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Mäder Total Composite Solutions acc. EN 45545-2 for Mass Transport and Railway : Coating, Gel-Coat and Resins meet stringent Norms

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Table of Content

- Norm EN 45545-2
  - Challenges, technologies to overcome them
  - Processing
  - Experiences so far with the EN 45545-2.
- Mäder in Mass Transport and Railway, Total Solutions

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EN 45545-2

Industrial Paints | *Peintures Industrielles* Decorative Paints | *Peintures Décoratives* Composites | *Composites*

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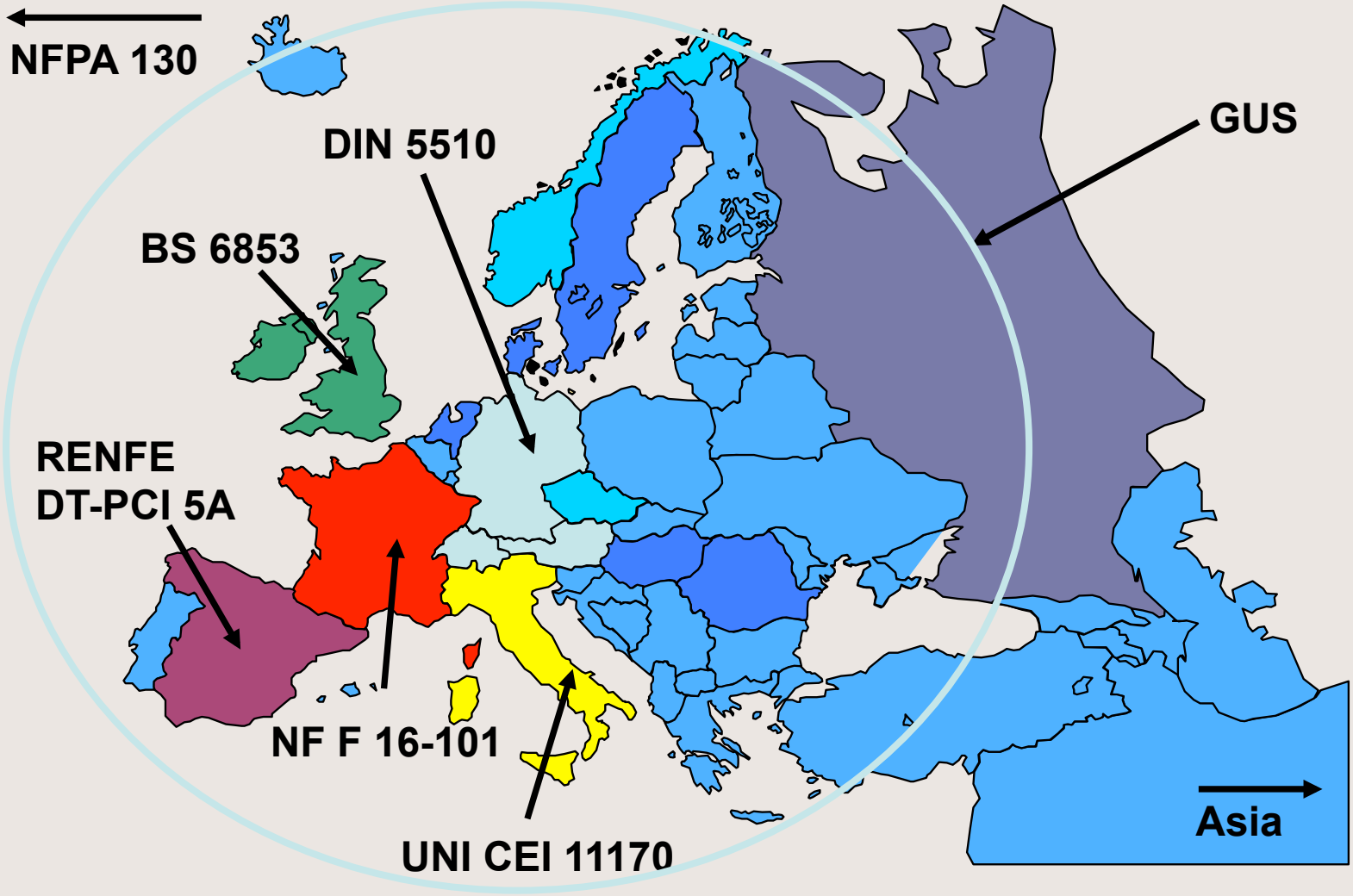
Mass Transit GRP FST Requirements Europe today



Flood of Certificates

Deutschland / Germany **DIN 5510-2**

Gelcoat	Br/Cl/Sb	Lackaufbau / coating	Laminat / reinforcement	Stärke / thickness	Br/Cl/Sb	Klassierung / classification
			Giralithe DITRA GL 2109-10(XP)	3 mm	nein/no	S4/SR2/ST2
			Giralithe DITRA GL 2109-11(XP)	4 mm	nein/no	S4/SR2/ST2
NUVOPOL Gelcoat 80-50 TG	nein/no		Giralithe DITRA GL 2109-10(XP)	3 mm	nein/no	S4/SR2/ST2
			NUVOPOL 80-03 G(P)	3.5 mm	nein/no	S4/SR2/ST2
NUVOPOL Gelcoat 80-50 TG	nein/no		NUVOPOL 80-03 G(P)	4.5 mm	nein/no	S4/SR2/ST2
NUVOPOL Gelcoat 80-50 TG	nein/no	NUVOVERN AQUA Füllgrund NUVOVERN DS	Giralithe DITRA GL 2109-10(XP)	5 mm	nein/no	S4/SR2/ST2

Frankreich / France **NF F 16-101**
NF F 92-501 M Klassierung/classification und NF X 70-100 / NF X 10-702 F Klassierung/classification

Gelcoat	Br/Cl/Sb	Lackaufbau / coating	Laminat / reinforcement	Stärke / thickness	Br/Cl/Sb	Klassierung / classification
			Giralithe SOMA GL 1104	4.5 mm	ja/yes	M1 F1
NUVOPOL Gelcoat 80-60 TGP (Spray)	ja/yes		Giralithe SOMA GL 1104	4.5 mm	ja/yes	M1 F1
NUVOPOL Gelcoat 80-60 TGP (Spray)	ja/yes	NUVOVERN AQUA Füllgrund NUVOVERN AQUA Emaillack	Giralithe SOMA GL 1104	4.5 mm	ja/yes	M1 F1
NUVOPOL Gelcoat 80-50 TG	nein/no		NUVOPOL 80-03 G(P)	4 mm	nein/no	M2 F1
NUVOPOL Gelcoat 80-50 TG	nein/no	NUVOVERN DS	NUVOPOL 80-03 G(P)	4 mm	nein/no	M2 F1
NUVOPOL Gelcoat 80-52 TGP (Spray)	nein/no		Giralithe DITRA GL 2109-11(XP)	4.5 mm	nein/no	M2 F1
NUVOPOL Gelcoat 80-52 TGP (Spray)	nein/no		Giralithe DITRA GL 2109-10(XP)	4 mm	nein/no	M2 F1

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Flood of Certificates

Polen / Polska — **PN-K-02511:2001**
(Prüfungen durch PESA SA Bydgoszcz) UIC 564-2 Ap 8

Gelcoat	Br/Cl/Sb	Lackaufbau / coating	Laminat / reinforcement	Stärke / thickness	Br/Cl/Sb	Klassierung / classification
NUVOPOL Gelcoat 80-50 TG	nein/no	NUVOVERN DS	NUVOPOL 80-03 G(P)	4 mm	nein/no	P1 A

Italien / Italy — **UNI CEI 11170,** Tabelle 1, Zeile 29
Einzelprüfungen: UNI 8456, UNI 9174
NF F 16-101 bestehend aus NF X 70-100 / NF X 10-702, F Klassierung

Gelcoat	Br/Cl/Sb	Lackaufbau / coating	Laminat / reinforcement	Stärke / thickness	Br/Cl/Sb	Klassierung / classification
NUVOPOL Gelcoat 80-50 TG	nein/no		NUVOPOL 80-03 G(P)	4 mm	nein/no	1B F1
NUVOPOL Gelcoat 80-60 TGP	nein/no		Giralithe SOMA GL 1104	4 mm	nein/no	1A F1

UIC — **Prüfung nach UIC Kodex 564-2 : 1991 standard, Appendix 4**
(Internationaler Eisenbahnverband)

Gelcoat	Br/Cl/Sb	Lackaufbau / coating	Laminat / reinforcement	Stärke / thickness	Br/Cl/Sb	Klassierung / classification
NUVOPOL Gelcoat 80-50 TG	nein/no		Giralithe DITRA GL 2109-10(XP)	4 mm	nein/no	B

Grossbritannien / Great Britain — **6853 Annex B.2**
(prEN 2825 und prEN 2826)

Gelcoat	Br/Cl/Sb	Lackaufbau / coating	Laminat / reinforcement	Stärke / thickness	Br/Cl/Sb	Klassierung / classification
NUVOPOL Gelcoat 80-50 TG	nein/no		Giralithe DITRA GL 2109-10(XP)	4.4 mm	nein/no	R = 0.25

