

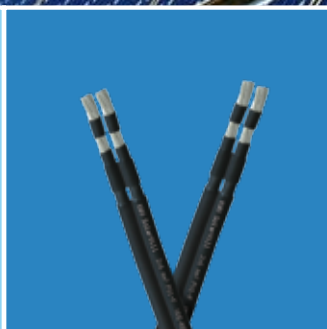
SolarVill®

**For the interconnections of PV Modules, Panel-Strings
and Inverters.**

SolarVill® PV1-F

SolarVill® XS PV1-F

SolarVill® UL 90



Efficient connections

As one of the best companies in our category, we make it a point of honour to give our costumers entire satisfaction, every day!

And that is why we are constantly looking to improve our work by putting emphasis on efficiency's management through commitment, expertise and needs understanding.

The photovoltaic market grows each year in a significant way all over the world. In Germany for example, the electricity generated by solar radiation covers already 2%* of the gross power consumption.

It also means that the energy produced by the photovoltaic systems become for many a very attractive investment. As a leader in the industry, Kabelwerke Villingen contributes to its growth since 2005 by offering innovative products. And now that the requirements for Photovoltaic Wires are getting much higher, our know-how insures to our customers the best quality on the market!

*Source: Bundesverband der Energie- und Wasserwirtschaft (BDEWW), Berlin

Kabelwerke Villingen GmbH

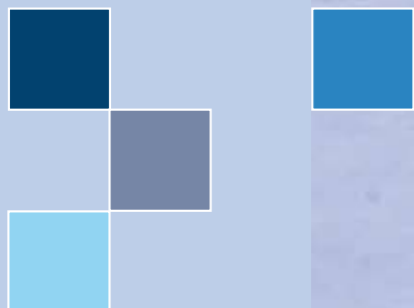




New manufacturing line

In order to fulfil the growing needs of the solar industry, Kabelwerke Villingen has opened in 2010 a new factory of 43,000 sq. ft. which is reserved exclusively to the production of the SolarVill® PV1-F (certified VDE & TÜV) and the SolarVill® UL90 (certified UL 4703).

Equipped with the most modern technology and certified ISO 9001:2008 and ISO 14001:2004, our new photovoltaic factory allows us to increase our production of PV wires by the triple, which also means that we may satisfy any kind of need.



The model you need!

Cables for all circumstances. Kabelwerke Villingen has Photovoltaic wires that could satisfy any demand. We put our experience to work for the benefit of our clients in order to give them a product with superior quality based on their requirements!

SolarVill® PV1-F

The ultimate Jack of all trades and a classic model of its kind in Europe. Available in three colours, the Kabelwerke Villingen's PV1-F is characterised by a high conductor's resistance and a wide temperature range.

SolarVill® PV1-F Duplex

This twin cable fulfils all tasks that the PV1-F is capable to achieve, in addition of what it allows a simplified handling process by the installation.

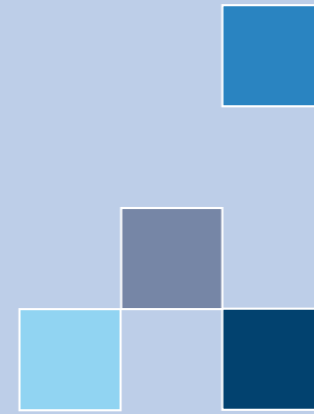
SolarVill® XS PV1-F

Our best seller's little sister. For the XS version the focus has been put on a favourable arrangement of the components during the assembly to offer the PV1-F at a lower price.

SolarVill® UL 90

The American. In order to respond to the increasing demand of the North American market, a specific solar cable has been developed in compliance with the UL standards. As the SolarVill® PV1-F, the UL 90 shows the best properties in its category in term of quality.

We would be happy to advice you and to give you as well all the information you need to know about these options.



SolarVill®

Applications:

SolarVill® is a Photovoltaic wire used for the interconnections of the PV Modules, Panel-Strings and Inverters. The PV1-F Label insure you the compliance with the higher standards of quality and safety for your PV installation, regarding the DKE requirements. SolarVill® is also available as a Twin cable.

