



The Composite Technology

EN 45545 HL3  
also with  
Carbon Fibre



Alstom ETR 675

**Total EN 45545 Solutions for Flame retardant  
Composites: Gel- & Topcoats, Resins and  
Coatings from one Company**

[www.madercomposites.com/EN45545](http://www.madercomposites.com/EN45545)

# Over 40 EN 45545 References since 2012, with all types of Coatings



**Stadler S-Bahn Pankow**



**ALSTOM Metro Sidney**



**BOMBARDIER UC490**  
S-Bahn Hamburg



**SIEMENS RRX**



**ALSTOM Riyadh Metro**



**BOMBARDIER REGIO 2N**



**BOMBARDIER FLEXITY II**  
Australia



**STADLER GIRUNO EC250**



# Vacuum Infusion for EN 45545 Composites

## High Speed Trains



Alstom ETR 675



## Locomotive Front Mask



Preparation with Glass and Peel-Ply



Infusion Start and after 4 Minutes



Low cost approach for lower strength requirements with GIRALITHEDITRA 2109-10 XP white 3010

## Regional Trains



Alstom Bombardier M7



Alstom Corradia Smart



Hitachi Caravaggio

## Metros



Alstom Lyon



Hitachi Saloniki



ALSTOM RER Paris

# Quality and Service for EN 45545 Composites since 2012

Mäder gives with a dedicated team full training and service to OEM's and composite makers.



## Theoretical Part



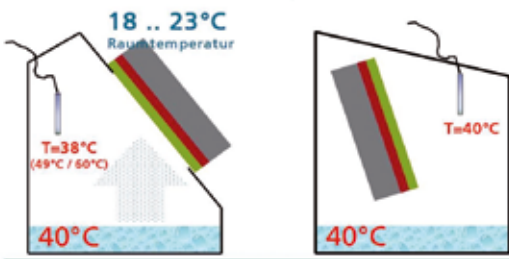
## Practical Part / Processing SOP

# Best in Class Water-/Humidity Resistance of Intumescent Gelcoats

**Condensed water test DIN EN ISO 6270**  
Coating materials – Determination of resistance to moisture

Part 1: Continuous condensation

Part 2: Method for using samples in condensation water climates



© Fraunhofer IPA  
Dr. Gert Noldeke/Rechner, 487 711 810 (M), Pöcherstr. 14a, 34109 Kassel, Germany 2015 11 17 ppt

**Humidity Resistance**

All Mäder Gelcoats/painted composites are tested according DIN EN ISO 6270-1 for 10 days inside and 20 days outside “no bubbles”

NUVOPOL Gelcoat 37-03,  
not coated passes over 20 days,  
coated over 40 days

EN 45545 Projects, with water based coatings

2012

2017



Bombardier Flexity II  
Blackpool



Bombardier Flexity II  
Goldcoast Australia



Bombardier Flexity II  
De Lijn



Bombardier TRAXX 3  
several Projects

Intumescent Gel Coat NUVOPOL 37-03  
Water based Primer  
Water based Topcoat

On going

## NUVOPOL Gelcoat 37-03

- ✓ Best in class water resistance
- ✓ In most colors available  
(with anti-graffiti clear coat recommended)
- ✓ 0,7–0,9mm application
- ✓ Faster tack-free
- ✓ Lower costs
- ✓ Experience since 2012

Water resistant painted intumescent Gelcoat since 2012 in operation for front masks and interiors passing EN 45545 HL 2 R1 and E17

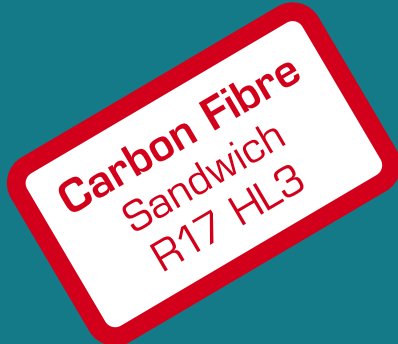
## NUVOPOL Gelcoat 37-05

- ✓ No auto-demoulding on large parts, even at high temperatures: Vacuum Infusion or HL the next day possible
- ✓ Very low smoke values: compensates smoke from coatings
- ✓ 0,8–1,0mm application
- ✓ HL3 R1 in colored gelcoat
- ✓ Flexible
- ✓ Experience since 2014

## NEW: NUVOPOL Gelcoat 37-07

- ✓ Excellent CFE values
- ✓ Low smoke
- ✓ Flexible
- ✓ Adjustable gel time
- ✓ excellent water/humidity resistance





