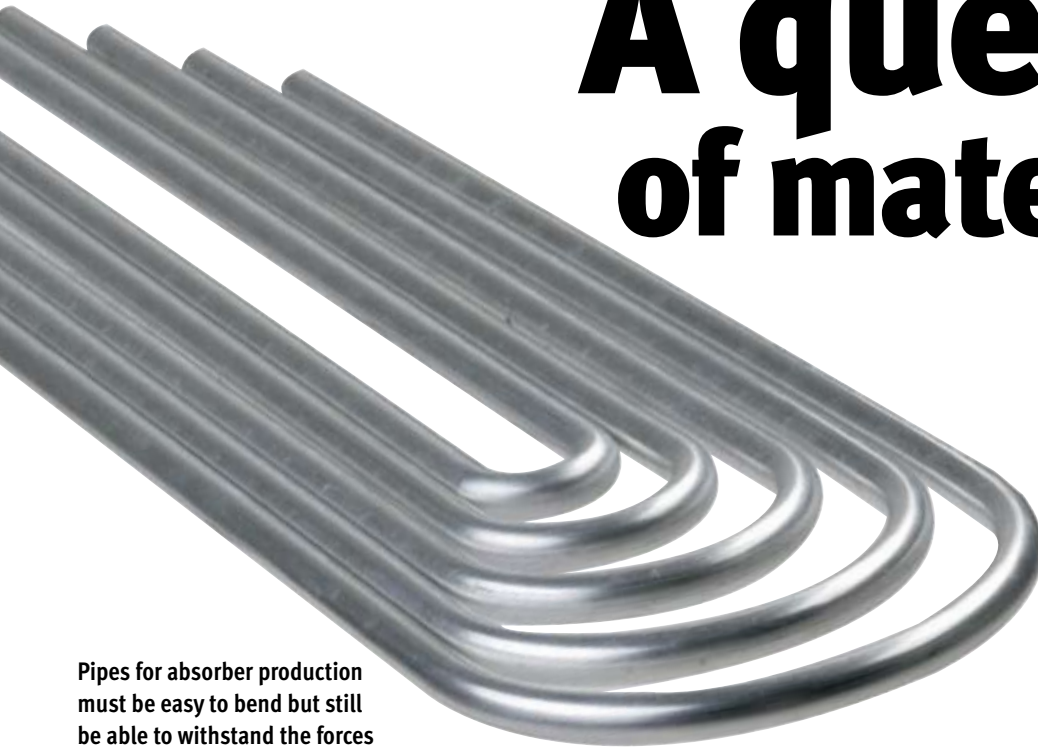


# A question of materials



Pipes for absorber production must be easy to bend but still be able to withstand the forces during the welding process.

Photo: Standard Metallwerke

Copper is the classic material for pipes in the home and solar technology sectors, but aluminium and stainless steel also have market segments in collector construction and especially pre-insulated solar pipes.

KME insulates the in plastic jacketed Wicu Eco with PU foam.

Photo: KME



**W**hether in the collector as an absorber pipe, as a flow pipe to the storage, or as a heat exchanger in the storage, pipes play a central role in solar heating. Absorber pipes must meet completely different requirements from solar loop pipes, however. Pipe manufacturers have long since adjusted to the requirements of the solar industry and offer a whole range of special solar products for absorber manufacturing (see table on pages 42 and 43) and solar loops (see table on pages 46 and 47). With absorber pipes, for example, it is

important that the pipes can be easily bent into meanders, as more and more collectors are going for this geometry (also see the collector overview on page 26). But the pipes still have to be robust enough to withstand the forces on them from the laser or ultrasonic head during welding. Pipes which are used in a vacuum have particularly special requirements. Heat pipes must also be cleaned on the inside so that the heat transfer medium remains pure.

The pipe manufacturers offer a wide spectrum of pipe thicknesses. Copper pipes in household

use generally have a wall thickness of 1 mm. KME Germany also offers this thickness for its pre-insulated copper solar pipes. In collector manufacturing the aim is to cut manufacturing costs and also to make things thinner. At KME the first thin-walled tests are currently being carried out. "Thanks to newly implemented alloys in the piping field I am pretty certain that we can move further into the thin-walled area," says KME Marketing Manager Klaus Steinhage. "The new alloys we are using give us a wall reduction while maintaining shape stability of the meanders, as well as the required pressure stability," he continues. It is still completely unclear whether the thin-walled pipes grant a good contact with the according sheet during laser welding thus enabling a good welding quality. "We'll have to see what the tests show," says Steinhage.

