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| Annex to Solar Keymark Certificate | | | | | | Licence Number | | 011-7S2827 R | | | | | | | | |
| | | | | | | Date issued | | 2019-02-01 | | | | | | | | |
| | | | | | | Issued by | | TÜV Rheinland Energy GmbH | | | | | | | | |
| Licence holder | | Ako Tec Produktionsgesellschaft | | | | Country | | Germany | | | | | | | | |
| Brand (optional) | | Ako Tec | | | | Web | | www.akotec.eu | | | | | | | | |
| Street, Number | | Grundmühlenweg 3 | | | | E-mail | | info@akotec.eu | | | | | | | | |
| Postcode, City | | 16278 Angermünde | | | | Tel | | +49 (0)3331 25 716 30 | | | | | | | | |
| Collector Type | | | | | | Evacuated tubular collector | | | | | | | | | | |
| Collector name | | | | | | Power output per collector | | | | | | | | | | |
| | | | | | | $G_b = 850 \text{ W/m}^2$, $G_d = 150 \text{ W/m}^2$ & $u = 1.3 \text{ m/s}$ $\vartheta_m - \vartheta_a$ | | | | | | | | | | |
| | | | | | | 0 K | 10 K | 30 K | 50 K | 70 K | 100 K | | | | | |
| | | | | | | W | W | W | W | W | W | | | | | |
| MEGA-Kollektor Segment mit 26 Röhren | | | | | | 159 | 4.33 | 1 983 | 2 184 | 3.87 | 2 122 | 2 095 | 2 040 | 1 985 | 1 930 | 1 848 |
| MEGA-Kollektor Segment mit 78 Röhren | | | | | | 159 | 12.99 | 5 950 | 2 184 | 11.60 | 6 365 | 6 283 | 6 119 | 5 954 | 5 790 | 5 543 |
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| Power output per m² gross area | | | | | | 490 | 484 | 471 | 458 | 446 | 427 | | | | | |
| Performance parameters test method | | Quasi dynamic | | | | | | | | | | | | | | |
| Performance parameters (related to A_G) | | η_0, b | a1 | a2 | a3 | a4 | a5 | a6 | a7 | a8 | Kd | | | | | |
| Units | | - | W/(m ² K) | W/(m ² K ²) | J/(m ³ K) | - | J/(m ² K) | s/m | W/(m ² K ⁴) | W/(m ² K ⁴) | - | | | | | |
| Test results | | 0.483 | 0.63 | 0.000 | 0.000 | 0.00 | 8 136 | 0.000 | 0.00 | 0.0E+00 | 1.10 | | | | | |
| Incidence angle modifier test method | | Quasi dynamic - outdoor | | | | | | | | | | | | | | |
| Incidence angle modifier | | Angle | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° | | | | | |
| Transversal | | $K_{\vartheta T, coll}$ | 1.24 | 1.25 | 1.29 | 1.08 | 1.23 | 1.18 | 1.15 | 0.97 | 0.00 | | | | | |
| Longitudinal | | $K_{\vartheta L, coll}$ | 1.00 | 1.00 | 0.99 | 0.98 | 0.97 | 0.94 | 0.89 | 0.44 | 0.00 | | | | | |
| Heat transfer medium for testing | | | | | | Water | | | | | | | | | | |
| Flow rate for testing (per gross area, A_G) | | | | | | dm/dt | 0.036 | kg/(sm ²) | | | | | | | | |
| Maximum temperature difference during thermal performance test | | | | | | $(\vartheta_m - \vartheta_a)_{max}$ | 70 | K | | | | | | | | |
| Standard stagnation temperature (G = 1000 W/m²; $\vartheta_a = 30^\circ\text{C}$) | | | | | | ϑ_{stg} | 170 | °C | | | | | | | | |
| Maximum operating temperature | | | | | | $\vartheta_{max, op}$ | 180 | °C | | | | | | | | |
| Maximum operating pressure | | | | | | $p_{max, op}$ | 1000 | kPa | | | | | | | | |
| Testing laboratory | | TÜV Rheinland Energy GmbH | | | | www.tuv.com/solarpower | | | | | | | | | | |
| Test report(s) | | 21242732.001rev1 | | | | Dated | | 01.02.2019 | | | | | | | | |
| Comments of testing laboratory | | | | | | Datasheet version: 6.0, 2018-10-30 | | | | | | | | | | |
| The results related to aperture area (as listed above) and hemispherical efficiency with 85% beam and 15 % diffuse irradiance at normal incidence are: $\eta_{0, hem, a} = 0.549$; $a_{1, a} = 0.704$; $a_{2, a} = 0.000$ | | | | | |  Genau. Richtig. TÜV Rheinland Energy GmbH Am Grauen Stein 51105 Köln | | | | | | | | | | |