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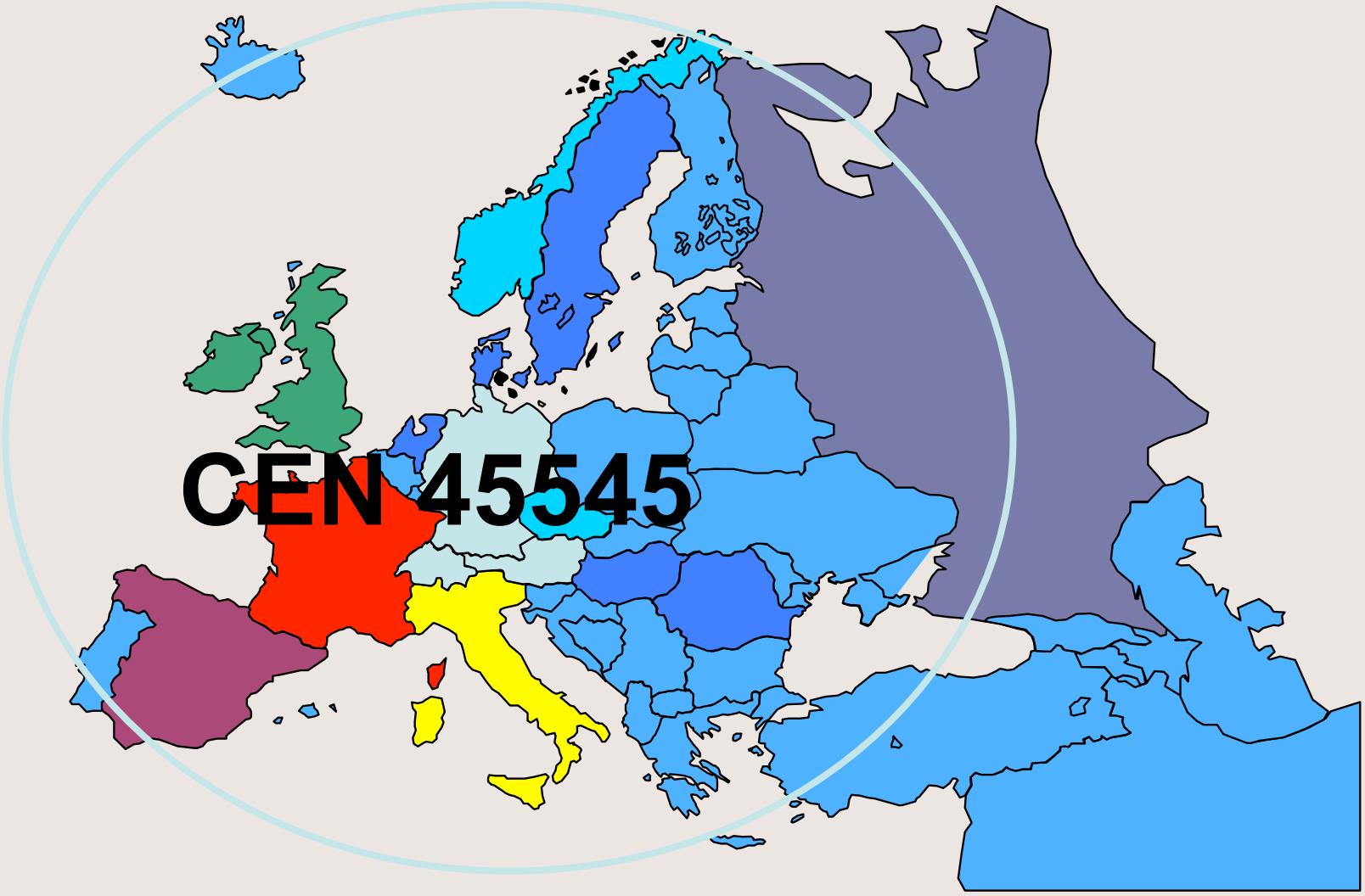
Europe from End 2012 „collection of tests“



Definition of Railway Vehicles

Railway vehicles in this standard are:

- Locomotives
- Multiple units
- Coaches
- Light rail vehicles
- Underground vehicles
- Trams
- Trolley buses (only in relation to the electrical equipment);
- Magnetic levitation vehicles

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Evaluation of Material Reaction to Fire

The 5 parameters for evaluation of reaction to fire are :

- Spread of flame
- Ignitability
- Heat release
- Smoke
- Toxicity

As far as possible, the behaviour of the fire is evaluated based on tests with material and components

in end-use condition!

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Tests with material and components in end-use condition!

Resin + Gelcoat + Primer + Top Coat = System Package
must pass the Fire and SmokeTests

→

Mäder develops and produces full Systems

Coating

Resins

Gelcoats

Primers

…

Hazard Levels

Categories and Fire Hazard Levels (=HL)

Design Categories Operation Categories	**N** **Standard Vehicles**	**A** **Automatic Vehicles, having no emergency exit**	**D** **Double decked Vehicles**	**S** **Sleeping and Couchette**
1	HL 1	HL 1	HL 1	HL 2
2	HL 2	HL 2	HL 2	HL 2
3	HL 2	HL 2	HL 2	HL 3
4	HL 3	HL 3	HL 3	HL 3

PR CEN TS 45545 Hazard Level Requirements

R1: Walls and Ceilings

Test Method	Parameter	Requirement	HL 1	HL 2	HL 3
Spread of Flame	CFE kW/m2	Minimum	20	20	20
Rate of Heat Release	MARHE kW/m2	Maximum		90	60
Smoke	Ds (4)	Maximum	600	300	150
Smoke	VOF4 Minutes	Maximum	1200	600	300
Smoke Toxicity	CIT_G after 8 Minutes	Maximum	1.2	0,9	0,75

CEN 45545

CEN 45545 requires advanced materials to:

1) pass more stringent tests
2) be processable

GRPs according to CEN 45545 will be more expensive:

1) new gelcoat technology
2) processing
3) coating even more important

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Mäder Coating and Composite Solutions passing CEN TS 45545

Test Methode	Parameter Unit	Req.	Req. No.	HL1 req. / eff.	HL2 req. / eff.	HL2 Painted req. / eff.	HL3 req. / eff.
Spread of Flame ISO 5658-2	CFE (kW/m2)	min.	R 1	20 / **22,6**	20 / **23**	20 / **29**	**20** / **24**
			R 16	13 / **22,6**	13 / **23**	13 / **29**	13 / **24**
Heat Release EN ISO 5660-1 50 kW/m²	MARHE (kW/m2)	max.	R 1	- / -	90 / **71**	90 / **72**	60 / **57,5**
			R 16	- / -	90 / **71**	90 / **72**	60 / **57,5**
Smoke Density EN ISO 5659-2 50 kW/m²	Ds(4)	max.	R 1	600 / **196**	300 / **196**	300 / **168**	150 / **106**
			R 16	600 / **196**	300 / **196**	300 / **168**	150 / **106**
Smoke Density EN ISO 5659-2 50 kWm²	Ds max	max.	R16	-	R1: DSmax inside not required	600 / **520**	300 / **428**
Smoke Density EN ISO 5659-2 50 kW/m²	VOF4 (Minutes)	max.	R 1	1200 / **363**	600 / **363**	600 / **340**	300 / **194**
			R 16	1200 / **363**	600 / **363**	600 / **340**	300 / **194**
Toxicity EN ISO 5659-2 50 kW/m²	CITG 8Min	max.	R 1	1,2 / **0,1**	0,9 / **0,24**	0,9 / **0,24**	0,75 / **0.27**
			R 16	-	1,8 / **0,24**	1,8 / **0,24**	1,5 / **0.27**
4 mm Composite Gelcoat 0.8 mm 3 Layers Glass Mat				**Colored Gelcoat**		**NUVOVERN Aqua Primer II+ Topcoat**	**Colored Gelcoat**
				NUVOPOL GELCOAT 37-03 TGP Resin DITRA 2109-11 XP		**NUVOPOL GELCOAT 37-03 TGP Resin DITRA 2109-10XP**	

R 1 : (InsideWalls, Ceilings, Interior
R 16: (Outside is mostly coated) Front of Trains until Cab Partition (incl. Coating Systems, Films)

Mäder Fire Retardant Systems overview

with and without coating

NORM	CLASS	RESIN	COLORED GELCOAT	APPROVED WITH COATING
prEN 45545	HL1, HL2, HL3 HL1, HL2 HL1, HL2	DITRA 2109-10 DITRA 2109-11 DITRA 2109-10	NUVOPOL 37-03 NUVOPOL 37-03 NUVOPOL 37-03	✓ ✓
NF P 92-501 NF F 16-501	M1 F1 M2 F1 M1 F1 M2 F1	DITRA 1210-12 DITRA 2109-11 SOMA GL 1104 DITRA 2109-11	NUVOPOL 37-03 NUVOPOL 37-03 NUVOPOL 80-60 NUVOPOL 80-52	 ✓ ✓
DIN 5510-2	S4 SR2 ST2	DITRA 2109-11 DITRA 2109-11	NUVOPOL 80-52 NUVOPOL 80-50	✓ ✓
UNI 111077	1A	DITRA 2109-10 DITRA 2109-11	NUVOPOL 80-60 NUVOPOL 37-03	 ✓

Ask for: UIC, ASNA, PLN etc. certificates

CEN TS 45545 Performance with Coating

GIRALITHE DITRA 2109-11XP with Gelcoat Nuvopol 37-03
(painted EN 45545 HL 1)

Bombardier

Bombardier Flexity II Blackpool

CEN TS 45545 Performance with / without Coating

GIRALITHE DITRA 2109-101P with different Gelcoats for Flirt NSP
Toilet Cabins, Driver Desk (painted EN 45545 HL2)

Stadler

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CEN TS 45545 HL 3 Performance with Coating

GIRALITHE DITRA 2109-10 XP with Gelcoat Nuvopol 37-05,
Coated for stair cases, passed EN 45545 HL 3 (HL 2 would be sufficient))

Experiences / Status Introduction

Target: Introduction 2012:

1. Few realised projects

2. Several in planning, Challenges:
    1. Pass EN 45545-2 HL 2, HL 3 coated
    2. Resin processing by RTM, RTM light, Vacuum Infusion
    3. Anti Graffiti, coated or uncoated
    4. High mechanical properties
    5. Front Parts: Sandwich Constructions (Smoke development)
    6. Less weight

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Mäder Group Key Figures

Turnover :	185 M €
Volume sold:	40 000 tons
Employees:	800 people
Presence in the world : map	See following
Manufacturing units :	16 factories
Research and development capacity:	7 laboratories
Research and development budget:	10 % of turnover
Other assets:	2 Design centers in France Cross licences with Japanese and American Companies

