## Annex to Solar Keymark Certificate

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|---|---|
| **Licence Number** | **011-7S2927 F** |
| **Date issued** | **2019-06-05** |
| **Issued by** | **DIN CERTCO** |

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|---|---|---|---|
| **Licence holder** | **ECOFER-Oikonomou Z Kostas** | **Country** | Greece |
| **Brand** (optional) | ECOFER | **Web** | www.ecofer.com.gr |
| **Street, Number** | Xanthippou 150 | **E-mail** | kzoik@ecofer.gr |
| **Postcode, City** | 15669 Papagou, Athens | **Tel** | +30 2 106 715 510 |

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

| **Collector name** | **Gross height** | **Gross area ($A_G$)** | **Gross length** | **Gross width** | **Aperture area ($A_a$)** | **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 | 112 K |
| | mm | m² | mm | mm | m² | W | W | W | W | W | W |
| **ECOFER SMARTEVO 20** | 85 | 2.02 | 2 006 | 1 007 | 1.83 | 1 386 | 1 313 | 1 159 | 994 | 817 | 409 |
| **ECOFER SMARTEVO 23** | 85 | 2.24 | 1 893 | 1 183 | 2.03 | 1 537 | 1 457 | 1 286 | 1 102 | 906 | 454 |
| **ECOFER SMARTEVO 25** | 85 | 2.52 | 2 008 | 1 258 | 2.31 | 1 729 | 1 639 | 1 446 | 1 240 | 1 020 | 511 |
| **ECOFER SMARTEVO 27** | 85 | 2.67 | 2 260 | 1 183 | 2.51 | 1 832 | 1 736 | 1 532 | 1 314 | 1 080 | 541 |
| **ECOFER SMARTEVO 29** | 85 | 2.93 | 2 007 | 1 458 | 2.72 | 2 011 | 1 905 | 1 682 | 1 442 | 1 185 | 594 |
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| **Power output per m² gross area** | | | | | | 686 | 650 | 574 | 492 | 405 | 203 |

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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** | 0.687 | 3.53 | 0.007 | 0.000 | 0.00 | 11 515 | 0.000 | 0.00 | 0.0E+00 | 0.99 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **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 | 0.99 | 0.96 | 0.92 | 0.86 | 0.73 | 0.34 | 0.00 |
| **Longitudinal** | $K_{\theta L,coll}$ | 1.00 | 1.00 | 0.99 | 0.96 | 0.92 | 0.86 | 0.73 | 0.34 | 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** | | $(\vartheta_m-\vartheta_a)_{max}$ | 82 K |
| **Standard stagnation temperature (G = 1000 W/m²; $\vartheta_a$ = 30 °C)** | | $\vartheta_{stg}$ | 199 °C |
| **Maximum operating temperature** | | $\vartheta_{max\_op}$ | n.a. °C |
| **Maximum operating pressure** | | $p_{max,op}$ | 1000 kPa |

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| **Testing laboratory** | TZS, ITW University Stuttgart | www.itw.uni-stuttgart.de | |
| **Test report(s)** | 10COL933/3OEM22 | **Dated** | 27.05.2019 |
| | 10COL934/3OEM22 | | 27.05.2019 |
| | 10COL934Q/3OEM22 | | 27.05.2019 |

**Comments of testing laboratory** — Datasheet version: 6.0, 2018-10-30

Documented performance parameters are taken from 10COL933/3OEM22 (ECOFER SMARTEVO 20)

TZS Forschungs- und Testzentrum für Solaranlagen
Institut für Thermodynamik und Wärmetechnik
Universität Stuttgart
Pfaffenwaldring 6, 70550 Stuttgart (Vaihingen)

| Annex to Solar Keymark Certificate | Licence Number | 011-7S2927 F |
|---|---|---|
| Supplementary Information | Issued | 2019-06-05 |

**Annual collector output 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 |
| ECOFER SMARTEVO 20 | 2 256 | 1 592 | 1 048 | 1 694 | 1 166 | 744 | 1 249 | 811 | 496 | 1 367 | 882 | 531 |
| ECOFER SMARTEVO 23 | 2 502 | 1 766 | 1 162 | 1 879 | 1 293 | 825 | 1 385 | 899 | 550 | 1 516 | 978 | 588 |
| ECOFER SMARTEVO 25 | 2 814 | 1 987 | 1 307 | 2 114 | 1 455 | 928 | 1 558 | 1 012 | 618 | 1 706 | 1 100 | 662 |
| ECOFER SMARTEVO 27 | 2 982 | 2 105 | 1 385 | 2 239 | 1 541 | 984 | 1 651 | 1 072 | 655 | 1 807 | 1 165 | 701 |
| ECOFER SMARTEVO 29 | 3 272 | 2 310 | 1 520 | 2 457 | 1 692 | 1 080 | 1 812 | 1 176 | 719 | 1 983 | 1 279 | 770 |
| Annual output per m² gross area | 1 117 | 788 | 519 | 839 | 577 | 368 | 618 | 402 | 245 | 677 | 436 | 263 |
| 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. 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) | | | | | B | -- |
| G (W/m²) > | 900 | $\vartheta_a$ (°C) > | 15 | $H_x$ (MJ/m²) > | | 540 |
| Maximum tested positive load | | | | | 2500 | Pa |
| Maximum tested negative load | | | | | 2250 | Pa |
| Hail resistance using steel ball (maximum drop height) | | | | | n.a. | m |

## Additional collector attribute(s)

- ☐ Using external power source(s) for normal operation
- ☐ Active or passive measure(s) for self-protection
- ☐ Co-generating thermal and electrical power
- ☐ Wind and/or infrared sensitive collector(s) (WISC)
- ☐ Façade collector(s)

## Energy Labelling Information

| | Reference Area, $A_{sol}$ (m²) | Hydraulic Designation Code |
|---|---|---|
| ECOFER SMARTEVO 20 | 2.02 | 8-V-1234S-A:7.2,1894-C:20.6,1060-D |
| ECOFER SMARTEVO 23 | 2.24 | 10-V-1234S-A:7.2,1779-C:20.6,1240-D |
| ECOFER SMARTEVO 25 | 2.52 | 11-V-1234S-A:7.2,1894-C:20.6,1310-D |
| ECOFER SMARTEVO 27 | 2.67 | 10-V-1234S-A:7.2,2149-C:20.6,1240-D |
| ECOFER SMARTEVO 29 | 2.93 | 12-V-1234S-A:7.2,1894-C:20.6,1510-D |

| Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$ | |
|---|---|
| Collector efficiency ($\eta_{col}$) | 53% |

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 ($\eta_0$) | 0.69 | -- |
| First-order coefficient ($a_1$) | 3.53 | W/(m²K) |
| Second-order coefficient ($a_2$) | 0.007 | W/(m²K²) |
| Incidence angle modifier IAM (50°) | 0.93 | -- |

*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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