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|--|--|-----------------------|--|--|--|----------------------|------------------------------------|--------------------------|--|--------------------------|-------|-------|------|-------|
| Annex to Solar Keymark Certificate -<br>Summary of EN ISO 9806:2013 Test Results   |  |                       |  |  | Licence Number   |                      | 011-7S1567 F                       |                          |  |                          |       |       |      |       |
|  |  |                       |  |  | Date issued  |                      | 2017-02-27                         |                          |  |                          |       |       |      |       |
|  |  |                       |  |  | Issued by  |                      | DIN CERTCO                         |                          |  |                          |       |       |      |       |
| Licence holder   |  | ATTACK, s.r.o         |  |  | Country  |                      | Slowakei                           |                          |  |                          |       |       |      |       |
| Brand (optional)   |  |                       |  |  | Web  |                      | www.attack.sk                      |                          |  |                          |       |       |      |       |
| Street, Number   |  | Dielenska Kruzna 5020 |  |  | E-mail   |                      | vitkovska@attack.sk                |                          |  |                          |       |       |      |       |
| Postcode, City   |  | 038 61 Vruty          |  |  | Tel  |                      | +421 434 003 130                   |                          |  |                          |       |       |      |       |
| Collector Type   |  |                       |  |  | Flat plate collector, glazed   |                      |                                    |                          |  |                          |       |       |      |       |
| Collector name   |  |                       |  |  | Gross area (A <sub>G</sub> )   | Gross length         | Gross width                        | Gross height             | Power output per collector<br>G <sub>b</sub> = 850 W/m <sup>2</sup> ; G <sub>d</sub> = 150 W/m <sup>2</sup><br>ϑ <sub>m</sub> - ϑ <sub>a</sub> |                          |       |       |      |       |
|  |  |                       |  |  | m <sup>2</sup>   | mm                   | mm                                 | mm                       | 0 K  | 10 K                     | 30 K  | 50 K  | 70 K | 100 K |
| ATTACK SOLARTHERM HSA 200  |  |                       |  |  | 2.03   | 1 731                | 1 170                              | 83                       | 1 527  | 1 445                    | 1 273 | 1 087 | 889  | 567   |
| Power output per m <sup>2</sup> gross area   |  |                       |  |  | 752  | 712                  | 627                                | 536                      | 438  | 279                      |       |       |      |       |
| Performance parameters test method   |  |                       |  |  | Steady state - indoor  |                      |                                    |                          |  |                          |       |       |      |       |
| Performance parameters (related to A <sub>G</sub> )  |  |                       |  |  | η <sub>0,hem</sub>   | a <sub>1</sub>       | a <sub>2</sub>                     |                          |  |                          |       |       |      |       |
| Units  |  |                       |  |  | -  | W/(m <sup>2</sup> K) | W/(m <sup>2</sup> K <sup>2</sup> ) |                          |  |                          |       |       |      |       |
| Test results   |  |                       |  |  | 0.752  | 3.927                | 0.008                              |                          |  |                          |       |       |      |       |
| Incidence angle modifier test method   |  |                       |  |  | Steady state - indoor  |                      |                                    |                          |  |                          |       |       |      |       |
| Bi-directional incidence angle modifiers   |  |                       |  |  | No   |                      |                                    |                          |  |                          |       |       |      |       |
| Incidence angle modifier   |  |                       |  |  | Angle  | 10°                  | 20°                                | 30°                      | 40°  | 50°                      | 60°   | 70°   | 80°  | 90°   |
| Transversal  |  |                       |  |  | K <sub>θT, coll</sub>  | -                    | -                                  | -                        | -  | 0.98                     | -     | -     | -    | 0.00  |
| Longitudinal   |  |                       |  |  | K <sub>θL, coll</sub>  | -                    | -                                  | -                        | -  | 0.98                     | -     | -     | -    | 0.00  |
| Heat transfer medium for testing   |  |                       |  |  | Water  |                      |                                    |                          |  |                          |       |       |      |       |
| Flow rate for testing (per gross area, A <sub>G</sub> )  |  |                       |  |  | dm/dt  |                      | 0.019                              | kg/(sm <sup>2</sup> )    |  |                          |       |       |      |       |
| Maximum temperature difference for thermal performance calculations  |  |                       |  |  | (ϑ <sub>m</sub> -ϑ <sub>a</sub> ) <sub>max</sub>   |                      | 100                                | K                        |  |                          |       |       |      |       |
| Standard stagnation temperature (G = 1000 W/m <sup>2</sup> ; ϑ <sub>a</sub> = 30 °C)   |  |                       |  |  | ϑ <sub>stg</sub>   |                      | 184                                | °C                       |  |                          |       |       |      |       |
| Effective thermal capacity, incl. fluid (per gross area, A <sub>G</sub> )  |  |                       |  |  | C/m <sup>2</sup>   |                      | 5.485                              | kJ/(Km <sup>2</sup> )    |  |                          |       |       |      |       |
| Maximum operating temperature  |  |                       |  |  | ϑ <sub>max, op</sub>   |                      | n.a.                               | °C                       |  |                          |       |       |      |       |
| Maximum operating pressure   |  |                       |  |  | p <sub>max, op</sub>   |                      | 1000                               | kPa                      |  |                          |       |       |      |       |
| Testing laboratory   |  |                       |  |  | TZS, ITW University Stuttgart  |                      |                                    | www.itw.uni-stuttgart.de |  |                          |       |       |      |       |
| Test report(s)   |  |                       |  |  | 2.04.00750.1.0-1-LT(3) issued by AIT<br>2.04.00750.1.0-1-QT(3) issued by AIT   |                      |                                    | Dated                    |  | 22.03.2011<br>22.03.2011 |       |       |      |       |
| Comments of testing laboratory   |  |                       |  |  | Datashet version: 5.01, 2016-03-01   |                      |                                    |                          |  |                          |       |       |      |       |
| This data sheet replaces the data sheet issued from AIT on 08.04.2011<br>Documented performance parameters are taken from 2.04.00750.1.0-1-LT(3) |  |                       |  |  |  <b>TZS</b> Forschungs- und Testzentrum für Solaranlagen<br><small>Institut für Thermodynamik und Wärmetechnik<br/>         Universität Stuttgart<br/>         Pfaffenwaldring 6, 70550 Stuttgart (Vaihingen)</small> |                      |                                    |                          |  |                          |       |       |      |       |
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| Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dincertco.de   |  |                       |  |  |  |                      |                                    |                          |  |                          |       |       |      |       |

