

Visit Report

To: GUOS,
Cc: WNGJ, ZUP, YAVY, YAME, YAGK, CAAG, GUOC

1 General

Customer : Nanhua
Participants : Nanhua : Mr.Zhao, Mr.Chen, Mr.Ming, Mr. Han
 EMS : A. Xue, M.Yang
Application : LED light cover (Industrial use)
Material : Grilamid TR 90 UV
Potential : 10 t/a
SOP : 05.2022
USP : Stress crack resistance
 UV resistance
 Successful market reference
 Low temperature resistance
 Vibration resistance



2 Summary / Conclusion / Opportunities

- We have introduced EMS Grilamid TR solutions for the special lighting applications. Nanhua shows great interests with our Grilamid TR 90 UV material and believes that we can solve their current stress crack problems.
- We also shared some successful stories from us which are very similar with their current products which makes them very interested in our solutions.
- Nanhua promise to test EMS Grilamid TR material using their current tool.
- Mezzo also introduced EMS metal replacement solutions to Nanhua.

3 Back ground information

Customer & Project information

- Nanhua is the famous local special lighting manufacturer since 1990s. Nanhua is focusing on the following special lighting area as Aviation, construction, marine, Engineering Machinery. They are not very sensitive with the cost.
- Nanhua has their own injection molding machines for optics components and has injection molding suppliers especially for transparency and other special lighting components.
- Nanhua has introduced the current solution of anti-explosion lights. They are using

the combination with High borosilicate tempered glass plus special PC material to reach the anti-explosion request.

- Nanhua is using special PC from IDEMITSU Japan now. Currently they met stress crack problems during internal salt spray test tests. Especially at the screw assembling area.

Part & test requirement

- Thermal shock test (-40 to 80°C/100 cycles)
- Temperature resistance test (Normally -40 to 50 °C, Short term max.120°C)
- IP67 test
- Vibration test
- Salt spray test
- Weathering test (2000 hours)

4 Action plan

No.	Measures	Resp.	Date
1	Provide material for Nanhua to do test	YAME	15.Oct.2021

Best Regards

Arthur Xue

Grilamid TR AD



Pictures from techday**Techday PPT**



南华机电

EMS-GRIVORY

The Leading Manufacturer of High Performance Polyamides

艾曼斯工程塑料有限公司

世界领先的高性能聚酰胺（尼龙）材料生产商

NANHUA

EMS
EMS-GRIVORY



Mezzo YANG
杨军

Key Account Manager Industry & Consumer
工业及消费品大客户经理
mezzo.yang@cn.emsgrivory.com
13812625167

Arthur XUE
薛小平

Application Development of Grilamid TR
应用开发经理
arthur.xue@cn.emsgrivory.com
15995715587



09:30 开场及公司简介

- EMS 同事介绍
- EMS 公司简介
- 金属取代介绍

Presenter: Mezzo YANG (杨军)

10:00 EMS TR透明尼龙材料介绍

- 材料介绍介绍-TR
- 透明尼龙材料成功案例

Presenter: Arthur Xue (薛小平)

10:30 EMS样品展示说明

- 样品涉及案例分析-Arthur Xue (薛小平)
-

11:00 提问和分享





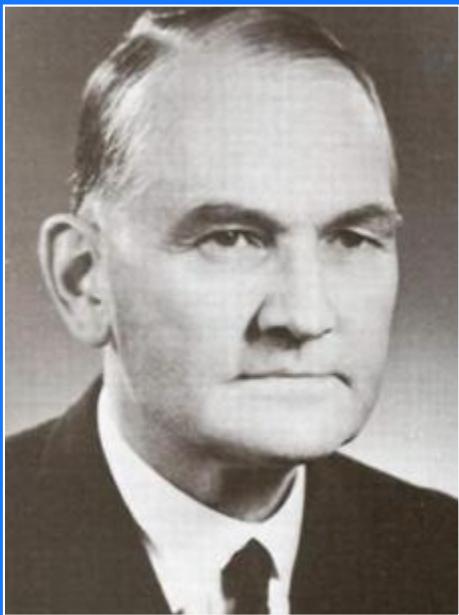
**Your Innovative
Development Partner
for Cost and Weight
Saving Solutions**



Headquarters Domat / Ems, Switzerland



EMS: Owner - managed



**Werner
Oswald**



**Christoph
Blocher**



**Magdalena
Martullo**

1936

1983

2003

Core Business - Then and Now



High Performance Polymers



Fertiliser

Fibres

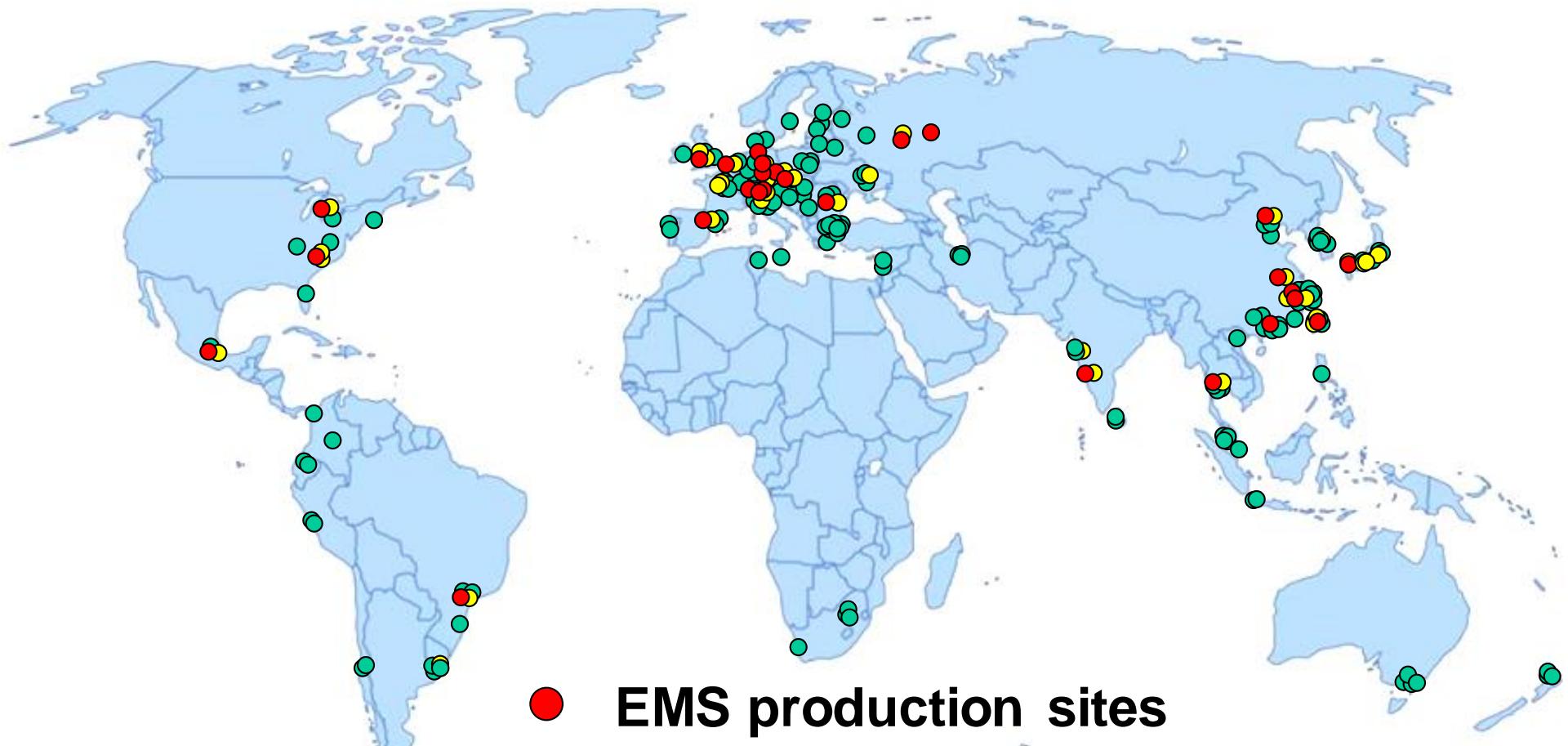
EMSER Water



1936 1940 1950 1960 1970 1980 1990 2000 2010 2019

EMS
EMS-GRIVORY

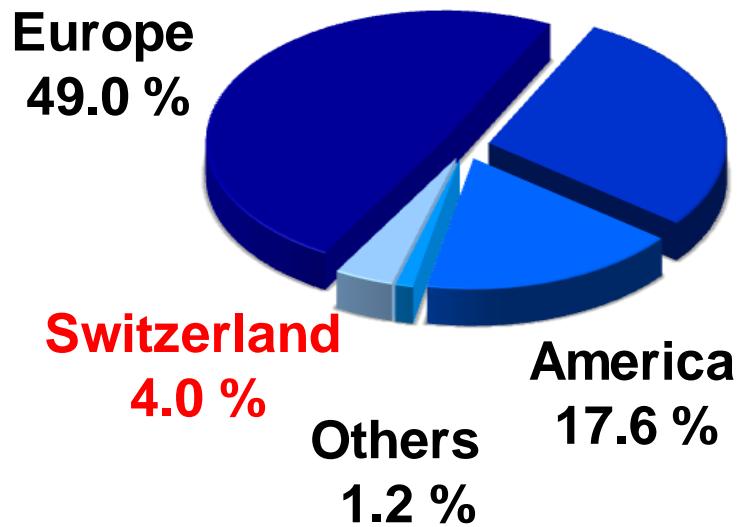
EMS: Worldwide Presence



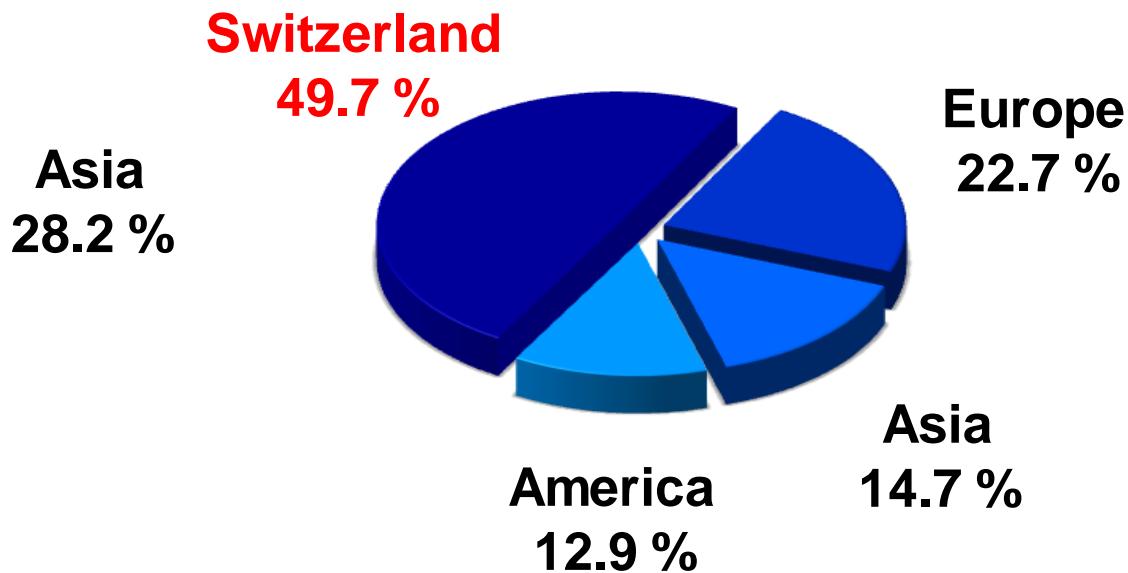
- **EMS production sites**
- **EMS sales organisations**
- **Distributors / Agents**

Regional sales figures 2020 EMS Group

Net Sales

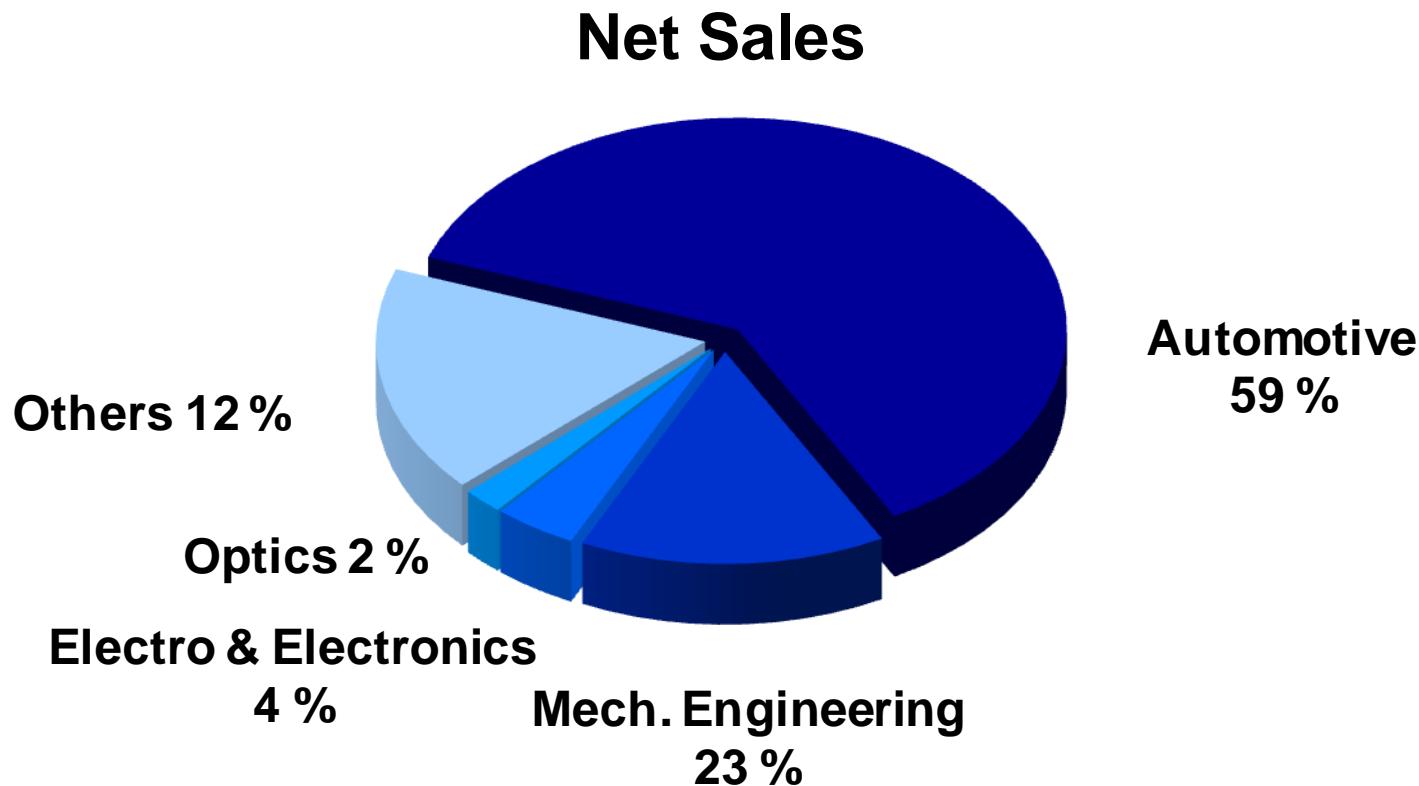


Production



Market Segments 2020

EMS Group



7 x "Global Supplier of the Year" General Motors



Detroit, March 10, 2016



Detroit, March 5, 2015



Orlando, March 31, 2017

Chris Naegeli, Magdalena Martullo,
Kristen M. Siemen, Christian Morf



Detroit, March 10, 2011



Detroit, March 13, 2012

- **Excellent, innovative technology / services**
- **Quick response time**
- **Entrepreneurial total-cost solutions**



Detroit, March 12, 2014



Detroit, March 13, 2013

"Top 150 Supplier" Volkswagen Group



"Regional Supplier Quality Achievement" 2017

Nissan North America



- High performance in production support
- Continual process optimisation
- Product development

Nashville, December 4, 2017

"Zero Fault Quality Supplier 2017" Toyota Kirloskar Motor



- Zero Fault Quality 2017
- High Reliability, Service and Efficiency
- Preferred Supplier for new Business

Bangalore, April 24 2018

Sagar Kulkarni

President
EFTEC India

Manish Dubey

Head Sales & Marketing
EFTEC India

"Premium - Supplier" since 2017 Continental



Castle of Rhäzüns, February 21, 2017

**Günter Fruth, Marco Prigandt, Magdalena Martullo,
Christian Morf, David Jensen**

EMS
EMS-GRIVORY

"Supplier of the Year 2019" Continental



- **Excellent delivery reliability**
- **Above-average product quality**
- **Innovative development partner**

"Preferred Supplier" since 2010

Bosch



- Innovative technology
 - Superior quality
 - Best-in-class development support
 - Tailor-made products
 - Competitive prices
- | | | | |
|--|-------------------------------------|-------------------------------------|---|
| Dr Karl Nowak
President Global Purchasing / Logistics | Magdalena Martullo
CEO EMS Group | Siegbert Gabriel
KAM EMS-GRIVORY | Alfons Lesch
Vice President Purchasing / Logistics |
|--|-------------------------------------|-------------------------------------|---|

Why are EMS' materials used?

