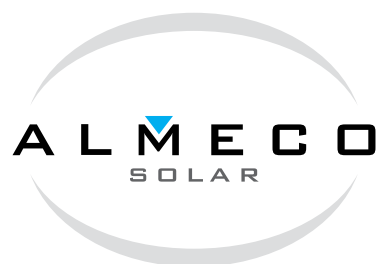


vega energy®



Solar reflective surfaces





Highly reflecting specular surfaces The highly reflecting vega energy specular surfaces are a key component of concentrating solar systems. They concentrate the solar radiation precisely to achieve extreme energy densities.

By using vega energy mirrors with their outstanding reflecting properties the performance can be increased significantly in concentrating parabolic systems (CSP) for the generation of solar thermal electricity, or process heat for industrial applications, air conditioning or sea water desalination. Performance improvements can also be reached by using vega energy mirrors in combinations with flat plate or vacuum tube solar thermal collectors and in combination with PV arrays.

The product range Almemo offers a range of reflector materials suitable for all applications in the solar energy field.

For glazed solar collectors where standard anodized aluminium does not provide enough reflectance, the vacuum coated products vega SP195 and vega SP198 provide very high levels of total and specular reflectance with excellent coating integrity, durability and U.V. resistance. Optimum reflectance of the solar spectral range is obtained by applying carefully controlled reflection enhancing layers, using continuous PVD (Physical Vapour Deposition) vacuum coating technology. These materials give reflection values of over 95% and 98% respectively on the vacuum coated strip. vega SP295 and vega SP298 are the top mirror finish versions of this range, with higher concentrating and reflecting characteristics and lower light diffusion.

The vega SP range of products is ideal for energy saving projects in indoor or protected environments.

The WR range reflector materials for external applications result from our ongoing research effort, which is driving towards even greater performance, combining higher mirror reflectance with longer product life. In these products the high reflectance vega surface is provided with an additional robust, highly transparent and weather resistant barrier coat that assures a long term high reflectivity performance in outdoor reflector applications. With their high maintained reflective performance, these products are designed for the manufacture of external solar reflectors.



Photovoltaic installations can benefit from enhanced sunlight exposure by incorporating in their design vega energy mirrors to re-direct energy onto the cell surfaces. A number of designs have been developed to improve PV array output, ranging from full parabolic systems and tracking modules to simple side reflectors on fixed arrays.

Photovoltaic systems, solar thermal and secondary reflectors

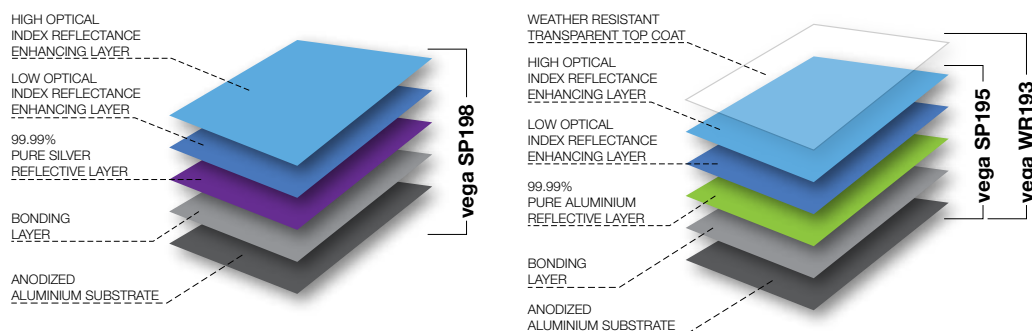
For large parabolic reflectors for process heat generation demanding high performance, vega WR193, with 90% solar reflectance, is the right choice. For smaller reflectors, for instance concentrators for vacuum tube arrays (CPC), where reflector life is a key factor but the best reflectivity performance is not essential, the SWR686 product is an ideal solution. Its 87% total reflectance and 84% solar reflectance are protected by a transparent weather resistant hydrophobic (water-repellent) top coat which guarantees long life in outdoor applications.