To what extent saving material is worthwhile for the manufacturer obviously strongly depends on the price of copper. In the last four years the price has fallen pretty steadily. It is currently fluctuating at around 7,000 US\$/t. According to Steinhage's appraisals, if the economic figures from the USA and China are positive then copper will hold this level or even rise again.

Aluminium has followed a similar price development in the last few years. The price is currently around 2,000 US\$/t. Replacing copper with this light metal thus has quite a large cost advantage, but the solar sector is hesitant. The collector overview in this issue shows that aluminium is only rarely used as the raw material. Is this going to change? "Fundamentally there still hasn't been any real run on aluminium, but we are now seeing some customers with a rising and

in particular a regular demand,” says Andreas Holle, Key Account Manager at Standard-Metallwerke from Germany. He continues: “Aluminium seems to have at least established itself on the market in some areas, and the longer these collectors have been on the market, the more other manufacturers will orientate themselves around this and want to benefit from the cost advantages.”

It would also be possible to make aluminium pipes thinner. Collector manufacturers are currently favouring using aluminium pipes in the absorber. S-Life Solar has a “hard” version with a diameter of 10 mm and a wall thickness of 1 mm. At Sammler they usually use 22 mm with a wall thickness also of 1 mm. “As we could certainly manufacture thinner-walled pipes, our customers still have room for movement in the future,” says Holle. Beyond solar thermal, aluminium has found a first use in the geothermal field. The company M-TEC Energie.Innovativ from Austria is using plastic-coated S-COT aluminium pipes from Standard-Metallwerke in its CO<sub>2</sub> ground probes.

### Pre-insulated solar pipes: thinner insulation

Copper and aluminium are also suitable materials for pre-insulated solar pipes. The alternative is stainless steel. This material is worked to form corrugated piping, which has the advantage of being easily bent. This is also because with wall thicknesses of 0.15 to 0.3 mm, it is much thinner than copper or aluminium.

The Turkish pipe and fittings manufacturer Ayvaz has brought out the pre-insulated stainless steel pipe NanoFlex. NanoFlex is available as a single or dual pipe. It is equipped with a silicon-covered sensor cable. What makes it special is the insulation made of nanogel. The thermal conductivity of this material, at 0.015 W/mK, is less than half that of the most commonly used EPDM foam. Thermal conductivity figures are valid for surrounding temperatures of 0 °C, as the products are mostly used for building insulation. As the temperature rises, the insulation properties of the materials decrease. Nanogel has a very low temperature-dependency, however. At 200 °C its thermal conductivity is just 0.019 W/mK and thus still almost as good as at the

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## Pipes for absorber production