System Solutions

Automotive
Costs, weight, design

Industry & Sanitary
Durability, approvals

Electro & Electronics
Safety, precision

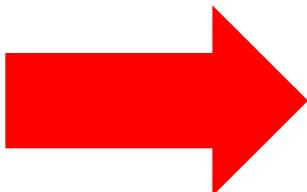
Optics
Comfort, quality

Metal replacement

High temperature

Media resistance

Design / Surface



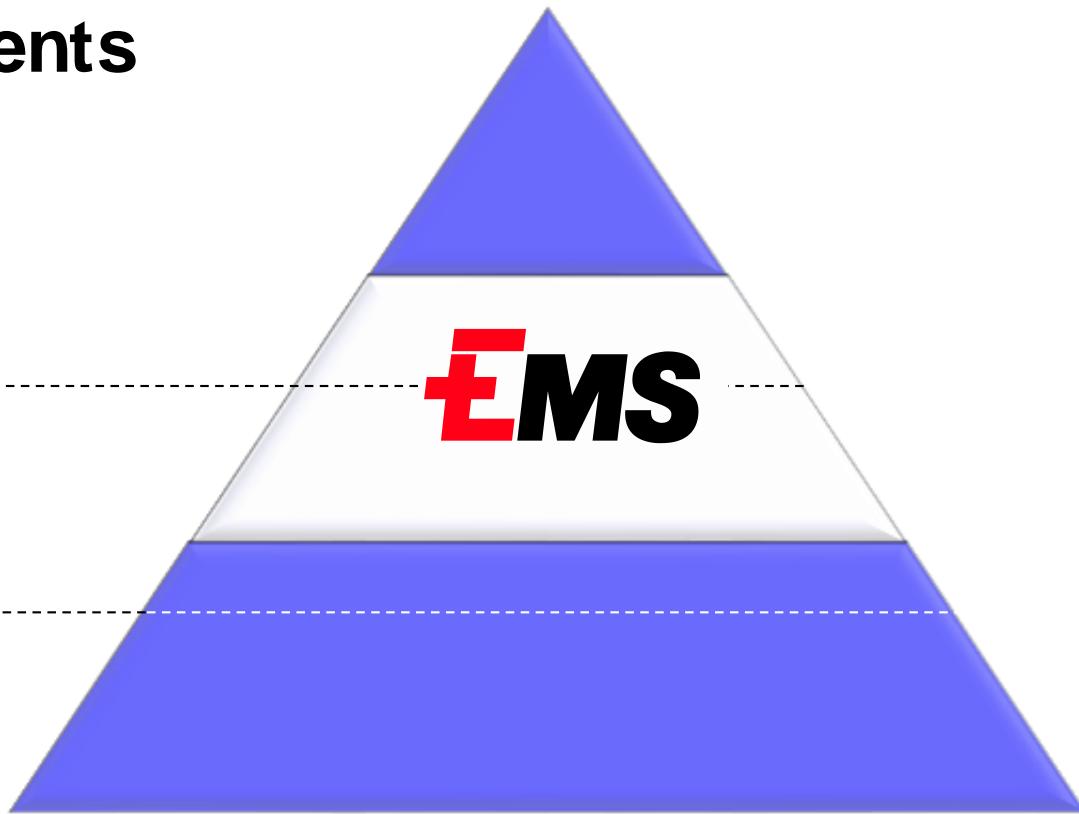
Positioning of EMS Polymers

Requirements

high

medium

low



EMS - GRIVORY: Application Development

Support in the Development of New Applications

- Material recommendation
- Component and mould calculation
- Manufacture of prototypes
- Material and part testing
- Processing support



Technical Development in Suzhou (China)



Application Development Centre



CATS-Calculation



Injection Moulding &
Extrusion Machines



Laboratory & Testing

EMS-GRIVORY: Market Segments



Automotive



Electro/Electronics



Optics



Industry



Sanitary



Household



Sports/Leisure



Medical Technology

Automotive



Interior



Powertrain



Exterior

Automotive



Air Intake



Electro/Electronics



Media Lines

Electromobility



Cooling System

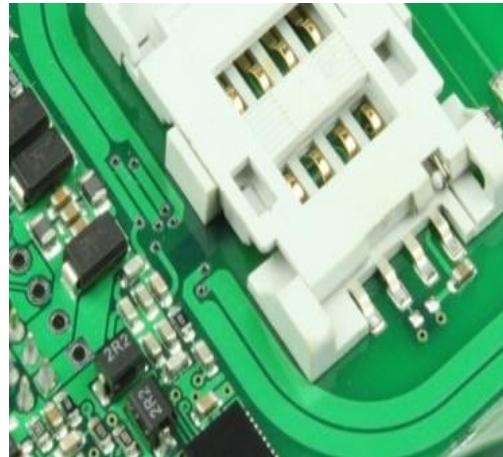


Flame Retardancy



High Voltage System

Electronics



**Smartphone
Smartwatch**



Connectors



Consumer Electronics

Electro



Electrical Equipment

Power Distribution



Pipes/Cables

Optics/Glasses



Sun

Corrective

Protective

Sport

Virtual Reality

Industry



**Ventilator
(antibacterial)**



Agriculture



Engineering



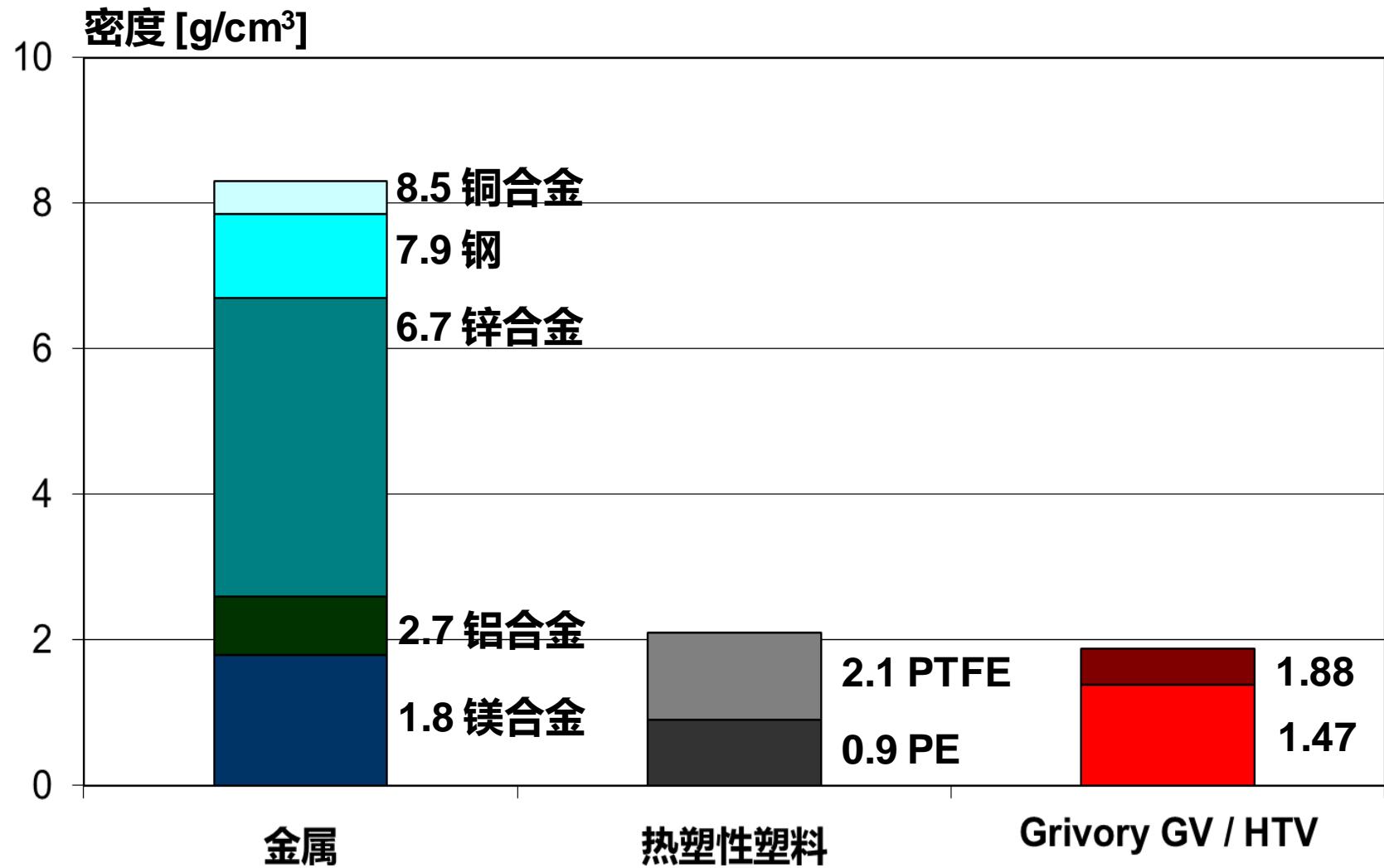
Metal Replacement 金属取代方案



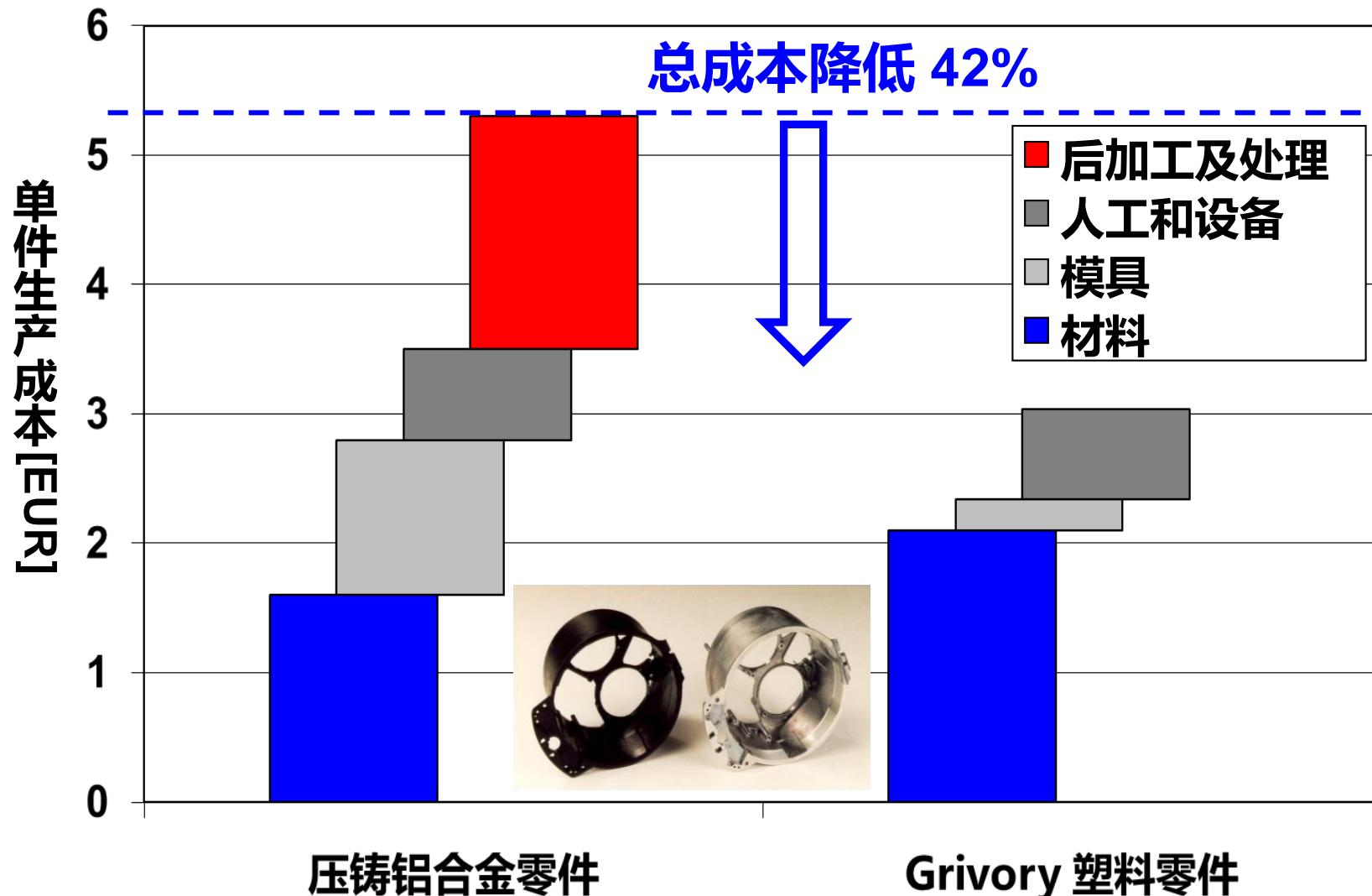
艾曼斯(苏州)
工程塑料有限公司



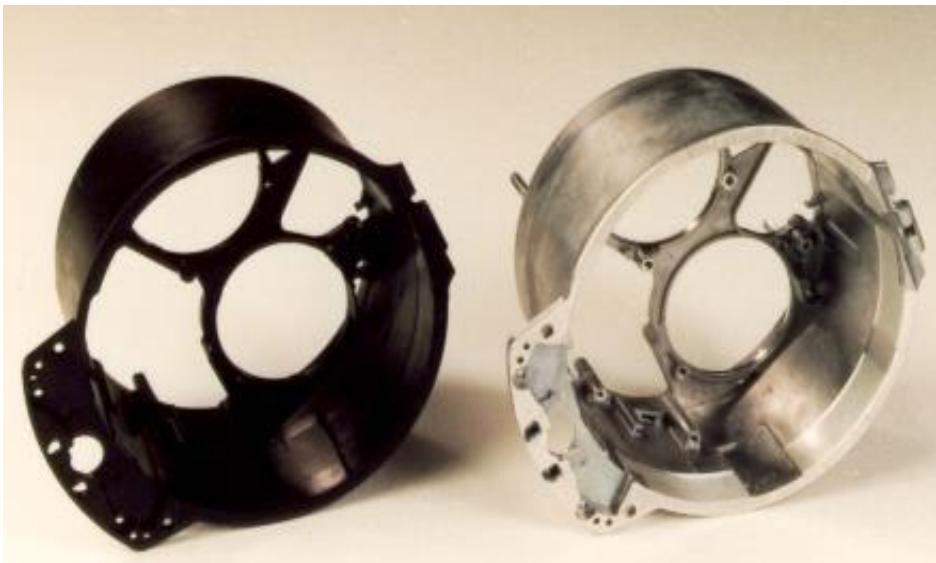
跟金属相比，塑料具有更低的密度



生产成本构成分析



生产成本构成分析



材料	压铸铝合金	Grivory
零件重量, kg	0.36	0.21
材料成本/件, EUR	1.6	2.1
模具成本, EUR	120,000	120,000
零件数量, 件	500,000	500,000
模具寿命, 次	100,000	1,000,000
模具数量	5	1
模具分摊成本/件, EUR	1.2	0.24
后处理(车削等), EUR	1.8	0

压铸铝合金 vs Grivory

- 显著的成本降低
- 41% 重量减轻
- 高注塑公差&产品外观而无需后处理
⇒ **42% 成本降低 (500,000 件/5年)**

节省后加工成本

金属成型件必要的后加工

- 去飞边
- 螺纹切削
- 表面喷砂处理
- 退火处理
- 表面喷涂处理
- 电镀处理



金属件必须经过后加工才能使用，使
Grivory GV替代金属可节省后加工成本

塑料真有这么强？

M8-钢螺钉旋入GVL-5H做成的螺帽里，装配条件如下：

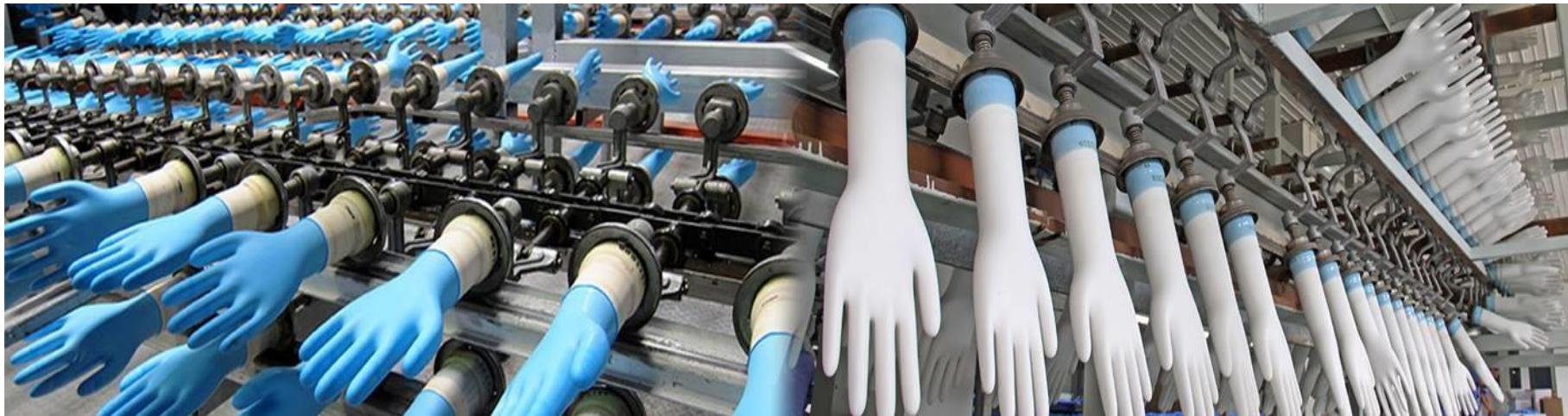
- 常温23°C, 50% 相对湿度
- Grivory GVL-5H 螺纹衬套
- 螺纹拧入 $3 \times D$ (24mm)