- For use in fixed installation or steady movement in free motion (without tensile load)
- For outdoor use in wet and dry locations
- Highly resistant to solar radiation
- Not to be used as buried cable

Available sizes:

Cross section in mm ² (AWG)	Conductor construction (in mm)	Nominal outer diameter in mm (inches)	Copper weight kg/km (lbs/1000ft.)	Cable weight kg/km (lbs/1000ft.)
1.5 (16)	30 x 0.25	4.3 (0.17)	14.0 (9.41)	32 (21.50)
2.5 (14)	50 x 0.25	4.5 (0.18)	24.0 (16.13)	40 (26.88)
4.0 (12)	56 x 0.30	5.2 (0.20)	38.4 (25.80)	59 (39.65)
6.0 (10)	84 x 0.30	5.9 (0.23)	57.6 (38.71)	81 (54.43)
10.0 (8)	80 x 0.40	6.9 (0.27)	96.0 (64.51)	127 (85.34)
16.0 (6)	126 x 0.40	8.3 (0.33)	151.1 (101.53)	193 (129.69)
25.0 (4)	196 x 0.40	10.1 (0.40)	234.0 (157.24)	301 (202.26)
35.0 (2)	266 x 0.40	11.3 (0.44)	315.7 (212.14)	398 (267.44)

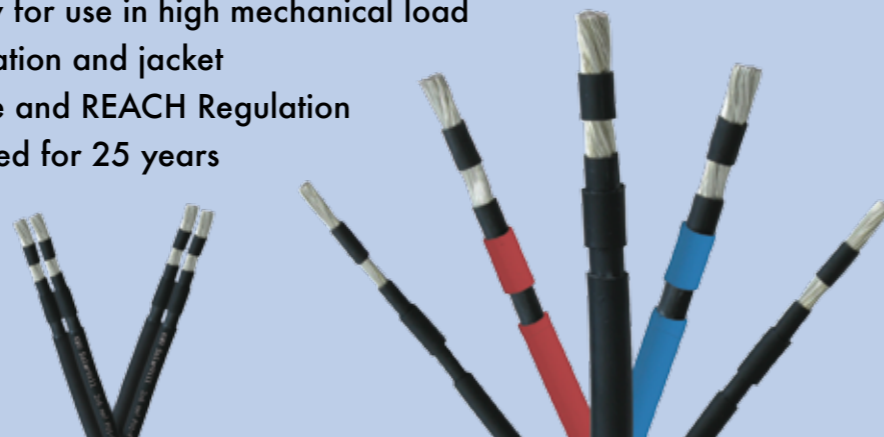
PV1-F (Available colours: black, red, blue)

Cross section in mm ² (AWG)	Conductor construction (in mm)	Nominal outer diameter in mm (inches)	Copper weight kg/km (lbs/1000ft.)	Cable weight kg/km (lbs/1000ft.)
4.0 (12)	56 x 0.30	5.4 x 10.6 (2.13 x 0.42)	76.8 (56.61)	118 (79.29)
6.0 (10)	84 x 0.30	6.2 x 12.1 (2.44 x 0.48)	115.2 (77.41)	162 (108.86)

PV1-F Duplex (Available colour: black)

Features:

- The cable is halogen-free and does not generate corrosive or toxic gases if burned
- The material used is highly flame-resistant and has low smoke emissions
- The material used for the cable's insulation and its jacket is highly resistant to atmospheric conditions such as UV radiation and abrasion
- A large temperature range allows the use under extreme weather conditions
- The cable has a superior flexibility for use in high mechanical load
- Easy stripping of the cable's insulation and jacket
- Compliant with the RoHS Directive and REACH Regulation
- Longer life expectancy - guaranteed for 25 years



DOUBLE INSULATED SINGLE WIRE FOR THE INTERCONNECTION OF PV SYSTEMS:

SolarVill® PV1-F

VDE REG: 8099
VDE E PV 01:2008-02
TÜV R 60031930
TÜV 2 PFG 1169/08.2007

SolarVill® PV1-F Duplex

VDE REG: 8099

Technical properties:

According to PV1-F VDE and TÜV requirements:

- Flexible tinned conductor (class 5 - DIN EN 60228)
- Short-circuit strength: up to 200°C/5s
- Hot Set Test at 200°C
- Hot Pressure Test: up to 140°C
- Long-term behaviour Test: 20,000h at 120°C
- Voltage Test (online test): 10kV
- Nominal Voltage: [U₀/U] AC 0.6/1.0kV
- AC Voltage Test: 6.5kV
- Possible Voltage up to 1.8kV (conductor/conductor, not grounded system, unloaded circuit)
- Highly resistant to acid, lye, ozone and UV
- Halogen free
- Temperature range: -40°C up to +90°C (fixed)
- Maximum temperature at the conductor +120°C

Other characteristics:

- Hot Set test at 250°C
- AC Voltage resistance [increase 2kV / 5 min] > 30kV
- Insulation resistance at 20°C > 800 MOhmkm
- Insulation resistance at 90°C > 50 MOhmkm
- Sea water resistant
- Temperature range:
 - 50°C up to 150°C (Fixed)
 - 25°C up to 125°C (Moved)
- Minimum bending radius:
 - 5 x cable diameter (Fixed)
 - 10 x cable diameter (Moved)



• BAUART
GEPRÜFT
• TYPE
APPROVED



**DOUBLE INSULATED SINGLE WIRE
FOR THE INTERCONNECTION OF PV SYSTEMS:**

SolarVill® XS PV1-F

TÜV R 60038725
TÜV 2 PFG 1169/08.2007



- BAUART GEPRÜFT
- TYPE APPROVED

Applications:

SolarVill® XS is a low-cost variant of the PV1-F Photovoltaic wire used for the interconnections of the PV Modules, Panel-Strings and Inverters. The SolarVill® XS PV1-F is TÜV 2 PFG 1169/08.2007 certified.

- For use in fixed installation or steady movement in free motion (without tensile load)
- For outdoor use in wet and dry locations
- Highly resistant to solar radiation
- Not to be used as buried cable

Available sizes:

Cross section in mm ² (AWG)	Conductor construction (in mm)	Nominal outer diameter in mm (inches)	Copper weight kg/km (lbs/1000ft.)	Cable weight kg/km (lbs/1000ft.)
2.5 (14)	44 x 0.25	4.5 (0.18)	20.7 (13.91)	38 (25.53)
4.0 (12)	50 x 0.30	5.0 (0.20)	33.8 (22.71)	54 (36.29)
6.0 (10)	74 x 0.30	5.6 (0.22)	50.4 (33.87)	74 (49.73)
10.0 (8)	74 x 0.40	6.9 (0.26)	88.1 (59.20)	119 (79.96)
16.0 (6)	114 x 0.40	7.7 (0.30)	136.9 (91.99)	174 (116.92)
25.0 (4)	189 x 0.40	9.3 (0.34)	229.2 (154.01)	296 (198.90)
35.0 (2)	259 x 0.40	10.7 (0.42)	314.9 (211.60)	397 (266.77)

Available colour: black



Features:

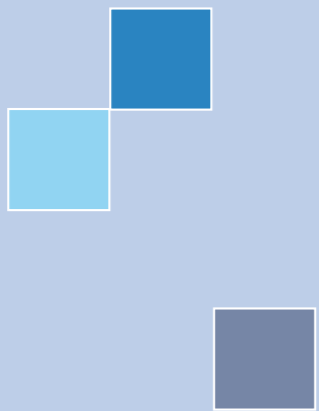
- The cable is halogen-free and does not generate corrosive or toxic gases if burned
- The material used is highly flame-resistant and has low smoke emissions
- The material used for the cable's insulation and its jacket is highly resistant to atmospheric conditions such as UV radiation and abrasion
- A large temperature range allow the use under extreme weather conditions
- The cable has a superior flexibility for use in high mechanical load
- The insulation and the jacket cannot be separated – for a simplified manufacturing process
- Compliant with the RoHS Directive and REACH Regulation
- Longer life expectancy - guaranteed for 25 years

Technical properties:

According to PV1-F TÜV requirements:

- Flexible tinned conductor (class 5 - DIN EN 60228)
- Short-circuit strength: up to 200°C/5s
- Hot Set Test at 200°C
- Hot Pressure Test: up to 140°C
- Long-term behaviour Test: 20,000h at 120°C
- Voltage Test (online test): 10kV
- Nominal Voltage: [U₀/U] AC 0.6/1.0kV
- AC Voltage Test: 6.5kV
- Possible Voltage up to 1.8kV (conductor/conductor, not grounded system, unloaded circuit)
- Highly resistant to acid, lye, ozone and UV
- Halogen free
- Temperature range: -40°C up to +90°C (fixed)
- Maximum temperature at the conductor +120°C





DOUBLE INSULATED WIRE FOR THE PV SYSTEMS INTERCONNECTION

SolarVill® UL 90

E 326361 UL Subject 4703
 Rating 90°C 600V AC
 wet and dry
 sunlight resistant

Applications:

SolarVill® UL90 meets the UL 4703 subject "Outline of investigation" relating to Photovoltaic wires and is designed:

- In compliance with the North American requirements
- For use in fixed installation or steady movement in free motion (without tensile load)
- For outdoor use in wet and dry locations
- To be highly resistant to solar radiation
- Not to be used as buried cable

Available sizes:

Conductor (tinned copper)	Nominal outer diameter in mm (inches)	Copper Weight kg/km (lbs/1000ft)	Approx. Weight kg/km (lbs/1000ft)
AWG 14	5.9 (0.232)	20.7 (13.9)	50 (34)
AWG 12	6.5 (0.256)	33.8 (22.7)	68 (46)
AWG 10	7.0 (0.276)	50.4 (33.9)	88 (59)
AWG 8	8.9 (0.350)	88.1 (59.2)	146 (98)
AWG 6	9.9 (0.390)	136.9 (92.0)	203 (136)
AWG 4	11.5 (0.453)	229.2 (154.0)	311 (209)
AWG 2	12.7 (0.500)	314.9 (211.6)	407 (273)

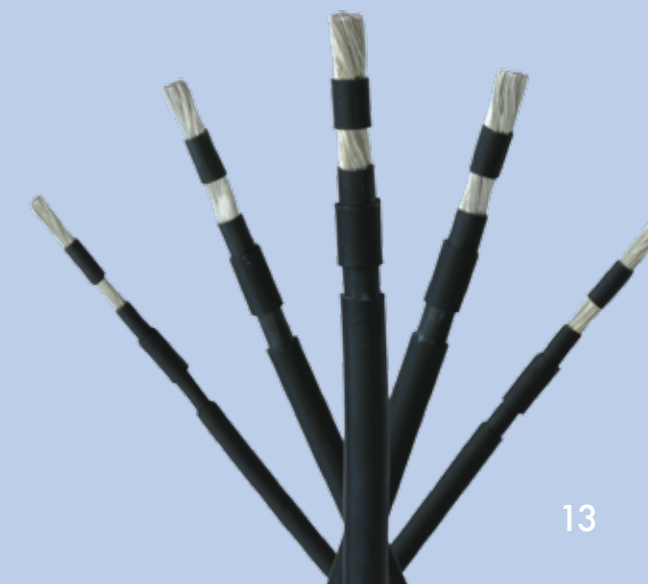
Available colour: black

Features:

- Rating 90 °C wet and dry, 600V AC
- The material used for the cable's insulation and its jacket is highly resistant to UV radiation and abrasion
- The cable meets the largest temperature range and is extremely resistant to cold
- The wire has optimized electrical qualities
- The cable has a superior flexibility for use in high mechanical load
- The cable is halogen-free and does not generate corrosive or toxic gases if burned
- The materials used are highly flame-resistant and have low smoke emissions
- Compliant with the RoHS Directive and REACH Regulation

Standards and properties:

- Conductor according to AWM tinned
- Flame retardance according to UL 1581 Sec. 1060 VW-1
- Deformation according to UL 44
- Cold bend down to -40 °C according to UL 1581
- Sunlight resistance according to UL 854
- Sea water resistance
- Acid and lye resistance
- Long Term Insulation resistance 90 °C: > 3 GOhm*m
- Temperature range: -40 °C up to 105 °C (Fixed)
-40 °C up to 90 °C (Moved)
- Minimum bending radius: 5 x cable diameter (Fixed)
10 x cable diameter (Moved)



