



PRODUCT SPECIFICATION

TiNOX[®] highly selective titanium-coating

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TiNOX[®] highly selective titanium-coating
for:



In 1995 TiNOX launched the first highly selective coating for solar thermal collectors. The new “blue” coating, based on **Titanium** and **Quartz**, marked a significant increase in performance and represented the first environmentally friendly alternative to the so far commonly used “Black-Chrome”- and “Black-Nickel-coatings”.

TiNOX is coated onto metal tapes in a specially designed roll-coating-process (PVD). By means of an electronic beam evaporator, titanium is evaporated under **vacuum** and condenses onto the metal tape while reacting with nitrogen and oxygen to **titanium-oxy-nitride**. Additionally quartz is evaporated forming a second antireflex- and protection layer.

The efficiency of any solar absorber depends on its ability to transfer sunlight into heat. **High absorption** of solar radiation is a basic condition and can be achieved quite easily. The challenge is to capture the solar-energy inside the material. The special TiNOX-coating does not only have a very high absorption. It reduces dramatically the irradiation in the infrared spectrum what makes the heat remain inside the absorber (**very low emission**). As a result, collectors equipped with a TiNOX-coated absorber work far more efficiently, even if the weather is cloudy.

We at TiNOX insist on **outstanding performance** and high quality of our products. Since 2004 our coating-units are equipped with an automatic computer process-control. Several spectrometers consistently analyse and if necessary readjust the optical values. All relevant data is recorded and checked twice by an experienced **quality control** team.

TiNOX is the only coating with Titanium and Quartz instead of Nickel or Chrome! It pollutes neither water nor air and is therefore the **most environmentally friendly process**.

TiNOX can be processed by **all common joining methods**: laser, plasma and ultrasonic welding, soft-soldering and reshaping processes.

1. Certified performance and long term stability

The outstanding properties of TiNOX[®] are certified by independent testing institutes:



Institut für Thermodynamik und Wärmetechnik,
1996-2001



Fraunhofer Institut Solare Energiesysteme,
1997 und 2000



Institut für Solartechnik, Hochschule Rapperswil,
2001



Swedish National Testing and Research Institute,
1996

The long term stability is tested regularly according ISO /CD 12952.2 and Task 10 test of the IEA.

These certificates prove that the TiNOX[®] absorber still maintains at least 95% of its initial performance after 25 years of use in a flat plate collector.

2. Optical Parameters

TiNOX classic[®]

Solar absorptance: $\alpha \approx 95 \% \pm 2 \%$

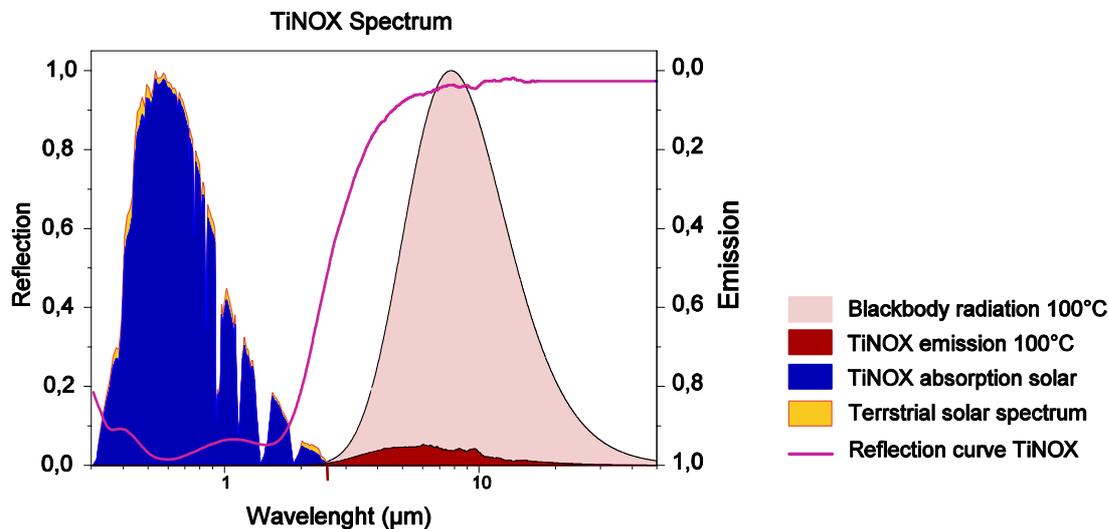
Thermal emittance (at 100°C): $\epsilon \approx 4 \% \pm 2 \%$

