| Summary of EN 12975 Test Results, annex to Solar KEYMARK Certificate | | Licence Number | 011-7S659 F |
|---|---|---|---|
| | | Issued | 2016-05-02 |

| | | | | |
|---|---|---|---|---|
| Company holding the | Thüsolar GmbH | | Country | Deutschland |
| Brand (optional) | | | Website | www.thuesolar.de |
| Street, street number | Doktor-Hermann-Ludewig-Ring 2 | | E-mail | info@thuesolar.de |
| Postal Code / City, province | 07407 | Rudolstadt | Tel/Fax | +49 3672 357-002 / -004 |

| | |
|---|---|
| Collector Type (flat plate glazed/un-glazed; evacuate tubular) | Flat plate collector - glazed |
| Thermal / photo voltaic hybid collector? (PVT collector) | No |
| Integration in the roof possible ? (manufacturers declaration) | No |

| Collector name | Aperture area (Aa) | Gross length | Gross width | Gross height | Gross area (AG) | Power output per collector module G = 1000 W/m² Tm-Ta 0 K | 10 K | 30 K | 50 K | 70 K |
|---|---|---|---|---|---|---|---|---|---|---|
| | m² | mm | mm | mm | m² | W | W | W | W | W |
| Thüsol S | 1.87 | 2 038 | 1 043 | 87 | 2.12 | 1 421 | 1 349 | 1 194 | 1 026 | 844 |

| | | | | |
|---|---|---|---|---|
| Performance test method | Glazed liquid heating collector - steady state - outdoor | | | |
| Performance parameters related to aperture area | η0 | a1 | a2 | |
| Units | - | W/(m²K) | W/(m²K²) | |
| Test results - Flow rate and fluid see note 1 | 0.760 | 3.779 | 0.009 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bi-directional incidence angle modifiers? | No | *Kϑ values are obligatory for 50°.* | | | | | | | | | |
| Incidence angle modifiers Kθ(θ) | Angle | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° |
| | Kθ(θ) | 1.00 | 0.99 | 0.97 | 0.40 | 0.90 | 0.82 | 0.64 | 0.12 | 0.00 |
| Incidence angle modifier not bi-directional - leave fields blank | | | | | | | | | | |

| | | | |
|---|---|---|---|
| Stagnation temperature - Weather conditions see note 2 | Tstg | 193 | °C |
| Effective thermal capacity | ceff = C/Ag | 10.54 | kJ/(m²K) |
| Max. intende operation temperature - see note 3 | Tmax,op | 193 | °C |
| Max. operation pressure - see note 3 | pmax,op | 600 | kPa |

Pressure drop table - for a collector family, the values shall be for the module with highest ΔP per m² aperture area

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow rate | kg/(s m²) | - | - | - | - | - | - | - | - | - | - |
| Pressure drop, ΔP | Pa | - | - | - | - | - | - | - | - | - | - |

| | | | | |
|---|---|---|---|---|
| Optional weather data | Location | | Link | |
| Testing Laboratory | TZS, ITW University Stuttgart | | | |
| Website | http://www.itw.uni-stuttgart.de | | | |
| Test report id. number | 09COL776 | | Date of test report | 2009.08.06 |
| During the test GDIF/GTOT was always between | 0 | and | 1 | |

**Comments of testing laboratory:**

This data sheet replaces the data sheet issued on 06.08.2009

The data sheet is issued on the newest version 4.06.

| | | | | | |
|---|---|---|---|---|---|
| *Note 1* | Flow rate | 0.017 | kg/(s m²) | Fluid | Water |
| *Note 2* | Irradiance, G = 1000 W/m²; Ambient temperature , Ta=30 °C | | | | |
| *Note 3* | Given by manufacturer | | | | |

Datasheet version: 4.06, 2014-01-15

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| Annual collector output based on EN 12975 Test Results, annex to Solar KEYMARK Certificate | Licence Number | 011-7S659 F |
|---|---|---|
| | Issued | 02.05.2016 |

**Annual collector output kWh/module**

| Collector name | Location and collector temperature (Tm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 |
| Thüsol S | 1 911 | 1 286 | 806 | 1 362 | 894 | 552 | 1 055 | 668 | 397 | 1 119 | 690 | 405 |

| Collector mounting: Fixed or tracking | Fixed; slope = latitude - 15° (rounded to nearest 5°) |
|---|---|

**Overview of locations**

| Location | Latitude ° | Gtot kWh/m² | Ta °C | Collector orientation or tracking mode |
|---|---|---|---|---|
| Athens | 38 | 1 765 | 18.5 | South, 25° |
| Davos | 47 | 1 714 | 3.2 | South, 30° |
| Stockholm | 59 | 1 166 | 7.5 | South, 45° |
| Würzburg | 50 | 1 244 | 9.0 | South, 35° |

| | | |
|---|---|---|
| Gtot | Annual total irradiation on collector plane | kWh/m² |
| Ta | Mean annual ambient air temperature | °C |
| Tm | Constant collector operating temperature (mean of in- and outlet temperatures) | °C |

The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool ScenoCalc. The collector output is calculated hour by hour according to the efficiency parameters from the Keymark test using constant collector operating temperature (Tm). A detailed description of the calculations is available at http://www.sp.se/en/index/services/solar/ScenoCalc/Sidor/default.aspx.

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Datasheet version: 4.06, 2014-01-15
ScenoCalc version: Ver. 4.06 (Jan, 2014)