可以承受多大负载？

..... kg



案例分析 – 医用手套生产线



- 现状：日益增长的市场需求而利润越来越低
- 需求：1) 降低生产成本； 2) 改善车间噪音； 3) 防止铁屑掉落影响产品质量

技术可行性分析



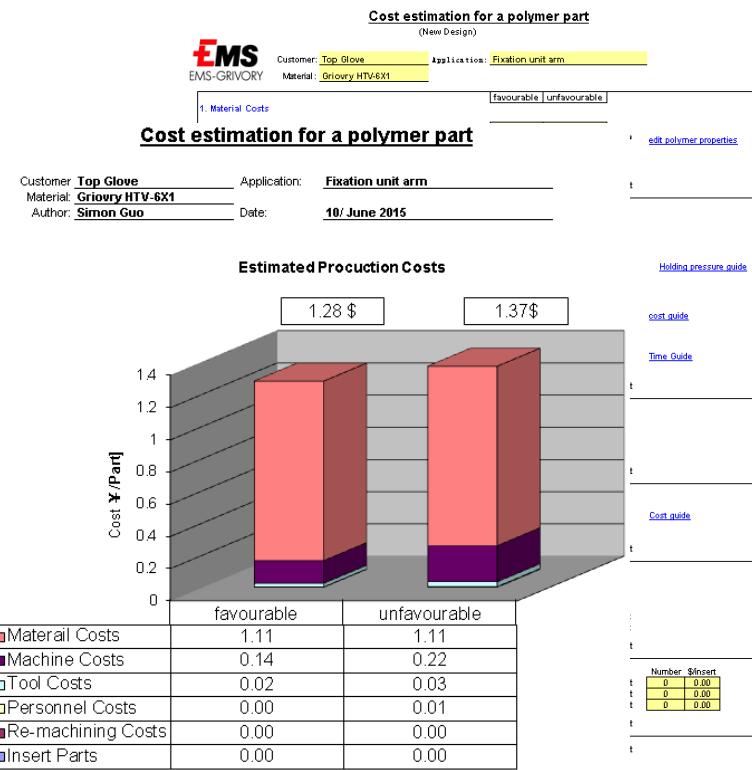
使用寿命 > 3 年 (7*24小时)

- 长期 100 °C -120 °C , 峰值 160 °C -180 °C (耐热老化)
- 硝酸 2.1%@60°C ; 氯水 1050ppm@40 °C , 强碱
3.2%@40 °C (耐化学性)
- SS304 导轨不间断滚动摩擦 (耐磨损)

经济可行性分析

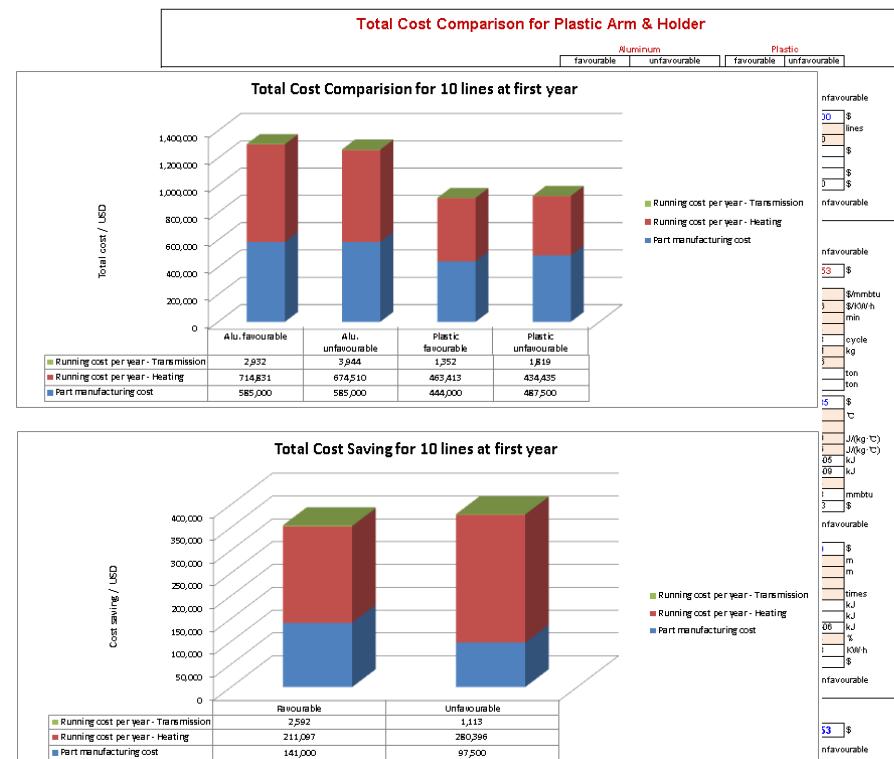
部件成本核算

Grivory HT 曲臂成本降低 15%
Grivory HT 磨盘成本降低 25%



生产成本核算

>20 万美金成本节省/ 20条线/ 一年
70% 成本来自加热能耗



开发协议签订

Development Agreement

between

EMS-CHEMIE(Suzhou) Ltd.
Business Unit EMS-GRIVORY
227# Song Bei Road, SIP
Suzhou, Jiangsu Province
P.R. China, 215126.(Hereafter referred to as "EMS-GRIVORY", or "EMS", or "EMS-CHEMIE (Suzhou)" as the case may be)

and

(hereafter referred to as "Client")

Subject of the co-operation:

Metal replacement of the former holder and arm for the Latex Glove Manufacturing Process

With its design and simulation services (Moldflow and Finite Element Analyses), EMS-GRIVORY offers a special service which provides support for the Client during the optimisation and realisation of the Application.

This service is intended by EMS-GRIVORY to help the Client achieve economical success with the Application in the market as quickly and successfully as possible.

The following agreement stipulates how the costs which result for EMS-GRIVORY will be divided between EMS-GRIVORY and the Client.

A. Summary of Responsibilities

EMS will support the development with the following key steps

1. EMS to send its designated project manager to exchange information with the project manager to establish clear basis for development
2. Carry out the plastic concept design work for both the holder and arm which includes computer simulation to verify design
3. Provide the prototype moulds according to the EMS design*
4. Run initial samples for testing in the EMS technical centre in Suzhou
5. EMS will provide initial sample material for test samples free of charge
6. Finalise design ready for production moulds



客户承诺!

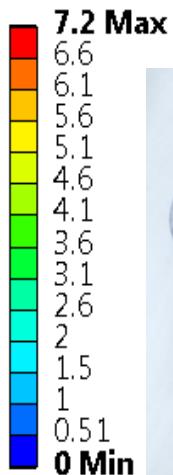
开发过程中的费用由EMS来先期承担，开发成功之后客户承诺使用EMS方案及材料至少三年！

Estimated development costs, USD

Plastic concept design work for holder	4'000
Plastic concept design work for arm	4'000
FEA simulation on arm and optimisations	5'000
Prototype tool (holder: 6'000, arm: 9'000)	15'000
Material cost for sample production	2'000
Internal testing / analysis	3'000
Engineering and sampling costs	4'000
Total cost	37'000

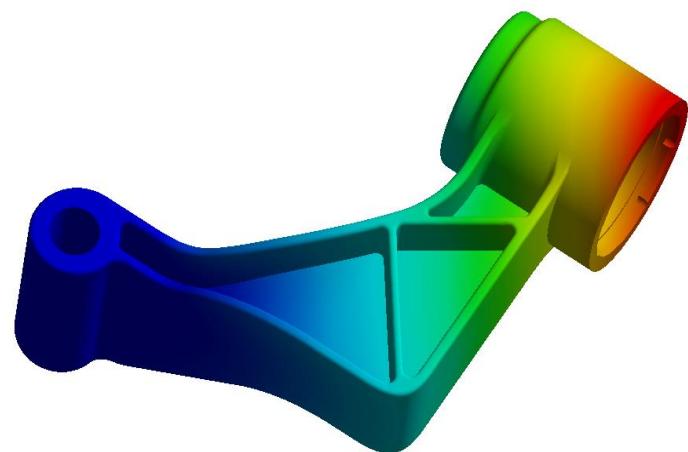
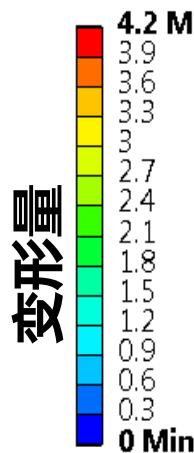
有限元分析 FEA

金属设计



变形量减少: 42%!

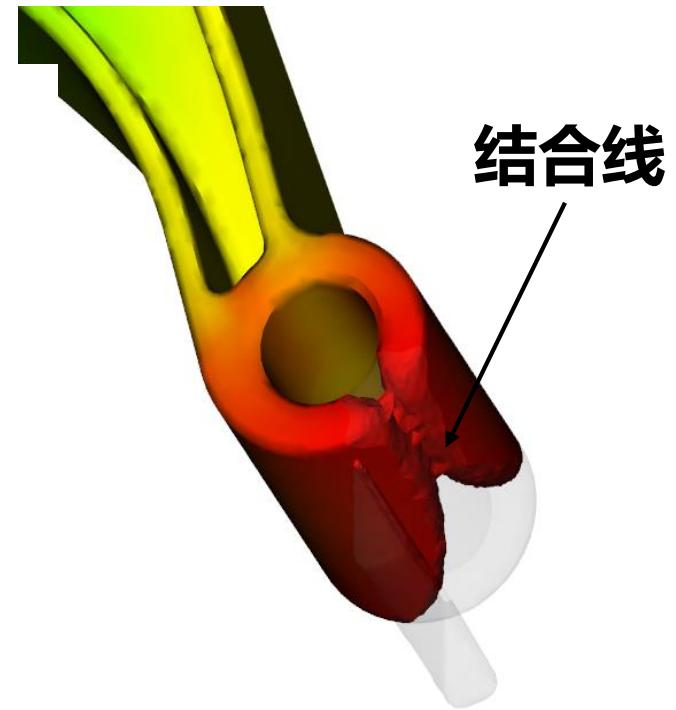
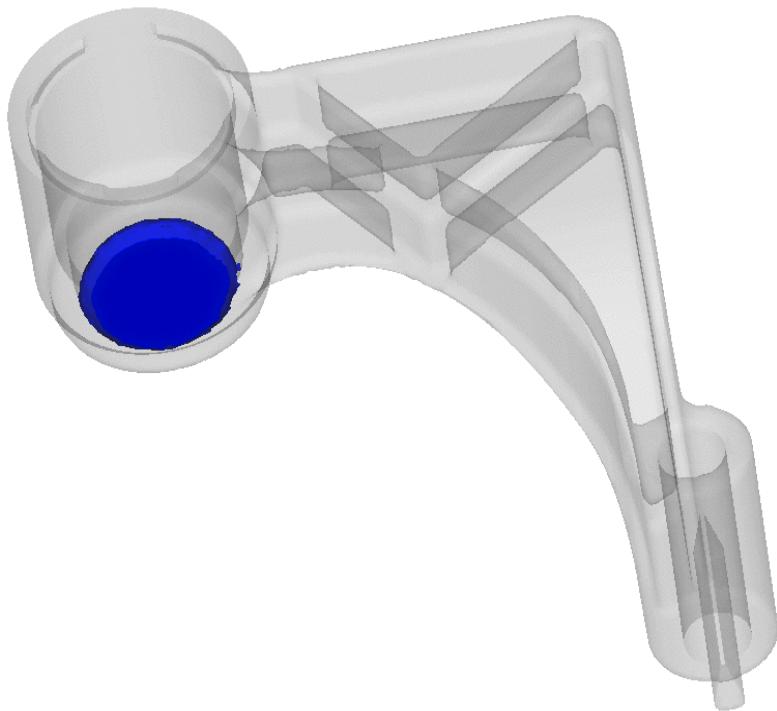
塑料化设计



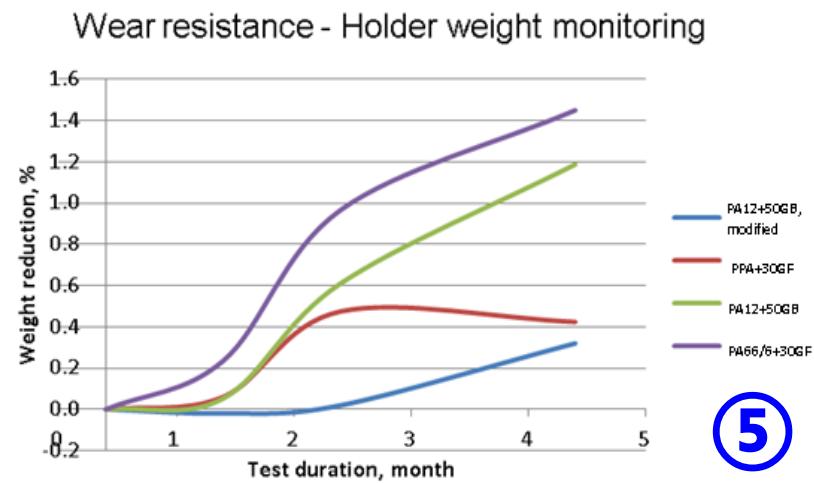
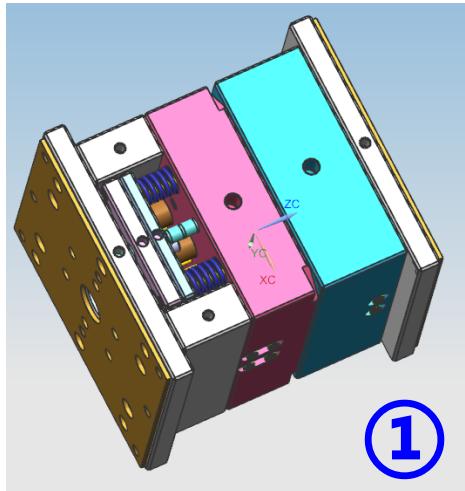
模流分析 MFA

Fill time
= 0.1105[s]
[s]

2.652
1.989
1.326
0.6631
0.0000



小批量验证

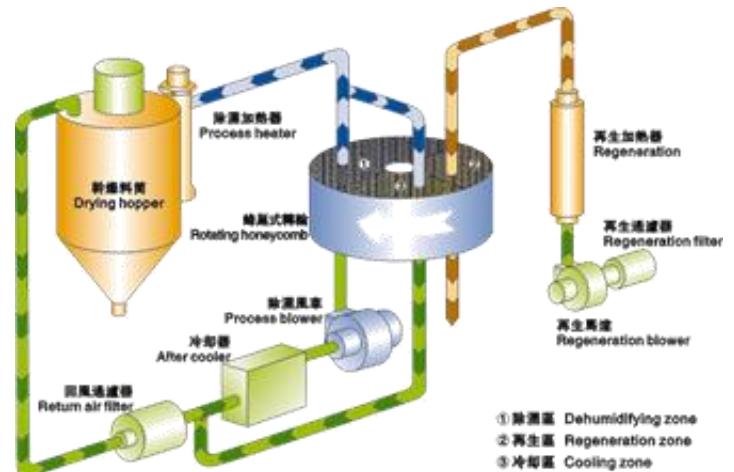


材料加工培训

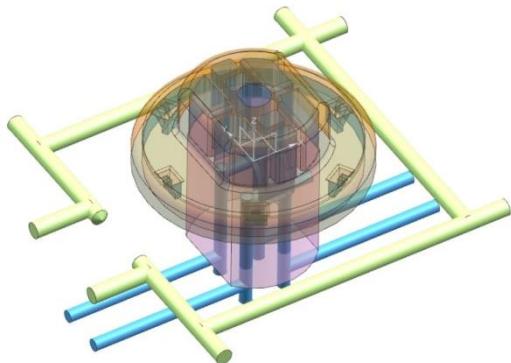
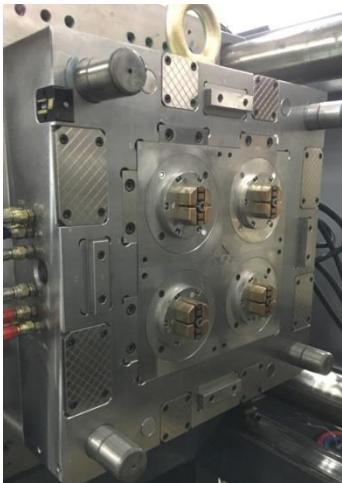
- 量产模具开模注意事项
- Grivory 加工注意事项
- 成型加工能力评估（干燥机，注塑机，模温控制机）



除湿干燥机原理



现场技术支持



- 浇口布置及类型
- 冷却及顶出系统设计
- 溢料井设计
- 模具 DFM 评估
- 现场试模支持
- 改善建议



正式量产

- 工艺优化以降低成型周期
- 协助解决生产问题
- 降解测试
- 干燥效率评估
- 质量管控建议



生产成本降低

金属零件



塑料零件



减重54%!

单个车间加热能耗降低5%! (~5万美金/年)

(能耗= 部件重量(kg) * 比热容 (J/kg. °C) * 温度变化)

EMS 技术服务 – 从创意到产品

可行性分析

设计优化

模具

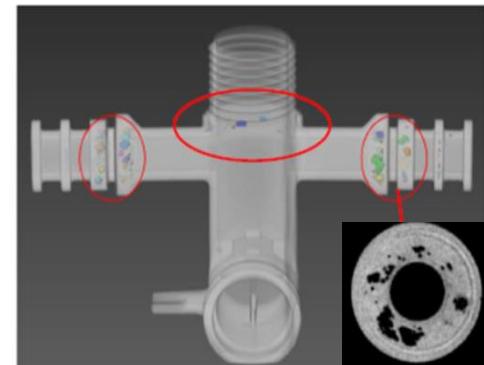
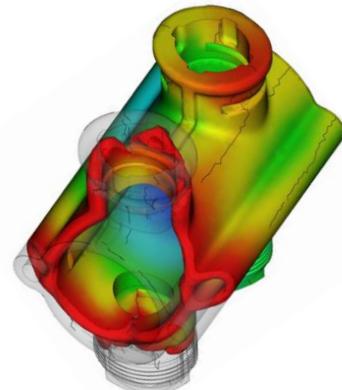
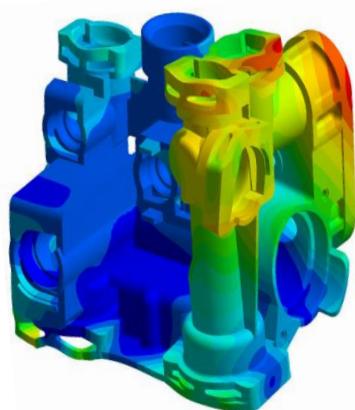
产品

材料推荐
成本分析
概念设计

结构分析

模流分析
协助开模

现场成型支持
协助产品测试
产品失效分析



Special Lighting Application Development

Arthur Xue / 薛小平

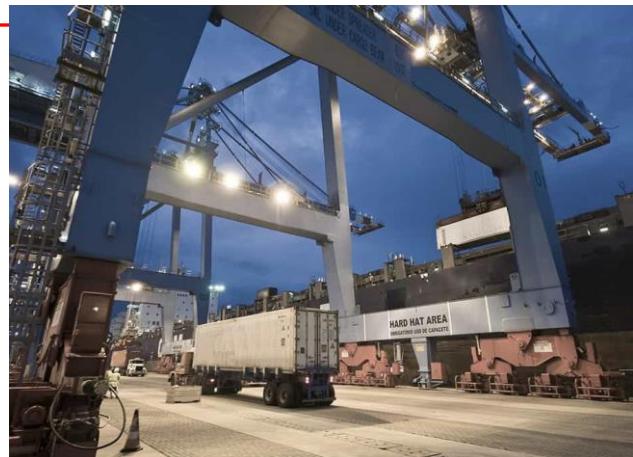
Application Development
EMS-Grivory (Suzhou) Ltd.