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|--|---|--------|----------------------|---|-----------------------------------|--------|---------------------------------------|-----------|--------------|------------------------------------|----------|-------|-------|
| Supplementary Information | | | | | | | Issued | | 2019-02-01 | | | | |
| Annual collector output in kWh/collector at mean fluid temperature ϑ_m | | | | | | | | | | | | | |
| | Standard Locations | Athens | | | Davos | | | Stockholm | | | Würzburg | | |
| Collector name | ϑ_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 |
| MEGA-Kollektor Segment mit 26 Röhren | | 4 185 | 3 904 | 3 640 | 3 698 | 3 433 | 3 191 | 2 654 | 2 418 | 2 216 | 2 831 | 2 583 | 2 363 |
| MEGA-Kollektor Segment mit 78 Röhren | | 12 551 | 11 709 | 10 919 | 11 090 | 10 297 | 9 571 | 7 959 | 7 252 | 6 647 | 8 492 | 7 746 | 7 088 |
| Annual output per m ² gross area | | 966 | 901 | 841 | 854 | 793 | 737 | 613 | 558 | 512 | 654 | 596 | 546 |
| Fixed or tracking collector | Fixed (slope = latitude - 15°; rounded to nearest 5°) | | | | | | | | | | | | |
| Annual irradiation on collector plane | 1765 kWh/m ² | | | 1714 kWh/m ² | | | 1166 kWh/m ² | | | 1244 kWh/m ² | | | |
| 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 ϑ_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. 6.0 (October 2018). A detailed description of the calculations is available at www.solarkeymark.org/scenocalc | | | | | | | | | | | | | |
| 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/m ²) > | 1000 | | ϑ_a (°C) > | | 20 | | H _x (MJ/m ²) > | | 600 | | | | |
| Maximum tested positive load | | | | | | | 3000 | | | Pa | | | |
| Maximum tested negative load | | | | | | | 2000 | | | Pa | | | |
| Hail resistance using steel ball (maximum drop height) | | | | | | | 35 | | | m | | | |
| Additional collector attribute(s) | | | | | | | | | | | | | |
| <input type="checkbox"/> Using external power source(s) for normal operation | | | | <input type="checkbox"/> Active or passive measure(s) for self-protection | | | | | | | | | |
| <input type="checkbox"/> Co-generating thermal and electrical power | | | | <input type="checkbox"/> Wind and/or infrared sensitive collector(s) (WISC) | | | | | | | | | |
| <input type="checkbox"/> Façade collector(s) | | | | | | | | | | | | | |
| Energy Labelling Information | | | | | | | | | | | | | |
| | Reference Area, A _{sol} (m ²) | | | | Hydraulic Designation Code | | | | | | | | |
| MEGA-Kollektor Segment mit 26 Röhren | 4.33 | | | | 1-H-12S-C:64,1983 | | | | | | | | |
| MEGA-Kollektor Segment mit 78 Röhren | 12.99 | | | | 1-H-12S-C:64,5949 | | | | | | | | |
| Data required for CDR (EU) No 811/2013 - Reference Area A _{sol} | | | | | | | | | | | | | |
| Collector efficiency (η_{col}) | 46% | | | | Zero-loss efficiency (η_0) | | | | 0.49 | | -- | | |
| Remark: Collector efficiency (η_{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/m ² , expressed in % and rounded to the nearest integer. Deviating from the regulation η_{col} is based on reference area (A _{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017. | | | | First-order coefficient (a ₁) | | | | 0.63 | | W/(m ² K) | | | |
| | | | | Second-order coefficient (a ₂) | | | | 0.000 | | W/(m ² K ²) | | | |
| | | | | Incidence angle modifier IAM (50°) | | | | 1.06 | | -- | | | |
| 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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