

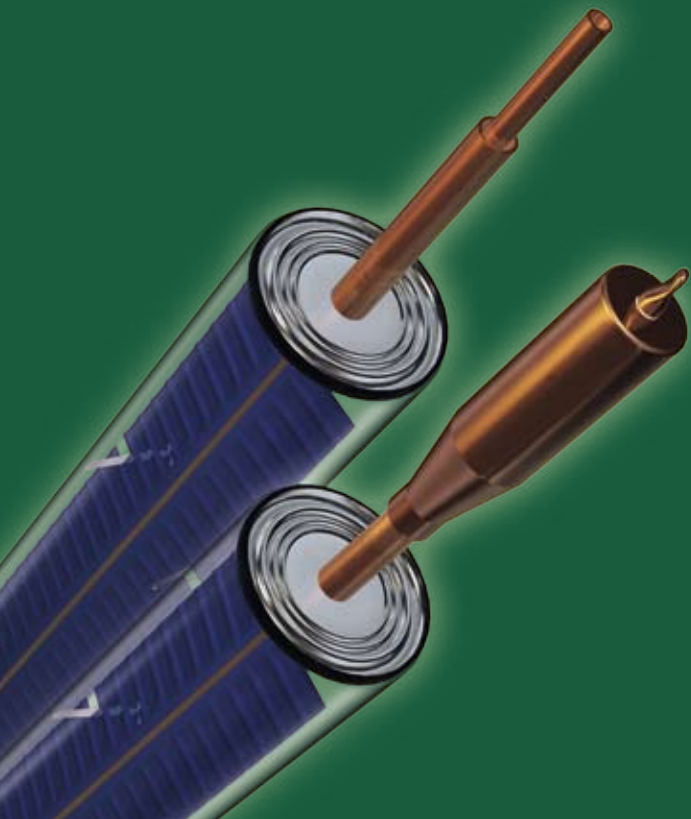
NARVA
GERMANY

SOLAR energy
natural **HEAT.**



Vacuum tubes

made in Germany





Innovationspreis
18. Thermie-Symposium
Kloster Banz
2008

Innovation award for NARVA product

At the 18. Symposium Thermal Solar Energy, held from 23rd to 25th April 2008 in Kloster Banz – Bad Staffelstein, NARVA received the award of innovation for its product vacuum tubes.

Decisive for the award to NARVA was an evaluation with regard to:

- Innovation
- Energetic relevance
- Market relevance
- Issued property rights

Prof. Dr. Goetzberger, speaker of the jury, particularly pointed out in his laudatory speech that with the NARVA tubes, a product is available which is excellently suitable for the solar process heat market. This area of application usually needs higher temperatures which are best achieved with the use of collectors with vacuum tubes.

Vacuum tubes made in Germany

NARVA carried out the step in solar technology in mid 2007. About a million vacuum tubes can be manufactured here per shift and year with a new plant.

Due to NARVA's 40-years of experience in the field of glass manufacture and processing, their extensive knowledge about coating and vacuum processes, as well as experience in the field of glass-metal-compounds, they have been able to realize the production and process very quickly.

Especially the patent-protected glass-metal-compound between sheathing and absorber makes the product robust and durable.

Through the coating with nano-particles, the transparency of the glass is once again considerably improved and with that, the effectiveness of the tubes.

The certified production in Brand-Erbisdorf includes all the essential production stages. The tube is made at the company's own glass factory; the prefabrication manufactures the copper absorber units. The assembly of both parts for the finished product takes place at the new plant which was put into operation in 2007.



The NARVA Vacuum tube

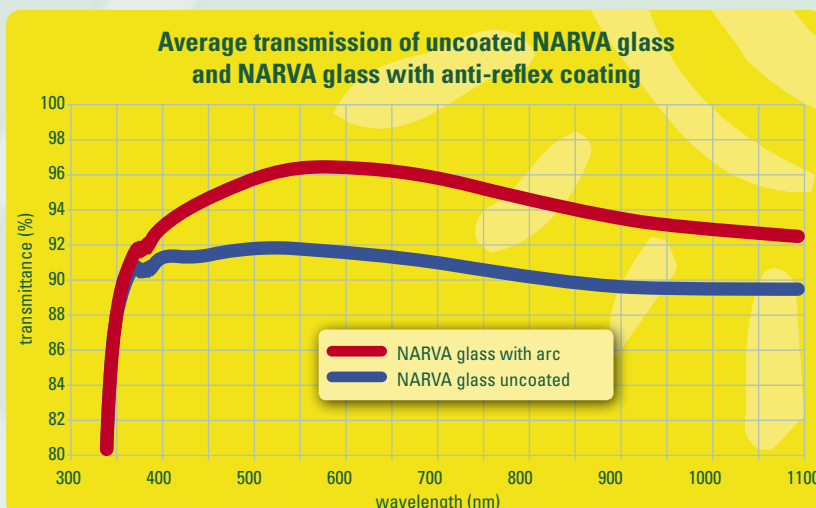
The highly transparent special glass of the cladding tube produced at NARVA's own glassworks is made from raw materials which are low in iron to make it particularly transparent for light.