NANHUA

EMS
EMS-GRIVORY

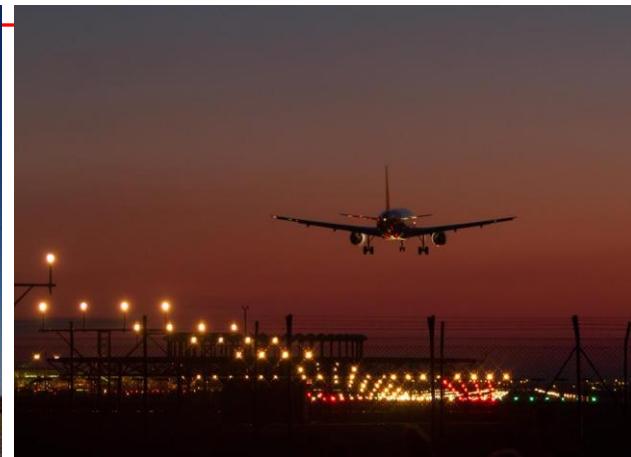
Application Field



Port & Wharf



Wind Energy



Aviation



Construction
Machinery



Transportation



Chemical Industry

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EMS-GRIVORY

Application Requirements

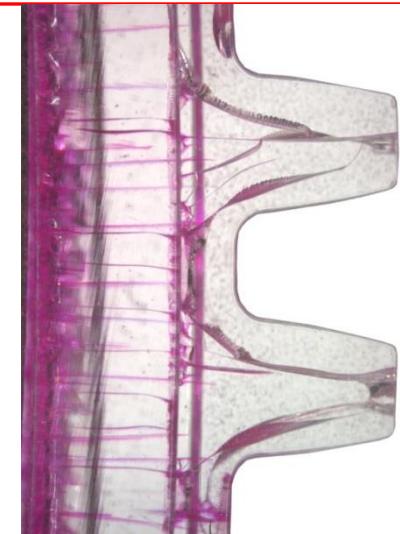
- ✓ High Light transmission
- ✓ Good color expression
- ✓ UV resistance
- ✓ Easy assembling
- ✓ Anti-Glare
- ✓ IP66 to IP67
- ✓ Explosion-proof
- ✓ Anti-vibration
- ✓ High/low temperature resistance
- ✓ High humidity environment
- ✓ Impact resistance
- ✓ Anti-corrosive
- ✓ Long life and maintenance free
- ✓ Various approvals (CCC, Coal approvals, CQST, CRCC, CCCF, CCS,)



Key Material - Requirements

Key Requirements:

- ✓ **Chemical resistance / Stress crack resistance**
- ✓ **High transparency**
- ✓ **Good weather (UV) resistance**
- ✓ **High & low temp. impact resistance**
- ✓ **Light scattering**
- ✓ **High heat resistance**
- ✓ **Low density**
- ✓ **2C with PA+GF materials**



Grilamid TR - USP

Key Requirements:

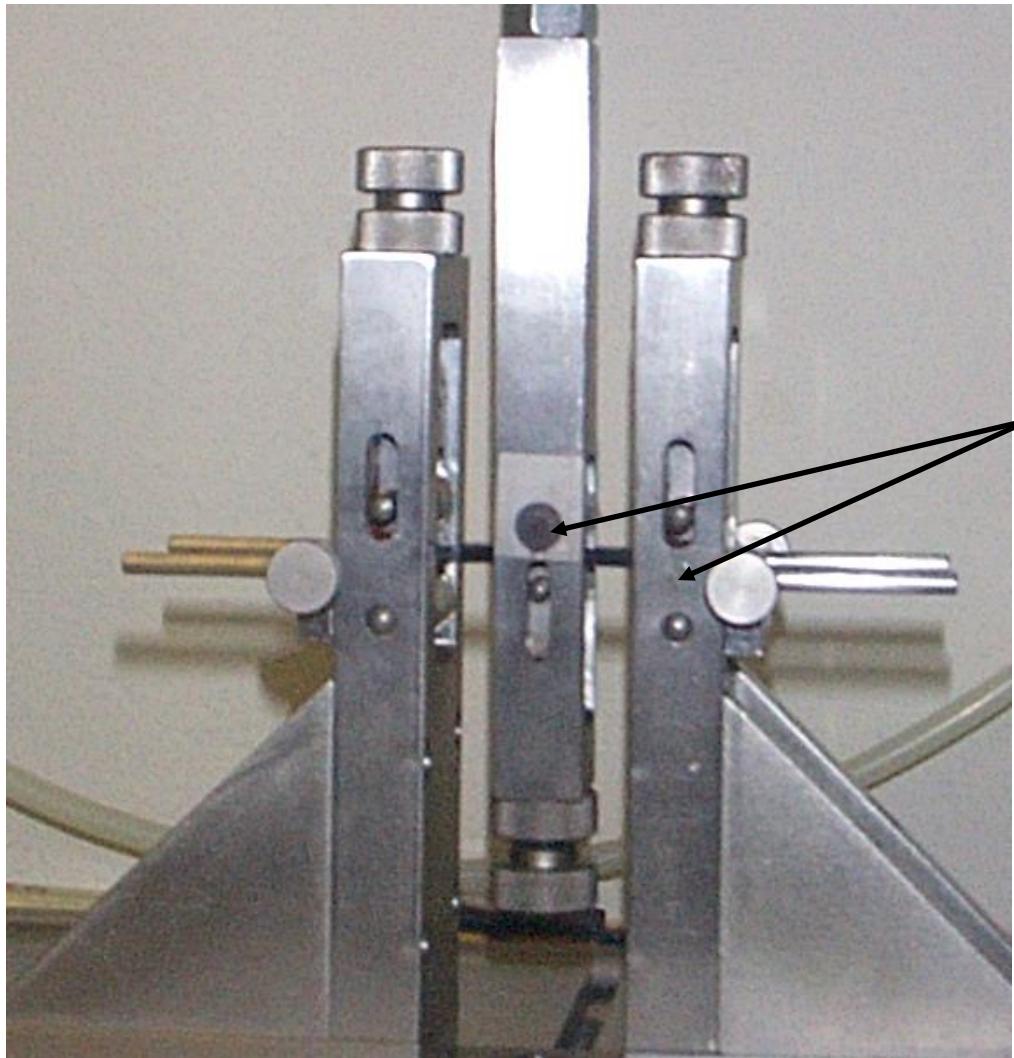
- ✓ Good weather (UV) resistance
- ✓ Chemical resistance / Stress crack resistance
- ✓ High & low temp. impact resistance
- ✓ 2C with PA+GF materials

Grilamid TR – Unique Property Combination

Properties of **transparent** polymer based on **PA**

- Transparency
 - Very low shrinkage
 - Very low warpage
 - Stiffness
- +
- Flexural fatigue strength
 - Stress crack resistance
 - Oil and fat resistance
 - Low water absorption
 - Hot water resistance
 - low density
 - Impact strength

Test of Flexural Fatigue Strength



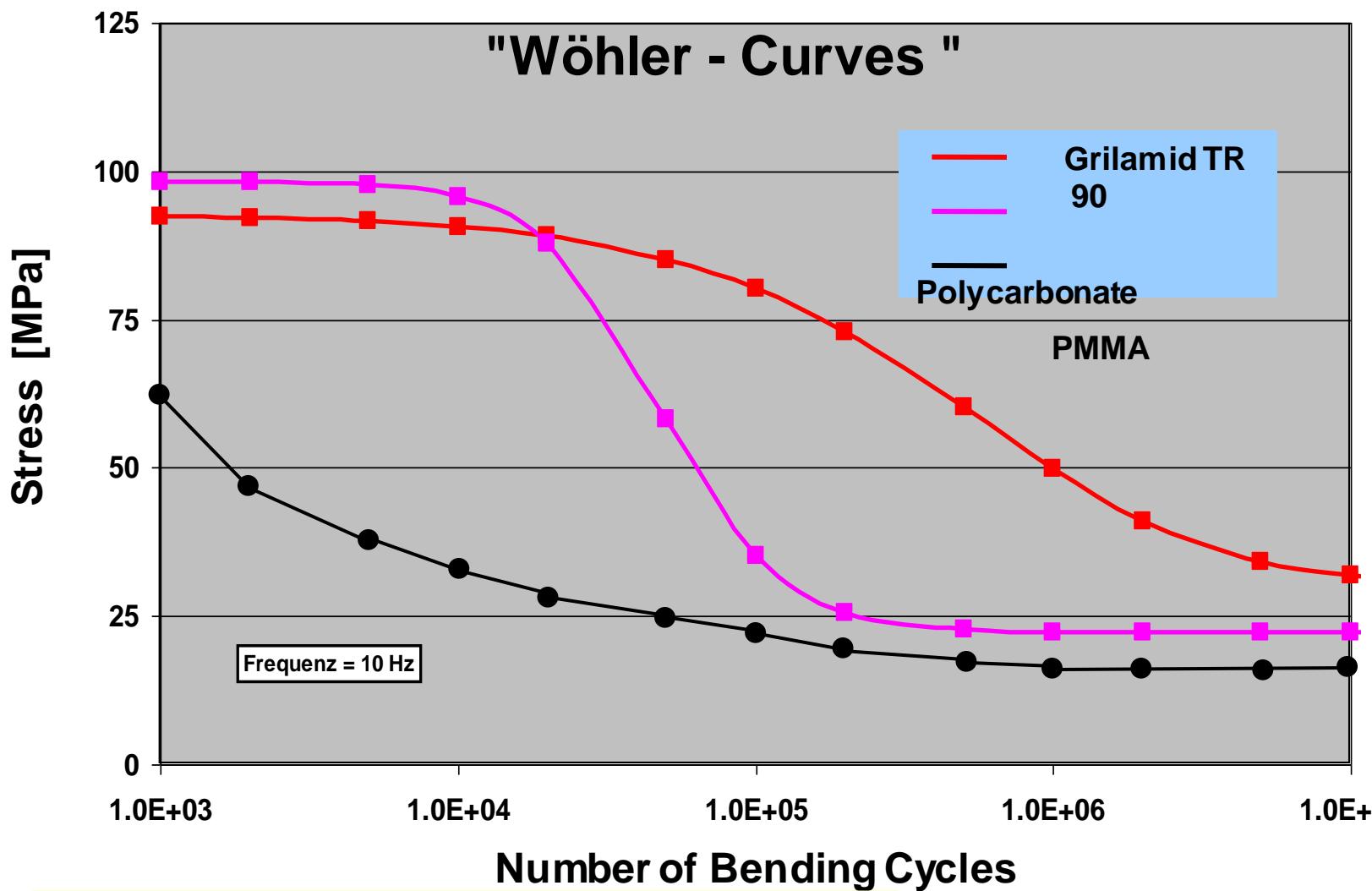
3 point support

Test piece (80x10x4mm)

Frequency: 10 Hz

Amplitude: ± 25 mm

Unbeatable Bending Resistance

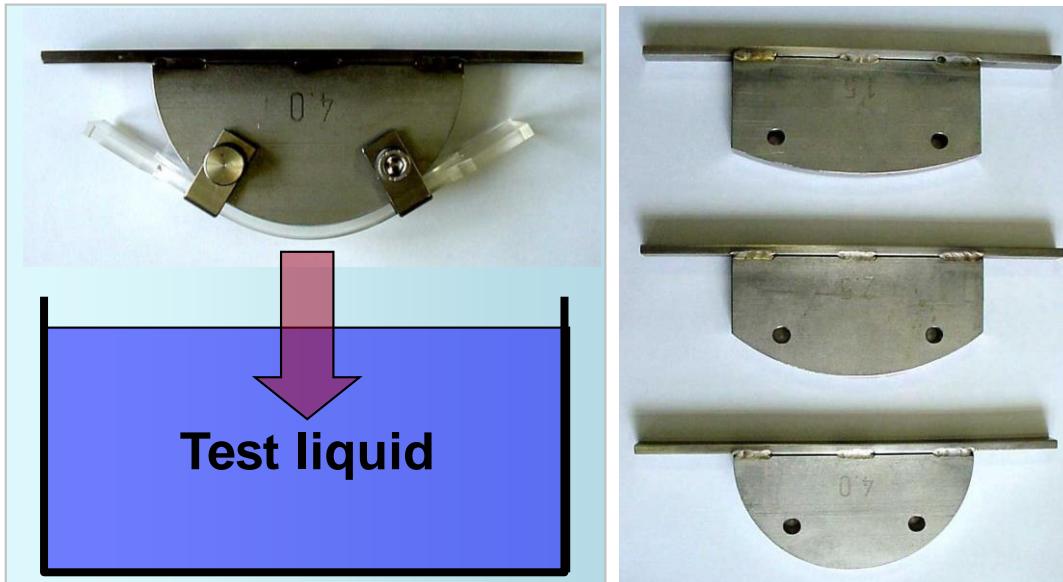


Example: repeated bending stress of 50 MPa:
Grilamid TR 90 withstands significant more cycles than
PC and PMMA

Test for Stress Crack Resistance

Mechanical Stress + Chemical Contact

Bending device



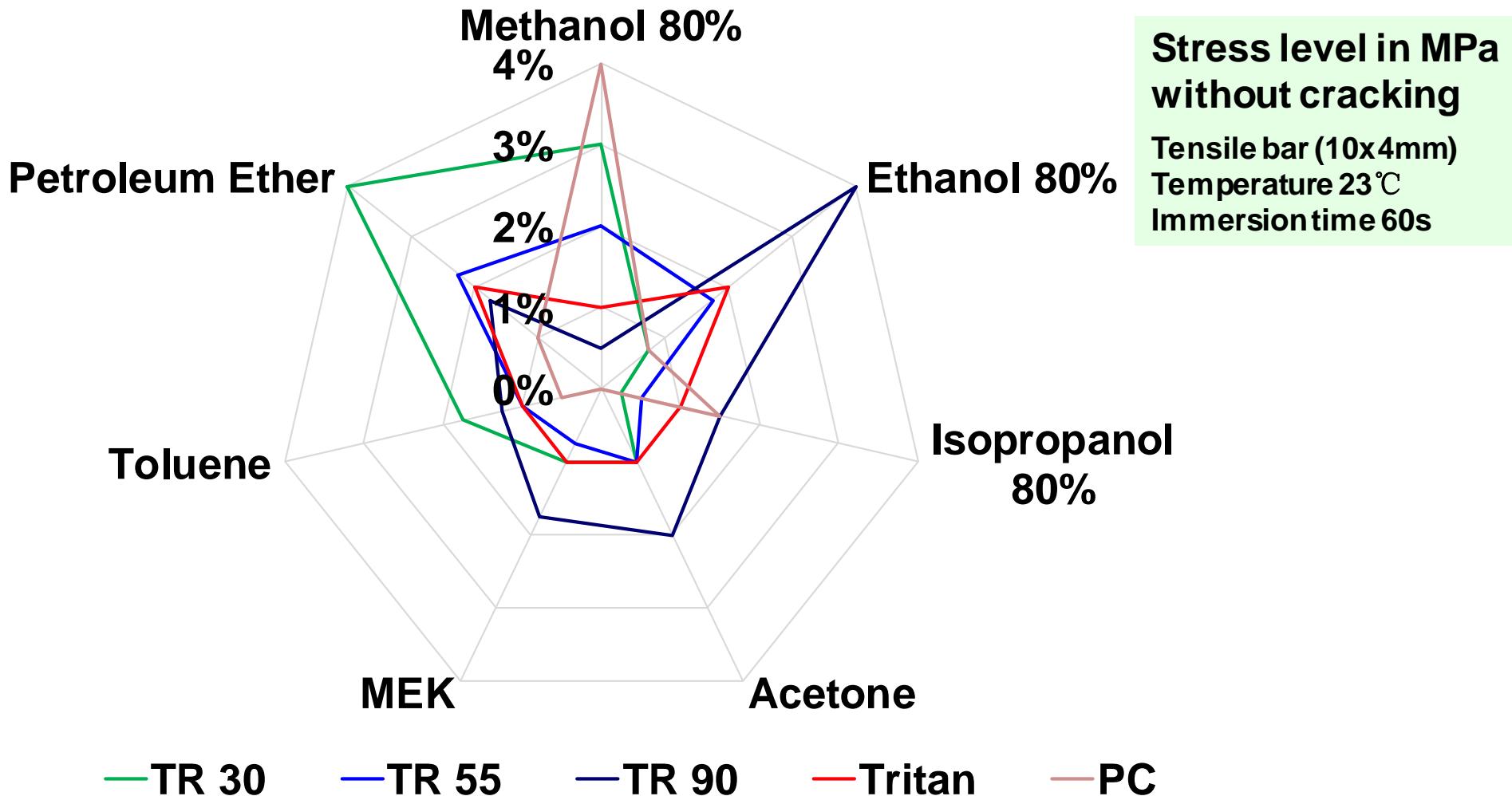
- 1,5% elongation
outer fibre strain
(≈ 2 kg tensile load)*
- 2,5% elongation
outer fibre strain
(≈ 4 kg tensile load)*
- 4,0% elongation
outer fibre strain
(≈ 6 kg tensile load)*