In Fresnel or large parabolic systems where imperfect focusing can lead to energy losses, vega aluminium can be adapted to make reflectors for use as secondary focusing mirrors with precise parabolic curvature to capture and re-focus solar energy on the absorber tube.

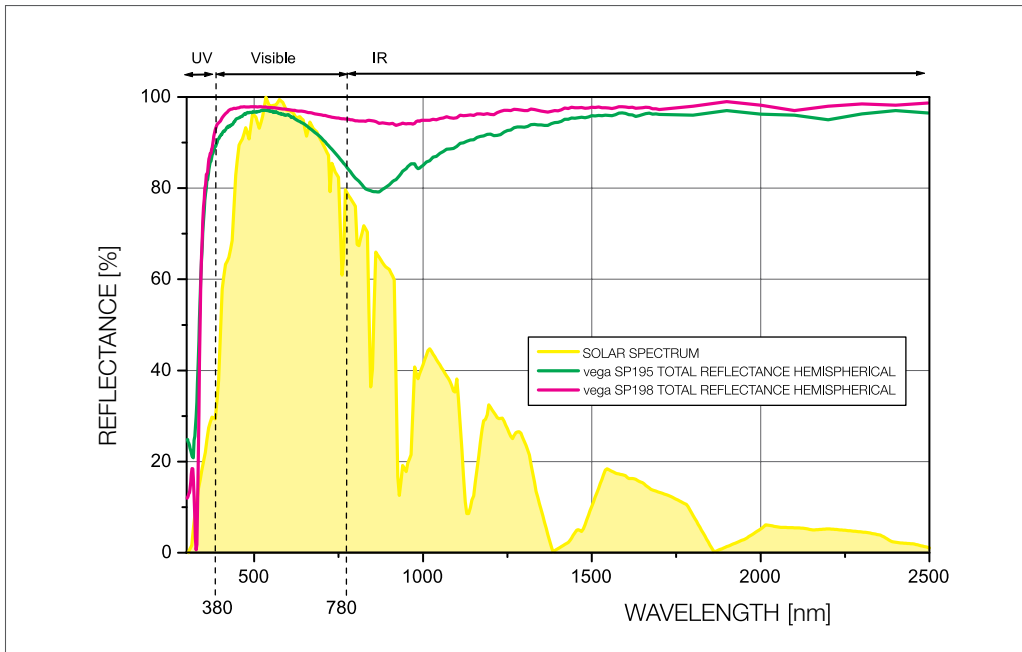
The high reflectance characteristics of vega WR193 make this aluminum product ideal for general use in the construction of reflective surfaces for solar energy generation, including process heating, air conditioning systems and seawater desalination. For more critical larger parabolic concentrators where optimum focusing of solar radiation is essential, vega WR293 with his higher specular efficiency and the same high level of surface protection promote greater energy focusing with up to 5% more energy reaching the absorber tube from the primary reflecting mirror.

Concentrating parabolic systems

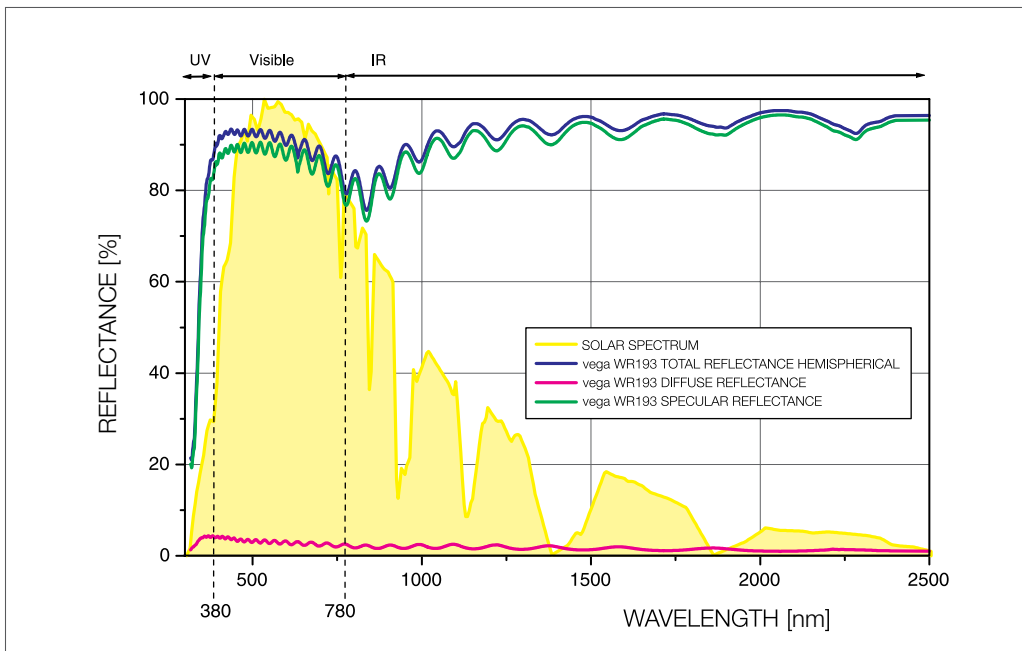
Whatever type of reflector system is desired, we can help provide the solution.



