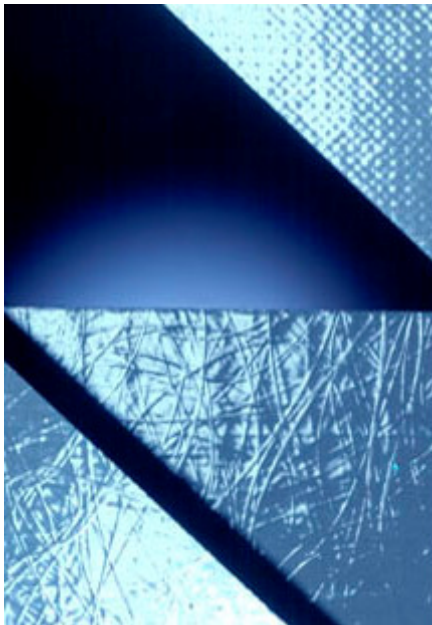
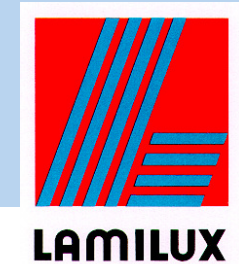




Advantages of GRP compared to Aluminium Sheets

Advantages of GRP compared to Aluminium



- Overview product advantages
 - Low weight at high mechanical strength
 - Weathering resistance especially against hail
 - Lower deformation-incline than aluminium
 - Corrosion resistance (no pitting)
 - On demand the GRP is protected by a special gel coat layer instead of a common finishing on aluminium
 - The gel coat is chemically bonded on the GRP (Spalling like on common finishing is not possible)
 - Gel coat provide high UV and colour stability over a long period
 - High gloss
 - Non-porous surface
 - Easy to clean
 - Unlimited colouring possibilities
 - Resistance to corrosion
 - Resistant to atmosphere conditions
 - The gel coat has a high flexibility and tensile elongation (it is crack insensitive)

Advantages of GRP compared to Aluminium



- Overview product advantages

- Resistant to chemicals
- GRP and the gel coat layer are solid coloured compared to painting
- printing and painting of the GRP is possible
- Easy to handle in the process (sawing, drilling, jet cutting, ...)
- Compared to the sharpness of the edges of aluminium the risk of injury (cutting) with GRP is lower
- High chunking resistance (screws, rivets)
- No breaks or buckling while processing
- Much better thermal insulation than aluminium
- GRP has a better sound reduction index than Aluminium
- Better environmental balance than with many other materials
- GRP is (without any special additives) an insulator
- GRP transfers forces only remote
- Repairing possibilities of damages and scratches
- Consistent quality through continuous production process
- Production width of GRP up to 3,20m!
- Qualified for a usage in the food industry
- Moisture resistant

Advantages of GRP compared to Aluminium



- Weathering resistance especially against hail
- Lower deformation-incline than aluminium

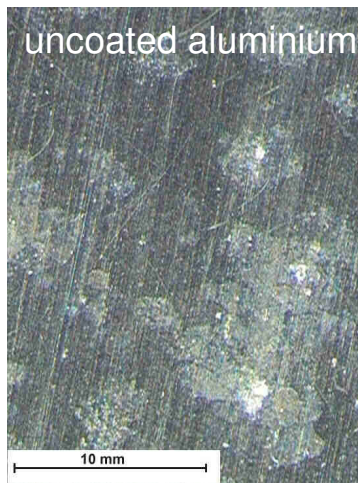


Advantages of GRP compared to Aluminium



- Corrosion resistance (no pitting)

9h „salt spray test“ DIN 50021



unbeschichtet (deutliche Korrosion)

