

| Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results        |  |   |                      |                                    | Licence Number   |       | 011-7S2248 F                 |       |                          |       |      |  |
|--|--|---|----------------------|------------------------------------|--|-------|------------------------------|-------|--------------------------|-------|------|--|
|  |  |   |                      |                                    | Date issued  |       | 2016-06-24                   |       |                          |       |      |  |
|  |  |   |                      |                                    | Issued by  |       |                              |       |                          |       |      |  |
| Licence holder   |  | Solimpeks Solar Energy Systems Corp.  |                      |                                    | Country  |       | Turkey                       |       |                          |       |      |  |
| Brand (optional)   |  |   |                      |                                    | Web  |       | www.solimpeks.com            |       |                          |       |      |  |
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| Collector Type   |  |   |                      |                                    | Flat plate collector, glazed   |       |                              |       |                          |       |      |  |
| Collector name   | Gross area (A <sub>G</sub> )<br>m <sup>2</sup> | Gross length<br>mm  | Gross width<br>mm    | Gross height<br>mm                 | Power output per collector<br>G <sub>b</sub> = 850 W/m <sup>2</sup> ; G <sub>d</sub> = 150 W/m <sup>2</sup><br>ϑ <sub>m</sub> - ϑ <sub>a</sub> |       |                              |       |                          |       |      |  |
|  |  |   |                      |                                    | 0 K  | 10 K  | 30 K                         | 50 K  | 70 K                     | 130 K |      |  |
|  |  |   |                      |                                    | W  | W     | W                            | W     | W                        | W     |      |  |
| Wunder ALS 2510  | 2,43   | 1.990   | 1.219                | 91                                 | 1.676  | 1.581 | 1.387                        | 1.188 | 985                      | 345   |      |  |
| Wunder ALS 2108  | 2,07   | 1.988   | 1.041                | 91                                 | 1.430  | 1.349 | 1.184                        | 1.014 | 840                      | 294   |      |  |
| Wunder ALS 1808  | 1,79   | 1.928   | 928                  | 91                                 | 1.236  | 1.166 | 1.023                        | 876   | 726                      | 254   |      |  |
| Power output per m <sup>2</sup> gross area   |  |   |                      |                                    | 691  | 652   | 572                          | 490   | 406                      | 142   |      |  |
| Performance parameters test method   |  | Steady state - outdoor  |                      |                                    |  |       |                              |       |                          |       |      |  |
| Performance parameters (related to AG)   |  | η <sub>0,hem</sub>  | a <sub>1</sub>       | a <sub>2</sub>                     |  |       |                              |       |                          |       |      |  |
| Units  |  | -   | W/(m <sup>2</sup> K) | W/(m <sup>2</sup> K <sup>2</sup> ) |  |       |                              |       |                          |       |      |  |
| Test results   |  | 0,691   | 3,90                 | 0,002                              |  |       |                              |       |                          |       |      |  |
| Incidence angle modifier test method   |  | Steady state - outdoor  |                      |                                    |  |       |                              |       |                          |       |      |  |
| Bi-directional incidence angle modifiers   |  | No  |                      |                                    |  |       |                              |       |                          |       |      |  |
| Incidence angle modifier   |  | Angle   | 10°                  | 20°                                | 30°  | 40°   | 50°                          | 60°   | 70°                      | 80°   | 90°  |  |
| Transversal  |  | K <sub>GT, coll</sub>   | 1,00                 | 1,00                               | 0,99   | 0,97  | 0,94                         | 0,86  | 0,73                     | 0,47  | 0,00 |  |
| Longitudinal   |  | K <sub>GL, coll</sub>   | 1,00                 | 1,00                               | 0,99   | 0,97  | 0,94                         | 0,86  | 0,73                     | 0,47  | 0,00 |  |
| Heat transfer medium for testing   |  | Water   |                      |                                    |  |       |                              |       |                          |       |      |  |
| Flow rate for testing (per gross area, A <sub>G</sub> )                              |  | dm/dt   | 0,018                | kg/(sm <sup>2</sup> )              |  |       |                              |       |                          |       |      |  |
| Maximum temperature difference for thermal performance calculations                  |  | (ϑ <sub>m</sub> -ϑ <sub>a</sub> ) <sub>max</sub>  | 130                  | K                                  |  |       |                              |       |                          |       |      |  |
| Standard stagnation temperature (G = 1000 W/m <sup>2</sup> ; ϑ <sub>a</sub> = 30 °C) |  | ϑ <sub>stg</sub>  | 194                  | °C                                 |  |       |                              |       |                          |       |      |  |
| Effective thermal capacity, incl. fluid (per gross area, A <sub>G</sub> )            |  | C/m <sup>2</sup>  | 3,8                  | kJ/(Km <sup>2</sup> )              |  |       |                              |       |                          |       |      |  |
| Maximum operating temperature  |  | ϑ <sub>max, op</sub>  | 120                  | °C                                 |  |       |                              |       |                          |       |      |  |
| Maximum operating pressure   |  | p <sub>max, op</sub>  | 1000                 | kPa                                |  |       |                              |       |                          |       |      |  |
| Testing laboratory   |  | TestLab Solar Thermal Systems, Fraunhofer ISE   |                      |                                    |  |       | http://www.collectortest.com |       |                          |       |      |  |
| Test report(s)   |  | ktb-2011-27<br>ktb-2011-28  |                      |                                    |  |       | Dated                        |       | 25.10.2011<br>25.10.2011 |       |      |  |
| Comments of testing laboratory   |  | Datasheet version: 5.01, 2016-03-01   |                      |                                    |  |       |                              |       |                          |       |      |  |
|  |  | TestLab<br>Solar Thermal<br>Systems<br>Heidenhofstraße<br>D-79110 Freiburg<br>Tel: +49 (0)761 4588 5354 |                      |                                    |  |       |                              |       |                          |       |      |  |