Immersion time in liquid: 1 Minute at 23 ° C
Bending stress (σ) at first appearance of stress cracks

Calculation $E \times \epsilon = \sigma$ (example: 1600 MPa \times 4% = 64 MPa tensile stress)

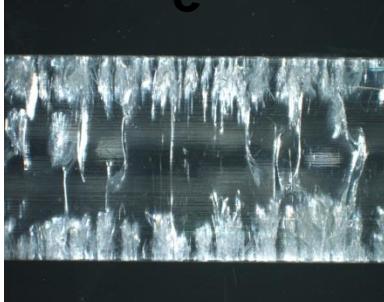
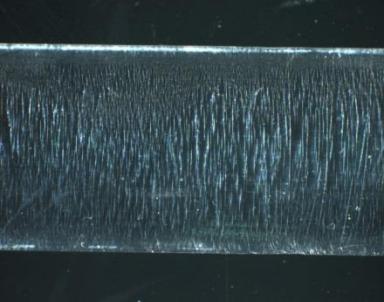
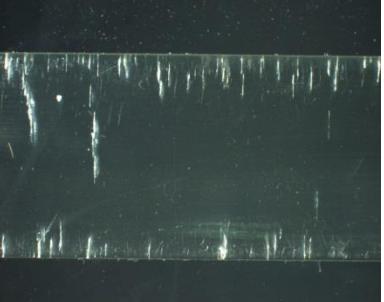
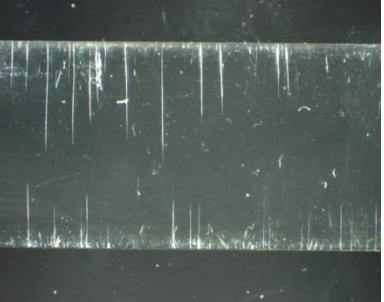
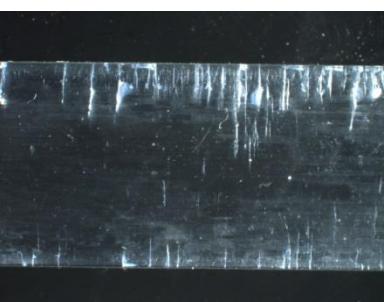
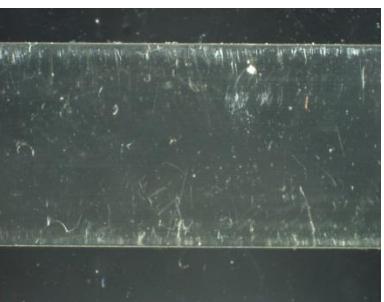
**Analogon to surface tensile stress: tensile load in a film of 0.1mm thickness on outer surface of test bar, example for Grilamid TR 90*

Excellent Stress Crack Resistance



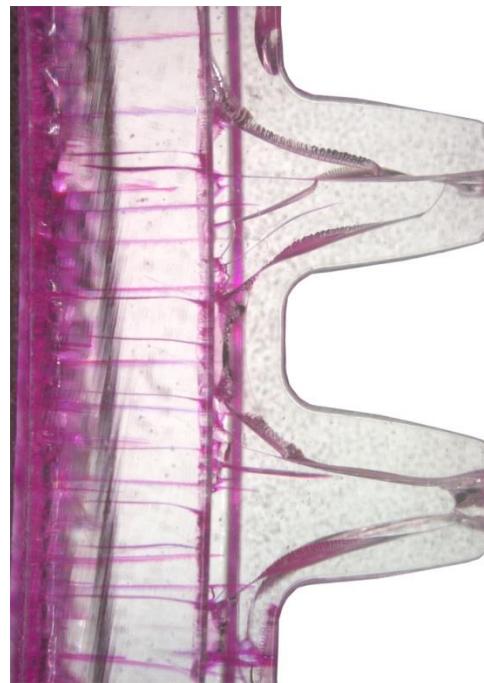
Note: transparent PA's get turbid in contact to alcohols

Stress Cracking with Skin Preparations

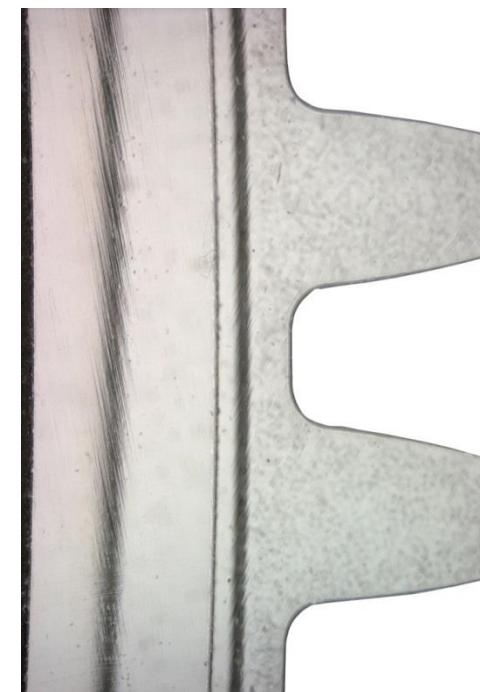
	Polycarbonat e	Copolyester	Polysulfone	Grilamid TR
Autan (Insect repellent)				
Atrix (Hand creme)				
Sun cream				

Grilamid TR - When the Chips are Down!

Mechanical stress + Contact with chemicals can
create stress cracks

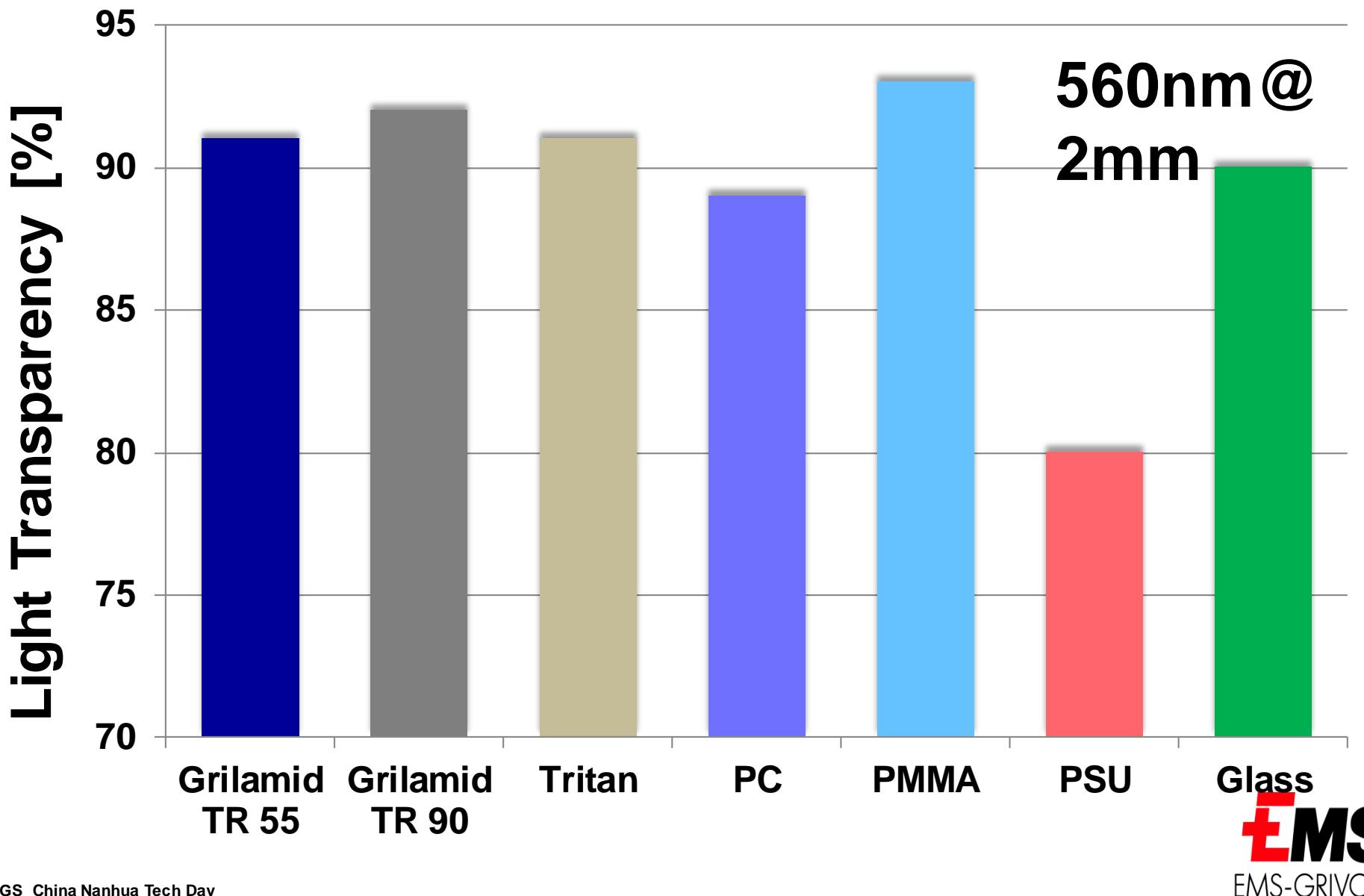


Polycarbonate

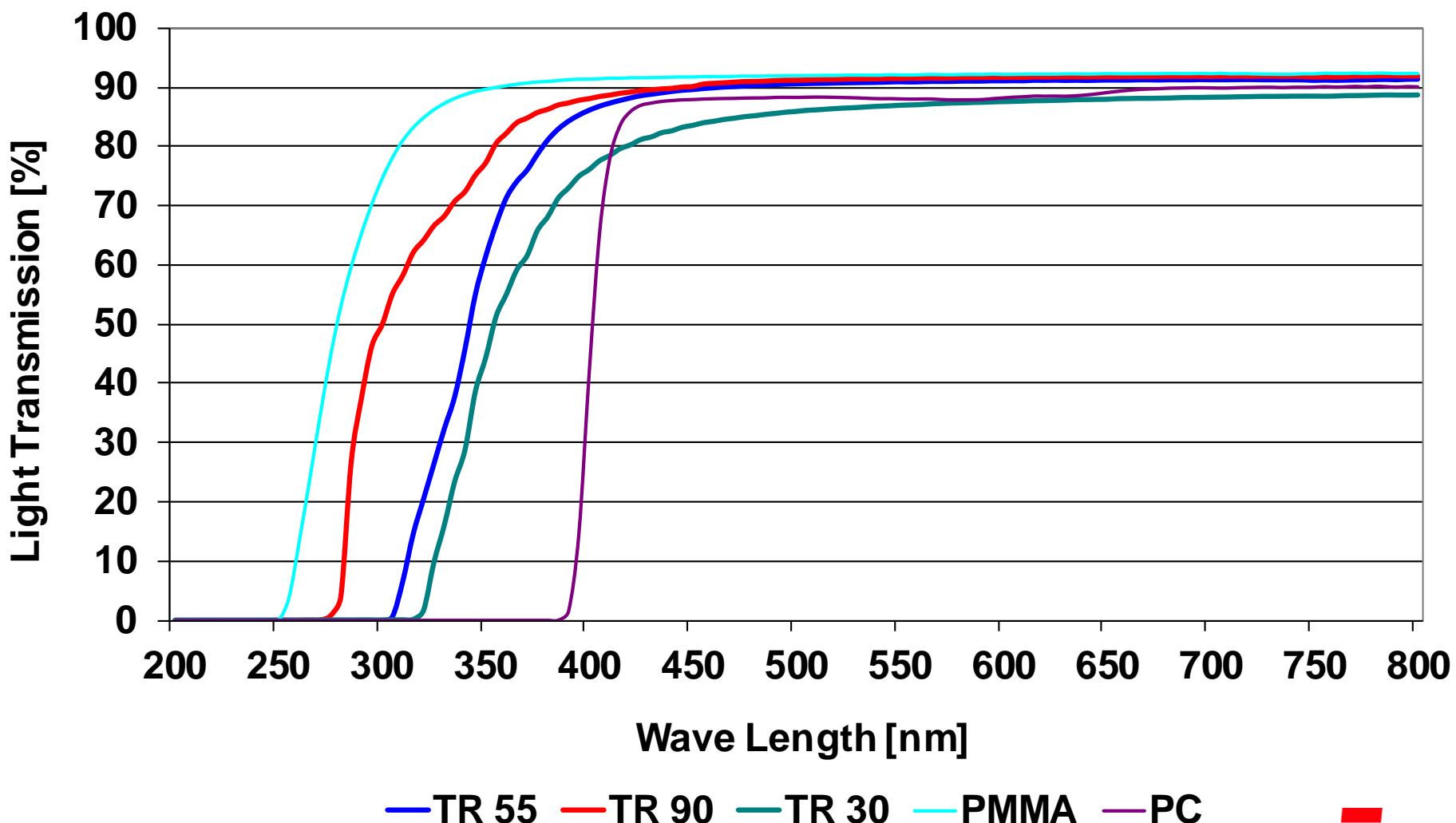


Grilamid TR

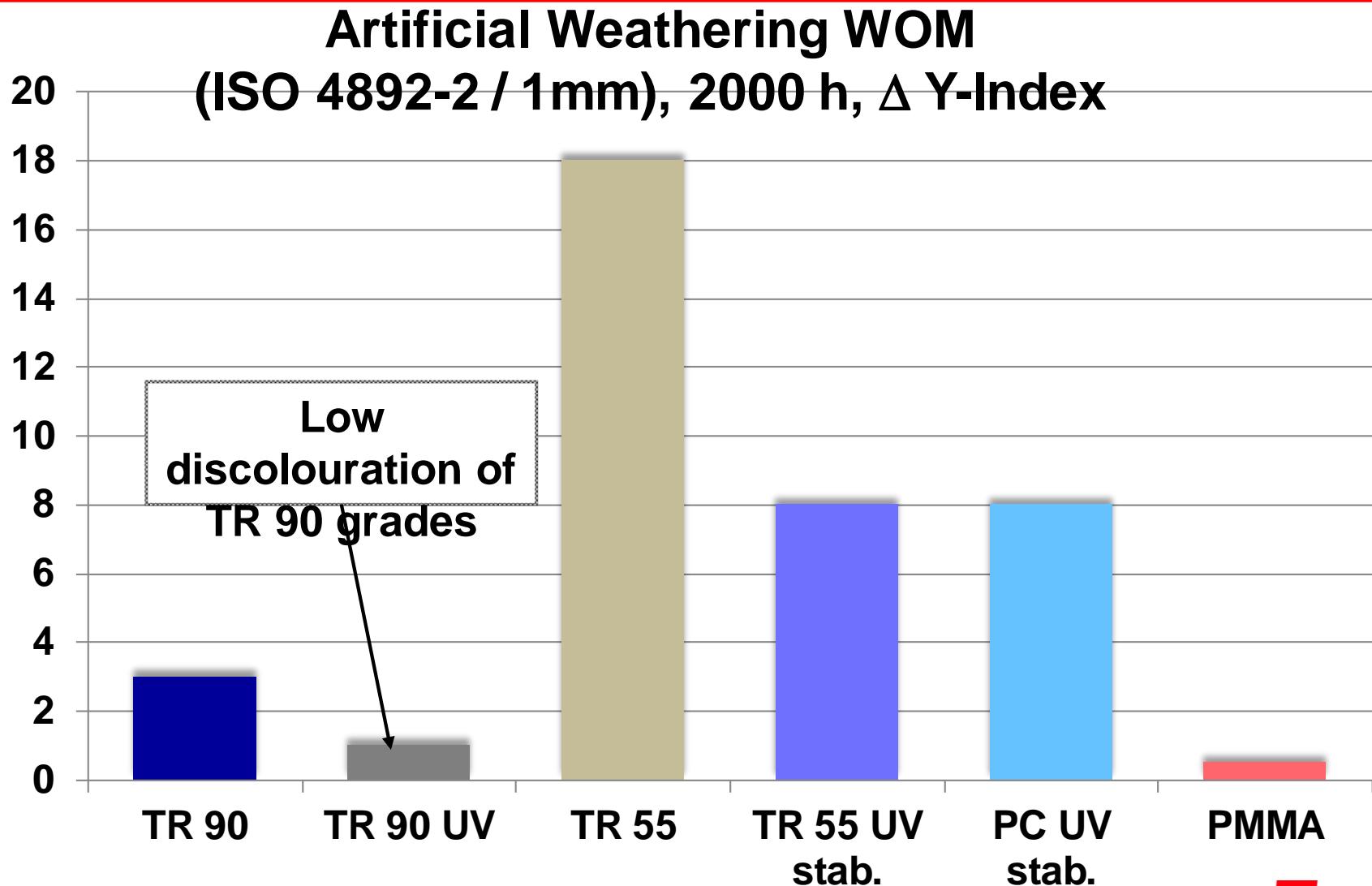
Grilamid TR - More Transparent



Grilamid TR - More Transparent

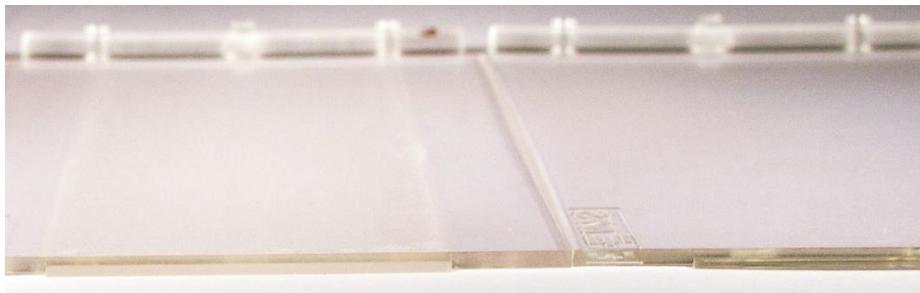


Weathering Influence on Colour



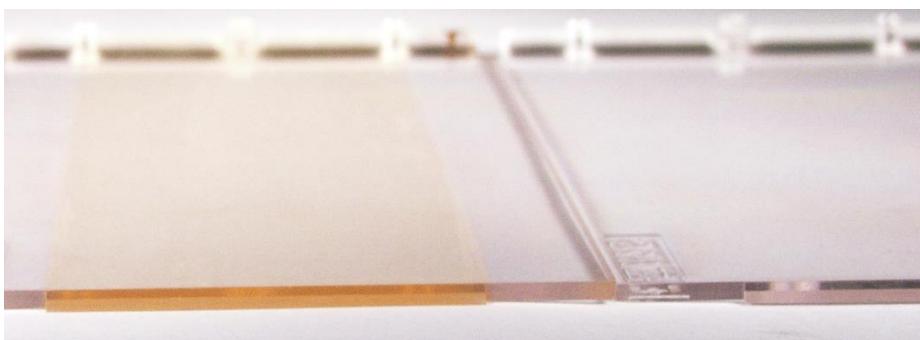
Weathering Influence on Colour

after WOM
[2000 h, 2mm plates]