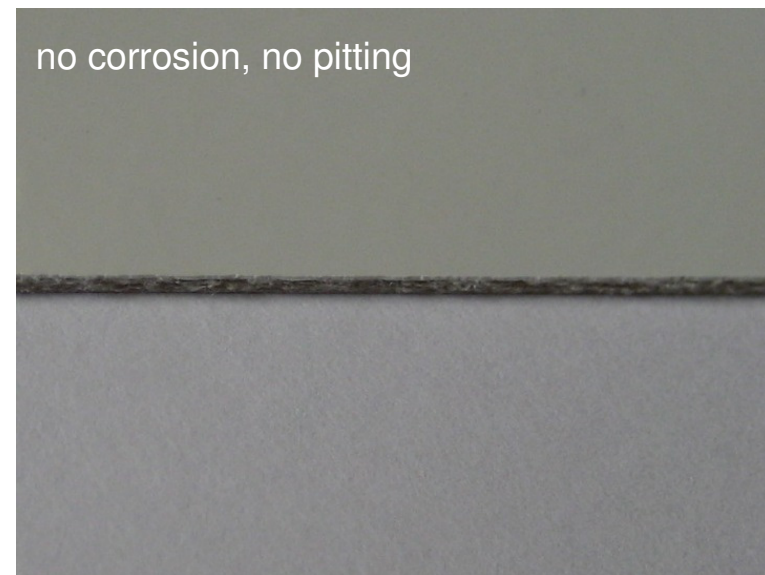


CVD-Quarz-Schutzschicht (kein Angriff feststellbar)

Vergleich Aluminiumoberflächen nach 9 h Salzsprühtest DIN 50021
Dunkelfeldaufnahmen

Substrate: uncoated and coated aluminium

480h „salt spray test“ DIN EN ISO 9227



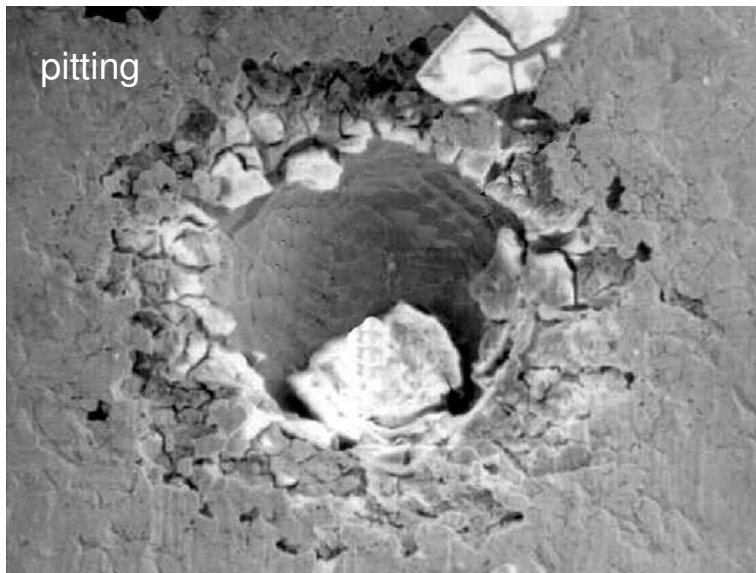
LAMILUX Super Plus Gelcoat 1,2 mm

Advantages of GRP compared to Aluminium



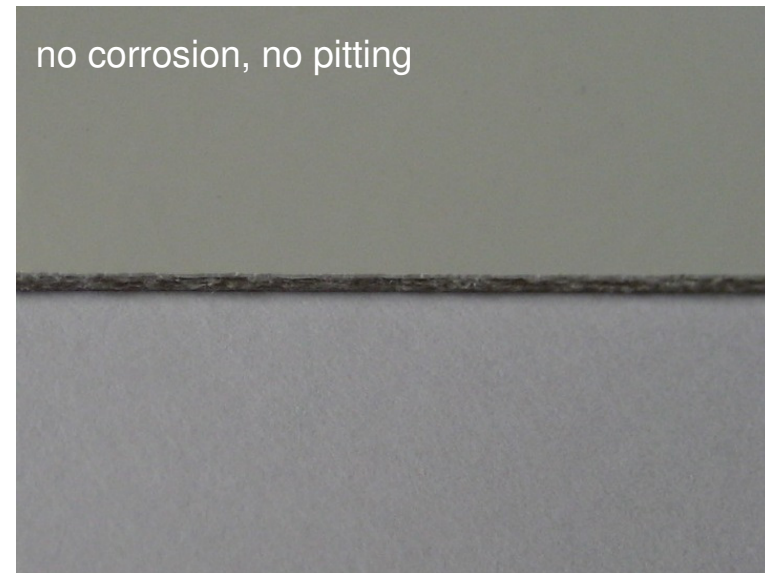
- Corrosion resistance (no pitting)

