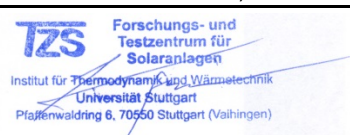


| Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results | | | | | | Licence Number | | 011-7S206 R | | | | |
|--|--|--------------------|-----------------------------------|----------------------|--|---|-----------|---------------------------------|-----------|------------|------|------|
| | | | | | | Date issued | | 2016-11-29 | | | | |
| | | | | | | Issued by | | DIN CERTCO | | | | |
| Licence holder | | | IVT GmbH & Co. KG | | | Country | | Deutschland | | | | |
| Brand (optional) | | | | | | Web | | www.ivt-rohr.de | | | | |
| Street, Number | | | Gewerbering Nord 5 | | | E-mail | | info@ivt-rohr.de | | | | |
| Postcode, City | | | 91198 Rohr | | | Tel | | +49 9876 9786-64 ; 9876 9786-69 | | | | |
| Collector Type | | | | | | Evacuated tubular collector | | | | | | |
| Collector name | Gross area (A _G) m ² | Gross length mm | Gross width mm | Gross height mm | Power output per collector G _b = 850 W/m ² ; G _d = 150 W/m ² θ _m - θ _a | | | | | | | |
| | | | | | 0 K W | 10 K W | 30 K W | 50 K W | 70 K W | 104 K W | | |
| Latento CPC 12 | 2.29 | 1 640 | 1 397 | 103 | 1 287 | 1 271 | 1 234 | 1 189 | 1 137 | 1 032 | | |
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| Power output per m ² gross area | | | | | 562 | 555 | 539 | 519 | 497 | 451 | | |
| Performance parameters test method | | | Steady state - outdoor | | | | | | | | | |
| Performance parameters (related to AG) | | | η _{0,hem} | a ₁ | a ₂ | | | | | | | |
| Units | | | - | W/(m ² K) | W/(m ² K ²) | | | | | | | |
| Test results | | | 0.562 | 0.654 | 0.004 | | | | | | | |
| Incidence angle modifier test method | | | Quasi dynamic - outdoor | | | | | | | | | |
| Bi-directional incidence angle modifiers | | | Yes | | | | | | | | | |
| Incidence angle modifier | | | Angle | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
| Transversal | | | K _{θT, coll} | 1.01 | 1.01 | 1.02 | 1.02 | 0.98 | 1.05 | 1.14 | 0.57 | 0.00 |
| Longitudinal | | | K _{θL, coll} | 1.00 | 1.00 | 0.99 | 0.98 | 0.95 | 0.89 | 0.76 | 0.38 | 0.00 |
| Heat transfer medium for testing | | | | | | Water | | | | | | |
| Flow rate for testing (per gross area, A _G) | | | | | | dm/dt | 0.020 | kg/(sm ²) | | | | |
| Maximum temperature difference for thermal performance calculations | | | | | | (θ _m -θ _a) _{max} | 104 | K | | | | |
| Standard stagnation temperature (G = 1000 W/m ² ; θ _a = 30 °C) | | | | | | θ _{stg} | 301 | °C | | | | |
| Effective thermal capacity, incl. fluid (per gross area, A _G) | | | | | | C/m ² | 8.017 | kJ/(Km ²) | | | | |
| Maximum operating temperature | | | | | | θ _{max, op} | 160 | °C | | | | |
| Maximum operating pressure | | | | | | p _{max, op} | 1000 | kPa | | | | |
| Testing laboratory | | | TZS, ITW University Stuttgart | | | www.itw.uni-stuttgart.de | | | | | | |
| Test report(s) | | | 14COL1031OEM04 14COL1032QOEM04 | | | Dated | | 28.11.2016 28.11.2016 | | | | |
| Comments of testing laboratory | | | | | | Datasheet version: 5.01, 2016-03-01 | | | | | | |
| This data sheet replaces the data sheet issued on 07.12.2015 Data sheet based on results of test report 06COL456 (18.07.2006) 011-7S089 R The data sheet is issued on the newest version 5.01 | | | | | |  | | | | | | |
| DIN CERTCO • Alboinstraße 56 • 12103 Berlin, Germany Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dincertco.de | | | | | | | | | | | | |