In addition the cladding tube is also coated with nano-particles of silicon dioxide, both inside and out.

The layers are sintered into the surfaces, making them smudge proof. This coating increases the transparency of the glass further, reaching the maximum glass transmission of 96%.

The coating on the cladding tube prevents weathering to the glass surface and also stabilizes the glass by sealing any micro-cracks. The comparatively high wall thickness of the NARVA vacuum tubes and their coating gives the tubes a high level of hail resistance, tested by TÜV Rheinland in accordance with the EN 12975-2 hail resistance test using an ice ball test.

The special glass of the vacuum tube also has a significantly lower permeability level for hydrogen and helium compared to the frequently used borosilicate glass. As a result, the vacuum properties of the tubes last for 20 years.



Glass-metal connection



Glass-metal connection

For the NARVA vacuum tube is used a new and highly robust glass-metal connection. The susceptibility to breakage of the previous known solutions is avoided by designing a connection on which the glass is not under any tensile load and resists strong axial and shear forces with ease.

The NARVA solution has been allocated international patent protection:

International patent: PTC/DE2006/001244

Int. publication number: WO 2007/033630

This construction is resistant to cavitation impacts and thermal stress loads caused by cold water irrigation from the stagnation process, as tested in accordance with EN 12975-2.



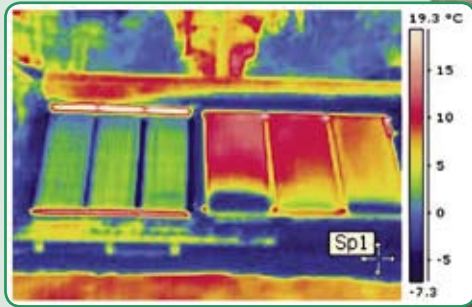
Absorber

In NARVA vacuum tubes are used the latest copper absorber plates with titanium oxide nitride coating on the market. The absorber sheeting is applied to the absorber pipe using ultra-sound welding technologies.

Through the use of efficient evacuation technologies and a getter a high final vacuum level is achieved in the collectors. The vacuum is protecting the absorber and avoids its degradation.

The absorber layer reveals no degradation in the quality of its properties even with a lifespan of around 20 years (see SPF report, 2004).

The absorber plates are available with one (Standard) and double-sided (Power) coating. Double-sided coating is used in collectors which are fitted with reflector systems. An increase in performance of up to 30% can therefore be achieved for each pipe.



Direct flow vacuum tubes

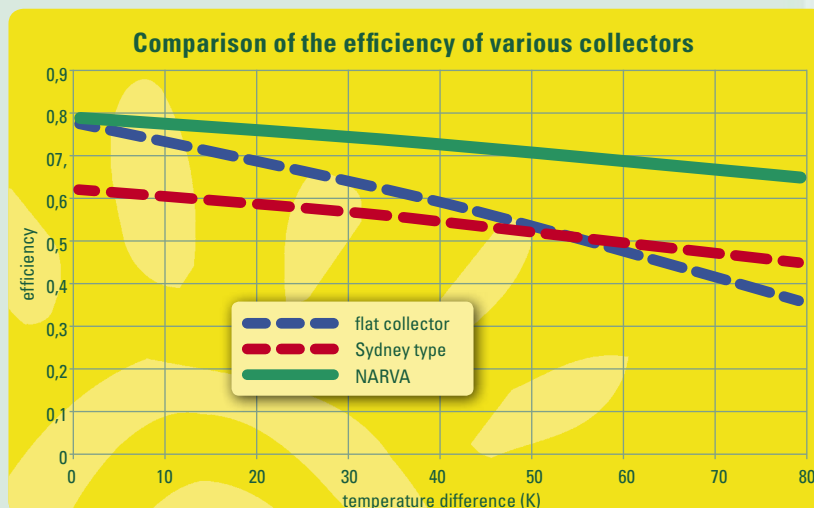
Measurements by TÜV Rheinland of the efficiency factor line of a customer module revealing the following values:

eta0: 0,781

k1: 1,12

k2: 0,004

Given the very even efficiency factor line for the NARVA vacuum tube, which falls only slightly as temperature difference increases, manufactured collectors are particularly suited to providing heat support and for applications which require high water temperatures (air conditioning, process heat, drying processes, laundries etc).