# Total EN 45545 Solutions for Flame retardant Composites: Gelcoats, UP-Resins and Coatings from one Company

Coating Options	Inside				Outside			
	Single Coat	Primer Top Coat		Primer Top Coat	Primer Base Coat Clear Coat	Primer Base Coat Clear Coat		
Primer (SB)		ARTHANE 51 FR	ETOKAT Grund FR	ETOKAT Grund FR	ARTHANE 51 FR	ETOKAT Grund FR	ETOKAT Grund FR	
Base Coat (SB)					ARTHANE 101			
Base Coat (WB)						NUVOVERN AQUA	HYDRO BASE CL 381 / NUVOVERN AQUA RAPID	
Clear or Topcoat (SB)	ARTHANE 251	ARTHANE 251	NUVOVERN DS 10:1		ARTHANE BARNIZ			
Clear or Topcoat (WB)				NUVOVERN AQUA DS		NUVOVERN AQUA	NUVOVERN AQUA	
<b>Gel Coat</b>	NUVOPOL 37-05 TGP / NUVOPOL 37-07 TGP (new)							
Processing Options	<b>Hand Lamination</b>							
	Resins	GIRALITHE DITRA 2019-10 XP / GIRALITHE DITRA 2109-10 XP white 3010 / GIRALITHE DITRA 2109-11 XP						
	Fiber Content	25–35% by w.						
	<b>RTM light / RTM</b>							
	Resins	GIRALITHE DITRA 2109-10 XP white 3010						
	Fiber Content	20–40% by w.						
Tests	<b>Performance</b>							
	Humidity Resistance	passed						
	EN 45545-2	HL2 / HL3			R17 HL3* with Carbon Fiber		HL2	
Anti Graffiti	yes		yes		yes	yes	yes	

**Gelcoat**  
The choice of the gelcoat depends on various factors: Please ask for special recommendation  
NUVOPOL 37-05 TGP and 37-07 TGP: Gelcoat thickness: 0,8–1,0 mm

**EN 45545 (R1, R17, R7, R8 ...)**  
Depending thickness, sandwich, coating and manufacturing methods  
\*\*Glass Sandwich

(SB) Solvent based  
(WB) Water based

**EN 45545 HL 3**  
also with  
Carbon Fibre

# Lightweight Composites for EN 45545 R17 / HL2 and HL3 by Infusion

## References of Front Cups

Weight Reduction with  
1.) Vacuum Infusion and  
2.) Carbon Fibers

Process	Glass Fiber		Carbon Fiber
	Class HL2 R17		Class HL3 R17
	Hand Lay Up	Infusion	Infusion
Fiber content	30%	63%	55%
Unit	kg	kg	kg
Gelcoat weight	1.2	1.2	1.2
Glass Fiber weight	5.4	5.4	–
Carbon Fiber weight	–	–	2.8
Resin weight	12.6	3.2	2.3
Total weight /m <sup>2</sup>	19.2	9.8	6.3
Total front weight	192.0	98.0	63.0
Weight reduction	–	94.0	129.0
Weight loss percentage	–	49%	67%

