**ICIM S.p.A. a socio unico**
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Capitale Soc EUR. 260.000,00 int. versato ed esistente
C.F./P. IVA e Iscriz. Reg. Imprese di Milano n. 12908230159 - R.E.A. n. 1596292



## Annex to Solar Keymark Certificate

| | |
|---|---|
| **Licence Number** | **ICIM-CLS-000168** |
| **Date issued** | **2021-06-18** |
| **Issued by** | **ICIM S.p.A.** |

| | | | |
|---|---|---|---|
| **Licence holder** | **ARISTON THERMO S.p.A.** | **Country** | Italy |
| **Brand** (optional) | – | **Web** | www.aristonthermo.com |
| **Street, Number** | Via Cola 27 | **E-mail** | Lorenzo.pucci@aristonthermo.com |
| **Postcode, City** | IT-60027 Osimo (AN) | **Tel** | +39 071 720 02 90 |

| | |
|---|---|
| **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 | 120 K |
| | m² | mm | mm | mm | W | W | W | W | W | W |
| **VN 2.2-2** | 2,19 | 1.100 | 1.994 | 70 | 1.536 | 1.457 | 1.293 | 1.122 | 945 | 469 |
| **Power output per m² gross area** | | | | | 702 | 665 | 591 | 513 | 431 | 214 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Performance parameters test method** | Steady state - outdoor | | | | | | | | | |
| **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** | 0,709 | 3,58 | 0,004 | 0,000 | 0,00 | 4.009 | 0,000 | 0,00 | 0,0E+00 | 0,93 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Incidence angle modifier test method** | | Steady state - 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 | 0,97 | 0,91 | 0,79 | 0,54 | 0,00 |
| **Longitudinal** | $K_{\theta L,coll}$ | 1,00 | 1,00 | 1,00 | 0,99 | 0,97 | 0,91 | 0,79 | 0,54 | 0,00 |

| | | | |
|---|---|---|---|
| **Heat transfer medium for testing** | Water-Glycole | | |
| **Flow rate for testing (per gross area, $A_G$)** | dm/dt | 0,020 | kg/(sm²) |
| **Maximum temperature difference during thermal performance test** | $(\vartheta_m-\vartheta_a)_{max}$ | 90 | K |
| **Standard stagnation temperature (G = 1000 W/m²; $\vartheta_a$ = 30 °C)** | $\vartheta_{stg}$ | 210 | °C |
| **Maximum operating temperature** | $\vartheta_{max_op}$ | 160 | °C |
| **Maximum operating pressure** | $p_{max,op}$ | 600 | kPa |

| | | | |
|---|---|---|---|
| **Testing laboratory** | SPF Institute for Solar Technology | www.spf.ch | |
| **Test report(s)** | C1855ISO | **Dated** | 18/06/2021 |

**Comments of testing laboratory**

Datasheet version: 6.1, 2019-09-26

SPF INSTITUT FÜR SOLARTECHNIK

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|---|---|---|
| **Supplementary Information** | **Issued** | **2021-06-18** |

**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 |
| VN 2.2-2 | | 2.496 | 1.784 | 1.214 | 1.890 | 1.334 | 895 | 1.389 | 921 | 589 | 1.513 | 996 | 627 |
| Annual output per m² gross area | | 1.140 | 815 | 554 | 863 | 609 | 409 | 634 | 420 | 269 | 691 | 455 | 286 |
| Annual efficiency, $\eta_a$ | | 65% | 46% | 31% | 53% | 37% | 25% | 54% | 36% | 23% | 56% | 37% | 23% |
| 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. 6.1 (September 2019). 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 | | | | | 2800 | Pa |
| Maximum tested negative load | | | | | 2400 | Pa |
| Hail resistance using ice balls (diameter) | | | | | 35 | mm |

## 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
- ☐ Façade collector(s)

## Energy Labelling Information

| | Reference Area, $A_{sol}$ (m²) |
|---|---|
| VN 2.2-2 | 2,19 |

## Additional Informative Technical Data

| Hydraulic Designation Code | Aperture Area, $A_a$ (m²) |
|---|---|
| 16-V-1234S-A:5.2,970-C:16.4,1995-D | 2,01 |

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

| | |
|---|---|
| Collector efficiency ($\eta_{col}$) | 55% |

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 ($\eta_0$) | 0,70 | -- |
| First-order coefficient ($a_1$) | 3,58 | W/(m²K) |
| Second-order coefficient ($a_2$) | 0,004 | W/(m²K²) |
| Incidence angle modifier IAM (50°) | 0,97 | -- |

*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.*