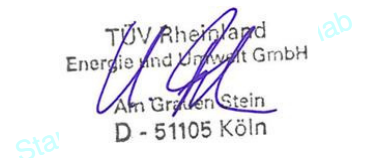


| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--|--------------------------|--|--|--|-----------------------------|---|-----------------------------|---|-------------------|-------------------------------|--------------------|--------------------|--------------------|------|--|------|--|------|--|------|--|------|--|
| Summary of EN 12975 Test Results, annex to Solar KEYMARK Certificate | | | | | | Certificate No. | | 011-7S1935 R | | | | | | | | | | | | | | | | | |
| | | | | | | Date of issue | | 25 June 2012 | | | | | | | | | | | | | | | | | |
| Company | | | Kingspan Renewables Ltd. | | | Country | | Northern Ireland; Unite | | | | | | | | | | | | | | | | | |
| Brand (optional) | | | 0 | | | Website | | www.kingspansolar.com | | | | | | | | | | | | | | | | | |
| Street, number | | | 180 Gilford Road | | | E-mail | | info@kingspansolar.com | | | | | | | | | | | | | | | | | |
| Postal Code | | | BT 63 5LF | | | Tel. | | +44 | | (0)28 3836 4500 | | | | | | | | | | | | | | | |
| City | | | Portadown, Co. Armagh | | | Fax | | +44 | | (0)28 3836 4501 | | | | | | | | | | | | | | | |
| Collector Type (flat plate / evacuate tubular / un-glazed) | | | | | | Evacuated tubular collector | | | | | | | | | | | | | | | | | | | |
| Integration in the roof possible ? | | | | | | No | | | | | | | | | | | | | | | | | | | |
| | | | | | | Power output per collector unit | | | | | | | | | | | | | | | | | | | |
| | | | | | | G = 1000 W/m ² Tm-Ta : | | | | | | 0 K | 10 K | 30 K | 50 K | 70 K | | | | | | | | | |
| Collector name | | | | | | Aperture area (Aa) [m ²] | Gross length [mm] | Gross width [mm] | Gross height [mm] | Gross area (AG) [m ²] | 0 K [W] | 10 K [W] | 30 K [W] | 50 K [W] | 70 K [W] | | | | | | | | | | |
| varisol HP135 | | | | | | 0,11 | 1.965 | 71 | 80 | 0,14 | 83 | 81 | 76 | 70 | 64 | | | | | | | | | | |
| varisol HP135 (for 10 tubes) | | | | | | 1,06 | 1.965 | 710 | 80 | 1,40 | 830 | 807 | 757 | 702 | 641 | | | | | | | | | | |
| varisol HP135 (for 20 tubes) | | | | | | 2,13 | 1.965 | 1.420 | 80 | 2,79 | 1.660 | 1.614 | 1.514 | 1.403 | 1.283 | | | | | | | | | | |
| varisol HP135 (for 30 tubes) | | | | | | 3,19 | 1.965 | 2.130 | 80 | 4,19 | 2.490 | 2.420 | 2270 | 2.105 | 1.924 | | | | | | | | | | |
| varisol HP135 (for 40 tubes) | | | | | | 4,26 | 1.965 | 2.840 | 80 | 5,58 | 3.320 | 3.227 | 3027 | 2.806 | 2.565 | | | | | | | | | | |
| varisol HP135 (for 50 tubes) | | | | | | 5,32 | 1.965 | 3.550 | 80 | 6,98 | 4.150 | 4.034 | 3784 | 3.508 | 3.207 | | | | | | | | | | |
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| Collector efficiency parameters related to aperture area (Aa) | | | | | | η_{0a} | | 0,780 | | - | | | | | | | | | | | | | | | |
| Type of fluid and flow rate see note 1 | | | | | | a_{1a} | | 2,112 | | W/(m ² K) | | | | | | | | | | | | | | | |
| | | | | | | a_{2a} | | 0,006 | | W/(m ² K ²) | | | | | | | | | | | | | | | |
| Stagnation temperature - Weather conditions see note 2 | | | | | | t _{stg} | | 192 | | °C | | | | | | | | | | | | | | | |
| Effective thermal capacity | | | | | | C _{eff} = C/Aa | | 4,74 | | kJ/(m ² K) | | | | | | | | | | | | | | | |
| Max. operation pressure - see note 3 | | | | | | p _{max} | | 600 | | kPa | | | | | | | | | | | | | | | |
| Incidence angle modifiers K_θ(θ) | | | | | | G _{DIF} /G _{TOT} | | θ _T / θ _L | | 50° | | 10° | | 20° | | 30° | | 40° | | 60° | | 70° | | | |
| | | | | | | min | | max | | K _θ (θ _T) | | 0,96 | | 1,00 | | 1,02 | | 1,06 | | 1,05 | | 0,88 | | 0,72 | |
| G _{DIF} /G _{TOT} : min&max - while measuring | | | | | | 0,08 | | 0,15 | | K _θ (θ _L) | | 0,97 | | 1,00 | | 1,00 | | 0,99 | | 0,98 | | 0,94 | | 0,89 | |
| | | | | | | <i>Optional values</i> | | | | | | | | | | | | | | | | | | | |
| Testing Laboratory | | | | | | TÜV Energie und Umwelt GmbH | | | | | | | | | | | | | | | | | | | |
| Website | | | | | | www.eco-tuv.de | | | | | | | | | | | | | | | | | | | |
| Test report id. number | | | | | | 21218850_P1_HP135; 21218850a_R | | | | | | | | | | | | | | | | | | | |
| Date of test report | | | | | | 25 June 2012 (both) | | | | | | | | | | | | | | | | | | | |
| Perf. test method | | | | | | EN 12975-2 6.3 (outdoor) | | | | | | | | | | | | | | | | | | | |
| Comments of testing laboratory : | | | | | | This collector is using a temperature limiter for stagnation protection. | | | | | | | | | | | | | | | | | | | |
| | | | | | | The special construction allows to put a various number of tubes together. The tube itself could be seen as collector. | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| Note 1 | | | | | | Fluid | | Water | | Flow rate | | 0,026 kg/s per m ² | | | | | | | | | | | | | |
| Note 2 | | | | | | Irradiance, G_s=1000 W/m² | | Ambient temperature, T_a=30 °C | |  | | | | | | | | | | | | | | | |
| Note 3 | | | | | | Given by manufacturer | | | | | | | | | | | | | | | | | | | |