9h „salt spray test“ DIN 50021



Substrate: uncoated aluminium

480h „salt spray test“ DIN EN ISO 9227

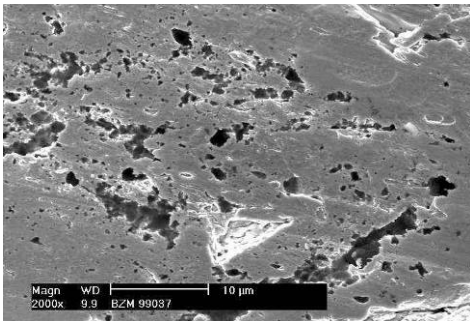


LAMILUX Super Plus Gelcoat 1,2 mm

Advantages of GRP compared to Aluminium



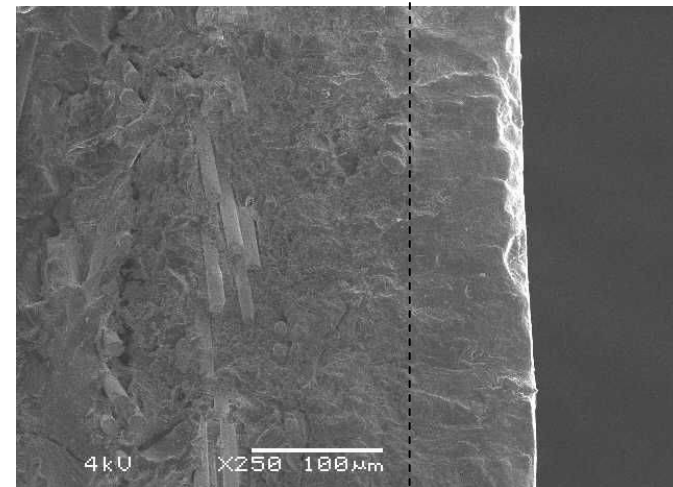
- Comparison of „salt spray test“ on Aluminium and GRP:
 - Just after 9 hours in the „salt spray test“ the uncoated aluminium began to corrode and showed pitting
 - The LAMILUX Super Plus Gelcoat 1,2 mm however showed no changes in the „salt spray test“ after 480 hours



Advantages of GRP compared to Aluminium



- On demand the GRP is protected by a special gel coat layer instead of a common finishing on aluminium
- This provides a lot of advantages
- The gel coat is chemically bonded on the GRP
Spalling like on common finishing is not possible
- The gel coat is fibre free and based on isophthalic acid



Advantages of GRP compared to Aluminium



- Gel coat provide high UV and colour stability over a long period
- High gloss
- Non-porous surface
- Easy to clean



Advantages of Gel Coat



- Unlimited colouring possibilities
 - RAL
 - NCS
 - Customer specific
 - Metallic
 - Translucent
- Resistance to corrosion
- Resistant to atmosphere conditions
 - Rainwater, seawater, de-icing salt, environmental pollution durability
 - Tough surface against dust and sand erosion



Advantages of Gel Coat



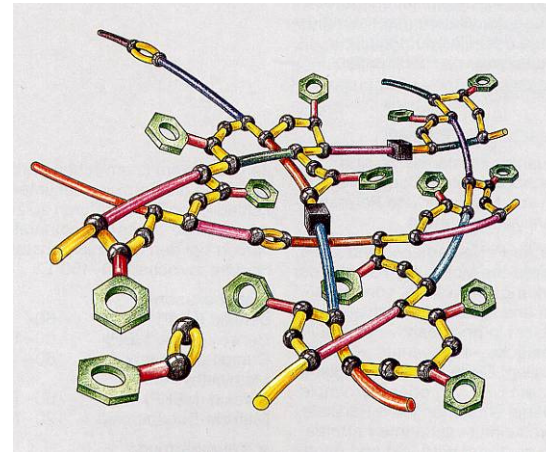
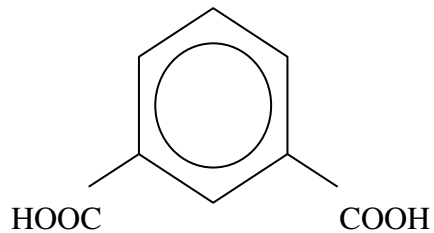
- The gel coat has a high flexibility and tensile elongation
- It is crack insensitive