Manufacturer	Product name	Material	According to norm	Delivery form	Max. length [m] <sup>3</sup>	Outside diameter [mm]	Wall diameter [mm]	Tensile strength [MPa]
Feinrohren	Green-Solar	Cu-DHP	EN 12449 / CompS	coils	-	6 up to 22	0.3 up to 1.2	>360 / >220
	Green-Solar	Cu-DHP	EN 12449 / CompS	lengths	6	6 up to 22	0.3 up to 1.2	>360 / >220
Halcor	Talos Solar Plus	Cu-DHP	EN 12449 or ASTM B75	coils <sup>6</sup>	-	6 up to 22	0.3 up to 1.2	360 / 290 / 220
	Talos Solar Plus	Cu-DHP	EN 12449 or ASTM B75	lengths	6	6 up to 22	0.3 up to 1.2	360 / 290 / 250 / 220
	Talos Dual Solar	bimetallic <sup>2</sup>	CompS	coils <sup>7</sup>	-	6 up to 16	0.45 up to 1.2	n/a
KME	Tectube_solar K Tectube_solar T	Cu-DHP	EN 12449 / CompS	coils <sup>5</sup>	-	6 up to 22	0.3 up to 0.8	approx. 420
	Tectube_solar S	Cu-DHP	EN 12449 / CompS	coils <sup>5</sup>	-	6 up to 22	0.3 up to 0.8	approx. 245
	Tectube_solar VK Tectube_solar VT	Cu-DHP	EN 12449 / CompS	coils <sup>5</sup>	-	6 up to 22	0.3 up to 0.8	approx. 420
	Tectube_solar VS	Cu-DHP	EN 12449 / CompS	coils <sup>5</sup>	-	6 up to 22	0.3 up to 0.8	approx. 245
	Tectube_solar K	Cu-DHP	EN 12449 / CompS	-	8	6 up to 35	0.3 up to 1.2	approx. 420 / approx. 275
	Tectube_solar S	Cu-DHP	EN 12449 / CompS	-	6	6 up to 35	0.3 up to 1.2	approx. 245
	Tectube_solar VK	Cu-DHP	EN 12449 / CompS	-	8	6 up to 35	0.3 up to 1.2	approx. 420
	Tectube_solar VS	Cu-DHP	EN 12449 / CompS	-	6	6 up to 35	0.3 up to 1.2	approx. 245
Standard-Metallwerke	S-Life Solar	aluminium (EN-AW3103)	CompS / EN-754-8	both	6	6 up to 25 <sup>4</sup>	0.3 up to 2.0 <sup>4</sup>	H12 ≥ 105 / H14 ≥ 115 / H18 ≥ 135
Wieland Electric	solarclean_classic	Cu-DHP	CompS	coils	-	6 up to 15	0.3 up to 1.2	≥ 360
	solarclean_hp	Cu-DHP	CompS	coils	-	6 up to 15	0.3 up to 1.2	≥ 360
	solarclean_plus	Cu-DHP	CompS	coils	-	6 up to 15	0.3 up to 1.2	≥ 360
	solarclean_eco	Cu-DHP	CompS	coils	-	6 up to 15	0.3 up to 1.2	≥ 360
	solarclean_SL	Cu-DHP	EN 12449	lengths	7.9	6 up to 15	0.3 up to 1.2	≥ 360
	industrial tube <sup>1</sup>	Cu-DHP	EN 12449	lengths	7.9	≥ 6	≥ 0.3	≥ 360 / ≥ 250 / ≥ 220
	industrial tube <sup>1</sup>	Cu-DHP	CompS / EN 12735-2	coils	-	6 up to 22	≥ 0.3	≥ 220

Special solar qualities: the specifications of the absorber pipes vary depending on the manufacturing process and the collector type.

Source: company data

freezing point. The material can withstand temperatures of up to 650 °C, which is well above the range of a classic solar thermal system for hot water generation.

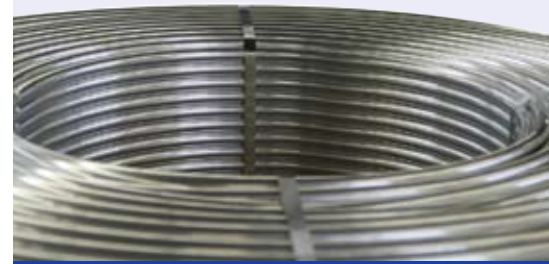
Ayvaz uses a nanogel layer just 5 mm thick. This saves space – not only on the journey from the manufacturer to the wholesaler. Many craftsmen buy a whole bobbin as it can be easily stowed away in their vehicles. They can then cut the pipe to exactly the required length at the building site and save quite a lot on not having waste cuttings. Ayvaz supplies DN12 and DN16 bobbins with lengths of 150 m. For DN20 and DN25 the lengths which fit on a bobbin are somewhat lower, at 125 and 100 m, respectively. Apart from bobbins, Ayvaz can also supply coils between 10 and 50 m long for all pipe dimensions. NanoFlex is also ideally suitable for being fitted between the roof battens under the roofing tiles. There is now an especially thin pipe available from Wip Meß- und Regelarmaturen Vertriebsgesellschaft, Germany. In this the company is less interested in the space saving and more interested in the cost savings, as the new Flex-Twin V Smart with

10 mm thick insulation is an inexpensive solution. Wip uses a fleece made of polyester fibres as the insulation material for its pre-insulated solar pipes.