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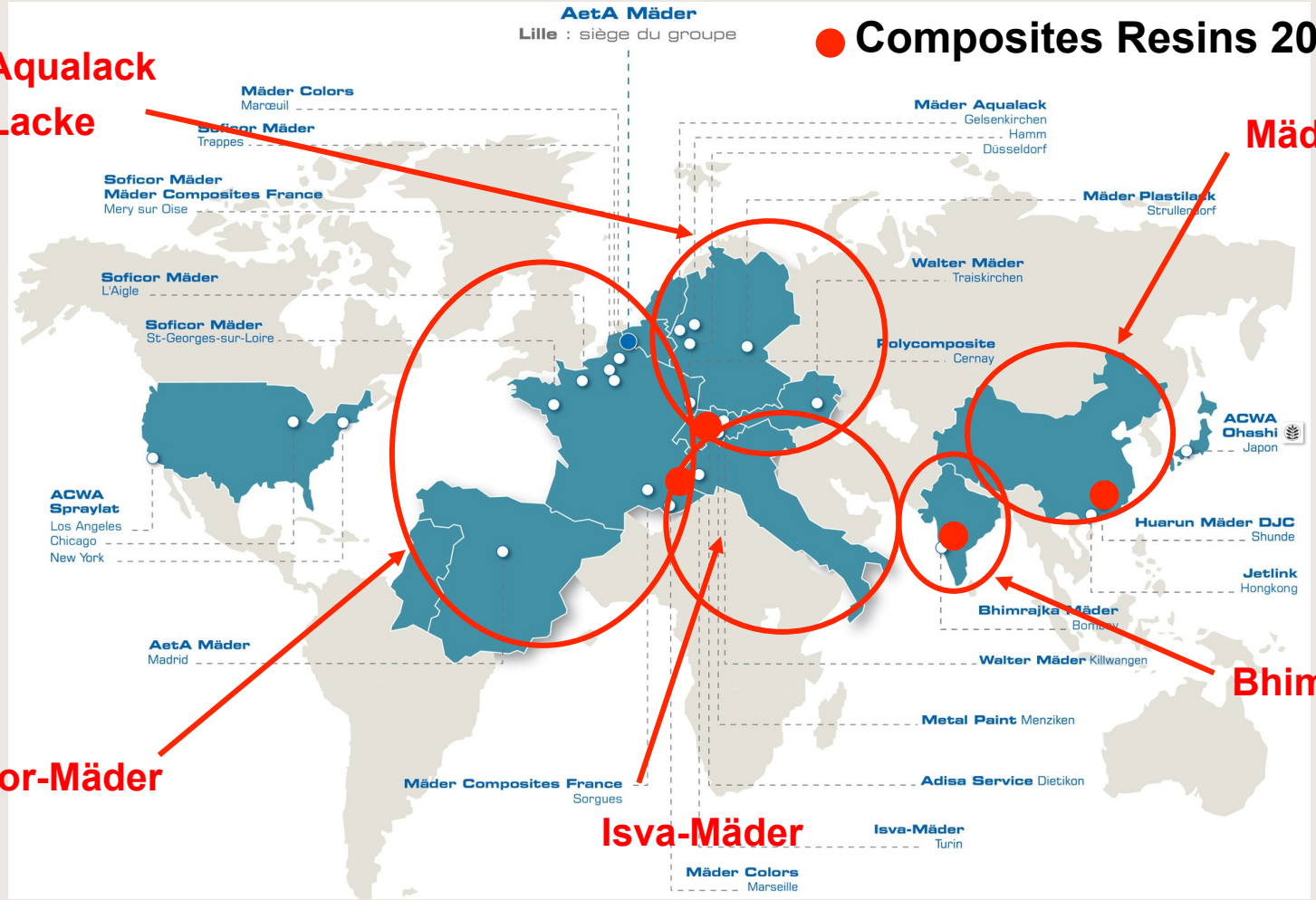
Worldwide presence



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Mäder in Mass Transport and Railway, Total Solutions

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Mäder in Mass Transport and Railway

1. Coatings for freight and passenger wagons …

2. Coatings for Buildings

3. UP Gel Coats, Resins.. for Composites

Exterior of coaches : Coating systems

- **Direct Gloss system**
  - 50 to 70 µm of glossy topcoat requiring accelerated drying (2 hours / colour)
  - Optimal for simple colour scheme
  - Difficult to handle with metallic colours

Exterior of coaches : Coating systems

- **Basecoat / Clearcoat system**
  - 15 to 30 µm of coloured basecoat with quick drying (30 – 45 min / colour)
  - 50 to 70 µm of glossy clearcoat (2 hours accelerated drying time)
  - Possibility of optimisation of cycle time especially with complex colour schemes
  - Better resistance to scratches, graffitis, dust, UV, …
  - Enhance the aesthetic aspect of metallic colours

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Flame retardant Gel Coats and UP Resins for Composites

- window masks
- end panels
- inspection covers
- seats
- cab mask
- skirt
- driver cabin interior panels

Sazcilar

ISTANBUL TAKSIM-YENIKAPI METRO

Mäder Composite and Coating Total Solutions

Mass Transit and Railway

Resin + Gelcoat + Primer + Top Coat = System Package

→ must pass the Fire and SmokeTests

Mäder develops and produces full Systems

Coating

Resins

Gelcoats

Primers

…

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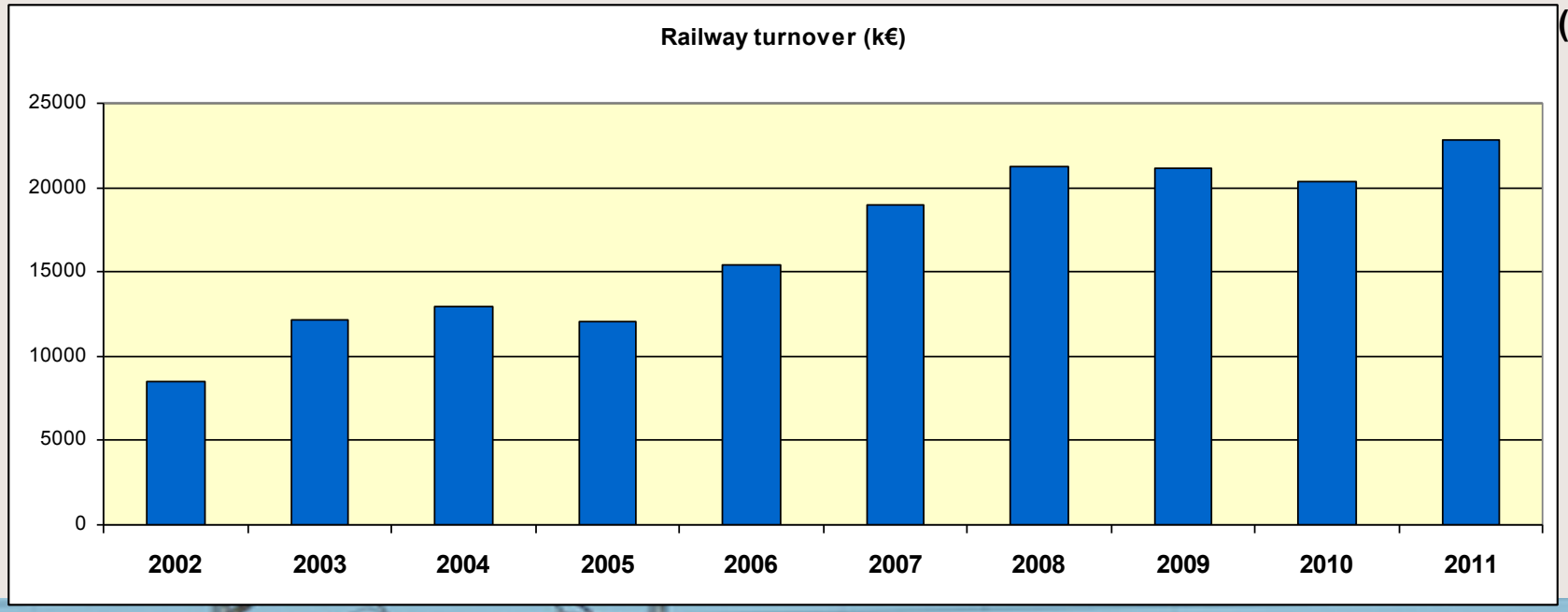
MÄDER is European Leader of Railway Coatings



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An Organisation dedicated to Railways

France : Soficor-Mäder / Mäder Composites france

- (+Corsain & Soritec) Railway experience : more than 30 years
- 4 Manufacturing plants : Saint Georges – Maroeuil – L'Aigle (S/C) Sorgues
- 1 R&D lab
- 1 design centre involved in rail in Saint Georges
- 2 resellers for service to subcontractors (Piramide and MAI)
- Markets linked : Morocco

Spain

- Local commercial service
- Local technical assistance

Belgium

- Commercial service from France
- Technical assistance from France

U.K.

- Local Reseller
- Locale technical assistance

Mäder

An Organisation dedicated to Railways

Germany : Mäder Aqualack

- Historical Companies : Aqualack
- Experience in Rail : more than 20 years
- 1 manufacturing units
- 1 assistance laboratory
- Linked markets : Poland, Eastern Europe

Czech Republic

- Local reselling partner
- Local technical assistance

Belgium

- Local reselling partner
- Local technical assistance

Netherlands

- Local reselling partner
- Local technical assistance

An Organisation dedicated to Railways

Switzerland : Mäder Coatings & Composites

- Historical Companies : Walter Mäder AG
- Experience in Rail : more than 40 years
- 2 manufacturing units (paints and composites)
- 2 research laboratories (paints and composites)
- Linked markets : Eastern Europe

Austria

- Local commercial service
- Local technical assistance

Hungary

- Local reselling partner
- Local technical assistance

Poland …

An organisation dedicated to Railways

Italy : Isva-Mäder

- JV 50% Mäder – 50% Isva Vernici
- Historical company : Isva Vernici
- Railway experience : more than 30 years
- 1 manufacturing plant
- 1 R&D lab
- Market linked : Egypt

In 2009, acquisition of Akzo Nobel's European railway business including the R&D lab, products formulas and a non competition agreement

An organisation dedicated to Railways

China : Huarun-Mäder (DaJinChuan)

- JV 50% Mäder – 50% Valspar Asia
- Railway experience : 4 years
- 1 Manufacturing plant
- 1 Assistance lab

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HUARUN-MÄDER

佛山市顺德区大金川工业涂料有限公司
Foshan Shunde Dajinchuan Industrial Paint Co.,Ltd.