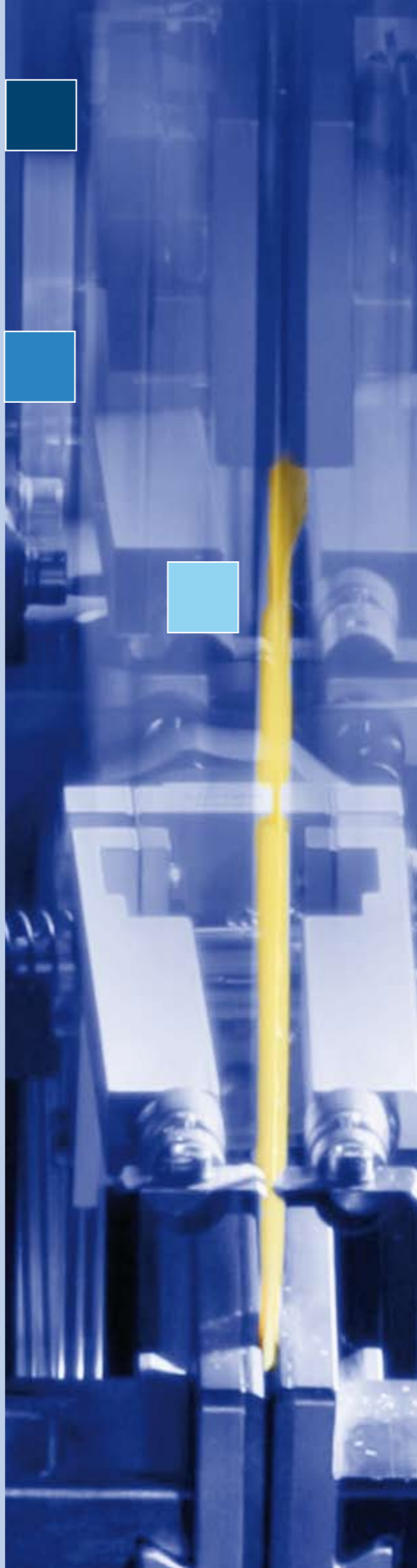
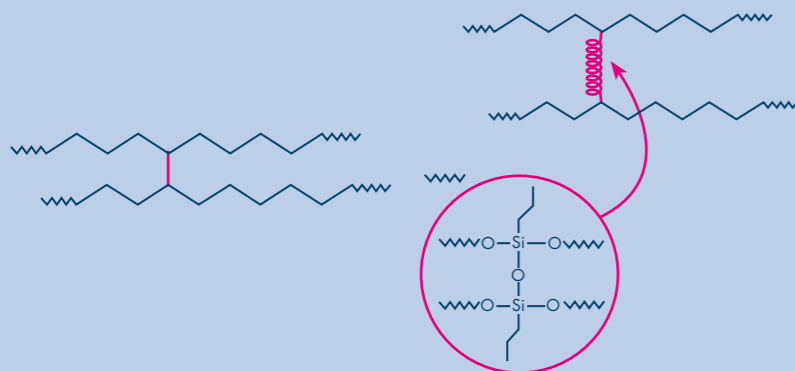
Silane crosslinking

By using a catalyst under the influence of humidity and heat, we may transform the structure of the molecules just as it could be done by the Electron beam crosslinking. In order to improve the quality, the catalyst is added to the based material during its production in a predetermined proportion.

It improves the material's qualities and gives a better resistance to heat, flame and mechanical influences. What is more, the Silane technology requires less energy which is to say that it is a much more economical and environmental procedure.