|   |                       |                     |
|---|-----------------------|---------------------|
| <b>Annex to Solar Keymark Certificate<br/>Supplementary Information</b> | <b>Licence Number</b> | <b>011-7S2248 F</b> |
|   | <b>Issued</b>         | <b>2016-06-21</b>   |

| Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$ , based on EN ISO 9806:2013 test results  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|--|---------------|---|-------|-------|-------------------------|-------|-----------|-------------------------|------|----------|-------------------------|-------|------|
| Standard Locations   | Athens        |   |       | Davos |                         |       | Stockholm |                         |      | Würzburg |                         |       |      |
| Collector name   | $\vartheta_m$ | 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 ALS 2510  |               | 2.654   | 1.828 | 1.196 | 1.972                   | 1.348 | 874       | 1.454                   | 929  | 575      | 1.583                   | 1.001 | 609  |
| Wunder ALS 2108  |               | 2.265   | 1.560 | 1.021 | 1.682                   | 1.150 | 746       | 1.241                   | 793  | 490      | 1.351                   | 854   | 520  |
| Wunder ALS 1808  |               | 1.958   | 1.348 | 882   | 1.454                   | 994   | 645       | 1.072                   | 685  | 424      | 1.168                   | 738   | 449  |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
|  |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |
| Annual output per m <sup>2</sup> gross area  |               | 1.094   | 753   | 493   | 813                     | 556   | 360       | 599                     | 383  | 237      | 653                     | 412   | 251  |
| Fixed or tracking collector  |               | Fixed (slope = latitude - 15°; rounded to nearest 5°) |       |       |                         |       |           |                         |      |          |                         |       |      |
| Annual irradiation on collector plane  |               | 1765 kWh/m <sup>2</sup>                               |       |       | 1714 kWh/m <sup>2</sup> |       |           | 1166 kWh/m <sup>2</sup> |      |          | 1244 kWh/m <sup>2</sup> |       |      |
| Mean annual ambient air temperature  |               | 18,5°C  |       |       | 3,2°C                   |       |           | 7,5°C                   |      |          | 9,0°C                   |       |      |
| Collector orientation or tracking mode   |               | South, 25°  |       |       | South, 30°              |       |           | South, 45°              |      |          | South, 35°              |       |      |
| The collector is operated at constant temperature $\vartheta_m$ (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 5.01 (March 2016). A detailed description of the calculations is available at <a href="http://www.solarkeymark.org/scenocalc">www.solarkeymark.org/scenocalc</a> |               |   |       |       |                         |       |           |                         |      |          |                         |       |      |

| Additional Information  |               |    |
|---|---------------|----|
| Collector heat transfer medium  | Water-Glycole |    |
| Hybrid Thermal and Photo Voltaic collector  | No            |    |
| The collector is deemed to be suitable for roof integration   | No            |    |
| The collector was tested successfully according to EN ISO 9806:2013 under the following conditions: |               |    |
| Climate class (A, B or C)   | EN 12975-2    | -- |
| Maximum tested positive load  | 1000          | Pa |
| Maximum tested negative load  | 1000          | Pa |
| Hail resistance using ice balls (diameter)  | -             | mm |

| Energy Labelling Information |   |  |  |
|------------------------------|---|--|--|
|                              | Reference Area, $A_{sol}$ (m <sup>2</sup> ) | Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$  |  |
| Wunder ALS 2510              | 2,43  | Collector efficiency ( $\eta_{col}$ )  | 53 %                                     |
| Wunder ALS 2108              | 2,07  | <i>Remark: Collector efficiency (<math>\eta_{col}</math>) is defined in CDR (EU) No 811/2013 as collector efficiency of the solar collector at a temperature difference between the solar collector and the surrounding air of 40 K and a global solar irradiance of 1000 W/m<sup>2</sup>, expressed in % and rounded to the nearest integer. Deviating from the regulation <math>\eta_{col}</math> is based on reference area (<math>A_{sol}</math>) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.</i> |  |
| Wunder ALS 1808              | 1,79  |  |  |
|                              |   |  |  |
|                              |   |  |  |
|                              |   | Data required for CDR (EU) No 812/2013 - Reference Area $A_{sol}$  |  |
|                              |   | Zero-loss efficiency ( $\eta_0$ )  | 0,691 --                                 |
|                              |   | First-order coefficient ( $a_1$ )  | 3,90 W/(m <sup>2</sup> K)                |
|                              |   | Second-order coefficient ( $a_2$ )   | 0,002 W/(m <sup>2</sup> K <sup>2</sup> ) |
|                              |   | Incidence angle modifier IAM (50°)   | 0,94 --                                  |
|                              |   | <i>Remark: The data given in this section are related to collector reference area (<math>A_{sol}</math>) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806. Consistent data sets for either aperture or gross area can be used in calculations like in the regulation 811 and 812 and simulation programs.</i>  |  |