Project	Company	Operational country	Builders	Type of train
EMU CRH 5	Huarun-Mäder	China	Alstom / CRC	HST

Project	Company	Operational country	Builders	Type of train
Singapore Metro	Huarun-Mäder	Singapore	CNR Sifang	Metro

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An organisation dedicated to Railways

India : Bhimrajka-Mäder JV

- Commercial offices in Mumbai
- Manufacturing plant to be implemented
- Lab to be implemented

TTNG 2010

Some References

High Speed Trains

High speed trains			
TGV Duplex RNGV	France	Alstom	In course
V250 Fira	Belgium & Netherland	Ansaldo Breda	In course
Prototype AGV Pégase	France	Alstom	Completed
TGV Duplex	France	Alstom	Completed
EMU CRH 5	China	Alstom / CRC	Completed
ETR 500	Italy	Alstom	Completed
ICN	Switzerland	Bombardier	Completed
ICE III	Germany	Bombardier	Completed
ICE II	Germany	Bombardier	Completed
TGK	Korea	Alstom / Rotem	Completed

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Some References

Regional and Commuter trains

Regional & suburban trains

S-Bahn Zurich II	Switzerland	Stadler	To be started
Nothern Ireland DMUs II	Nothern Ireland	CAF	To be started
Mi09 RATP	France	Alstom & Bombardier	To be started
Due piani Trenitalia	Italy	Firema & Officine veronesi	In course
CTR Ferrovie Nord Milano	Italy	Alstom	In course
BAF Minuetto Trenitalia	Italy	Alstom	In course
DMU IC4 DSB	Danmark	AnsaldoBreda	In course
TSR Ferrovie Nord Milano	Italy	AnsaldoBreda	In course
EMU 2N Marocco ONCF	Morocco		In course
Meneghino Nord Milano	Italy	AnsaldoBreda & Firema	In course
NCDP Trenitalia II	Italy	Officine Veronesi	In course
EMU Ferrovie Circuvesuviana	Italy	Firema	In course
EMU Ferrovie Appulop Lucane	Italy	Firema	In course
Regio 2N FNME	Italy	Firema	In course
ATR 220	Poland	Pesa	In course
Izmir Commuter EMUs	Turkey	CAF	In course
NAT	France	Bombardier	In course
AGC	France	Bombardier	In course
TER 2N NG	France	Alstom & Bombardier	In course
Bari Nord II	Italy	Alstom	Completed
Bari Barletta	Italy	Alstom	Completed
Bari Nord I	Italy	Alstom	Completed
EMU Trento Male	Italy	Alstom	Completed
Torino-Ceres	Italy	Alstom	Completed
EMU NSB	Norway	AnsaldoBreda	Completed
NCDP Trenitalia I	Italy	Officine Veronesi	Completed
EMU Ragione Puglia	Italy	Pesa	Completed
DM 90	Netherlands	Bombardier & Talbot	Completed
IC 2000	Switzerland	Bombardier	Completed
S-Bahn Zurich I	Switzerland	Siemens	Completed
Desiro Southwest	England	Siemens	Completed
GTW New Jersey	USA	Stadler	Completed
GTW 2/6 Thurbo AG	Switzerland	Stadler	Completed
GTW LiLo (Linz)	Austria	Stadler	Completed
BLS Nina	Switzerland	Bombardier	Completed
X TER	France	Alstom	Completed
Hillside	Australia	Alstom	Completed
Corradia Duplex prototype	France	Alstom	Completed
Mi2N	France	Alstom & Bombardier	Completed
Z2N	France	Alstom	Completed

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Some References

Metros

Metros			
Singapore Metro	Singapore	CNR Sifang	To be started
Milano L5	Italy	AnsaldoBreda	To be started
Metro Ryadh	Saudi Arabia	AnsaldoBreda	To be started
Metro Roma Cityway	Italy	Ansaldo Breda	In course
Metro Fortaleza		AnsaldoBreda & Firema	In course
Metro Roma C	Italy	AnsaldoBreda	In course
Metro Valencia	Spain	Vossloh	In course
Paris MF 2000	France	Bombardier	In course
Istanbul II	Turkey	Alstom	In course
VAL 208 Uijeongbu	Korea	Siemens	In course
Metro Roma	Italy	Alstom	Completed
Metro Madrid	Spain	AnsaldoBreda	Completed
Metro Washington	USA	AnsaldoBreda	Completed
VAL 208 Rennes	France	Siemens	Completed
VAL 208 Roissy	France	Siemens	Completed
VAL 208 Toulouse B	France	Siemens	Completed
VAL 208 Torino	Italy	Siemens	Completed
Metro Kaohsiung	China	Siemens	Completed
Caracas Los Teques	Venezuela	Alstom	Completed
Caracas IV	Venezuela	Alstom	Completed
Caracas III	Venezuela	Alstom	Completed
Istanbul I	Turkey	Alstom	Completed

Some References

Tilting Trains

Tilting trains			
Virgin WCML II	England	Alstom	To be started
Helsinki - Saint Petersburg	Finland / Russia	Alstom	In course
Cisalpino ETR 610	Switzerland / Italy	Alstom	In course
New Pendolino ETR 600	Italy	Alstom	In course
SM3 Finlandia II	Finland	Alstom	Completed
Virgin WCML	England	Alstom	Completed
Pendolino Slovenia	Slovenia	Alstom	Completed
SM3 Finlandia I	Finland	Alstom	Completed
CP Portogallo II	Portugal	Alstom	Completed
ETR 480	Italy	Alstom	Completed
CP Portogallo I	Portugal	Alstom	Completed
ETR 470 Cisalpino	Switzerland	Alstom	Completed
ETR 460	Italy	Alstom	Completed

Some References

Tramways (LRV)

Tramways			
Citadis Dubai	Dubai	Alstom	To be started
Sirio Kayseri	Turkey	AnsaldoBreda	In course
Roma Viterbo	Italy	AnsaldoBreda & Firema	In course
Tram Goteborg II	Sweeden	AnsaldoBreda	In course
Citadis Angers	France	Alstom	In course
TTNG SNCF	France	Alstom	In course
Tram Torino	Italy	Alstom	Completed
Citiway Roma	Italy	Alstom	Completed
Tram Messina	Italy	Alstom	Completed
Sirio Bergamo	Italy	AnsaldoBreda	Completed
Tram Goteborg I	Sweeden	AnsaldoBreda	Completed
Flexcity Bremen	Germany	Bombardier	Completed
Flexcity New Jersey	USA	Bombardier	Completed
Flexcity Munchen	Germany	Bombardier	Completed
Tram Nuremberg	Germany	Bombardier	Completed
Tram Zurich	Switzerland	Bombardier	Completed
Tram Francfurt	Germany	Bombardier	Completed
Antalya	Turkey	CAF	Completed
Vitoria	Spain	CAF	Completed
Citadis Tunis	Tunisia	Alstom	Completed
Citadis Bordeaux II	France	Alstom	Completed
Citadis Valenciennes	France	Alstom	Completed
Citadis Bordeaux I	France	Alstom	Completed
Citadis RATP I	France	Alstom	Completed
TVR Nancy	France	Bombardier	Completed
TVR Caen	France	Bombardier	Completed
Citadis Melbourne	Australia	Alstom	Completed

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Mäder Group Environmental Policy

The E-Care Commitment

ENVIRONMENTAL DIMENSION

1 ***To promote*** *the design and creation of eco-friendly products and solutions through Innovation, Research and Development.*
2 ***To protect*** *the environment by adopting day-to-day practices that help to preserve our natural resources and limit energy consumption.*
3 ***To provide*** *quality products and services which meet the needs and expectations of our customers, and which strictly conform to safety and environmental impact standards.*
4 ***To set up*** *checking and monitoring tools that enable us to prevent and reduce environmental hazards.*

SOCIAL, LABOUR AND COMMUNITY DIMENSION

5 ***To ensure*** *our employees enjoy personal development opportunities and to guarantee them safe working conditions.*
6 ***To develop*** *completely open communications with our different partners and contacts.*
7 ***To respect*** *the local values and cultures of the countries in which the Group operates.*
8 ***To encourage*** *our partners, subcontractors and service providers to adhere to these values and to help us fulfil our commitment to Sustainable Development.*

E-Care
by Mäder
we care about nature

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Norm EN 45545-2 Challenges

- Requirements
- Technologies to overcome them
- Processing
- Experiences so far with the EN 45545-2.

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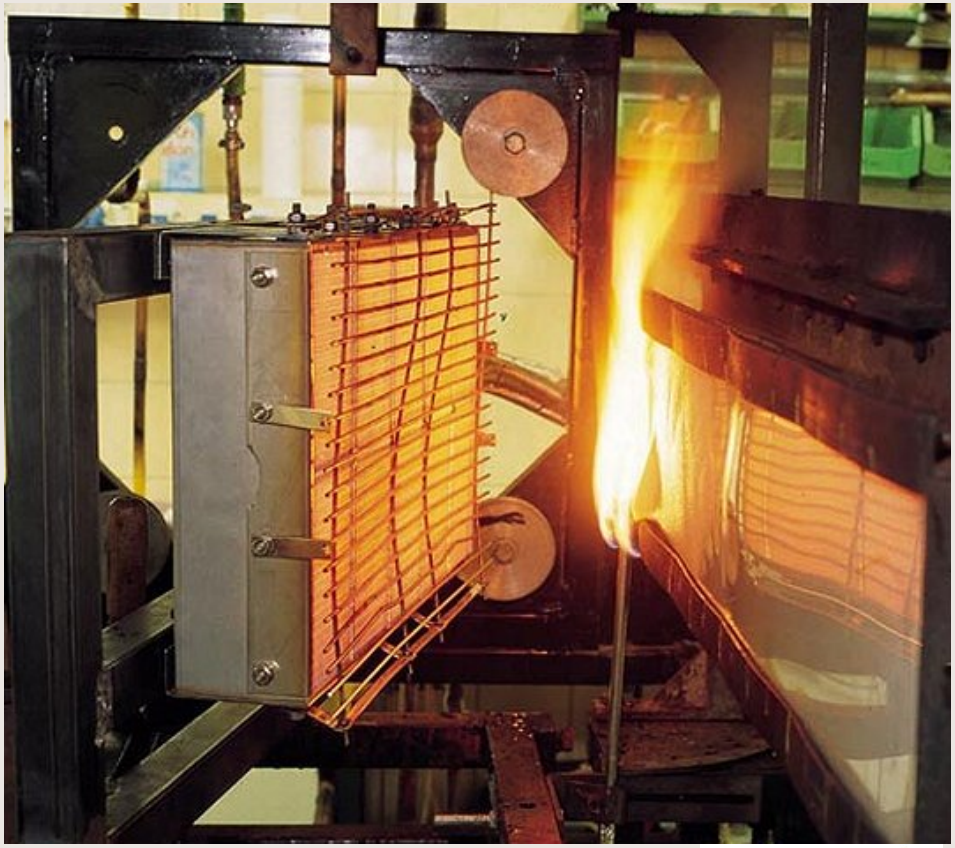
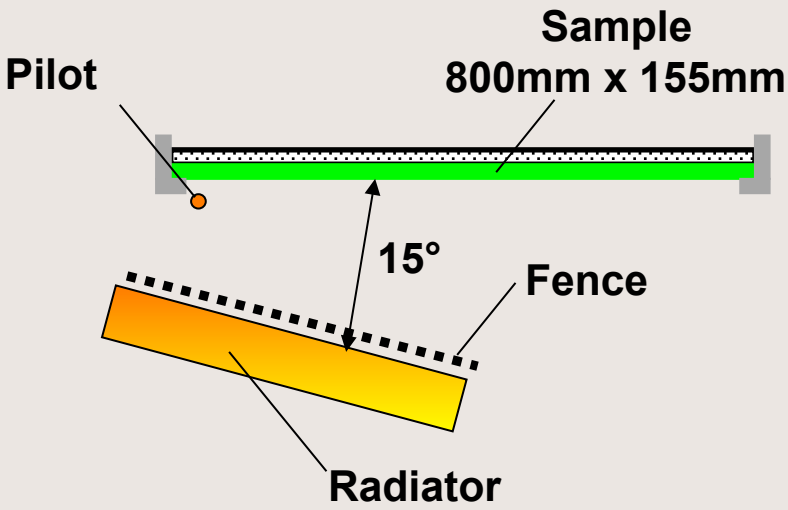
CEN TS 45545-2 Test Methods (Material Classes)