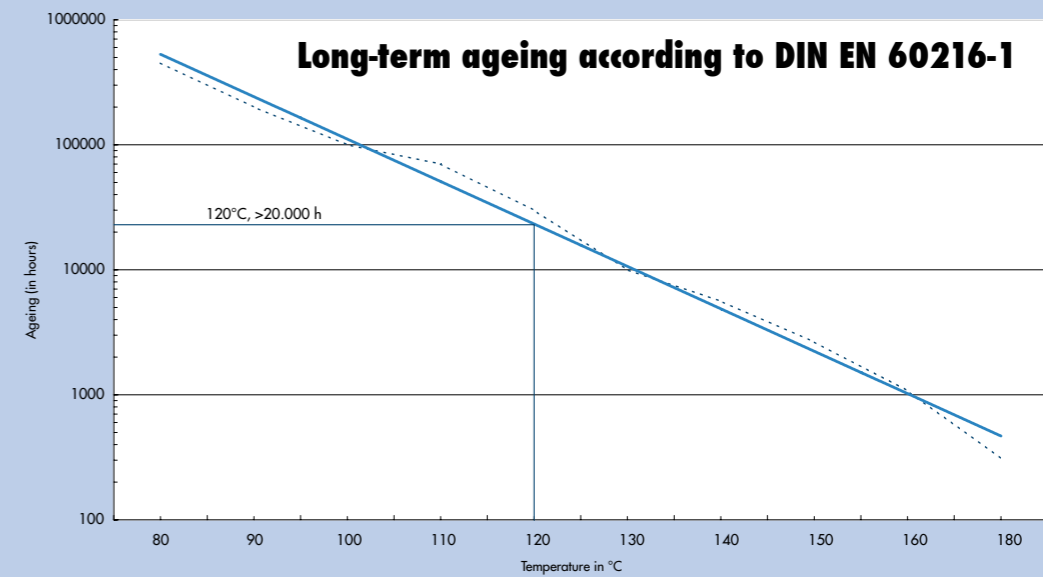
Benefits of the Silane crosslinking:

- Lower spend of energy
- Cost-effective production
- Better mechanical properties
- Resistance to high temperatures

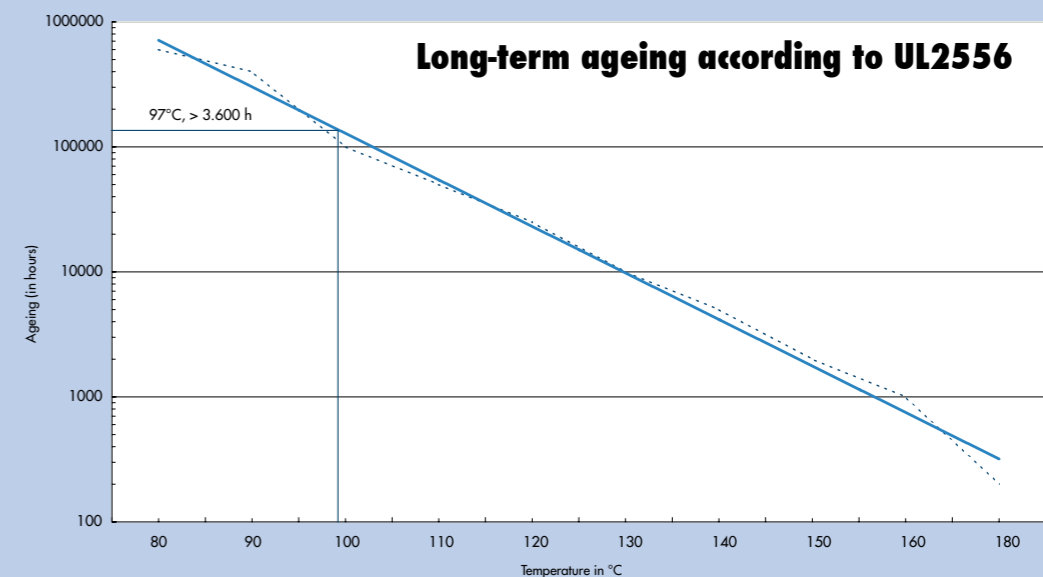


Temperature Index according to EN 60216-1 & UL 2556

The SolarVill® PV1-F is subjected to the Temperature Index standard established by the European Norms (NE), which describe the ageing characteristics of the cable. The test conditions are fixed at 120°C during 20,000 hours after what the elongation-at-break should be of 50% absolute. The diagram represents the ageing behaviours of the SolarVill® PV1-F and the SolarVill® Duplex.