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|---|-----------------------|--------------------|
| Annex to Solar Keymark Certificate Supplementary Information | Licence Number | 011-7S206 R |
| | Issued | 2016-11-29 |

Annual collector output in kWh/collector at mean fluid temperature ϑ_m , based on ISO 9806:2013 test results

| Standard Locations | ϑ_m | Athens | | | Davos | | | Stockholm | | | Würzburg | | |
|---|---------------|---|-------|-------|-------------------------|-------|-------|-------------------------|-------|-------|-------------------------|-------|-------|
| | | 25°C | 50°C | 75°C | 25°C | 50°C | 75°C | 25°C | 50°C | 75°C | 25°C | 50°C | 75°C |
| Collector name | | | | | | | | | | | | | |
| Latento CPC 12 | | 2 222 | 2 040 | 1 830 | 1 946 | 1 754 | 1 547 | 1 397 | 1 235 | 1 071 | 1 499 | 1 329 | 1 153 |
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| Annual output per m ² gross area | | 970 | 891 | 799 | 850 | 766 | 676 | 610 | 539 | 468 | 654 | 580 | 503 |
| 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. 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 | 2250 | Pa |
| Maximum tested negative load | 1500 | Pa |
| Hail resistance using ice balls (diameter) | 35 | mm |

Energy Labelling Information

| | Reference Area, A_{sol} (m ²) | Data required for CDR (EU) No 811/2013 - Reference Area A_{sol} | |
|----------------|---|--|--|
| Latento CPC 12 | 2.29 | Collector efficiency (η_{col}) | 53 % |
| | | 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 9806:2013. | |
| | | Data required for CDR (EU) No 812/2013 - Reference Area A_{sol} | |
| | | Zero-loss efficiency (η_0) | 0.562 -- |
| | | First-order coefficient (a_1) | 0.65 W/(m ² K) |
| | | Second-order coefficient (a_2) | 0.004 W/(m ² K ²) |
| | | Incidence angle modifier IAM (50°) | 1.00 -- |
| | | 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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|--|------------------------------|--|--|--|--|--|------------------------------------|------------|--------------------------|------------|-------|-------|-------|-------|
| Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results | | | | | Licence Number | | 011-7S206 R | | | | | | | |
| | | | | | Date issued | | 2016-11-29 | | | | | | | |
| | | | | | Issued by | | DIN CERTCO | | | | | | | |
| Licence holder | IVT GmbH & Co. KG | | | | Country | Deutschland | | | | | | | | |
| Brand (optional) | | | | | Web | www.ivt-rohr.de | | | | | | | | |
| Street, Number | Gewerbering Nord 5 | | | | E-mail | info@ivt-rohr.de | | | | | | | | |
| Postcode, City | 91198 Rohr | | | | Tel | +49 9876 9786-64 ; 9876 9786-69 | | | | | | | | |
| Collector Type | | | | | Evacuated tubular collector | | | | | | | | | |
| Collector name | | | | | Power output per collector Gb = 850 W/m ² ; Gd = 150 W/m ² $\vartheta_m - \vartheta_a$ | | | | | | | | | |
| | | | | | 0 K | 10 K | 30 K | 50 K | 70 K | 104 K | | | | |
| | | | | | W | W | W | W | W | W | | | | |
| Latento CPC 18 | | | | | 3.42 | 1 640 | 2 087 | 103 | 1 932 | 1 908 | 1 853 | 1 786 | 1 708 | 1 551 |
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| Power output per m² gross area | | | | | 565 | 558 | 542 | 522 | 499 | 453 | | | | |
| Performance parameters test method | | | | | Steady state - outdoor | | | | | | | | | |
| Performance parameters (related to AG) | | | | | $\eta_{0,hem}$ | a1 | a2 | | | | | | | |
| Units | | | | | - | W/(m ² K) | W/(m ² K ²) | | | | | | | |
| Test results | | | | | 0.565 | 0.657 | 0.004 | | | | | | | |
| Incidence angle modifier test method | | | | | Quasi dynamic - outdoor | | | | | | | | | |
| Bi-directional incidence angle modifiers | | | | | Yes | | | | | | | | | |
| Incidence angle modifier | | | | | Angle | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
| Transversal | | | | | $K_{\theta T, coll}$ | 1.01 | 1.01 | 1.02 | 1.02 | 0.98 | 1.05 | 1.14 | 0.57 | 0.00 |
| Longitudinal | | | | | $K_{\theta L, coll}$ | 1.00 | 1.00 | 0.99 | 0.98 | 0.95 | 0.89 | 0.76 | 0.38 | 0.00 |
| Heat transfer medium for testing | | | | | Water | | | | | | | | | |
| Flow rate for testing (per gross area, A_G) | | | | | dm/dt | 0.020 | kg/(sm ²) | | | | | | | |
| Maximum temperature difference for thermal performance calculations | | | | | $(\vartheta_m - \vartheta_a)_{max}$ | 104 | K | | | | | | | |
| Standard stagnation temperature (G = 1000 W/m²; $\vartheta_a = 30^\circ\text{C}$) | | | | | ϑ_{stg} | 301 | °C | | | | | | | |
| Effective thermal capacity, incl. fluid (per gross area, A_G) | | | | | C/m ² | 8.053 | kJ/(Km ²) | | | | | | | |
| Maximum operating temperature | | | | | $\vartheta_{max, op}$ | 160 | °C | | | | | | | |
| Maximum operating pressure | | | | | $p_{max, op}$ | 1000 | kPa | | | | | | | |
| Testing laboratory | | | | | TZS, ITW University Stuttgart | | www.itw.uni-stuttgart.de | | | | | | | |
| Test report(s) | | | | | 14COL1031OEM04 14COL1032QOEM04 | | Dated | | 28.11.2016 28.11.2016 | | | | | |
| Comments of testing laboratory | | | | | Datashet version: 5.01, 2016-03-01 | | | | | | | | | |
| This data sheet replaces the data sheet issued on 07.12.2015 Data sheet based on results of test report 06COL456 (18.07.2006) 011-7S089 R The data sheet is issued on the newest version 5.01 | | | | |  Forschungs- und Testzentrum für Solaranlagen Institut für Thermodynamik und Wärmelehre Universität Stuttgart Pfaffenwaldring 6, 70560 Stuttgart (Vaihingen) | | | | | | | | | |
| DIN CERTCO • Alboinstraße 56 • 12103 Berlin, Germany Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dincertco.de | | | | | | | | | | | | | | |