Ref.	Standard	
T01	EN ISO 4589-2	Oxygen index
T02	**ISO 5658-2**	**Spread of flame**
T03	**ISO 5660-1**	**Cone calorimeter**
T04	EN ISO 9239-1	Flame spread of floorings
T05	EN ISO 11925-2	Ignitability
T06	ISO/TR 9705-2	Furniture calorimeter
T07	EN ISO 12952 -3/4	Ignitability of bedding items
T08	IEC/TS 60695-1-40	Guidance - Insulating liquids
T09	EN 50266-2-4	Vertical flame spread of cables
T10	**EN ISO 5659-2**	**Smoke Generation**
T11	**CEN/TS 45545-2, C**	**Gas analysis - FTIR**
T12	NF-X70-100-1	Gas analysis
T13	EN 61034-2	Smoke density of cables

Hurdle 1: T02 - ISO 5658-2 Spread of flame



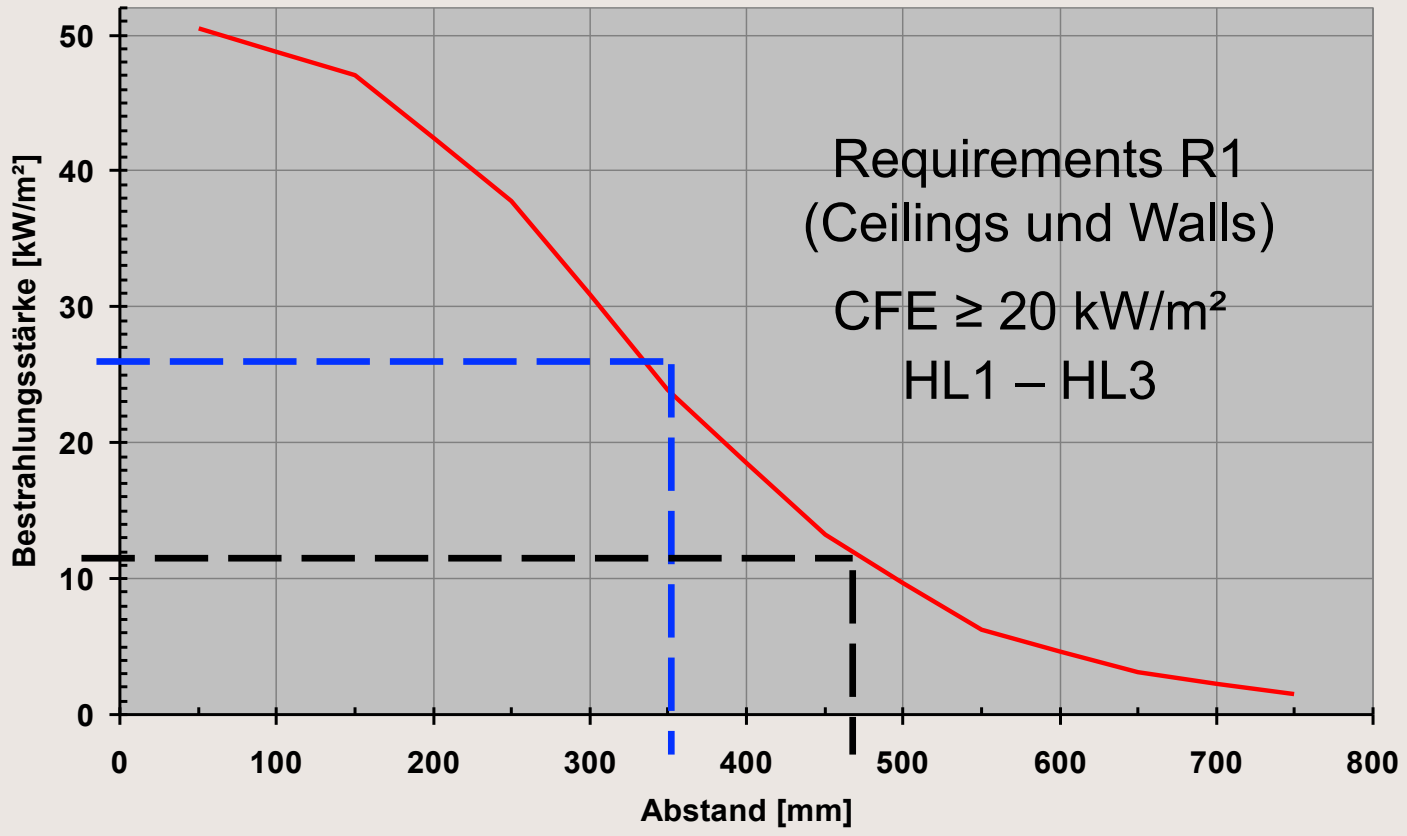
CFE [kW/m²] - critical heat flux at extinguishment



T02 - ISO 5658-2 Spread of Flame

Heat Flux

Coating?



Distance

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Experiences / How to arrive…

1. **Gel Coats**
   - Conventional technology is unsufficient: Intumescent Technology
     Intumescent systems are not without problems

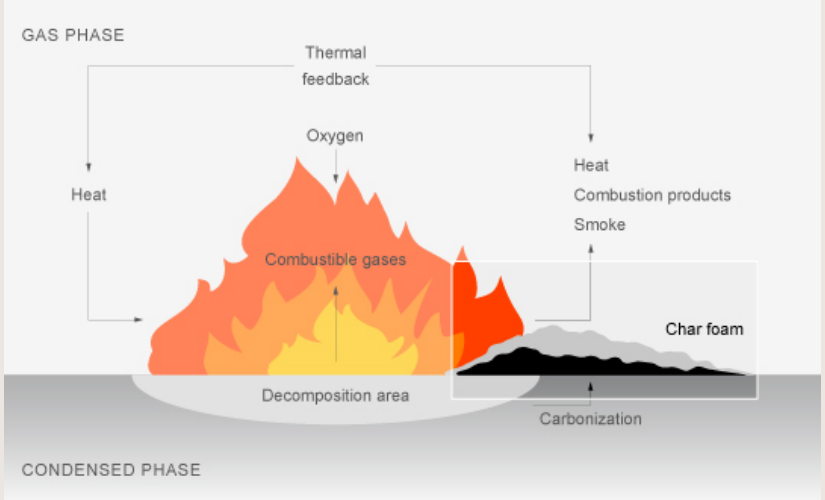
2. **Resins**
   -"Common" not halogenated ATH filled resins do not full fill the highest requirements
   - or are too high viscous for modern/closed processing methods

3. **Coatings**
   - Influence flammability and smoke development
   - Often specified by train builders (tested for compliancy?)

HL 3, HL 2 Intumescent Gelcoat Nuvopol 37-03

High fire protection trough intumescent effect:

- Intumescence = swelling, foaming of a carbon rich foam layer
- has a heat insulating effect
- reduces further oxygen access
- reduces fuel transport into the flame
- prevents dripping



HL 3, HL 2 Intumescent Gelcoat Nuvopol 37-03

High fire protection trough intumescent effect:

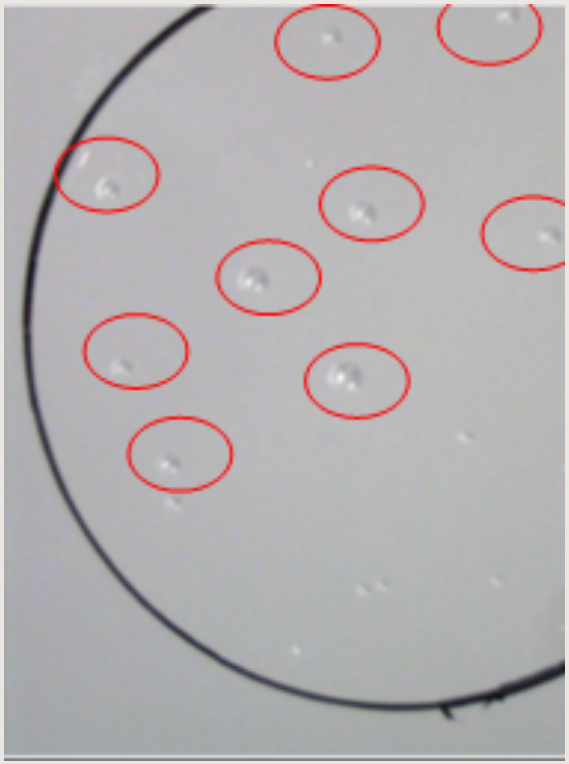
Intumescent Gelcoats: pass test

1. Protection given

2. Not every intumescent gel coat is resistend to humidity / only for inside

3. Intumescend gel coats are much more expensive

4. Depending from supplier thickness up to 1 mm, processing?



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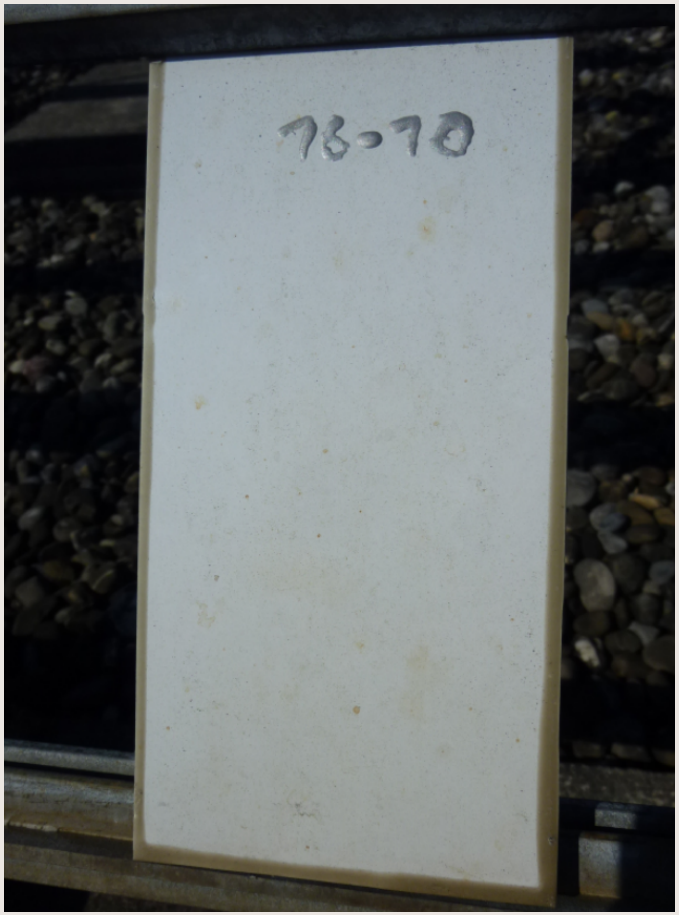
Water Resistance of Intumescent Gel Coats

Test: Mäder intumescend gel coat 37-03 TGP after storage in humidity chamber (40°C / 100 % rel. F.)

Water Resistance of Intumescent Gel Coats

Test: Mäder intumescent gel coat 37-03 TGP
after storage 1 Jahr outside (no coating)

No bubbles…



Experiences / How to arrive…

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Easy Processing Flame Retardant UP Resins

Challenge:

Normaly problems with highly filled halogen-free UP resins:

- Separation / Settlement of mineral flame additive
- High viscosity, poor penetration of glass mats
- Mostly only hand lay-up possible (Separation of fillers by injection)

Accumulation of Filler

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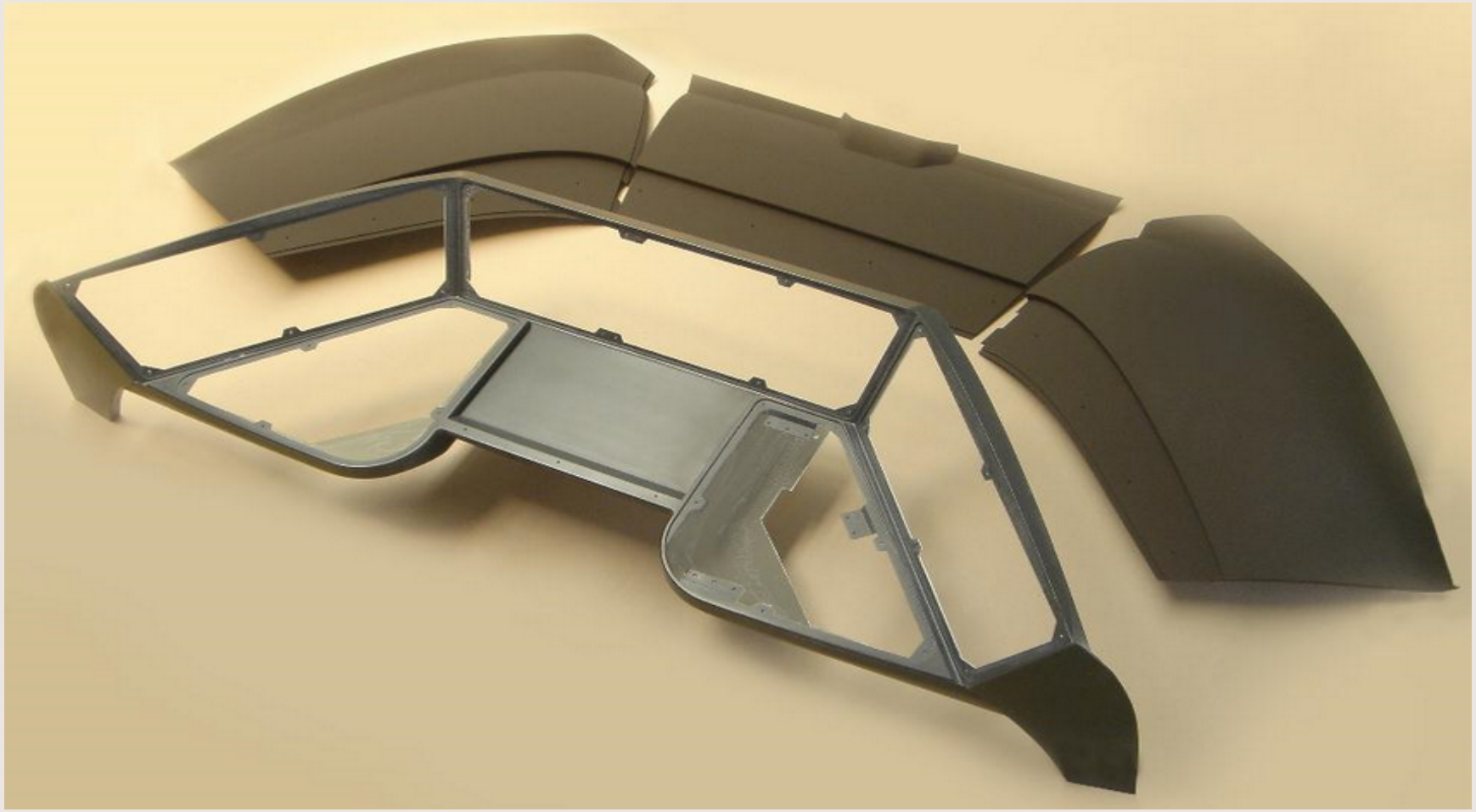

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Easy Processing Flame Retardant UP Resins

GIRALITHE DITRA 2109-11XP (passes PR CEN TS 45545 HL 2) is different:

- Low viscosity
- Fast wetting of glass mats
- Easy to process by
  - Hand lay-up
  - Spraying
  - Vacuum Infusion (no/little separation of flame additive)
  - RTM light
  - RTM

GIRALITHE is not a development product, its in use already

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Easy Processing Flame Retardant UP Resins

GIRALITHE DITRA 2109-11XP is different:

made by 3AC

Stadler

RTM Light Production of Front Cups for years

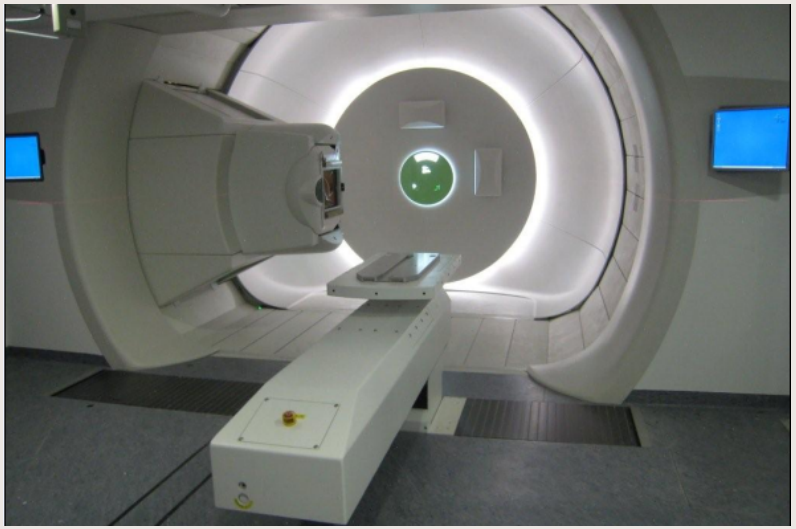
Mäder

Easy Processing Flame Retardant UP Resins

GIRALITHE DITRA 2109-11XP (passes PR CEN TS 45545 HL 2) is different:

Vacuum Infusion

(Vacuum Bag Technology) 6 m², 20 Min. Infusion Time



Customer: unbelievable performant solution in comparison to RTM process (cheaper, faster, easier)

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Easy Processing Flame Retardant UP Resins

GIRALITHE DITRA 2109-11XP (passes PR CEN TS 45545 HL 2) is different:

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Easy Processing Flame Retardant UP Resins

GIRALITHE DITRA 2109-11XP (besteht PR CEN TS 45545 HL 2)

RTM Production von Wagon Window Frames

Process

- Cleaning / Release Agent: 10 Min.
- Gelcoat Application / drying
  up to 5 Layers 580g/m2: 20 Min.
- Injection time: 5 Min.
- Curing 50 DC: 25 Min.
- Demolding: 5 Min.