### Flow and return lines with different thicknesses

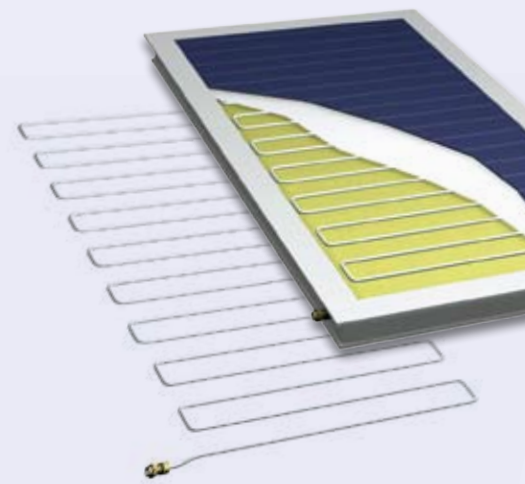
A further new product is the Flex-Twin V Clever, which has different insulation thicknesses on the flow and return lines. “On the flow side 25 mm is possible: on the return side 10 mm. With this mix we get a whole new price structure,” says Senior Sales Manager Christof Kutschera. The 10 year guarantee which Wip now provides on the UV resistance of the covering is also new. Despite the tough market conditions, Kutschera sees a generally positive trend: “We have been able to acquire new customers.”

L’isolante K-Flex from Italy has also looked at the thickness of the pipes and launched a particularly thin version, the Twin Solar System Slim. The company uses classic EPDM foam with a thickness of 9 mm. Here too, the idea is to use the pipes under roof tiles and in



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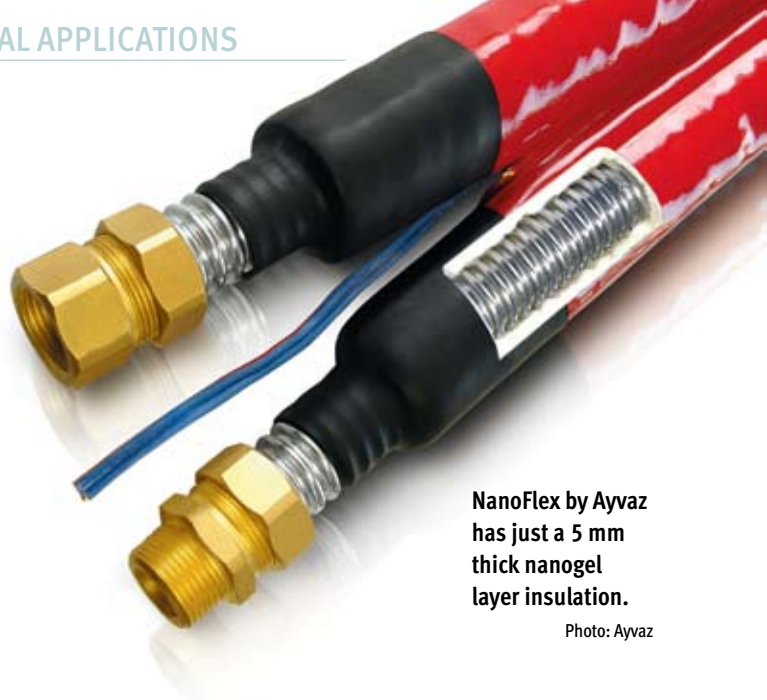
	Surface for ultrasonic welding	Specialities
	yes	for vacuum application
	yes	for vacuum application
	yes	-
	yes	-
	yes	optimised hardness for laser welding of meanders
	yes	-
	yes	-
	yes	hard tubes for vacuum application
	yes	soft tubes for vacuum application
	yes	-
	yes	-
	yes	hard tubes for vacuum application
	yes	soft tubes for vacuum application
	yes	-
	yes	-
	yes	clean inside and outside for heatpipes
	yes	optimised bending properties
	no	sufficient for laser welding
	yes	-
	no	-
	no	-

CompS = company standard; <sup>1</sup> only for manifolds; <sup>2</sup> copper inside, aluminium outside; <sup>3</sup> only for fixed lengths; <sup>4</sup> or on request; <sup>5</sup> 150, 225 or 450 kg; <sup>6</sup> 90 up to 580 kg; <sup>7</sup> 45 up to 240 kg;

other confined spaces. According to their prospectus, L'isolante K-Flex supplies a special de-reeler for the Slim product for € 3,402, with which the spool can be easily handled. "Our de-reeler is easy to use at the job site, warehouse and stores," says Martina Kühtz from marketing at L'isolante K-Flex.