**Also for structural applications:**

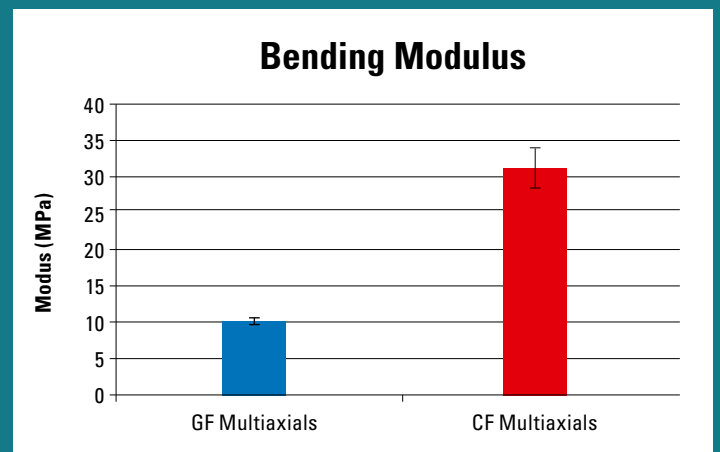
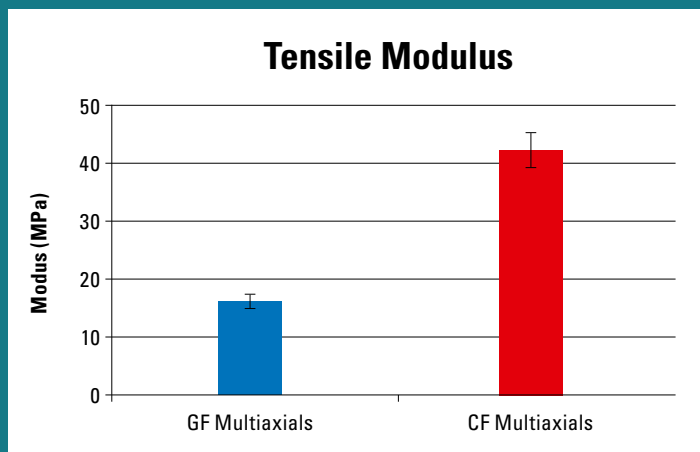
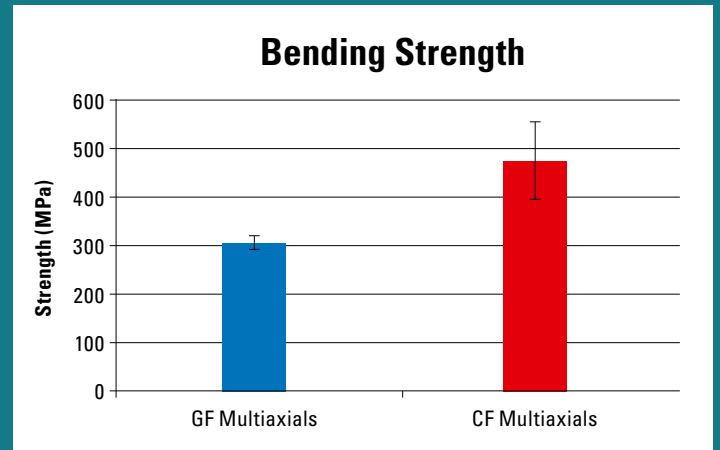
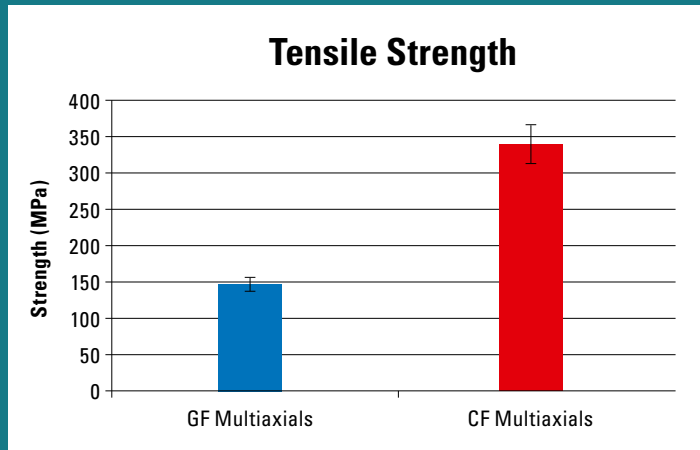
NUVOCRYL FR 60-60 G  
With up to 65% glass  
content with NUVOFIBER-  
BIAX/QUADRIAX glass  
>> 50% lighter weight

NUVOCRYL FR 60-100  
with up to 55% carbon  
fiber content  
>> 67% lighter weight

# Highest Fire Performance with new Resin Technology: Inherent Fire resistant Resins without Fillers

## Nuvocryl FR 60-100:

- ✓ HL3 with paint / antigraffitti finish (3 layers)
- ✓ Excellent mechanical properties