Advantages of Gel Coat



- Resistant to chemicals
- UP resin gel coat based on isophthalic acid



Advantages of Gel Coat



- GRP and the gel coat layer are solid coloured compared to painting
 - Insensitive to scratches
 - Non-sensitive to stone-chipping
 - Additional painting is not necessary



Advantages of Gel Coat



- Nevertheless printing and painting of the GRP is possible
- Easy to roughen
- Uncomplicated to paint



Advantages of GRP compared to Aluminium



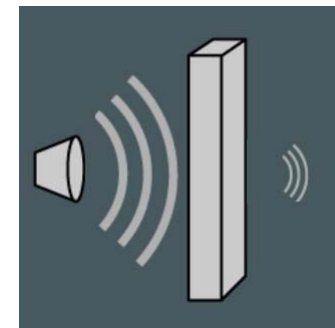
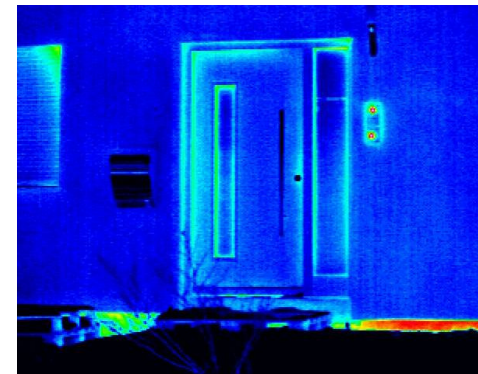
- Easy to handle in the process (sawing, drilling, jet cutting, ...)
- Compared to the sharpness of the edges of aluminium the risk of injury (cutting) with GRP is lower
- High chunking resistance (screws, rivets)
- No breaks or buckling while processing



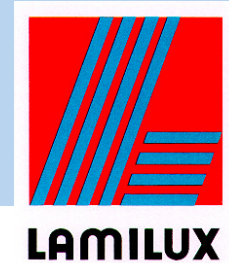
Advantages of GRP compared to Aluminium



- High strength
- Much better thermal insulation than aluminium
 - GRP has a heat conductivity about 0,21 W/mK
 - Aluminium has a over 1.100 times higher heat conductivity with approx. 237 W/mK
- GRP has a better sound reduction index than aluminium
 - this is especially an advantage for applications with higher demands on sound reduction (e.g. roof)



Advantages of GRP compared to Aluminium



- Better environmental balance than with many other materials

Environmental balance	Unit	Construction Steel S235J2	Stainless Steel AISI316L	GRP E23	Aluminium AlMgSi1
Energy consumption	GJ	270	300	120	269
Critical volume of polluted air	m ³	697	k.A.	74	565
Critical volume of polluted water	m ³	7,3 * 10 ⁶	k.A.	17,7 * 10 ⁶	53,6 * 10 ⁶

Source: Greenbuilding, Issue 05/09, Bauen, Page 27

- the production of Aluminium or Construction steel has a approx. 125 % higher energy consumption in comparison to the production of GRP
- in comparison to the production of GRP, the production of Aluminium has a 7,5 times higher volume of critical polluted air

Advantages of GRP compared to Aluminium



- GRP is (without any special additives) an insulator
- GRP does not conduct electricity
 - Insulator $\rho > 10^{12} \Omega \cdot \text{cm}$
 - Semiconductor $\rho = 10^{-4} \text{ to } 10^{12} \Omega \cdot \text{cm}$
 - Conductor $\rho < 10^{-4} \Omega \cdot \text{cm}$