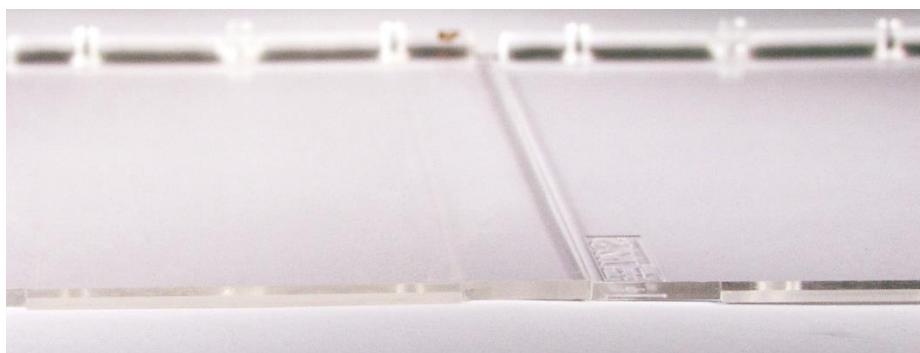


Original

Grilamid TR 90 UV
Delta YI = 1.5



Polycarbonate
Delta YI = 9.8

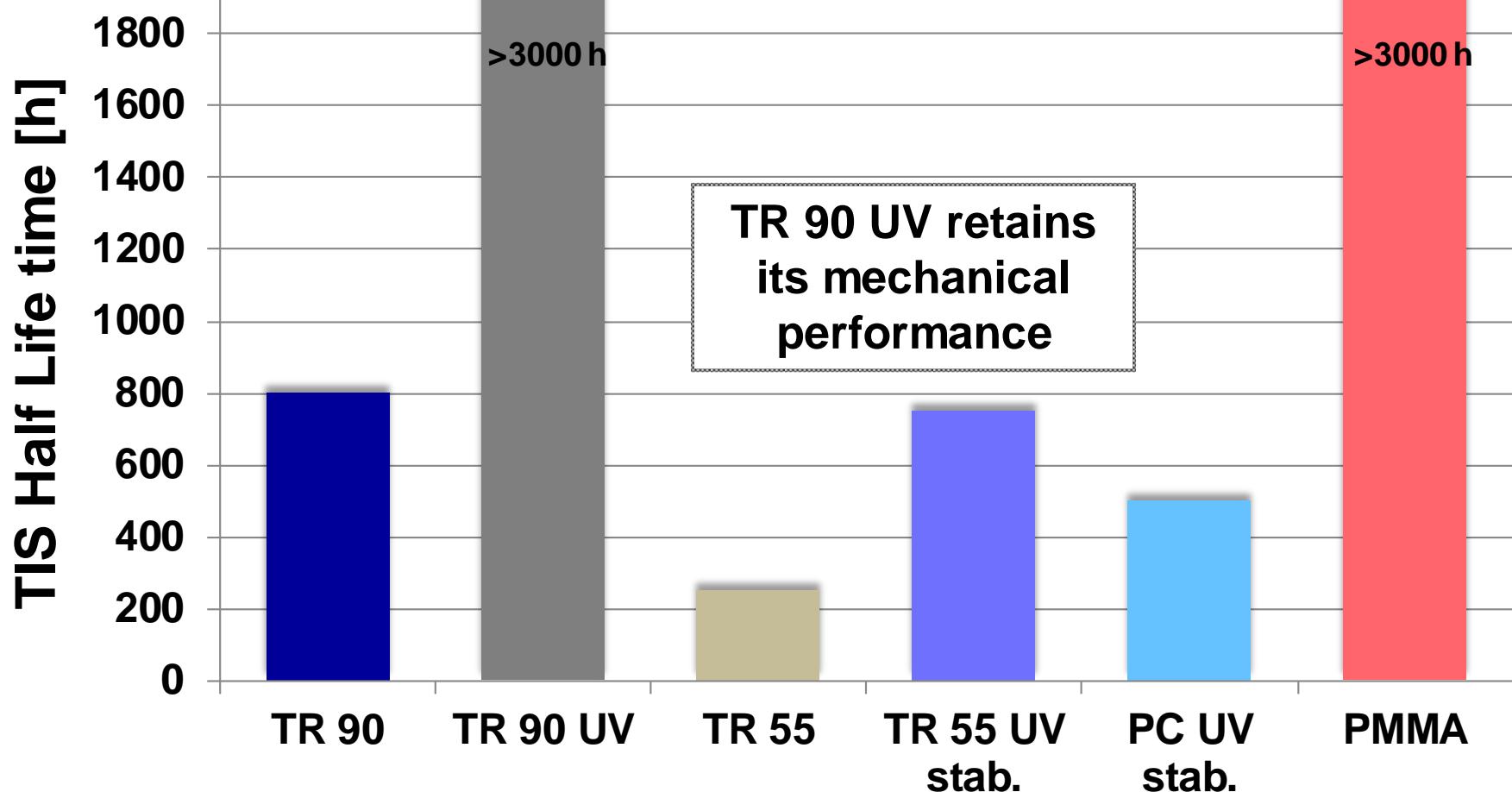


PMMA
Delta YI = 0.5

Weathering Influence on Mechanics

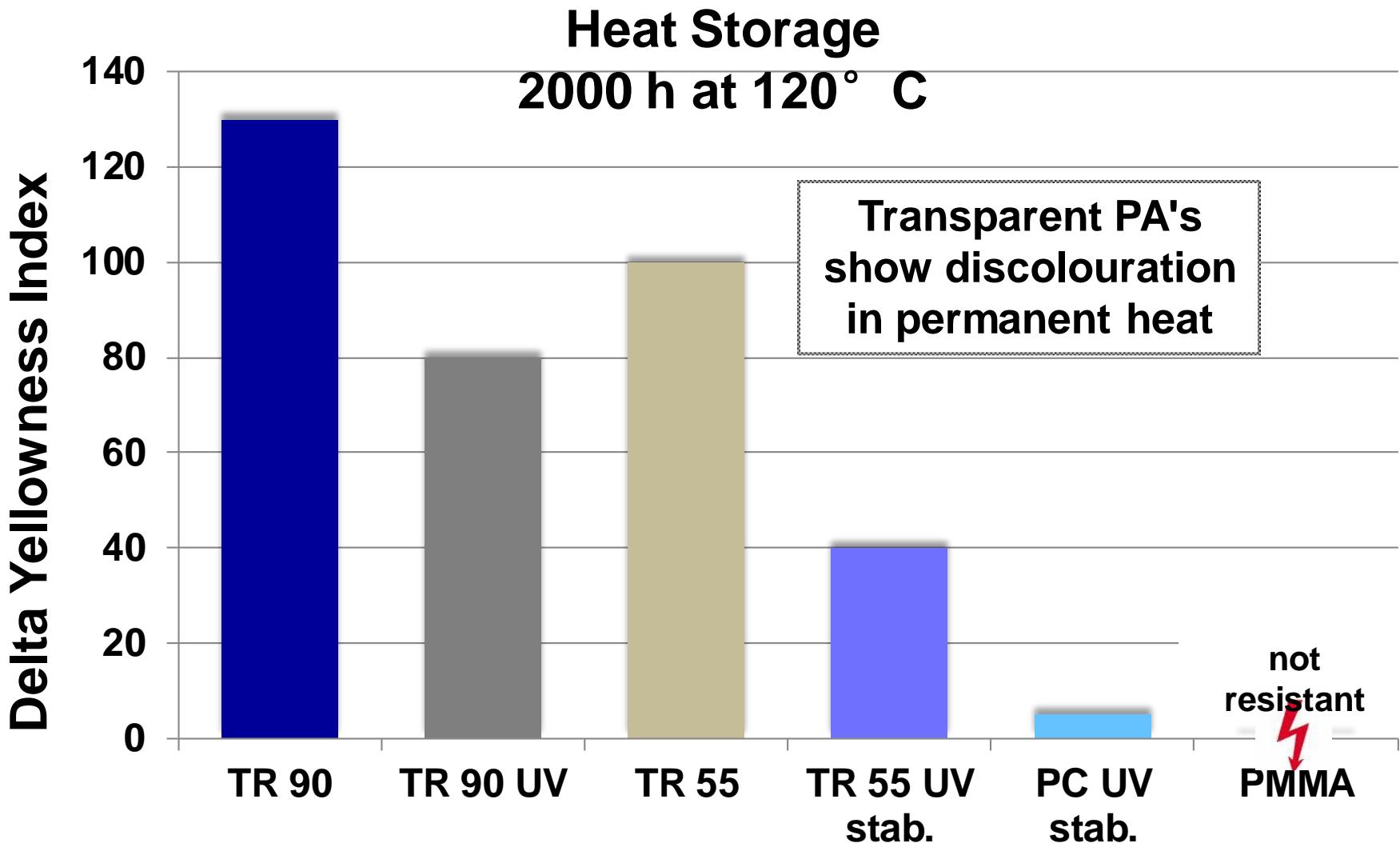
Artificial Weathering WOM

(ISO 4892-2 / 1mm), 2000 h, Tensile Impact Half Life Time



TR 90 UV retains
its mechanical
performance

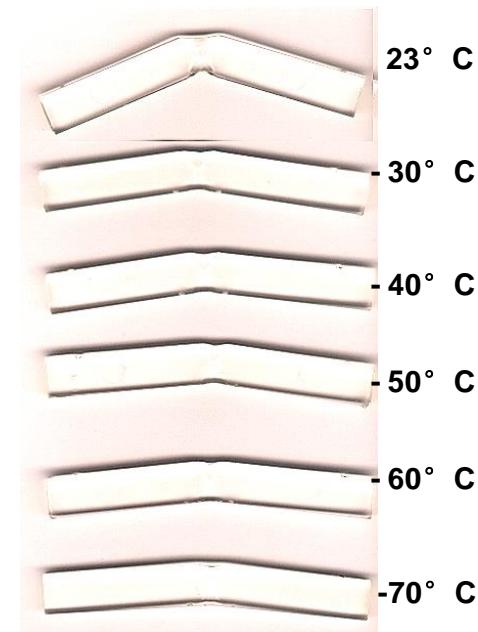
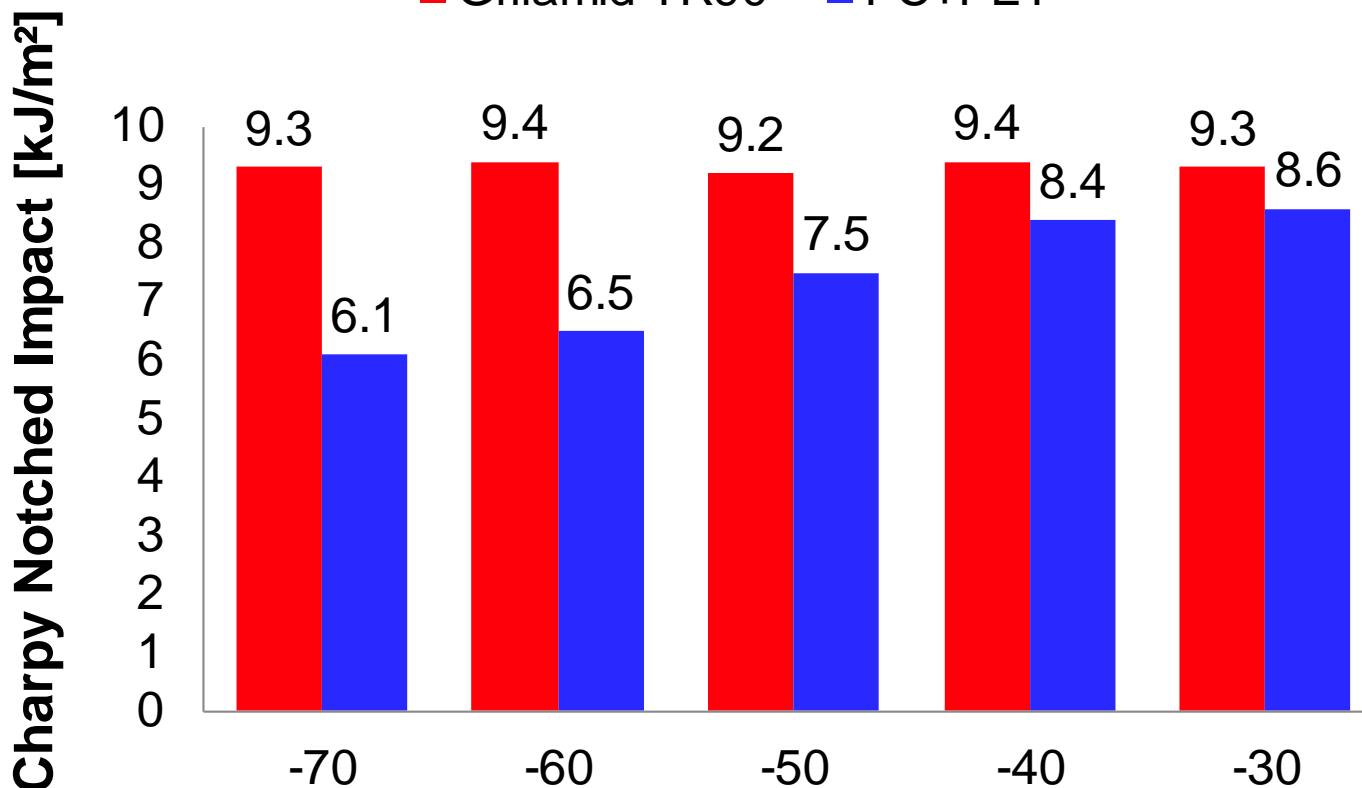
Heat Influence on Colour