**Annual collector output based on EN 12975 Test Results,
annex to Solar KEYMARK Certificate**

Certificate No.

011-7S1935 R

Issued

25 June 2012

Annual collector output kWh

| Collector name | Location and collector temperature (T _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 |
| varisol HP135 | 139 | 115 | 93 | 122 | 100 | 80 | 83 | 65 | 50 | 89 | 70 | 54 |
| varisol HP135 (for 10 tubes) | 1.386 | 1.153 | 931 | 1.220 | 1.003 | 796 | 826 | 650 | 501 | 892 | 704 | 538 |
| varisol HP135 (for 20 tubes) | 2.772 | 2.306 | 1.862 | 2.441 | 2.006 | 1.592 | 1.651 | 1.301 | 1.002 | 1.785 | 1.407 | 1.075 |
| varisol HP135 (for 30 tubes) | 4.159 | 3.458 | 2.793 | 3.661 | 3.009 | 2.387 | 2.477 | 1.951 | 1.503 | 2.677 | 2.111 | 1.613 |
| varisol HP135 (for 40 tubes) | 5.545 | 4.611 | 3.725 | 4.882 | 4.013 | 3.183 | 3.302 | 2.601 | 2.004 | 3.570 | 2.815 | 2.151 |
| varisol HP135 (for 50 tubes) | 6.931 | 5.764 | 4.656 | 6.102 | 5.016 | 3.979 | 4.128 | 3.252 | 2.505 | 4.462 | 3.518 | 2.689 |
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Collector mounting: Fixed or tracking

Fixed; slope = latitude - 15° (rounded to nearest 5°)

Overview of locations

| Location | Latitude ° | G _{tot} kWh/m ² | T _a °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° |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| | | |
|------------------|--|--------------------|
| G _{tot} | Annual total irradiation on collector plane | kWh/m ² |
| T _a | Mean annual ambient air temperature | °C |
| T _m | Constant collector operating temperature (mean of in- and outlet temperatures) | °C |

Calculation of the annual collector performance is done by the official Solar Keymark spreadsheet tool. Hour by hour the collector output is calculated according to the efficiency parameters from the Keymark test using constant collector operating temperature (T_m). Detailed description with all equations used is available from the Solar Keymark web site (direct link:<http://www.estif.org/solarkeymark/annexb1.php>)

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Datasheet version:

VERSION 3.5, 2012.01.13

Calculation program version:

3.07, October 2011 (SP)