TiNOX art-line[®]

Solar absorptance: $\alpha \approx 91 \% \pm 2 \%$

Thermal emittance: $\epsilon \approx 4 \% \pm 2 \%$

3. Reflection spectrum of the TiNOX absorber



4. Technical definition of the colour

TiNOX[®] uses the L*C*h system according DIN 5033 for the technical description of the colour. Normalised light D65 and a observation angle of 10° are used. The colour values are measured and regulated continuously during the production by 5 spectrometers.

For the TiNOX[®] products following ranges for the colour angle h are divided:

TiNOX classic[®] 265° < h < 290° deep blue

TiNOX art-line[®] 55° < h < 80° bronze

Definition of the colour homogeneity:

Maximum deviation of the colour angle over the whole width of the absorber stripe:

±7° in colour angle h

5. Carrier material

Dimensions:

TiNOX[®] is coated in PVD-coating machines on copper foil up to 1200 mm width.
Own cutting facilities enable TiNOX to deliver the absorber material on customer demand:

Delivery form: Coil- und plate ware
(Optionally with paper or protective foil interlayer)

Thickness: 0,12 - 0,3 mm +/- 0,02 mm

Width: 60 mm up to 1.200 mm
tolerance according DIN 1791

Mechanical properties:

Copper: SF-Cu, SW-Cu or OF-Cu,
chemical composition and properties according
EN 1652 / EN 10204

Breaking elongation: $\geq 10\%$ (A10)

Tensile strength Rm: ≥ 240 N/mm²

Proof strength Rp_{0,2}: ≥ 200 N/mm²

Allowed bending radius: ≥ 5 mm

Hardness: HV 90 ± 20

Surface roughness: Ra 0,6 ì m

Peel strength: according DIN 58196-6

Physical properties

Electrical conductivity: ≥ 40 m/Ω mm²

Heat conductivity: ≥ 320 W/m K

6. Handling

TiNOX[®] absorber material can be processed by all common joining methods, including:

- Ultrasonic welding
- Plasma welding
- Laser welding
- Soft soldering
- Reshaping

Deep drawing and emboss processes are possible in principle. Please contact TiNOX for consultants.

The TiNOX absorber material may not be exposed to direct contact with strong oxidising or reducing chemicals, especially in soldering processes.

Maximum temperature load for processing TiNOX material:

On air:	275°C up to 20 minutes
	300°C up to 5 minutes
Under Vacuum:	380°C up to 60 minutes

7. Storage

Coils may not be stacked during transportation and storage. TiNOX[®] absorber material must be protected from shocks, impacts and mechanical stress during transportation and storage.

TiNOX[®] absorber material requires storage in dry, dust free and closed rooms.

Only acid and solvent free, as well as non exhaling materials (insulation material, paper and wood, etc.) may be used for packaging, transportation and storage.

8. Quality control

DIN EN ISO 9001: 2000



The TiNOX company works according the
Quality management system DIN EN ISO 9001: 2000

EMAS – proved environmental management system



The TiNOX company is official registered user of the environmental
management system according the **EU prescription 761/2001**.

9. Warranty

The TiNOX company guarantees compliance with the optical parameters as mentioned in point 2 of this document for a period of

five years,

provided that the “Instructions for application and further processing” of TiNOX material have been followed.

Depending on the type of the reported fault, the TiNOX Company will meet its warranty obligations through repair or replacement of the delivered material. Further claims are excluded.

Obvious problems and damage must be reported to the TiNOX Company immediately following delivery.

Your partner for highly selective coatings

www.tinox.com

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