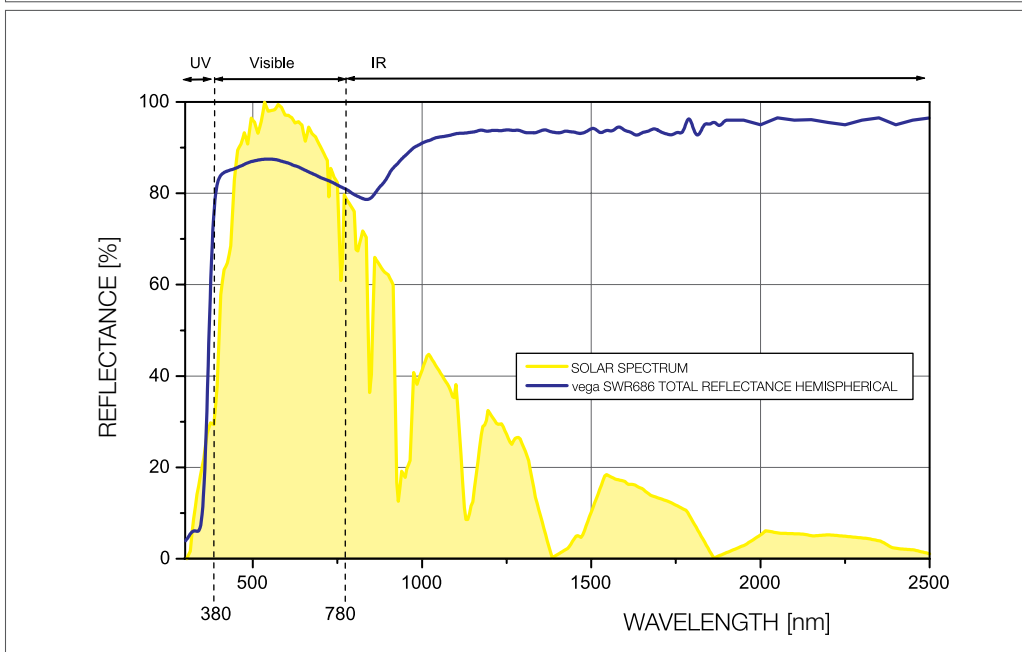
Graphs showing the spectral reflectance of vega SP195 and vega SP198 compared with the solar spectrum. See key for details.



Graphs showing the spectral hemispherical, specular and diffuse reflectance of vega WR193 compared with the solar spectrum. See key for details.



The spectral reflectance of SWR686 compared with the solar spectrum.