The sheathing, which according to EN 13859 should provide good UV protection, is brick red, for looks are important. Golden Century Technology from China thinks so too. It has thus extended the colour range of its EPDM jackets, which are now available in white, blue, red and black. They have also improved the dual pipe. "We have the break point design, with which you can separate twin solar pipes into two separate single solar pipes without destroying any jacketing," says Golden Century Technology Export Manager Kitty Gong.

When a solar system goes into stagnation it gets hot. Unless you limit the temperature with heat pipes that can switch off (see collector overview page 26). In this case the solar loop insulation does not need to withstand high temperatures. 3i International Innova-



NanoFlex by Ayvaz has just a 5 mm thick nanogel layer insulation.


Photo: Ayvaz



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tive Industries from Greece thus supplies two versions of its Isotube corrugated stainless steel pipe. One is insulated using NBR foam and can withstand 125 °C for short periods. The other, using EPDM foam insulation, can withstand 175 °C for short periods. Isotube is available as a single or dual pipe, with or without a sensor cable. The covering is made of a copolymer; which the specification sheet says provides excellent UV protection, as determined by the company according to the ASTM D 518 method.

Solar Speed Flex from China also supplies insulation made of NBR foam. The company has developed a cold-coating process for the polyethylene covering because the conventional process is too hot for the NBR foam. Eric R. Hawkins from Solar Speed Flex sees a wide range of uses here: “70 % of all solar thermal systems exported from China have non-pressurised tanks. They can never go above 90 °C, so why offer the more expensive EPDM?” he asks. Additionally, the return side can be insulated using NBR foam as it does not go above 65 °C even in stagnation phases. This naturally requires having steam generation under control, so that hot steam does not enter the return side. Solar Speed Flex has also developed a low-temperature alternative for stainless steel pipes. New in the range are pre-insulated Pex al Pex pipes and their respective brass fittings. The maximum temperature for the aluminium-plastic construction lies at almost 100 °C. Hawkins generally prefers single pipes: “The flow and return pipes are not of equal length. We offer single coils, one with a sensor wire, the other without.” The different lengths mean that with dual pipes the flow pipe must always be shortened by 2 to 3 m, and this waste length is then thrown away.

### Connection technology: a quick click

The connection of the pipes to the collector should be just as fast and simple as the plumber’s job of installing the solar loop using pre-insulated pipes. For some time now the manufacturers have been supplying

quick-click connectors (also see S&WE 11+12/2013, page 46) The quick connection pipes by Ayvaz are called push-fit. The corrugated stainless steel pipe is pushed into a brass fitting. A clicking sound indicates that the pipe is correctly in place. Then you simply tighten the nut and you are done. "The push-fit connection system is the fastest and easiest connection method for the solar thermal business," says Kadir Okumuş, International Marketing Executive at Ayvaz. L'isolante K-Flex also has a "clack" quick connection coupling in its range. According to Martina Kühtz the advantages are the tightening with less effort and no displacement of the pipe in the coupling. Both Ayvaz and L'isolante K-Flex seal the connection metallicity. Wip also uses metal self-sealing screw connections. The company has increased its range of connections to 40 variations, from DN12 to DN40. Metallicity sealed 90° connections are also possible. Solar Speed Flex has also expanded its range of connectors. "We now have a full range of brass compression fittings, where no flange tool is needed," says Eric R. Hawkins. The connection contains a silicone seal and a grab ring. Connector technology requires specialists and one of the suppliers is Tiemme from Italy, which developed the patented Cobrasun series. Cobrasun is a range of quick connect fittings for corrugated stainless steel pipes DN 16-20-25.

### Collector connector: always flexible

Golden Century Technology has expanded its product range with metallicity sealing collector connectors this year. The elastic pipes take on the compensator function. According to Kitty Gong they can be used in extremely hot or cold weather too. Ayvaz also supplies various collector connectors under the name Pan-Flex. There are variations with a union nut for pressing or



Flex-Twin V Clever by Wip has differing insulation thicknesses on the flow and return lines.