The UL Subject 4703 fix at 90°C the temperature rating for a PV wire. To make sure that the standard is reached, the cable is tested during 150 days (3,600 hours) at a temperature of 97°C, after what the elongation-at-break must be at least 50% and the tensile strength of 2 MPa. Our SolarVill® UL 90 still reach the UL standard regarding the Temperature Index, even after 10,000 hours! It could also be rated 125°C.





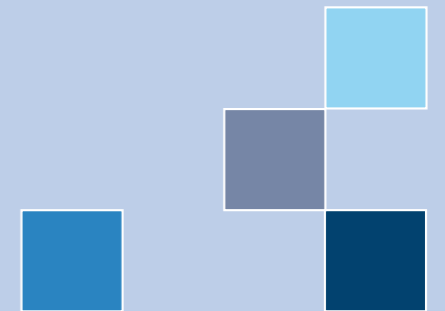
Halogen-free = No toxic or corrosive gases

Halogen-free products are composed with almost no elements such as Bromine, Iodine, Fluor or Chlor. In case of fire, Halogen component may release toxic or corrosive gases, which could turn into an acid solution if they are in contact with water. Corrosive, toxic and flammable gases may cause serious damages to property and to humans.

The Halogen-free measure is based on the standard No. 60754-1 of the IEC (International Electrotechnical Commission) and the European Norm (EN) No. 50267. According to the normative requirements, the pH value should not be less than 4.3 and the conductivity not higher than 10 $\mu\text{S}/\text{mm}$.

The tests are done by using a pH Meter and a conductivity Electrode as well as by the titration of the combustion gases.

All products of the SolarVill® serie are Halogen-free according to these standards and release no flammable corrosive gases.

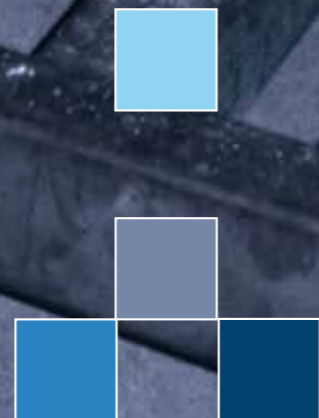




Smoke Density

The procedure by which we measure the smoke density that could be generated by the material in case of fire is an essential factor in the evaluation of its fire behaviour. It may be crucial when it comes to evacuate people and could also make the work easier for the firemen. Made of a Low Smoke Material, the SolarVill® shows a transparency property superior at 60%.

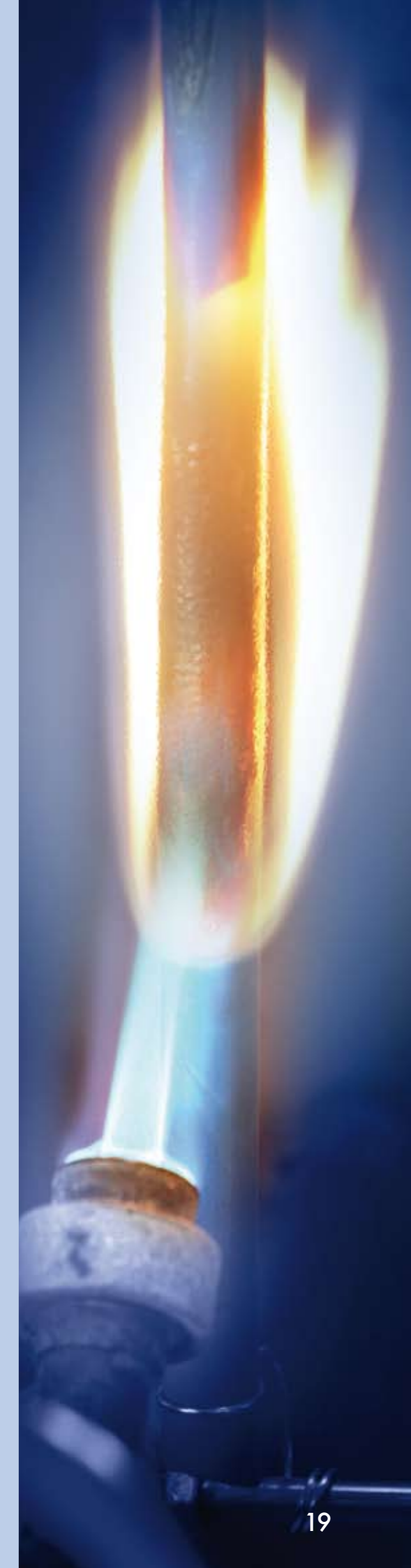
The tests are performed in a test chamber where the samples are inflamed. The ones from which emerged smoke gases are detected by the use of a photometric system.