Product	Application type	Total solar reflectance [%]	Total reflectance "visible range" [%]	Diffuse reflectance [%]	Specular reflectance [%]
STANDARD		ASTM 891-87 **	ASTM E 1651 DIN 5036-3	DIN 5036-3 1° APERTURE	ISO 7668 60°
vega SP195	Indoor or enclosed reflectors	≥ 92	≥ 95	< 11	≥ 89
vega SP295	Indoor or enclosed reflectors	≥ 92	≥ 95	< 6	≥ 91
vega SP198	Indoor reflectors only	≥ 95	≥ 98	< 11	≥ 93
vega SP298	Indoor reflectors only	≥ 95	≥ 98	< 7	≥ 94
STANDARD		Rnh ASTM G173	ASTM E 1651 DIN 5036-3	Rnd ASTM G173	Rnh-Rnd ASTM G173
vega WR193*	Outdoor reflectors	89.9***	≥ 93	1.6%***	88.3***
vega WR293*	Outdoor reflectors	≥ 89	≥ 93	< 2.5%	≥ 88
Specular SWR686	Outdoor reflectors	≥ 84	≥ 87	< 3%	≥ 80

Product features and reflectivity values

* Also available reverse side lacquered

** Solar reflectance values are calculated with reference to solar spectral data air mass 1.5

*** Values independently measured by  Fraunhofer ISE



Material characteristics and mechanical properties

Base material	Pre-anodized aluminium 1090 alloy purity 99.9%	Availability	Sheets or coils max. width 1,250 mm thickness 0.3 – 0.8 mm
Specification	UNI-EN 573-3	General tolerances	Thickness ± 0.03 mm
Temper	Nominal H18 Specification UNI-EN 485-2		Width ± 0.15 mm
Tensile strength [MPa]	125 - 180		Length (cut sheets) ± 1 mm/m
Proof stress [MPa]	105 - 170		
Elongation [%]	> 2	Note	All products above can be delivered in various sizes and shapes according to customer requirements

All information provided is based on up-to-date values where possible. Optical values are average results from 0.4 mm metal and are published for guidance only; they may vary according to raw material thickness. For more detailed information please contact our technical sales department. Physical characteristics of the materials are in accordance with EN (European Committee for Standardization).

Product characteristics **vega SP** products are based on pre-anodized aluminium strip, PVD coated with a multi-layer reflection stack.

vega WR products are additionally coated with a highly transparent and protective UV and weather resistant top coat.

Specular SWR products are made using pre-anodized aluminium coated with a special weather resistant top coat.



Resistance testing and long term product performance

Physical tests	Standard	Result	Corrosion tests	WR PRODUCTS	
Cross hatch adhesion test	EN ISO 2409	No loss of coating adhesion	UV resistance	EN ISO 4892-3	< 0.5% reflectance change in 1000 h
180° bend test	BS EN ISO 1519	No coating failure	Neutral salt spray	ASTM B 117 ISO 9227 NSS	< 1% reflectance loss after 3000 h
Falling ball impact test	BS EN ISO 6272-1	No coating failure	Humidity resistance	ISO 4623	< 0.5% reflectance change after 500 h

Almeco guarantees that reflectance of the mirrors will be maintained within 3% of their original value for 10 year period.*

Products with protective tape are guaranteed for six months after delivery if they are stored in a conditioned room (temperature 20-30°C and relative humidity 50-60%) and kept away from sunlight and any heating source. Protective tape is not UV resistant.

For more than fifty years the Almeco Group has devoted itself to making aluminium products with reflective and decorative surface finishes. This specialization has led to the Group becoming one of the world's largest producers of components for the lighting and solar energy industries. **The Company**

All vega energy products are manufactured in Germany at Almeco GmbH, which incorporates the Solar Business Division of Almeco Group. With modern, high technology vacuum coating and manufacturing lines, Almeco GmbH specializes in high-tech reflector and absorber coatings that convert sunlight into heat energy in an efficient, reliable and environmentally friendly manner.

vega energy is "made in Germany". In Bernburg (Saxony-Anhalt), Almeco installed one of the most modern PVD coating systems in the world for roll-to-roll manufacturing of highly reflective aluminium surfaces. **PVD coating facility**

* subject to the use of an appropriate reflector cleaning programme

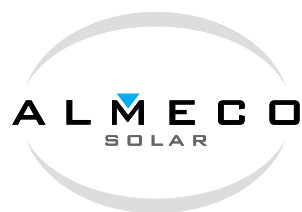




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Munich – Germany

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