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| Annex to Solar Keymark Certificate Supplementary Information | Licence Number | 011-7S206 R |
| | Issued | 2016-11-29 |

Annual collector output in kWh/collector at mean fluid temperature ϑ_m , based on ISO 9806:2013 test results

| Standard Locations | ϑ_m | Athens | | | Davos | | | Stockholm | | | Würzburg | | |
|---|---------------|---|-------|-------|-------------------------|-------|-------|-------------------------|-------|-------|-------------------------|-------|-------|
| | | 25°C | 50°C | 75°C | 25°C | 50°C | 75°C | 25°C | 50°C | 75°C | 25°C | 50°C | 75°C |
| Collector name | | | | | | | | | | | | | |
| Latento CPC 18 | | 3 337 | 3 063 | 2 749 | 2 922 | 2 634 | 2 324 | 2 097 | 1 855 | 1 609 | 2 250 | 1 996 | 1 732 |
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| Annual output per m ² gross area | | 976 | 896 | 804 | 854 | 770 | 680 | 613 | 542 | 471 | 658 | 584 | 506 |
| 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. 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 | 2250 | Pa |
| Maximum tested negative load | 1500 | Pa |
| Hail resistance using ice balls (diameter) | 35 | mm |

Energy Labelling Information

| | Reference Area, A_{sol} (m ²) | Data required for CDR (EU) No 811/2013 - Reference Area A_{sol} | |
|----------------|---|--|--|
| Latento CPC 18 | 3.42 | Collector efficiency (η_{col}) | 53 % |
| | | <i>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/m², 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 9806:2013.</i> | |
| | | Data required for CDR (EU) No 812/2013 - Reference Area A_{sol} | |
| | | Zero-loss efficiency (η_0) | 0.565 -- |
| | | First-order coefficient (a_1) | 0.66 W/(m ² K) |
| | | Second-order coefficient (a_2) | 0.004 W/(m ² K ²) |
| | | Incidence angle modifier IAM (50°) | 1.00 -- |
| | | <i>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.</i> | |