Photo: WIP



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## Overview of pre-insulated solar pipes

Manufacturer	Product name	Product type	Pipe dimension [DN]	Pipe material	Connections	Sealing	Insulating material	Insulation thickness [mm]
3i International Innovative Industries	Isotube	single or dual with or without wire	12/16/20/25	stainless steel	quick connect	metal / graphite	EPDM	9/13/19
	Isotube	single or dual with or without wire	12/16/20/25	stainless steel	quick connect	metal / graphite	NBR	9/13/19
Aeroline	Cu Split 100	dual with wire	10/12/15/18	copper	quick connect	brass	EPDM	14/15/16
	Inox Spit 100	dual with wire	12/16/20/25	stainless steel	quick connect	metal	EPDM	15/17/18/25
Armaccel	Armaflex DuoSolar VA	dual with wire	12/16/20/25	1.4404	quick connect	metal	EPDM	14/20
	Armaflex DuoSolar CU	dual with wire	12/15/18	copper	standard fittings	n/a	EPDM	14/20
Austroflex	Solarflex	dual with wire	10 up to 32	1.4404	quick connect / flat seal	metal	EPDM	13/19
	CU-Solarflex	dual with wire	10 up to 18	copper	n/a	n/a	EPDM	13/19
Ayvaz	Nano-Flex	single or dual with wire	12/16/20/25/32	stainless steel	quick connect	metal	Pyrogel XT	5
	EZ-Flex	single or dual with wire	12/16/20/25/32	stainless steel	quick connect	metal	EPDM	13
FPT Systems	Standard	single or dual	12 up to 25	1.4404	n/a	metal	EPDM	13/19
	Premium	single or dual	12 up to 25	1.4404	n/a	metal	EPDM	13/19
Golden Century Technology	Solar Hose	single or dual with wire	12/16/20/25	stainless steel	quick connect	strong fiber	EPDM	13/20
Halcor	Talos Ecutherm Solar	single with or without wire	15/18 22	Cu-DHP	standard fittings	n/a	PEX + PES	13
	Talos Ecutherm Solar	dual with or without wire	15/18 22	Cu-DHP	standard fittings	n/a	PEX + PES	13
Kaimann	Kaiflex Solar EPDMplus 2in2 VA	dual with wire	12/16/20/25	1.4404	quick connect / flat seal	copper	EPDM	14/19
	Kaiflex Solar EPDMplus 2in2 CU	dual with wire	15/18	copper	quick connect	copper	EPDM	14
KME	Wicu Eco	single	12 up to 54	Cu-DHP	standard copper fittings	n/a	PU	11 up to 27.5
L'isolante K-Flex	Twin Solar annular pipe	dual with wire	16/20/25	stainless steel	quick connect	metal	EPDM	14/20/25
	Twin Solar slim	dual with wire	16/20/25	stainless steel	quick connect	metal	EPDM	14/20/25
Meibes	Inoflex	single or dual with or without wire	12/16/20/25	1.4404	quick connect	PTFE	EPDM	14
Rattay	Solar EPDM Duo	single or dual with wire	12/16/20/25/32	stainless steel	quick connect / flat seal	n/a	EPDM	14/19
Solar Metal Flex	Solar Flexpipe 2in2	dual	12/16/20/25	1.4404 <sup>2</sup>	quick connect / flat seal	brass / aramid or PTFE	EPDM	13
	Solar Flexpipe 1in1	single	12/16/20/25	1.4404 <sup>2</sup>	quick connect / flat seal	brass / aramid or PTFE	EPDM	13
Solar Speedflex	Speedflex	single	12/16/20/25/32	stainless steel	brass compression	silicone or carbon	EPDM / NBR	13 up to 45
	Speedflex	dual	12/16/20/25/32	stainless steel	brass compression	silicone or carbon	EPDM / NBR	13 up to 45
Solardual	Solarleitung 2in2	dual with wire	8 up to 50	1.4404	flat seal	Centellen-HD-3822	EPDM	14/20
	Solarleitung 1in1	single with wire	8 up to 50	1.4404	flat seal	Centellen-HD-3822	EPDM	14/20
Waterway	Twinway Split TWSS	dual	15 up to 32	1.4404	fittings / soldered	graphite	EPDM	14/20
	Twinway Split TWSW	dual	16 up to 25	1.4404	fittings / soldered	metal	EPDM	14/20
WIP	Flex-Twin V230	dual with or without wire	8/12/16/20/25/32	1.4404	quick connect / flat seal	brass / graphite	polyester fleece	10/13/20/26/35
	Flex-Twin P230	dual with or without wire	8/12/16/20/25/32	1.4404	quick connect / flat seal	brass / graphite	polyester fleece	10/13/20/26/35

