@solimpeks.com</b> |             |             |             |  |
| <b>Postal Code / City, province</b>   |  | <b>42050 Karatay - KONYA</b>                           |                        |  |                                    | <b>Tel/Fax</b>  |  | <b>90 332 444 06 02</b>   |             |             |             |  |
| <b>Collector Type (flat plate glazed/un-glazed; evacuate tubular)</b>   |  |  |                        |  |                                    | <b>Flat plate collector - glazed</b>  |  |                           |             |             |             |  |
| <b>Thermal / photo voltaic hybrid collector? (PVT collector)</b>  |  |  |                        |  |                                    | <b>No</b>   |  |                           |             |             |             |  |
| <b>Integration in the roof possible? (manufacturers declaration)</b>  |  |  |                        |  |                                    | <b>Yes</b>  |  |                           |             |             |             |  |
|   | <b>Collector name</b>  | <b>Aperture area (Aa)</b>                              | <b>Gross length</b>    | <b>Gross width</b>   | <b>Gross height</b>                | <b>Gross area (AG)</b>  | <b>Power output per collector module</b> |                           |             |             |             |  |
|   |  |  |                        |  |                                    |   | <b>G = 1000 W/m<sup>2</sup></b>          |                           |             |             |             |  |
|   |  |  |                        |  |                                    |   | <b>Tm-Ta</b>                             |                           |             |             |             |  |
|   |  |  |                        |  |                                    |   | <b>0 K</b>                               | <b>10 K</b>               | <b>30 K</b> | <b>50 K</b> | <b>70 K</b> |  |
|   |  | <b>m<sup>2</sup></b>                                   | <b>mm</b>              | <b>mm</b>  | <b>mm</b>                          | <b>m<sup>2</sup></b>  | <b>W</b>                                 | <b>W</b>                  | <b>W</b>    | <b>W</b>    | <b>W</b>    |  |
|   | <b>WUNDER ANP 1808</b>   | 1,62   | 1.929                  | 930  | 90                                 | 1,79  | 1.153                                    | 1.027                     | 763         | 481         | 183         |  |
|   | <b>WUNDER ANP 2108</b>   | 1,92   | 1.988                  | 1.218  | 90                                 | 2,07  | 1.367                                    | 1.218                     | 904         | 570         | 216         |  |
|   | <b>WUNDER ANP 2510</b>   | 2,23   | 1.988                  | 1.218  | 92                                 | 2,42  | 1.588                                    | 1.414                     | 1.050       | 662         | 251         |  |
|   | <b>WUNDER ANP 2710</b>   | 2,47   | 2.214                  | 1.205  | 92                                 | 2,67  | 1.759                                    | 1.566                     | 1.163       | 733         | 278         |  |
| <b>Performance test method</b>  |  |  |                        |  |                                    | <b>Glazed liquid heating collector - steady state - indoor</b>  |  |                           |             |             |             |  |
| <b>Performance parameters related to aperture</b>   |  |  | $\eta_0$               | a1   | a2                                 |   |  |                           |             |             |             |  |
| <b>Units</b>  |  |  | -                      | W/(m <sup>2</sup> K)                                       | W/(m <sup>2</sup> K <sup>2</sup> ) |   |  |                           |             |             |             |  |
| <b>Test results - Flow rate and fluid see note 1</b>  |  |  | 0,712                  | 7,652  | 0,013                              |   |  |                           |             |             |             |  |
| <b>Bi-directional incidence angle</b>   |  | <b>No</b>  |                        | <i>K<math>\theta</math> values are obligatory for 50°.</i> |                                    |   |  |                           |             |             |             |  |
| <b>Incidence angle modifiers K<math>\theta</math>(<math>\theta</math>)</b>  |  | <b>Angle</b>   | 10°                    | 20°  | 30°                                | 40°   | 50°                                      | 60°                       | 70°         | 80°         | 90°         |  |
| <b>Incidence angle modifier not bi-directional - leave fields blank</b>   |  | <b>K<math>\theta</math>(<math>\theta</math>)</b>       |                        |  |                                    |   | 0,92                                     |                           |             |             | 0,00        |  |
| <b>Stagnation temperature - Weather conditions see note 2</b>   |  |  |                        |  |                                    | <b>Tstg</b>   | <b>153,6 °C</b>                          |                           |             |             |             |  |
| <b>Effective thermal capacity</b>   |  |  |                        |  |                                    | <b>ceff = C/Ag</b>  | <b>5,818 kJ/(m<sup>2</sup>K)</b>         |                           |             |             |             |  |
| <b>Max. intended operation temperature - see note 3</b>   |  |  |                        |  |                                    | <b>Tmax,op</b>  | <b>135 °C</b>                            |                           |             |             |             |  |
| <b>Max. operation pressure - see note 3</b>   |  |  |                        |  |                                    | <b>pmax,op</b>  | <b>1000 kPa</b>                          |                           |             |             |             |  |
| <b>Pressure drop table - for a collector family, the values shall be for the module with highest <math>\Delta P</math> per m<sup>2</sup> aperture area</b>  |  |  |                        |  |                                    |   |  |                           |             |             |             |  |
| <b>Flow rate</b>  | <b>kg/(s m<sup>2</sup>)</b>  | 0,000  | 0,005                  | 0,012  | 0,019                              | 0,026   | 0,033                                    |                           |             |             |             |  |
| <b>Pressure drop, <math>\Delta P</math></b>   | <b>Pa</b>  | 0  | 20                     | 60   | 100                                | 150   | 190                                      |                           |             |             |             |  |
| <b>Optional weather data</b>  |  | <b>Location</b>  |                        |  |                                    |   | <b>Link</b>                              |                           |             |             |             |  |
| <b>Testing Laboratory</b>   |  | <b>Fundación CENER-CIEMAT, LEST</b>                    |                        |  |                                    |   |  |                           |             |             |             |  |
| <b>Website</b>  |  | <b>www.cener.com</b>                                   |                        |  |                                    |   |  |                           |             |             |             |  |
| <b>Test report id. number</b>   |  | 30.2452.0-1-1 30.2452.0-2-1<br>30.2452.0-3-1 30.2452.0 |                        |  |                                    | <b>Date of test report</b>  |  | <b>2014/09/15</b>         |             |             |             |  |
| <b>During the test GDIF/GTOT was always between</b>   |  |  | 0,15                   | <b>and</b>   | 0,15                               |   |  |                           |             |             |             |  |
| <b>Comments of testing laboratory:</b>  |  |  |                        |  |                                    |   |  |                           |             |             |             |  |
| The collectors models WUNDER ANP 1808 and WUNDER ANP 2710 were tested according to ISO 9806:2013. According to SKM rules the results of the collector model WUNDER ANP 1808 are representative for the whole WUNDER ANP family. |  |  |                        |  |                                    |   |  |                           |             |             |             |  |
|   |  |  |                        |  |                                    |   |  |                           |             |             |             |  |
| <b>Note 1</b>   | <b>Flow rate</b>   | 0,022  | kg/(s m <sup>2</sup> ) | <b>Fluid</b>   | <b>Water</b>                       |   |  |                           |             |             |             |  |
| <b>Note 2</b>   | <b>Irradiance, G = 1000 W/m<sup>2</sup>; Ambient temperature, Ta=30 °C</b> |  |                        |  |                                    |   |  |                           |             |             |             |  |
| <b>Note 3</b>   | <b>Given by manufacturer</b>   |  |                        |  |                                    |   |  |                           |             |             |             |  |
|   |  |  |                        |  |                                    | <br><b>Datasheet version: 4.06, 2014-01-15</b> |  |                           |             |             |             |  |
| <b>DIN CERTCO • Alboinstraße 56 • 12103 Berlin, Germany</b><br><b>Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dincertco.de</b>  |  |  |                        |  |                                    |   |  |                           |             |             |             |  |