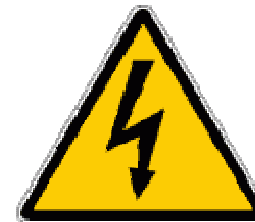
GRP

specific resistance:
approx. $10^{15} - 10^{16} \Omega \cdot \text{cm}$



Aluminium

specific resistance:
approx. $26^{-9} \Omega \cdot \text{cm}$



Advantages of GRP compared to Aluminium



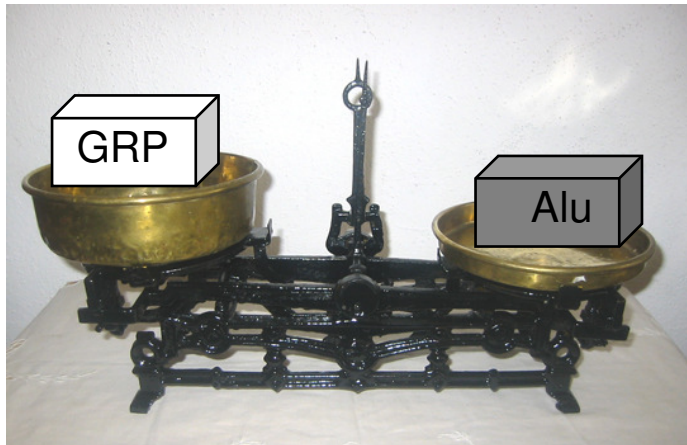
- GRP transfers forces only remote
 - In case of a small accident merely a slight part around the force transmission point has been damaged
- Repairing possibilities of damages and scratches
 - For more information, see our [repair manual and recommendations](#) on the LAMILUX homepage and do not hesitate to contact us if you need any support



Advantages of GRP compared to Aluminium



- Using GRP can save weight (and energy) in a lot of cases
 - Density of GRP (in our case) is about 1,35 g/cm³
 - Density of aluminium is about 2,7 g/cm³



Advantages of GRP compared to Aluminium

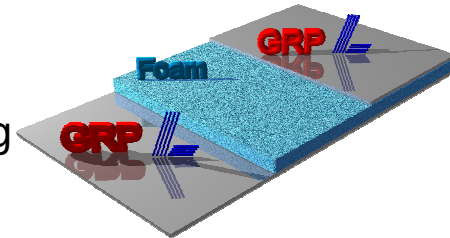


- Using GRP can save weight (and energy) in a lot of cases
 - For instance this means for a sandwich-panel:

If you use 2.0 mm GRP instead of 1.2 mm aluminium

GRP: $2 * 1 \text{ m}^2 * 2.0 \text{ mm} * 1,35 \text{ kg/m}^2\text{*mm} = 5,4 \text{ kg}$

Aluminium: $2 * 1 \text{ m}^2 * 1.2 \text{ mm} * 2,7 \text{ kg/m}^2\text{*mm} = 6,48 \text{ kg}$



→ in this case you can save approx. 1 kg per m² sandwich panel

or in other words:

→ you reduce the weight of the sandwich panel about 15 %

Advantages of GRP compared to Aluminium



- Physical Properties of GRP in comparison to Aluminium

	GRP	Aluminium
Density [kg/m ³]	approx. 1.350 (depending on glass content)	2.700
Linear expansion	approx. $30 - 40 \cdot 10^{-6} \text{ 1/K}$ (depending on glass content, thickness, resin)	$24 \cdot 10^{-6} \text{ 1/K}$
Heat conductivity [W/mK]	0,21	approx. 237
Tensile strength [N/mm ²]	35 – 150 (depending on glass content / glass construction, product-type)	approx. 70 – 400 (depending on alloy)
Tensile elongation [%]	1,3 – 4,0 (depending on glass content, resin)	approx. 3 - 40 (depending on alloy)

Advantages of GRP compared to Aluminium



- Physical Properties of GRP in comparison to Aluminium
 - Thin sheet aluminium often has to be “corrugated” to handle it easy in the process and to have a good stiffness in the product
 - This is not necessary with GRP
 - The high stiffness of GRP allows to use a flat and smooth surface