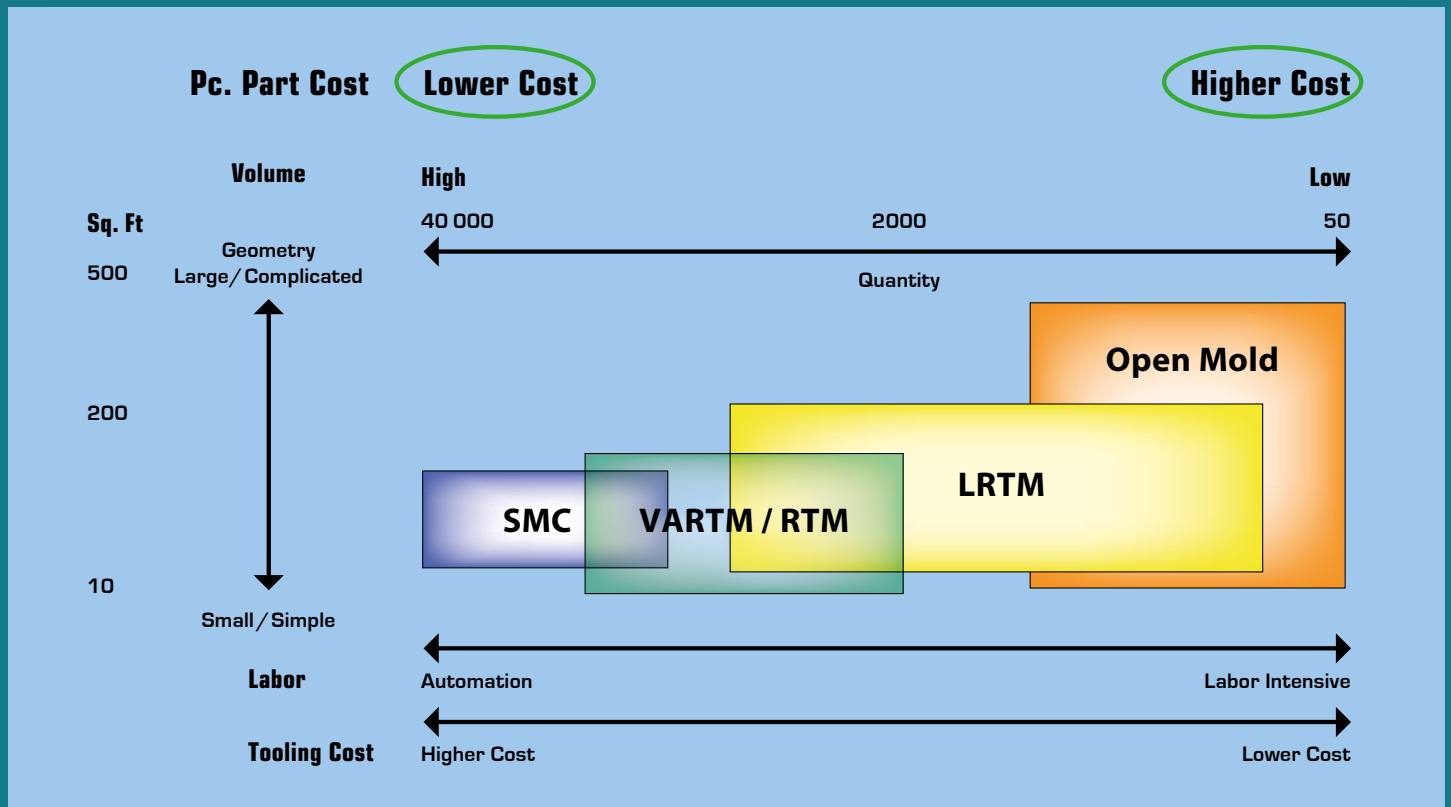


**GF:** 1 × Biax 0/90 + 1 × Biax ±45 + 1 × Biax 0/90, 530 g/m<sup>2</sup> +150 g/m<sup>2</sup> CSM

**CF:** 1 × Biax 0/90 + 1 × Biax ±45 + 1 × Biax 0/90, 400 g/m<sup>2</sup> 24K



# Manufacturing Efficiency with RTM-Light



## It is not Hand Lamination or SMC

For many interior composites the RTM / RTM Light method is more cost efficient and has shorter lead times.

## RTM Light System:

Gelcoat: NUVOPOL 37-05 TGP or NUVOPOL 37-07 TGP

Resin: GIRALIGHT DITRA 2109-10 XP

## Advanced RTM Light

- ✓ High quality composites with constant weight and properties
- ✓ Industrial process
- ✓ Lower costs per part than hand lamination from about 100 pieces

## RTM Light versus SMC

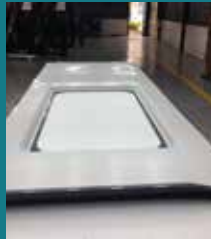
- ✓ Shorter lead time
- ✓ Low in front costs
- ✓ No limitation in dimensions (up to Front Cups)
- ✓ No dependences from press availability: wider supplier range

# RTM Light References

## Interiors



**ALSTOM** Metro Sidney



RTM Light System  
 Gelcoat NUVOPOL 37-05 TGP  
 Resin GIRALITHE DITRA 2109-10 XP  
 grey 3100  
 Gel-, curing time adjustable



**BOMBARDIER** UC490 S-Bahn Hamburg



RTM Light System  
 Gelcoat NUVOPOL 37-05 TGP  
 Resin GIRALITHE DITRA 2109-10 XP  
 white 3010  
 Pre-accelerated for fast molding



**BOMBARDIER** REGIO 2N



RTM Light System  
 Gelcoat NUVOPOL 37-05 TGP  
 Resin GIRALITHE DITRA 2109-10 XP  
 white 3010  
 Pre-accelerated for fast molding



**MÁV-Start** Intercities + Trains



RTM Light System  
 Gelcoat NUVOPOL 37-05 TGP  
 Resin GIRALITHE DITRA 2109-10 XP  
 white 3010  
 Pre-accelerated for fast molding

## Exteriors



**Alstom** Citadis X05



RTM Light System  
 Gelcoat NUVOPOL 37-05 TGP  
 Resin GIRALITHE DITRA 2109-10 XP  
 white 3010  
 Pre-accelerated for fast molding

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