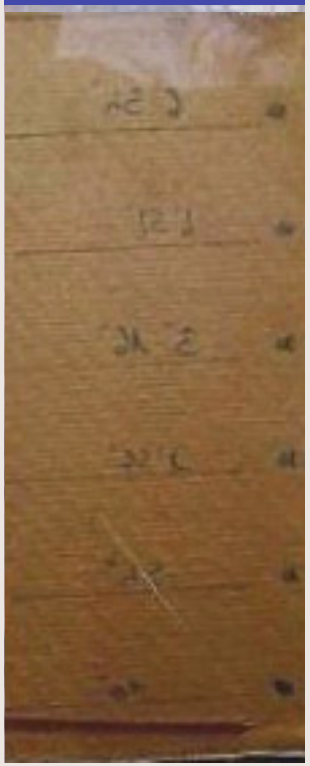
Total: about 1h

Infusion Tests (VI, RTM light)

Without Net

External Flow

ROVIFLOW



Source:Chomarat

Experiences / Conclusions

1. Project Start:
   - Choice of production methode (number of parts, strength, sandwich, coating..?…)
2. Evaluation of resin system:

“Pure UP Systems”:

- ✓ Reliable, no surprice
- ✓ No unknown (risc) factors
- ✓ Relatively eqonomique
- ✓ With/without halogen
- \- Limited flow

Modified UP/Acrylics (for closed mould processes):

- ✓ Lower viscous at same FST level
- \- Relatively expensive
- \- New process parameters (esp. hardening)

Experiences / How to arrive…

1. **Gel Coats**
   - Conventional technology is unsufficient: Intumescent Technology
     Intumescent systems are not without problems

2. Resins
   -"Common" not halogenated ATH filled resins do not full fill the highest requirements
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   - Influence flammability and smoke development
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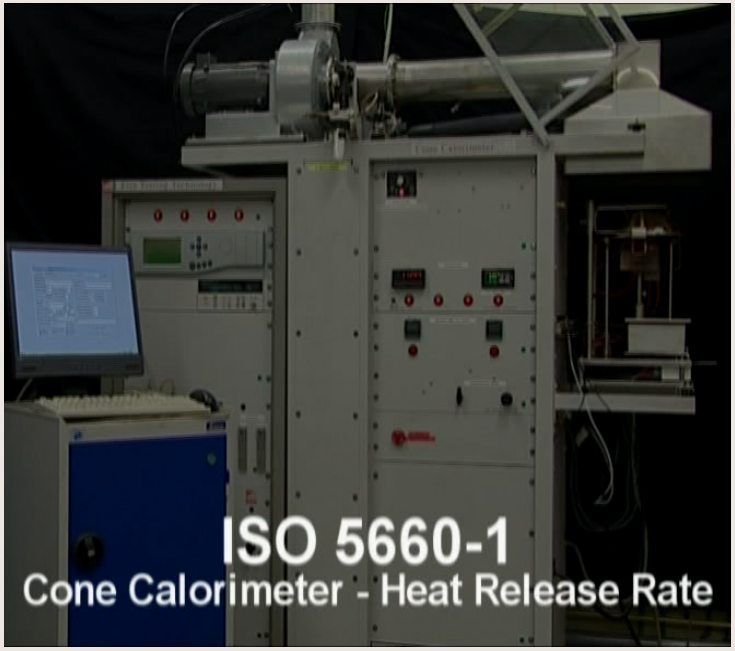
ISO 5660-1 Cone Calorimeter (Rate of Heat Release)

MARHE: Maximum average rate of heat emission (kw/m2)
The maximum value of ARHE during the time period t=0 to t=tend
(Oxygen Methode)



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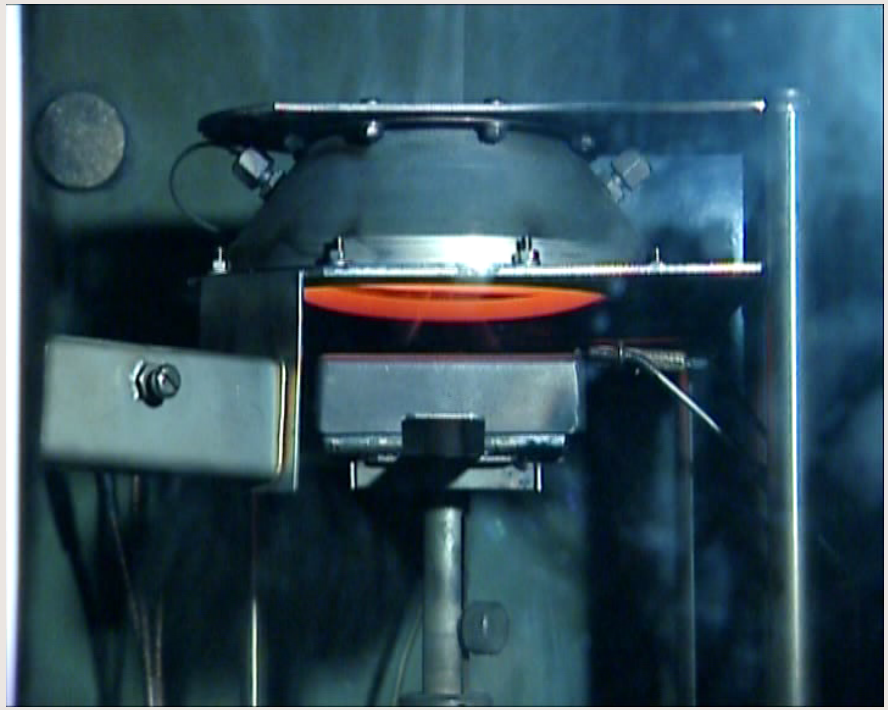
T02 - DIN EN ISO 5659-2 Smoke Generation

Determination of optical density by a single-chamber test



- 25 kW/m² with Pilot Flame
  or 50 kW/m².
- Samples:
  (75 * 75 * ≤ 25) mm
- Smoke sampling for Toxicity
- Smoke det. after 4 til 8 min.
- Max. Value from the 2
- Samples

T02 - DIN EN ISO 5659-2 Smoke Toxicity

8 Gas Components are measured
(CO2, CO, HF, HCl, HBr, HCN, NOX, SO2)

:

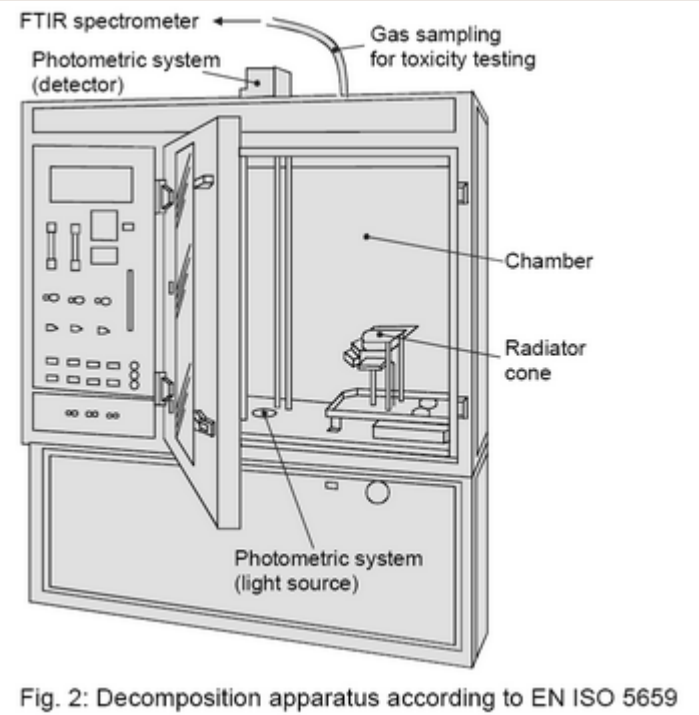
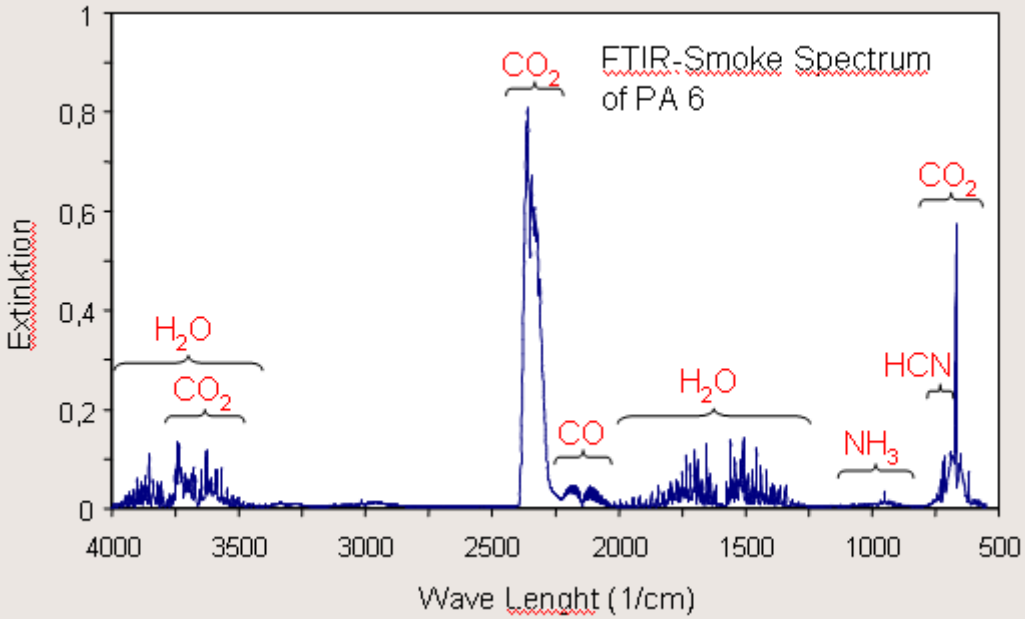


