TÜVRheinland®
DIN CERTCO
Precisely Right.

IGTE



| Annex to Solar Keymark Certificate | | Licence Number | 011-7S2021 F |
|---|---|---|---|
| | | Date issued | 2023-11-08 |
| | | Issued by | DIN CERTCO |

| | | | |
|---|---|---|---|
| Licence holder | Solimpeks Enerji San. Ve Tic. A.Ş. | Country | TÜRKIYE |
| Brand (optional) | | Web | https://solimpeks.com |
| Street, Number | Fevzi Çakmak Mh. 10753. Sk. No: 3-3A | E-mail | kalite@solimpeks.com |
| Postcode, City | Karatay/KONYA | Tel | +90 533 631 8446 |

| | |
|---|---|
| Collector Type | Flat plate collector |

| Collector name | Gross area ($A_G$) | Gross length | Gross width | Gross height | Power output per collector Gb = 850 W/m2, Gd = 150 W/m2 & u = 1.3 m/s $\vartheta_m - \vartheta_a$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0 K | 10 K | 30 K | 50 K | 70 K | 115 K |
| | m² | mm | mm | mm | W | W | W | W | W | W |
| WUNDER ALS 2108 DRAIN | 2.07 | 1,988 | 1,041 | 90 | 1,468 | 1,401 | 1,246 | 1,062 | 850 | 271 |
| WUNDER ALS 2510 DRAIN | 2.42 | 1,988 | 1,218 | 90 | 1,716 | 1,638 | 1,456 | 1,241 | 994 | 317 |
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| Power output per m² gross area | | | | | 709 | 677 | 602 | 513 | 411 | 131 |

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| Performance parameters test method | Quasi dynamic | | | | | | | | | |
| Performance parameters (related to $A_G$) | η0, b | a1 | a2 | a3 | a4 | a5 | a6 | a7 | a8 | Kd |
| Units | - | W/(m²K) | W/(m²K²) | J/(m³K) | - | J/(m²K) | s/m | W/(m²K⁴) | W/(m²K⁴) | - |
| Test results | 0.713 | 3.08 | 0.017 | 0.000 | 0.00 | 11,843 | 0.000 | 0.00 | 0.0E+00 | 0.97 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Incidence angle modifier test method | | Quasi dynamic - outdoor | | | | | | | | |
| Incidence angle modifier | Angle | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
| Transversal | $K_{\theta T,coll}$ | 1.00 | 1.00 | 1.00 | 0.99 | 0.96 | 0.88 | 0.70 | 0.35 | 0.00 |
| Longitudinal | $K_{\theta L,coll}$ | 1.00 | 1.00 | 1.00 | 0.99 | 0.96 | 0.88 | 0.70 | 0.35 | 0.00 |

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|---|---|---|---|
| Heat transfer medium for testing | | Water | |
| Flow rate for testing (per gross area, $A_G$) | | dm/dt | 0.020 kg/(sm²) |
| Maximum temperature difference during thermal performance test | | $(\vartheta_m-\vartheta_a)_{max}$ | 85 K |
| Standard stagnation temperature (G = 1000 W/m²; $\vartheta_a$ = 30 °C) | | $\vartheta_{stg}$ | 200 °C |
| Maximum operating temperature | | $\vartheta_{max\ op}$ | 135 °C |
| Maximum operating pressure | | $p_{max,op}$ | 1000 kPa |

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|---|---|---|---|
| Testing laboratory | Institut für Gebäudeenergetik, Thermotechnik und Energiespeicherung (IGTE) | http://www.igte.uni-stuttgart.de | |
| Test report(s) | 23COL1695<br>23COL1696<br>23COL1696Q | Dated | 25.10.2023<br>25.10.2023<br>25.10.2023 |

| | |
|---|---|
| Comments of testing laboratory | Ver. 6.2 (13.01.2022) |
| Documented performance parameters are taken from 23COL1695 (WUNDER ALS 2108 DRAIN) | TZS Forschungs- und Testzentrum für Solaranlagen<br>Institut für Thermodynamik und Wärmetechnik<br>Universität Stuttgart<br>Pfaffenwaldring 6, 70550 Stuttgart (Vaihingen) |

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| Supplementary Information | Issued | 2023-11-08 |

**Gross Thermal Yield in kWh/collector at mean fluid temperature $\vartheta_m$**

| 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 2108 DRAIN | 2,404 | 1,743 | 1,132 | 1,847 | 1,280 | 786 | 1,354 | 893 | 530 | 1,477 | 971 | 568 |
| WUNDER ALS 2510 DRAIN | 2,810 | 2,038 | 1,324 | 2,160 | 1,496 | 919 | 1,583 | 1,044 | 619 | 1,727 | 1,135 | 664 |
| Gross Thermal Yield per m² gross area | 1,161 | 842 | 547 | 892 | 618 | 380 | 654 | 431 | 256 | 714 | 469 | 274 |
| Annual efficiency, $\eta_a$ | 66% | 48% | 31% | 55% | 38% | 23% | 56% | 37% | 22% | 57% | 38% | 22% |
| Fixed or tracking collector | Fixed (slope = latitude - 15°; rounded to nearest 5°) | | | | | | | | | | | |
| Annual irradiation on collector plane | 1765 kWh/m² | | | 1630 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. 6.2 (13.01.2022). A detailed description of the calculations is available at http://www.estif.org/solarkeymarknew/

## Additional Information

| | | | | | |
|---|---|---|---|---|---|
| Collector heat transfer medium | | | | Water-Glycole | |
| The collector is deemed to be suitable for roof integration | | | | No | |
| The collector was tested successfully under the following conditions: | | | | | |
| Climate class (A+, A, B or C) | | | | A | -- |
| G (W/m²) > | 1000 | $\vartheta_a$ (°C) > | 20 | $H_x$ (MJ/m²) > | 600 |
| Maximum tested positive load | | | | 3000 | Pa |
| Maximum tested negative load | | | | 2750 | Pa |
| Hail resistance using steel ball (maximum drop height) | | | | 2 | m |

## Additional collector attribute(s)

| | | | |
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| Using external power source(s) for normal operation | No | Active or passive measure(s) for self-protection | No |
| Co-generating thermal and electrical power | No | Façade collector(s) | No |

## Energy Labelling Information

| | Reference Area, $A_{sol}$ (m²) |
|---|---|
| WUNDER ALS 2108 DRAIN | 2.07 |
| WUNDER ALS 2510 DRAIN | 2.42 |

## Additional Informative Technical Data

| Hydraulic Designation Code | Aperture Area, $A_a$ (m²) |
|---|---|
| 1-H-1234S-9.1,18350-16.6,1095-D | 1.89 |
| 1-H-1234S-9.1,21750-16.6,1272-D | 2.24 |

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

| | |
|---|---|
| Collector efficiency ($\eta_{col}$) | 56% |

Remark: Collector efficiency (ηcol) 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 ηcol is based on reference area (Asol) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.

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

| | | |
|---|---|---|
| Zero-loss efficiency ($\eta_0$) | 0.71 | -- |
| First-order coefficient ($a_1$) | 3.08 | W/(m²K) |
| Second-order coefficient ($a_2$) | 0.017 | W/(m²K²) |
| Incidence angle modifier IAM (50°) | 0.98 | -- |

*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.*