Impact Performance

Notched

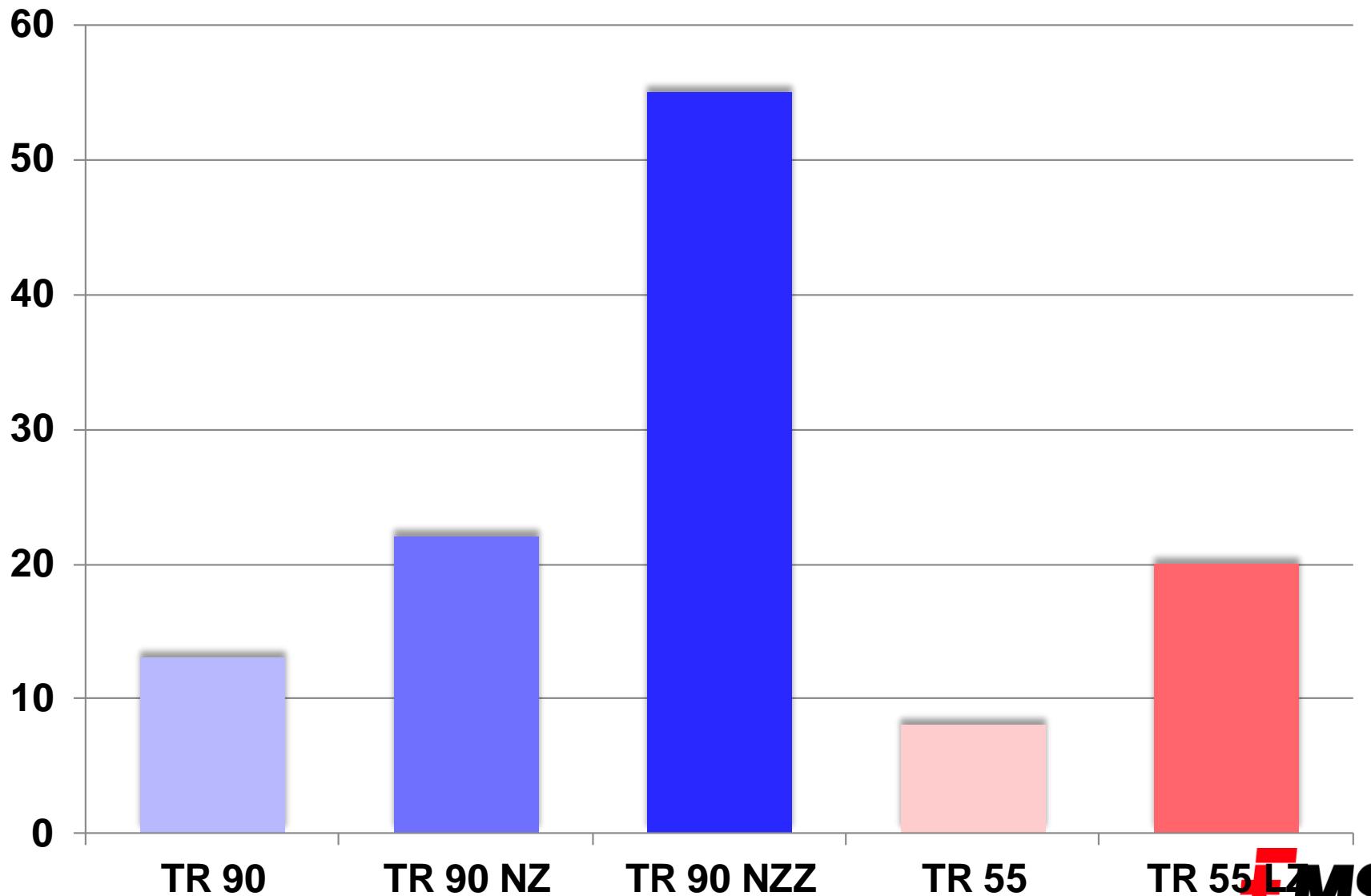
Unnotched



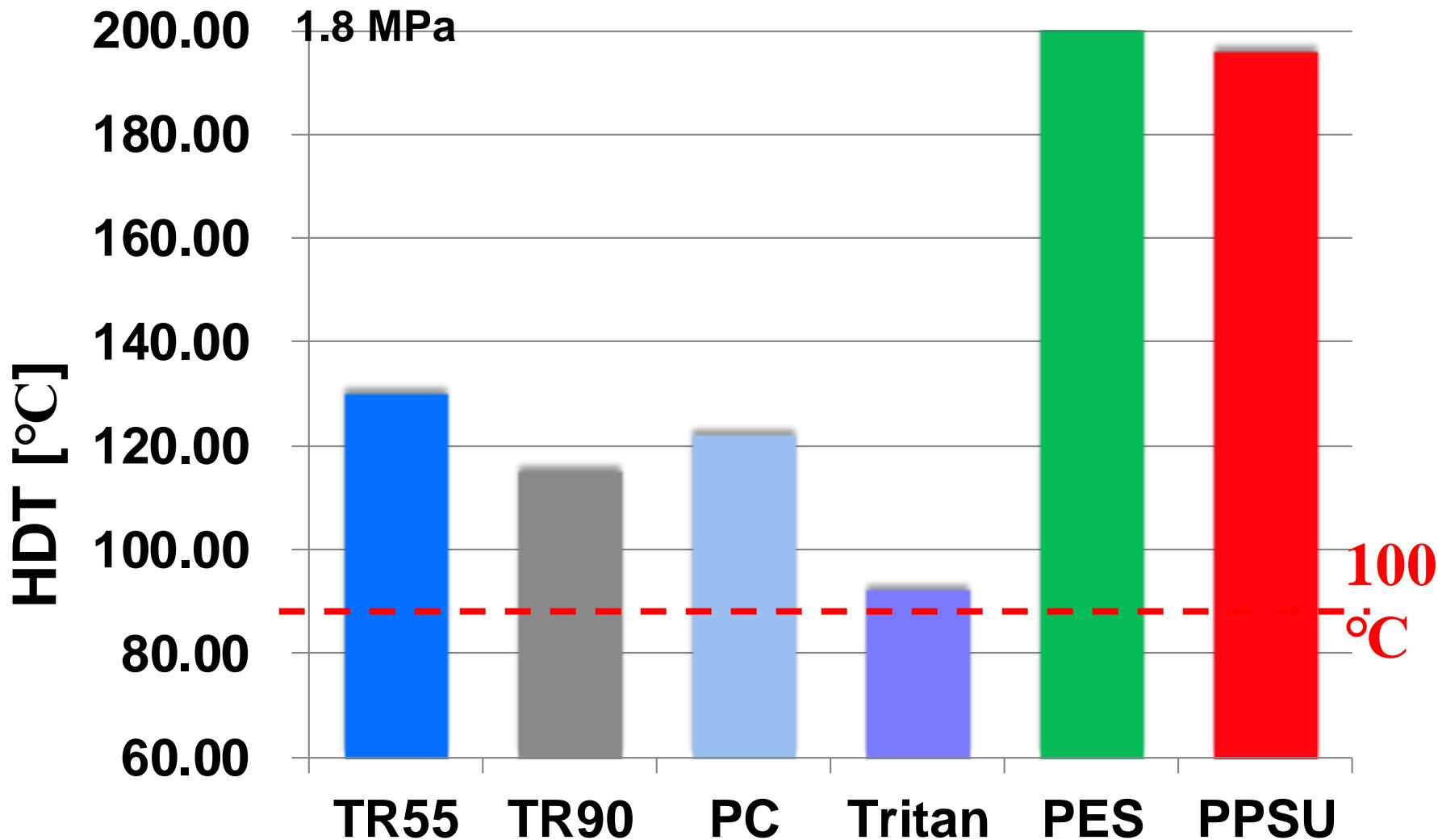
Temperature in $^{\circ}\text{C}$

No drop of impact strength of Grilamid TR 90
at low temperatures

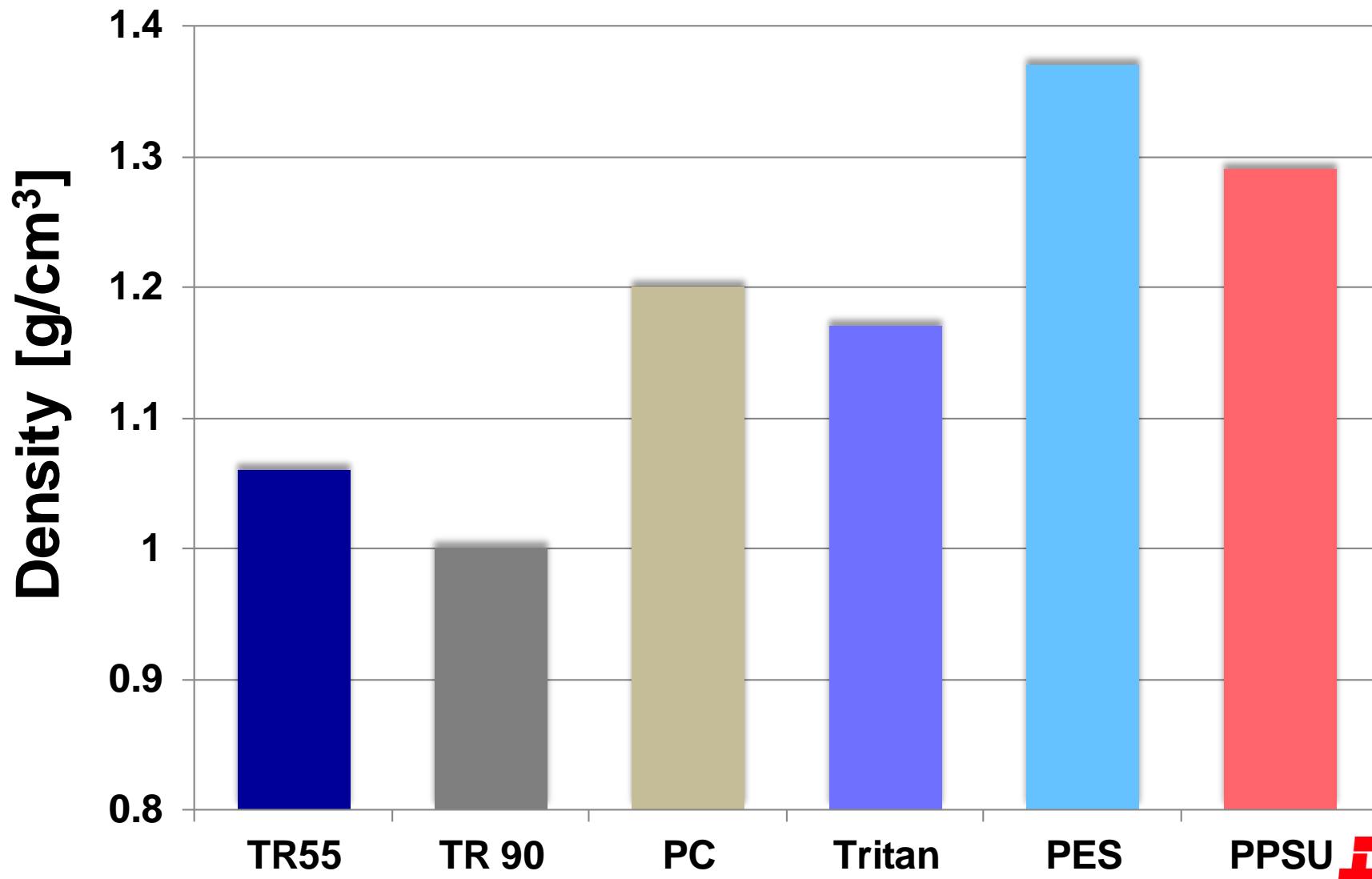
Impact Performance



Grilamid TR - HDT > 100 °C

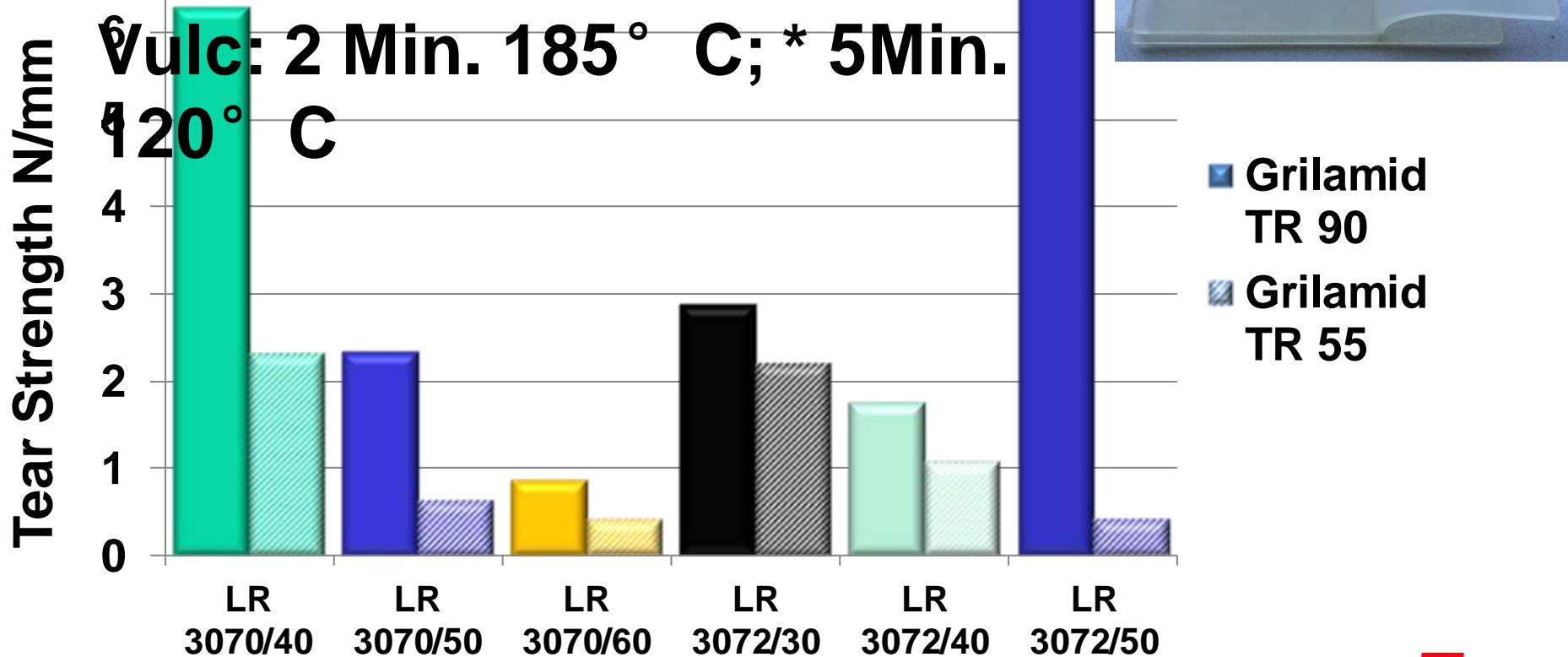


Grilamid TR - Lowest Density



Elastosil® Bonding With Grilamid TR

Test specimen surface was degreased with Ethanol before vulcanization



■ Grilamid
TR 90
■ Grilamid
TR 55

Opaque and Light Scattering

Clear

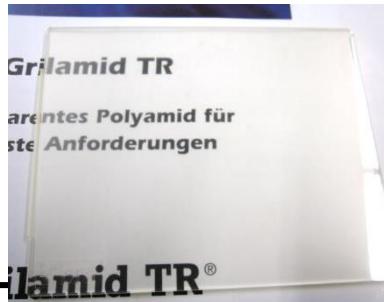
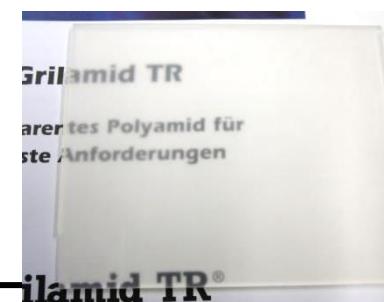


Opaque



X: light source

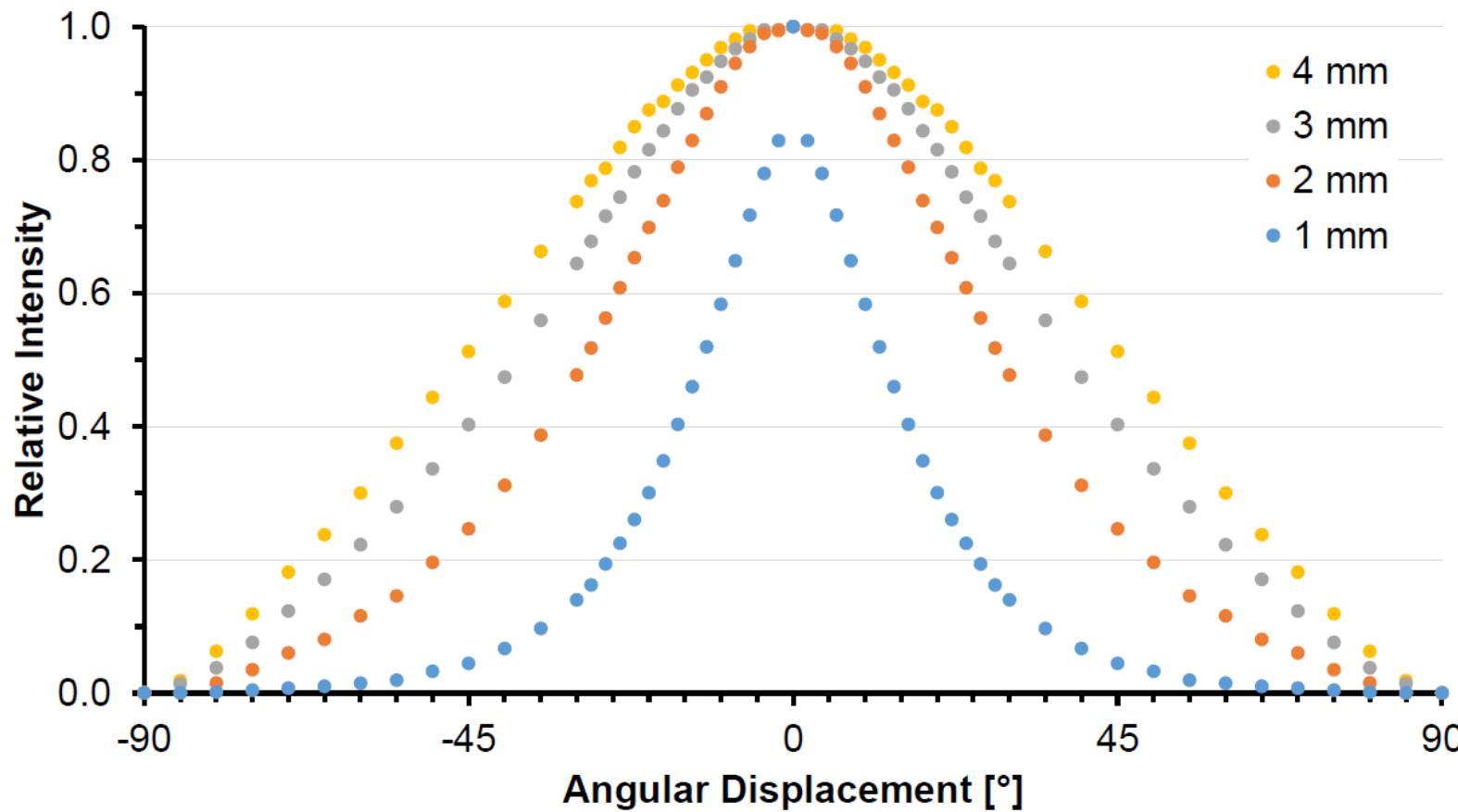
Opaque and Light Scattering-(TR 30 based)

	XE 11271	XE 11509	XE 11515
Light scattering	low	middle	high
Transparency [%]	82	88	70
Haze [%]	91	100	100
Clarity [%]	10	1	1
Half-Value Angle [°]	n.a.	n.a.	37*
Visible Contact Transparency (plate thickness 2 mm)			

*Half-Value Angle 12° at 1mm, 28° at 2mm, 45° at 4mm.