PE = polyethylene, LDPE = low-density polyethylene, HDPE = high-density polyethylene, PES = polyester, PVF = polyester fleece, PEX = cross linked polyethylene; PA = polyamide; PU = polyurethane foam; NBR = nitrile butadiene rubber foam; EPDM = ethylene propylene diene monomer rubber foam; PTFE = polytetrafluoroethylene; 1.4404 = stainless steel according to AISI 316L

<sup>1</sup> according to EN13501; <sup>2</sup> others on request; <sup>3</sup> UV cold process tape; <sup>4</sup> FM approved test 4924, also UL5; <sup>5</sup> according to DIN4102; <sup>6</sup> for EPDM 150 °C and for NBR 100 °C

insertion. The insertion connectors have two O-rings. Flexibl from Germany, a specialist in connector technology, uses three O-rings. According to Company Head Timm Beutler, one O-ring is enough for the sealing; the second is only there to prevent oxygen from reaching the first one, thus preventing ageing processes. But what happens if the collector field

does not enter operation until weeks or months after the installation? Then oxygen inside the pipes will reach the first sealing ring. The third O-ring prevents that too.

A further connector specialist is the Witzenmann from Germany. The company has developed a metallic sealing connector fitting for wide-ranging

Envelope	$\lambda$ with 0 °C [W/mK]	$\lambda$ with 40 °C [W/mK]	Max. temperature [°C]	Fire protection class	Warranty [years]
co-polymer	0.038	0.045	150	E	5
co-polymer	0.035	0.040	105	E	5
foil	0.036	0.040	150	EL	n/a
foil	0.036	0.040	150	EL	n/a
braiding	0.038	0.042	150	E	5
braiding	0.038	0.042	150	E	5
LDPE	0.038	0.042	150	D-s3-d0	2
LDPE	0.038	0.042	150	D-s3-d0	2
UV resistant foil	0.015	n/a	650	A2	n/a
PA-braiding	0.036	n/a	150	n/a	n/a
none	0.038	0.042	150	n/a	n/a
PES	0.038	0.042	150	n/a	n/a
HDPE	0.034	0.039	150	B1 <sup>5</sup>	15
PE	0.035	n/a	150	E	n/a
PE	0.035	n/a	150	E	n/a
braiding	0.038	0.042	150	E	5
braiding	0.038	0.042	150	E	5
PVC	n/a	0.026	150	n/a	5
co-polymer	0.038	0.042	150	E	5
co-polymer	0.038	0.042	150	E	7
PE	0.038	0.040	150	E	5
PE	0.038	0.042	150	E	3
PE	0.038	0.042	150	E	5
PE	0.038	0.042	150	E	5
PE <sup>3</sup>	0.036	0.040	150/100 <sup>6</sup>	V-0 <sup>4</sup>	10
PE <sup>3</sup>	0.036	0.040	150/100 <sup>6</sup>	V-0 <sup>4</sup>	10
foil	0.038	0.045	150	B2 <sup>5</sup>	2
foil	0.038	0.045	150	B2 <sup>5</sup>	2
polyolefins	0.038	0.042	150	n/a	n/a
polyolefins	0.038	0.042	150	n/a	n/a
PE	0.030	0.039	220	B2 <sup>5</sup>	10
PE	0.030	0.039	220	B2 <sup>5</sup>	10

A more comprehensive overview of pre-insulated solar pipes can be found at: [www.sunwindenergy.com/sectors/solar-thermal](http://www.sunwindenergy.com/sectors/solar-thermal).  
Source: company data

applications in heating and service water loops. Here too, the seal is already integrated into the pressure ring screw connection. Witzemann supplies its connector technology both as a collector connector with thin-walled bellows and as connectors for pre-insulated dual pipe lines.

Jens-Peter Meyer

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