## Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results

| | |
|---|---|
| Licence Number | SKM 9984 |
| Date issued | 2016-12-20 |
| Issued by | DQS Hellas |

| | | | |
|---|---|---|---|
| Licence holder | EUROENERGY Ltd | Country | Bulgaria |
| Brand (optional) | THERMOSYSTEMA, ECO DYNAMIC | Web | |
| Street, Number | Katountsi | E-mail | info@euroenergy-bg.com |
| Postcode, City | 2830, Santanski | Tel | 00359 74382200 |

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|---|---|
| Collector Type | Flat plate collector, glazed |

| Collector name | Gross area ($A_G$) | Gross length | Gross width | Gross height | Power output per collector Gb = 850 W/m²; Gd = 150 W/m² ϑm - ϑa: 0 K | 10 K | 30 K | 50 K | 70 K | 50 K |
|---|---|---|---|---|---|---|---|---|---|---|
| | m² | mm | mm | mm | W | W | W | W | W | W |
| ECOSOL 150 | 1.50 | 1,500 | 1,000 | 92 | 951 | 878 | 730 | 581 | 430 | 581 |
| ECOSOL 187 | 1.87 | 1,500 | 1,250 | 92 | 1,186 | 1,094 | 910 | 724 | 536 | 724 |
| ECOSOL 200 | 2.00 | 2,000 | 1,000 | 92 | 1,268 | 1,170 | 973 | 774 | 574 | 774 |
| ECOSOL 250 | 2.50 | 2,000 | 1,250 | 92 | 1,585 | 1,463 | 1,216 | 968 | 717 | 968 |
| Power output per m² gross area | | | | | 634 | 585 | 486 | 387 | 287 | 387 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Performance parameters test method | Steady state - outdoor | | | | | | | | |
| Performance parameters (related to AG) | η0,hem | a1 | a2 | | | | | | |
| Units | - | W/(m²K) | W/(m²K²) | | | | | | |
| Test results | 0.634 | 4.890 | 0.001 | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | $K_{\theta T,coll}$ | | | | | 0.82 | | | | 0.00 |
| Longitudinal | $K_{\theta L,coll}$ | | | | | 0.82 | | | | 0.00 |

| | | | |
|---|---|---|---|
| Heat transfer medium for testing | | Water | |
| Flow rate for testing (per gross area, $A_G$) | dm/dt | 0.020 | kg/(sm²) |
| Maximum temperature difference for thermal performance calculations | $(\vartheta_m-\vartheta_a)_{max}$ | 50 | K |
| Standard stagnation temperature (G = 1000 W/m²; $\vartheta_a$ = 30 °C) | $\vartheta_{stg}$ | 144.5 | °C |
| Effective thermal capacity, incl. fluid (per gross area, $A_G$) | $C/m^2$ | 10 | kJ/(Km²) |
| Maximum operating temperature | $\vartheta_{max\_op}$ | 100 | °C |
| Maximum operating pressure | $p_{max,op}$ | 100 | kPa |

| | | | |
|---|---|---|---|
| Testing laboratory | NCSR "DEMOKRITOS"- SOLAR & ENERGY SYSTEMS LAB | http://www.solar.demokritos.gr | |
| Test report(s) | 4176 DE1 | Dated | 7/7/2016 |
| | 4177DE1 | | 7/7/2016 |
| | 4178DE1, 4190DE1 | | 20/7/2016, 20/9/2016 |

| | |
|---|---|
| Comments of testing laboratory | Datasheet version: 5.01, 2016-03-01 |

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|---|---|---|
| Supplementary Information | Issued | 2016-12-20 |

**Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$, based on 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 |
| ECOSOL 150 | 1,342 | 778 | 417 | 922 | 538 | 280 | 688 | 374 | 189 | 749 | 396 | 198 |
| ECOSOL 187 | 1,673 | 970 | 520 | 1,149 | 671 | 349 | 858 | 466 | 235 | 934 | 494 | 247 |
| ECOSOL 200 | 1,789 | 1,037 | 557 | 1,229 | 718 | 373 | 917 | 499 | 252 | 999 | 528 | 264 |
| ECOSOL 250 | 2,236 | 1,297 | 696 | 1,536 | 897 | 467 | 1,146 | 623 | 314 | 1,249 | 660 | 330 |
| Annual output per m² gross area | 895 | 519 | 278 | 614 | 359 | 187 | 459 | 249 | 126 | 499 | 264 | 132 |
| Fixed or tracking collector | Fixed (slope = latitude - 15°; rounded to nearest 5°) | | | | | | | | | | | |
| Annual irradiation on collector plane | 1765 kWh/m² | | | 1714 kWh/m² | | | 1166 kWh/m² | | | 1244 kWh/m² | | |
| 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 ϑm (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 www.solarkeymark.org/scenocalc

## 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) | A | -- |
| Maximum tested positive load | 2400 | Pa |
| Maximum tested negative load | 2400 | Pa |
| Hail resistance using steel ball (maximum drop height) | 2 | m |

## Energy Labelling Information

| | Reference Area, $A_{sol}$ (m²) |
|---|---|
| ECOSOL 150 | 1.50 |
| ECOSOL 187 | 1.87 |
| ECOSOL 200 | 2.00 |
| ECOSOL 250 | 2.50 |

**Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$**

| | | |
|---|---|---|
| Collector efficiency ($\eta_{col}$) | 44 | % |

*Remark: Collector efficiency ($\eta_{col}$) 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/m², expressed in % and rounded to the nearest integer. Deviating from the regulation $\eta_{col}$ is based on reference area ($A_{sol}$) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.*

**Data required for CDR (EU) No 812/2013 - Reference Area $A_{sol}$**

| | | |
|---|---|---|
| Zero-loss efficiency ($\eta_0$) | 0.634 | -- |
| First-order coefficient ($a_1$) | 4.89 | W/(m²K) |
| Second-order coefficient ($a_2$) | 0.001 | W/(m²K²) |
| Incidence angle modifier IAM (50°) | 0.82 | -- |

*Remark: The data given in this section are related to collector reference area ($A_{sol}$) 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.*

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