Heatpipe vacuum tubes

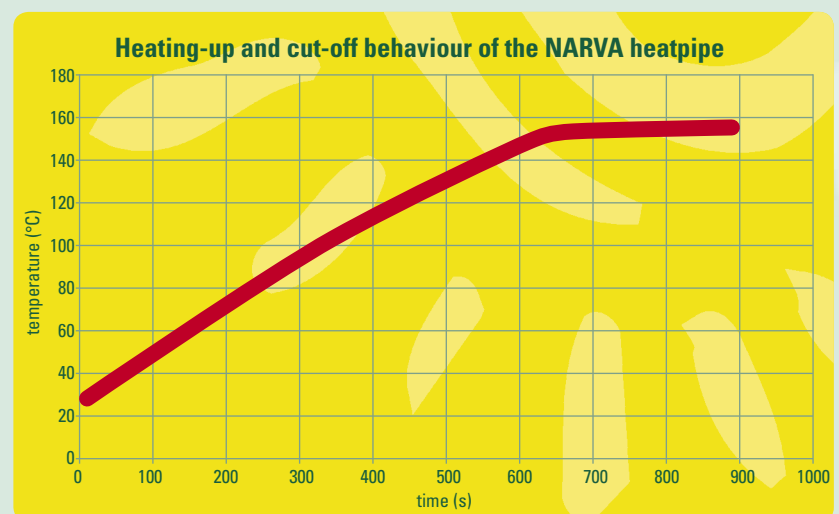
NARVA selected a construction for the heatpipe where no vent in the condenser was necessary. The temperature of the NARVA heatpipe vacuum tube condenser does not exceed 160°C even when stagnant. As such, the device incorporates intrinsic safety features.

The vaporizer fluid has been specially selected to ensure that no frost damage or fluid decomposition can occur over the 20 year product lifespan.

Inside the heatpipe the pressure is max. 13 bar in stagnation.

The condenser has been optimized in size and geometry for achieving a high efficiency factor and to enable a large working area in terms of the gradient of the collector.

The collector functions at its maximum performance when positioned upright or up to an angle of 20°.





Technical Data

Coating of absorber: one side (Standard)	NARVA Vacuum tube direct flow				NARVA Vacuum tube heatpipe			
Nominal length	800	1.500	1.775	2.000	800	1.500	1.775	2.000
Length of glass tube (mm)	810	1.510	1.785	2.010	810	1.510	1.785	2.010
Diameter of glass tube (mm)	56				56			
Length of connecting pipe (mm)	57				30,5			
Aperturface of glass tube (m ²)	0,0386	0,0750	0,090	0,1010	0,0386	0,0750	0,090	0,1010
Nominal tube output (W) at an irradiance of 1000 W/m ²	30	59	71	80	28	56	67	76
Absorbed heat at 1000 kWh/a*m ² global radiation temperature difference 40 K (kWh/a)	27	53	64	72	25	50	60	68
Absorbed heat at 1000 kWh/a*m ² global radiation temperature difference 100 K (kWh/a)	23	45	54	61	21	42	50	57
Heat transmission coefficient linear (W/m ² *K)	1,12				1,12			
Heat transmission coefficient quadratic (W/m ² *K ²)	0,004				0,004			
Efficiency factor	0,781				0,750			
Instructions for use	<ul style="list-style-type: none"> - As a result of the flat characteristic of the tube it may be used for continuous operation at a temperature of the heat carrier up to 150 °C - The tubes fulfil the requirements according to DIN EN 12975-2 - The tubes are designated for a lifetime of 20 years - If there is a risk of frost there should be used a corresponding heat carrier - The temperature of lost motion can reach 315 °C 				<ul style="list-style-type: none"> - The vacuum tubes are working up to an angle of 20 degrees without any performance loss. - The tubes fulfil the requirements according to DIN EN 12975-2 - The tubes are designated for a lifetime of 20 years - The switch off temperature is 160 °C 			
Order numbers								
Nominal length	NARVA Vacuum tube direct flow			NARVA Vacuum tube heatpipe				
	Standard	Power		Standard	Power			
800	1301 / 003	1301 / 012		1302 / 007	1302 / 004			
1.500	1301 / 002	1301 / 014		1302 / 008	1302 / 006			
1.775	1301 / 016	1301 / 017		1302 / 013	1302 / 014			
2.000	1301 / 006	1301 / 005		1302 / 001	1302 / 005			

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