Opaque and Light Scattering-(TR 30 based)

Spatial Radiation Distribution (Grilamid TR XE 11515)



Light Scattering Grades

Grilamid TR XE 11271

Contact transparency



With distance of approx. 3mm



thickness = 2mm

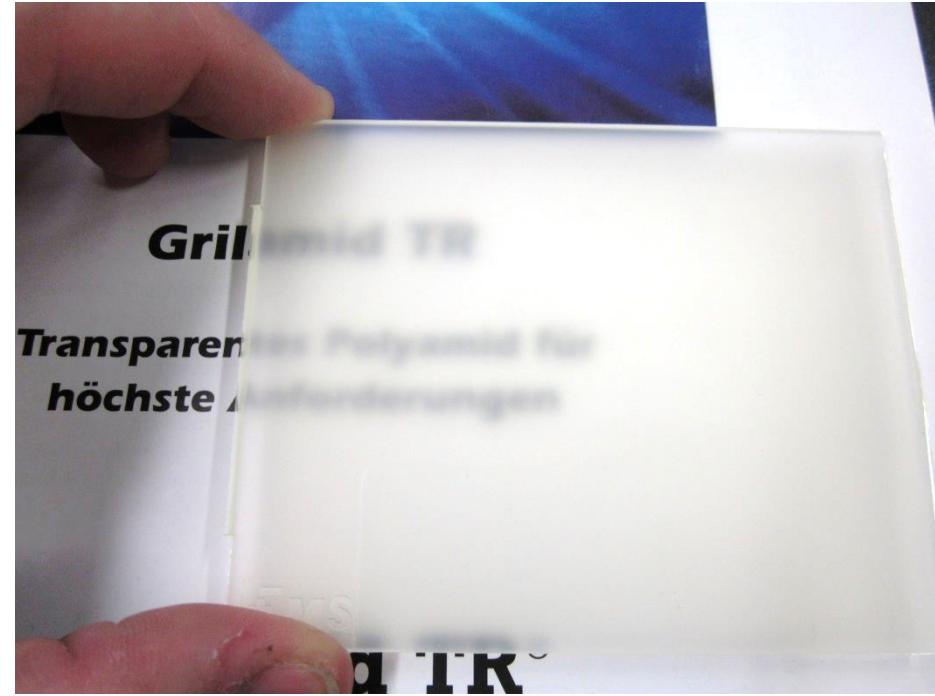
Light Scattering Grades

Grilamid TR XE 11509

Contact transparency



With distance of approx. 3mm



thickness = 2mm

EMS
EMS-GRIVORY

Light Scattering Grades

Grilamid TR XE 11515

Contact transparency



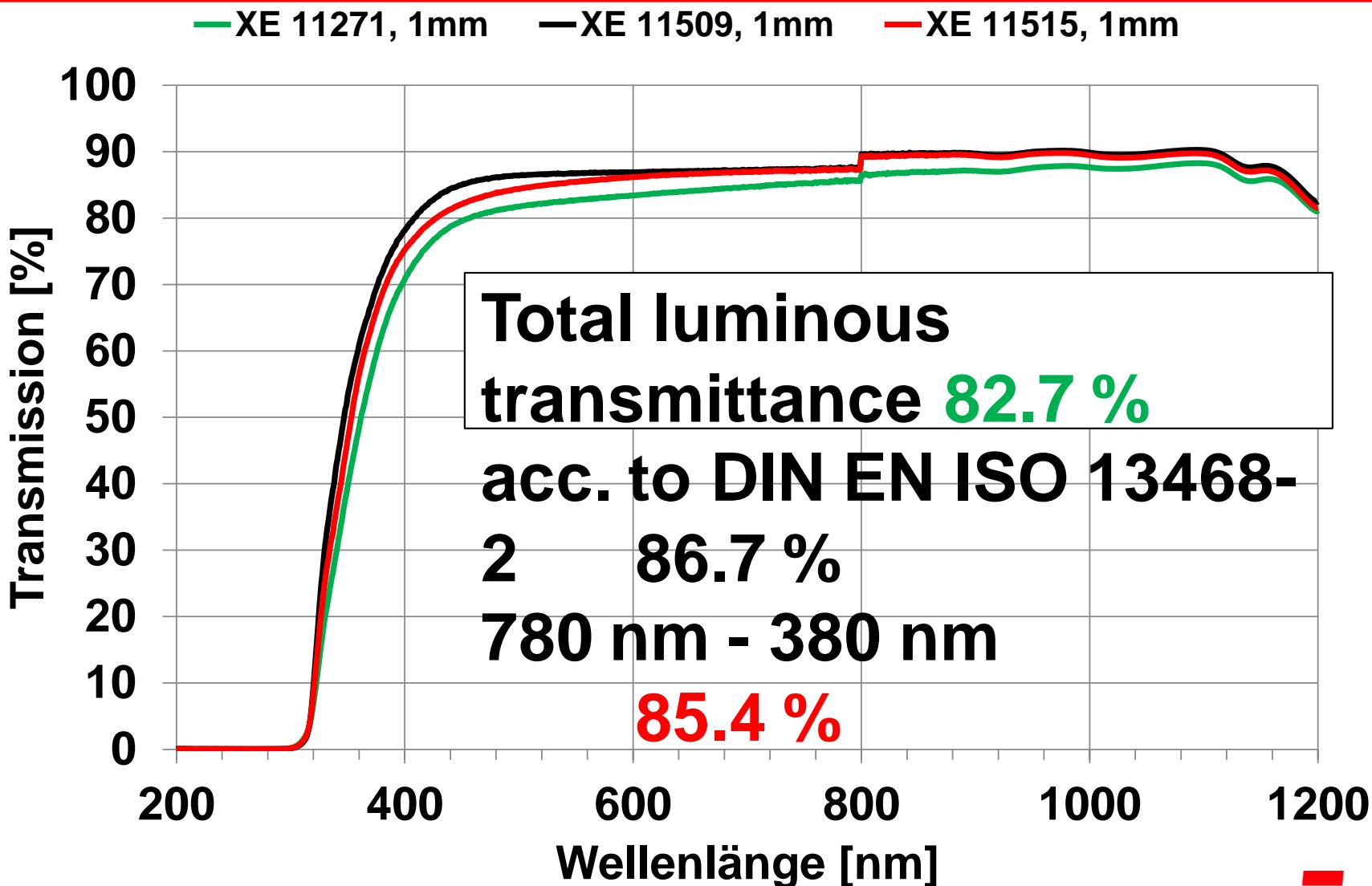
With distance of approx. 3mm



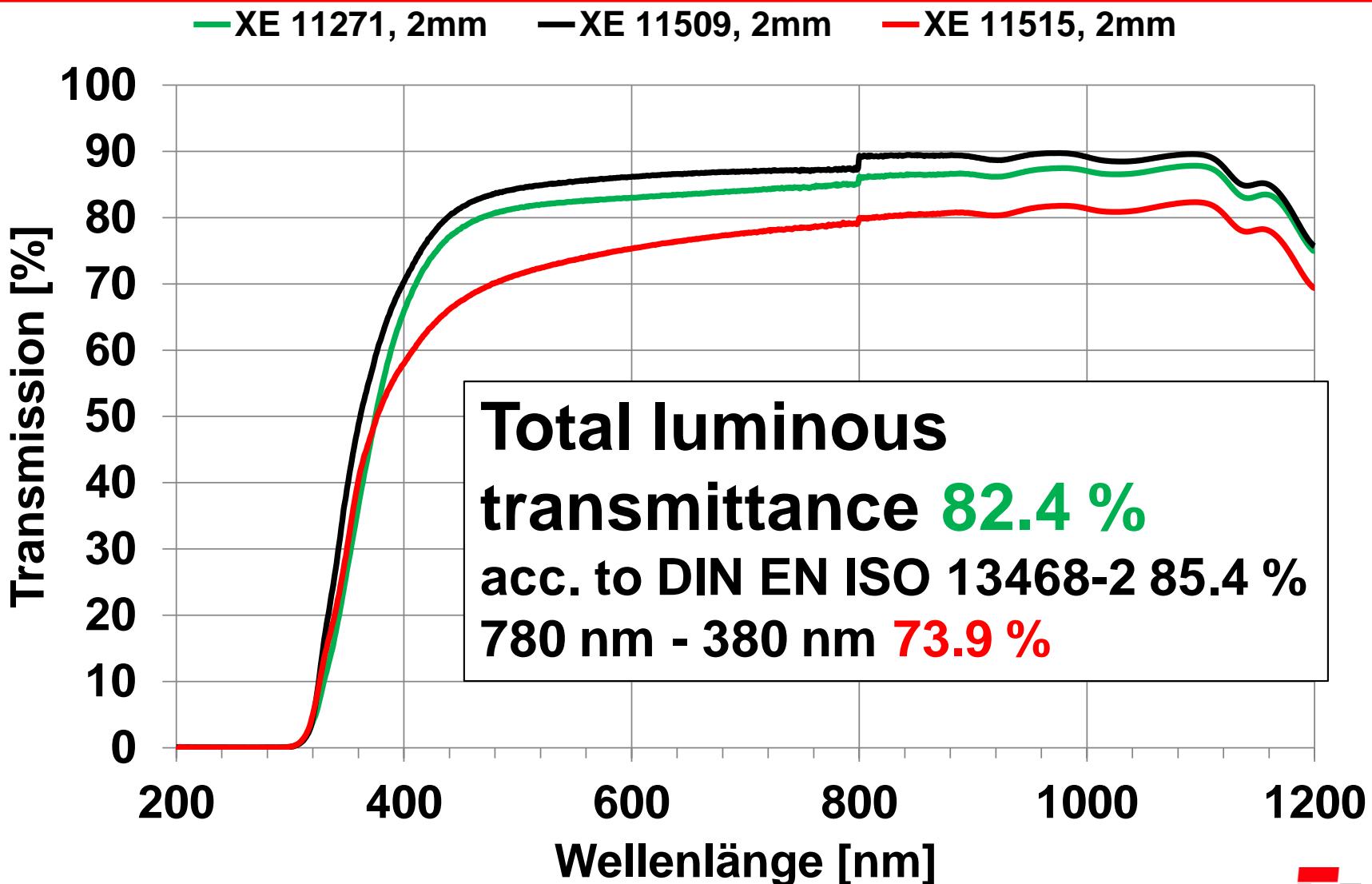
thickness = 2mm

EMS
EMS-GRIVORY

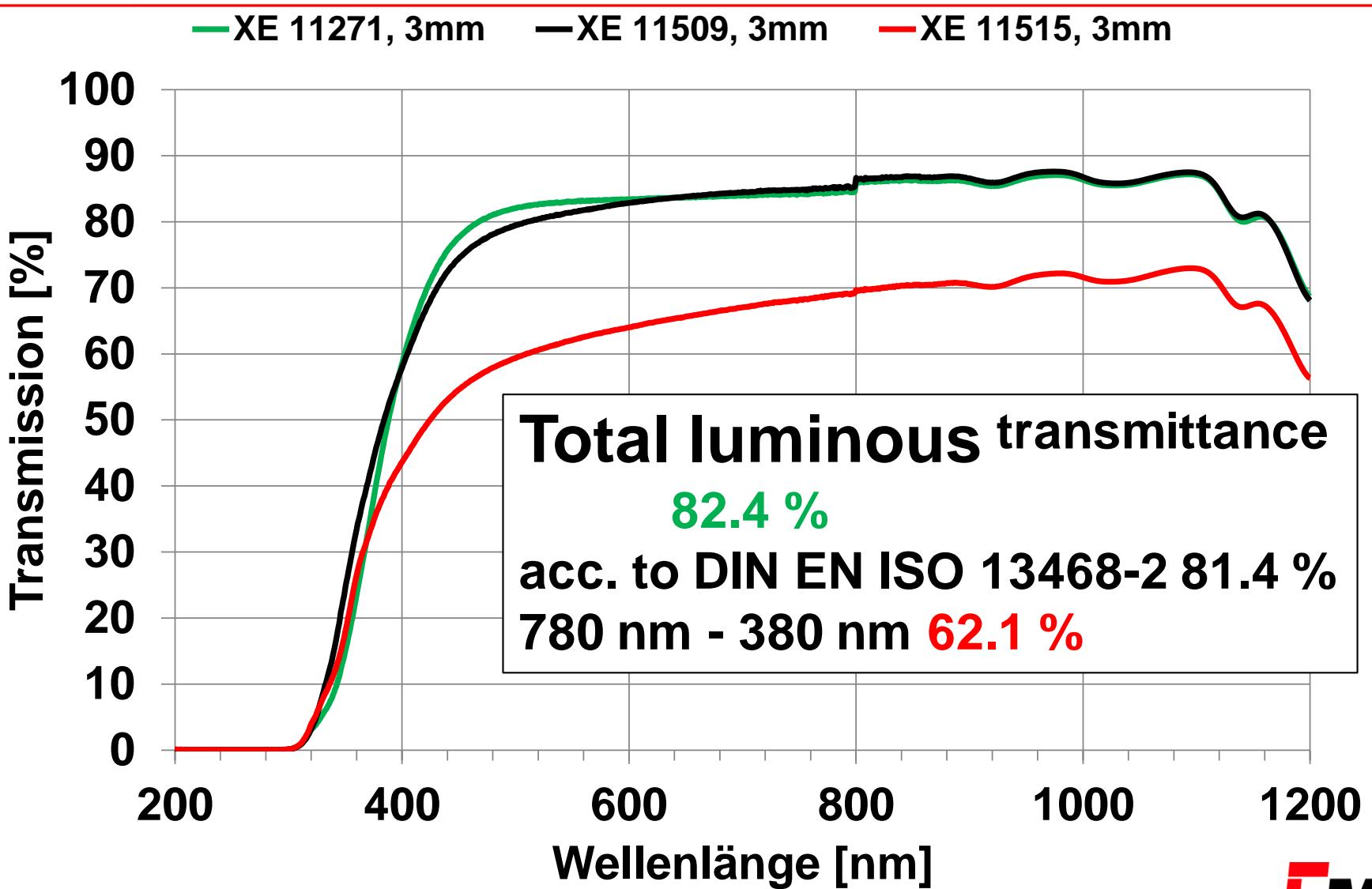
Transmission Curves at 1mm



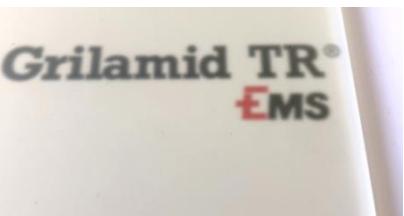
Transmission Curves at 2mm



Transmission Curves at 3mm



Opaque and Light Scattering-(TR 90 based)

	TR 90 white 6870	TR 90 UV white 6260	FE 11560
Light scattering	low	middle	middle-high
Transparency [%]	81	47	90
Haze [%]	99	100	100
Clarity [%]	36	2	5
Visible Contact Transparency (plate thickness 1 & 3 mm)	 1 mm 3 mm	 1 mm 3 mm	 3 mm

Special Areas - LED Work Light

Success factors:

- stress cracking resistant
- chemical resistant
- scratch resistant
- high impact resistant
- weather/UV-resistant

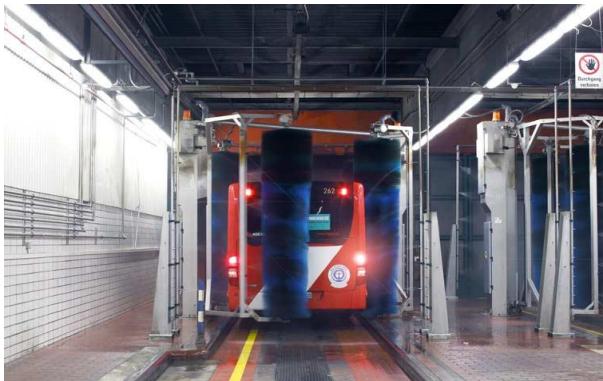


Grilamid TR 55



EMS
EMS-GRIVORY

Special Areas - Lamp Covers



Grilamid TR 90 LX

Success factors:

- stress cracking resistant
- chemical resistant
- scratch resistant

Special Areas - Signal Lamp

Success factors:

- FDA approved
- chemical resistant
- high impact resistant
- BPA-free
- 3-A Sanitary Standard (USA)



Floor Luminaires – LED Lights / Housing

Success factors:

- high weather resistance
- high stiffness
- 2-C Molding (material-locking
= watertight)



Housing: **Grilamid LV-5H**



Lenses: **Grilamid TR90 UV**

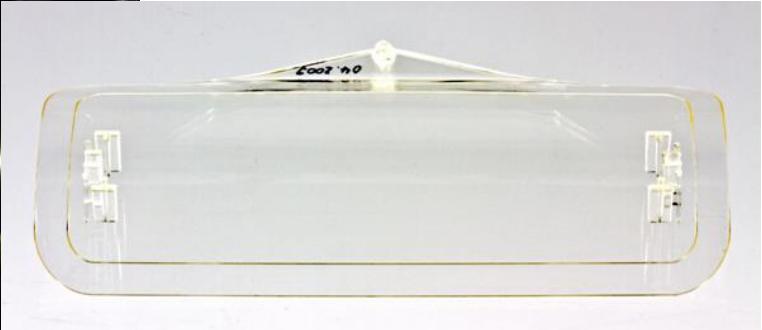
Aerospace - Landing Lights



Success factors:

- stress cracking resistant
- chemical resistant
- high impact resistant
- weather/UV-resistant
- low weight ($1\text{g}/\text{cm}^3$)

Grilamid TR 90



Work Lights



Grilamid TR 90 UV

- High transparency and purity
- Chemical resistance
- Excellent weathering resistance

Heavy Machinery - LED Floodlights



Success factors:

- high impact strength at low temperatures
- chemical resistance
- long-term UV resistance
- No visible yellowing



Grilamid TR 90 UV

Maritime Shipping - LED Lenses



Success factors:

- sea water resistant
- chemical resistant
- scratch resistant
- high impact resistant
- weather/UV-resistant



Grilamid TR 90 UV



Maritime Shipping – Aqua Light

Grilamid TR 90 UV



Success factors:

- sea water resistant
- chemical resistant
- scratch resistant
- high impact resistant
- weather/UV-resistant

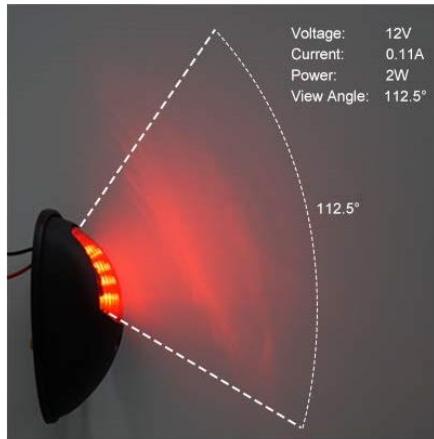
Maritime Shipping – LED Lights

Grilamid TR 90 UV

Suitable for most pontoon, yacht, skeeter, touring car, fishing boat, speed boat and other boats.

Success factors:

- sea water resistant
- chemical resistant
- scratch resistant
- high impact resistant
- weather/UV-resistant



LED Light Lens



- Transparency
- Toughness
- Chemical resistance
- Weathering resistance
- Scratch resistance



Disclaimer

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