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| <b>Annex to Solar Keymark Certificate</b><br><b>Supplementary Information</b> | <b>Licence Number</b> | <b>011-7S1567 F</b> |
|   | <b>Issued</b>         | <b>2017-02-27</b>   |

| Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$ , based on ISO 9806:2013 test results |               |   |       |       |                         |       |      |                         |      |      |                         |      |      |
|--|---------------|---|-------|-------|-------------------------|-------|------|-------------------------|------|------|-------------------------|------|------|
| 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 |
| ATTACK SOLARTHERM HSA 200  |               | 2 523   | 1 780 | 1 167 | 1 889                   | 1 297 | 821  | 1 402                   | 904  | 548  | 1 528                   | 982  | 585  |
|  |               |   |       |       |                         |       |      |                         |      |      |                         |      |      |
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|  |               |   |       |       |                         |       |      |                         |      |      |                         |      |      |
| Annual output per m <sup>2</sup> gross area  |               | 1 243   | 877   | 575   | 931                     | 639   | 405  | 691                     | 445  | 270  | 753                     | 484  | 288  |
| Fixed or tracking collector  |               | Fixed (slope = latitude - 15°; rounded to nearest 5°) |       |       |                         |       |      |                         |      |      |                         |      |      |
| Annual irradiation on collector plane  |               | 1765 kWh/m <sup>2</sup>                               |       |       | 1714 kWh/m <sup>2</sup> |       |      | 1166 kWh/m <sup>2</sup> |      |      | 1244 kWh/m <sup>2</sup> |      |      |
| 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  $\vartheta_m$  (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](http://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)   | C             | -- |
| Maximum tested positive load  | 1000          | Pa |
| Maximum tested negative load  | 1000          | Pa |
| Hail resistance using steel ball (maximum drop height)  | n.a.          | m  |

| Energy Labelling Information |   |  |  |
|------------------------------|---|--|--|
|                              | Reference Area, $A_{sol}$ (m <sup>2</sup> ) | Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$  |  |
| ATTACK SOLARTHERM HSA 200    | 2.03  | Collector efficiency ( $\eta_{col}$ )  | 58 %                                     |
|                              |   | <i>Remark: Collector efficiency (<math>\eta_{col}</math>) 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<sup>2</sup>, expressed in % and rounded to the nearest integer. Deviating from the regulation <math>\eta_{col}</math> is based on reference area (<math>A_{sol}</math>) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.</i> |  |
|                              |   | <b>Data required for CDR (EU) No 812/2013 - Reference Area <math>A_{sol}</math></b>  |  |
|                              |   | Zero-loss efficiency ( $\eta_0$ )  | 0.752 --                                 |
|                              |   | First-order coefficient ( $a_1$ )  | 3.93 W/(m <sup>2</sup> K)                |
|                              |   | Second-order coefficient ( $a_2$ )   | 0.008 W/(m <sup>2</sup> K <sup>2</sup> ) |
|                              |   | Incidence angle modifier IAM (50°)   | 0.98 --                                  |
|                              |   | <i>Remark: The data given in this section are related to collector reference area (<math>A_{sol}</math>) 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>  |  |