Advantages of our Production Process



- Consistent quality through continuous production process
- We can supply you with GRP up to 3,20 m width, this is really unique in the continuous production of GRP and continuous sheet materials
- Due to our automated temperature control on the line we are able to produce tension free material



Overview of LAMILUX GRP Product Range



- Thickness 0,8 – 5,0 mm
- Width max. 3.200 mm
- Delivery form sheets up to 12 m length - coils up to 300 m length
- Colour RAL, NCS, dual colour or customized colours
- Reinforcement glass mats, woven fabric, multi-axial fabrics
- Surface veil, gel coat
- Optical characteristics woven structure, veil, high gloss, mat finish, decor
- Reverse side smooth, corona treated, sanded



Advantages of our Production Process



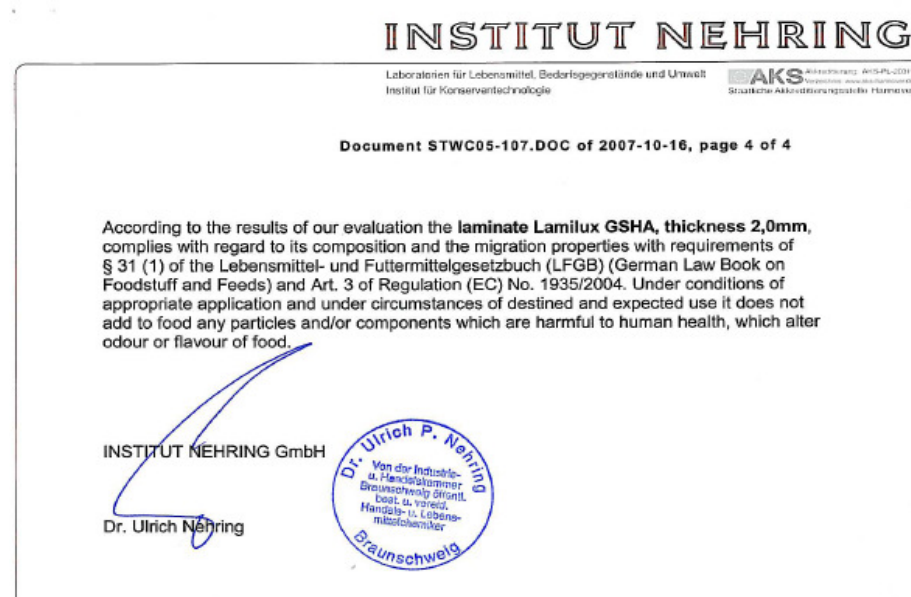
- Besides the unlimited colour range it is possible to produce translucent material, for instance for the roof of trailers



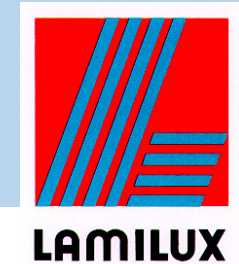
Advantages of our Production Process



- Our material is qualified for a usage in the food industry
- This was analysed and approved by „Institut Nehring“
(extract from the original test certificate)



Advantages of our Production Process



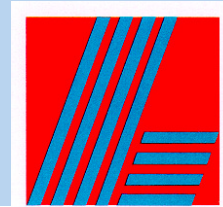
- Due to the moisture resistance of the GRP, the material has a good resistance to microorganisms and moulds
- For example: tests showed, that LAMILUX GRP material without any antibacterial additives is resistant to staphylococcus aureus ATCC 6538
 - After 24 hours nothing could be detected

[cfu/sample]

Test strain -->	Staphylococcus aureus ATCC 6538	
	0'	after 24 hours
01 CXS07.0239-1, Blank	1.0*10 ⁵ 1.1*10 ⁵	<100 <100
02 CXS07.0239-2, IRGAGUARD B6000		<100 <100
03 CXS07.0239-3, IRGAGUARD B6000		<100 <100
01 CXS07.0239-1, Blank Without preincubation	1.0*10 ⁵ 1.1*10 ⁵	<100 <100

O/n culture *Staphylococcus aureus* ATCC 6538: 8.7*10⁹ KBE/ml (1:10000)