|   |                |              |
|---|----------------|--------------|
| Annual collector output based on EN 12975 Test Results,<br>annex to Solar KEYMARK Certificate | Licence Number | 011-7S2313 F |
|   | Issued         | 19/09/2014   |

| Annual collector output kWh/module |  |       |      |       |      |      |           |      |      |          |      |      |
|------------------------------------|--|-------|------|-------|------|------|-----------|------|------|----------|------|------|
| Collector name                     | Location and collector temperature (T <sub>m</sub> ) |       |      |       |      |      |           |      |      |          |      |      |
|                                    | Athens   |       |      | Davos |      |      | Stockholm |      |      | Würzburg |      |      |
|                                    | 25°C   | 50°C  | 75°C | 25°C  | 50°C | 75°C | 25°C      | 50°C | 75°C | 25°C     | 50°C | 75°C |
| WUNDER ANP 1808                    | 1.734  | 807   | 268  | 1.061 | 451  | 116  | 826       | 335  | 87   | 913      | 360  | 99   |
| WUNDER ANP 2108                    | 2.055  | 957   | 318  | 1.257 | 534  | 138  | 979       | 397  | 103  | 1.082    | 426  | 118  |
| WUNDER ANP 2510                    | 2.386  | 1.111 | 369  | 1.460 | 620  | 160  | 1.137     | 461  | 120  | 1.257    | 495  | 137  |
| WUNDER ANP 2710                    | 2.643  | 1.231 | 409  | 1.617 | 687  | 177  | 1.259     | 511  | 132  | 1.392    | 549  | 151  |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
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|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
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|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |
|                                    |  |       |      |       |      |      |           |      |      |          |      |      |

|                                       |   |
|---------------------------------------|---|
| Collector mounting: Fixed or tracking | Fixed; slope = latitude - 15° (rounded to nearest 5°) |
|---------------------------------------|---|

| Overview of locations |            |  |                      |  |
|-----------------------|------------|--|----------------------|--|
| Location              | Latitude ° | G <sub>tot</sub><br>kWh/m <sup>2</sup> | T <sub>a</sub><br>°C | Collector orientation or tracking mode |
| Athens                | 38         | 1.765                                  | 18,5                 | South, 25°                             |
| Davos                 | 47         | 1.714                                  | 3,2                  | South, 30°                             |
| Stockholm             | 59         | 1.166                                  | 7,5                  | South, 45°                             |
| Würzburg              | 50         | 1.244                                  | 9,0                  | South, 35°                             |
|                       |            |  |                      |  |
|                       |            |  |                      |  |
|                       |            |  |                      |  |

|                  |  |                    |
|------------------|--|--------------------|
| G <sub>tot</sub> | Annual total irradiation on collector plane                                    | kWh/m <sup>2</sup> |
| T <sub>a</sub>   | Mean annual ambient air temperature  | °C                 |
| T <sub>m</sub>   | Constant collector operating temperature (mean of in- and outlet temperatures) | °C                 |

The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool ScenoCalc. The collector output is calculated hour by hour according to the efficiency parameters from the Keymark test using constant collector operating temperature (T<sub>m</sub>). A detailed description of the calculations is available at <http://www.sp.se/en/index/services/solar/ScenoCalc/Sidor/default.aspx>.

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|  | ScenoCalc version:<br>Ver. 4.06 (Jan, 2014) |