Flame retardance according to EN 60332-1-2 & UL 1581

To be qualified as flame-retardant within the regulation fixed by the norm DIN EN 60332-1-2, the cables with a diameter of 25 cm or less must successfully succeed to the flame test. After a vertical flame treatment under a 1 KW pre-mixed flame during 60 sec., the material shall put out by itself and that the damages so caused should not be superior at 60 cm. The SolarVill® PV1-F meets those standards!

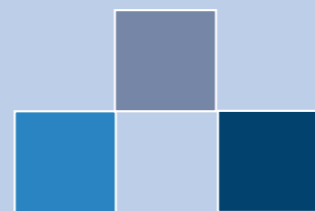
Regarding the flame retardance, the SolarVill® UL 90 is tested according the UL1581 requirement. The flame is applied 5 times during 15 seconds. After each time, the sample should not burn more than 60 seconds. Above that, the cotton should not set on fire and the indicator flag should not be destroyed at more then 25 %.



Acid, lye, ammonia

The SolarVill® PV1-F is also resistant to acid and lye such as required by the European norm EN 60811-2-1. In other words, the mechanical properties of the PV1-F still remain after respectively 7 days in an acid and an alkaline solution (N-oxalic acid and N-sodium hydroxide solution), at a temperature of 23 °C. The same kind of test is used to confirm the resistance to ammonia.

Although nothing is required by the UL Standards, the material used for the SolarVill® UL90 is however absolutely acid and lye resistant!



Weather, Ozone and UV resistance

High requirements such as UV and Ozone resistance must be fulfilled in the matter of the possible exposure to weather conditions through outside applications. The UV resistance is measured by testing the ability of the material to withstand a weatherometer exposure with minimal change in its mechanical properties. The SolarVill® is so tested twice as long as prescribed by the norm which proves therefore its optimal resistance to UV.

The ozone resistance's test is achieved in an ozone chamber under a gas concentration of 200 ppm for an exposure duration of 72 hours at a temperature of 40 °C. The cable is previously rolled up around a mandrel and must pass the test without cracking or degradation of properties. All the products from the SolarVill® series are both UV and Ozone resistant.

SolarVill Garantie

Terms of Guarantee for Solar Cable SolarVill

KWV Kabelwerke Villingen GmbH issues a guarantee for their solar cable SolarVill, which is suitable for the wiring of photovoltaic plants, for a duration of 25 years. The guarantee applies to all the products from the SolarVill® PV1-F series as well as to the SolarVill® UL 90.

Solar cable SolarVill® will be able to deliver steady performance according to the requirement profile for cable PV-system specified in DKE Deutsche Kommission, for a duration of 25 years in typical central European climate if it has been professionally installed.

The warranty only includes the defect solar cable if, after examination, there is a justified claim for guarantee. The damaged cable will, in case of guarantee, be replaced by one of the same type or equivalent.

Warranty claims are excluded if the defect of the delivered cable is caused by inappropriate or improper maintenance and use, natural disasters, influences of the other solar components as well as the actions of third parties. Warranty claims are excluded if the standards DIN VDE 0298-4, HD 384.5.52 and HD 60364-7-712 according to the requirements for PV-cables had been ignored.

Beyond the special regulations stated above our general Terms of Delivery of Kabelwerke Villingen GmbH available under www.kwv-vs.de apply.

Yours sincerely

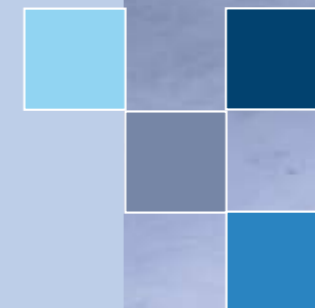
KWV, Kabelwerke Villingen GmbH



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- TYPE APPROVED





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version: 04/2011