Quality and Consistency



LAMILUX



Raw Material Control

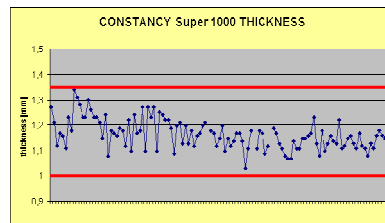
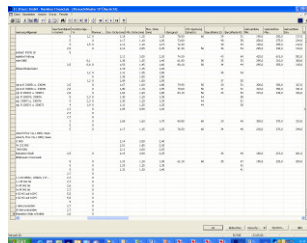
- 100% of all resins
- Partial control of glass mats

Process control and final control

- 100% process control
- Final control:
 - Every second coil: barcol hardness, thickness, delamination, transparent
 - 2 times per shift: surface tension, gel coat thickness
 - 3 times per shift: pinholes



Feedback and Statistic



Laboratory

- Approx. 1% of the production
- Tensile and binding strength
- Residual styrene
- Gloss
- Yellowing
- Long term surface tension
- IR-test
- Barcol hardness
- Glass content
- Surface tension, dyne level
- Long term temperature tests
- Bending radius



27.05.2009

M. Gräf

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Continuous Product Testing



- Impact and tensile strength
- Test reports



Continuous Product Testing



- Heat-cold bending test
 - 8 hours at 80 °C
 - 16 hours at -30 °C



- Heat-cold test
 - 8 hours at 80 °C
 - 16 hours at -30 °C



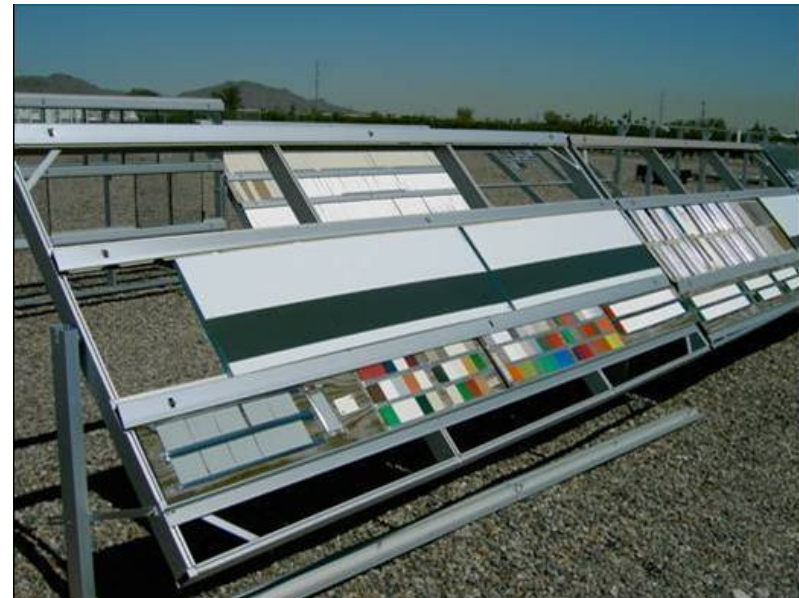
Continuous Product Testing

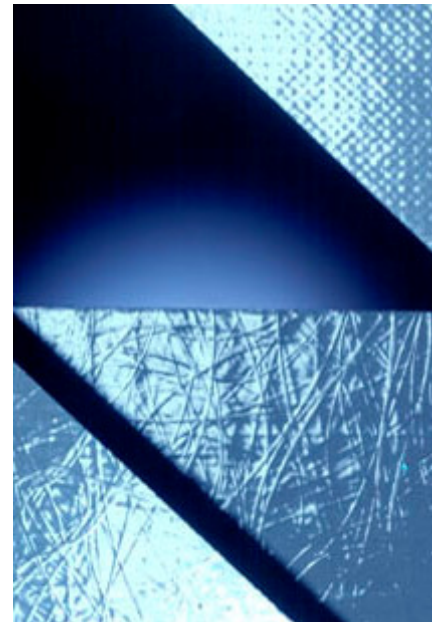


- Halogen radiation at 80 °C



Continuous SUN-tests in Arizona





We are looking forward to welcoming you to LAMILUX