Fig. 2: Decomposition apparatus according to EN ISO 5659



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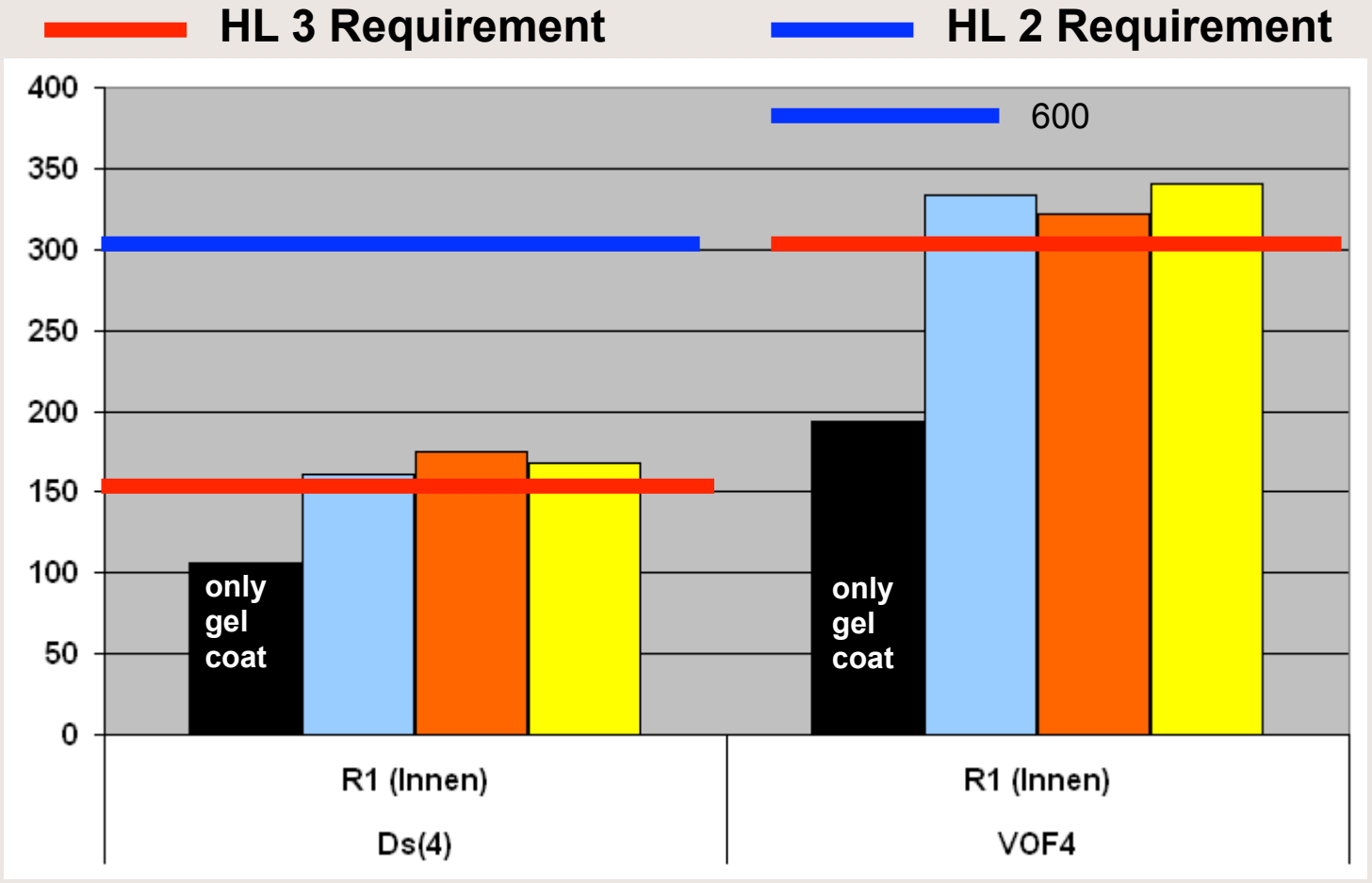
3rd Hurdle: Smoke development with/without coating (1-3)



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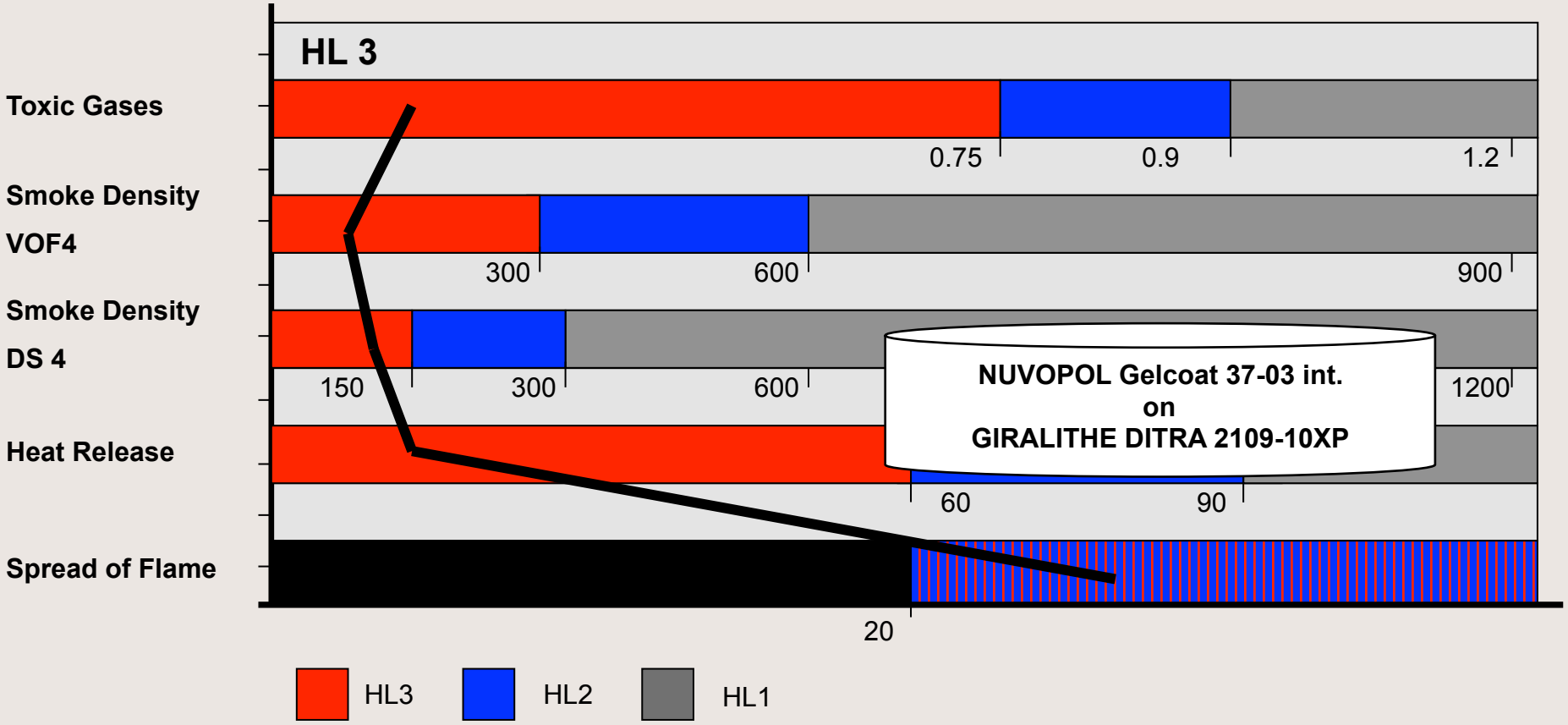
CEN TS 45545 Performance with / without Coating

HL 3 System with Gelcoat and Resin……..



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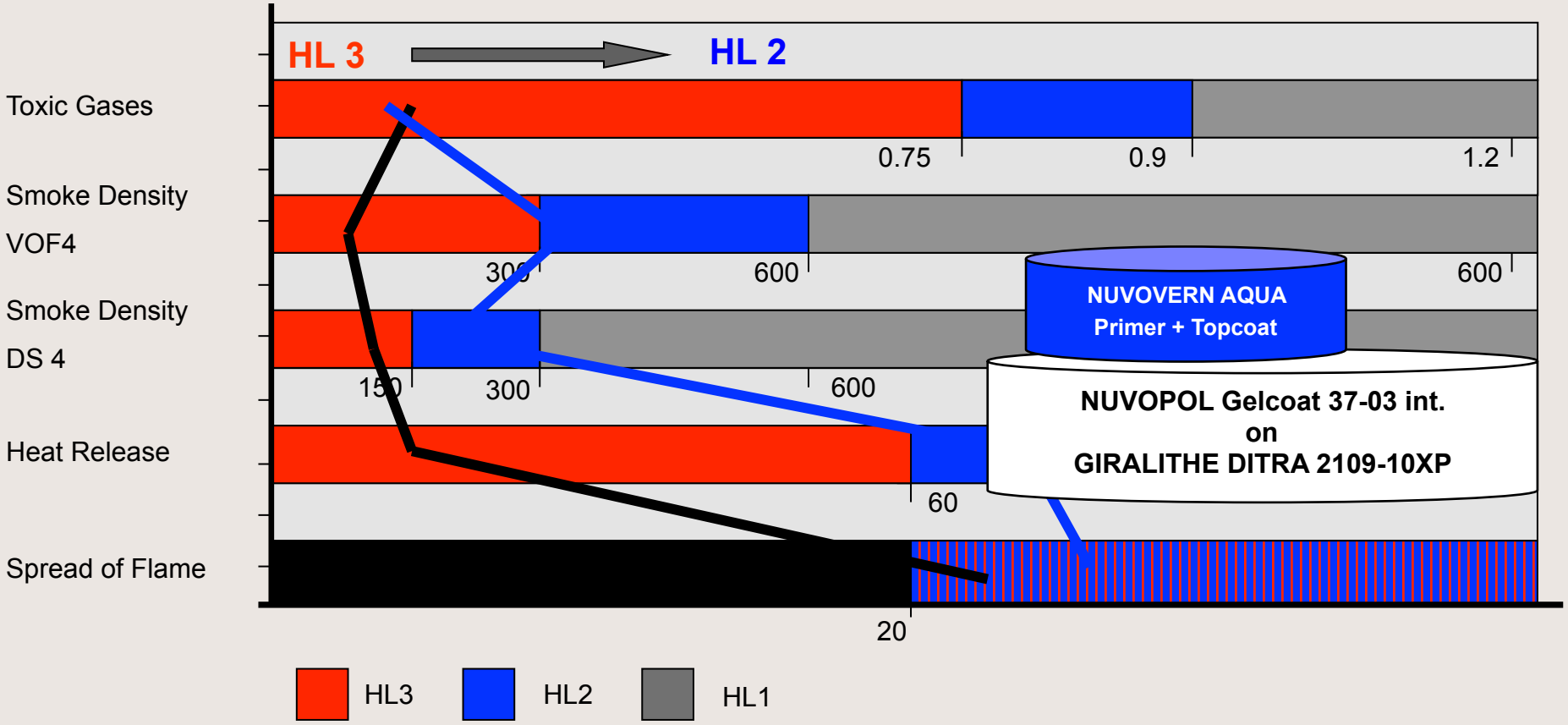
CEN TS 45545 Performance with / without Coating

…becomes a HL2 System when painted



Experiences

1. Project start:
   - Composite producer makes a sample,
   may be there are reinforcing rips (foam inlays) needed
2. - OEM prescribes a coating system
   - **HL 2 / HL 3 is often not achieved since not adjusted/no experience there**

3. The mould is already made, the customer wants a structured grp surface...

4. Antigraffiti action required…

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Conclusions / Coatings Inside

1. Project start:

   -Coordination of all partners about total concpt

2. **Coating or better colored gel coat?**

   pro Gel Coat:

   - ✓ More easy to pass the requested hazard level (HL 1-3)
   - ✓ Thicker layer (0.5 mm): more protection
   - ✓ Considerably lower total costs

   pro Coating:

   - ✓ No, less metamerie problemes with other parts
   - ✓ Higher antigraffity effect possible
   - ✓ Higher unity of structures and colores when several producers supplie
   - ✓

Metamerie

…results when pigment compositions are not exactly the same

artificial light day light

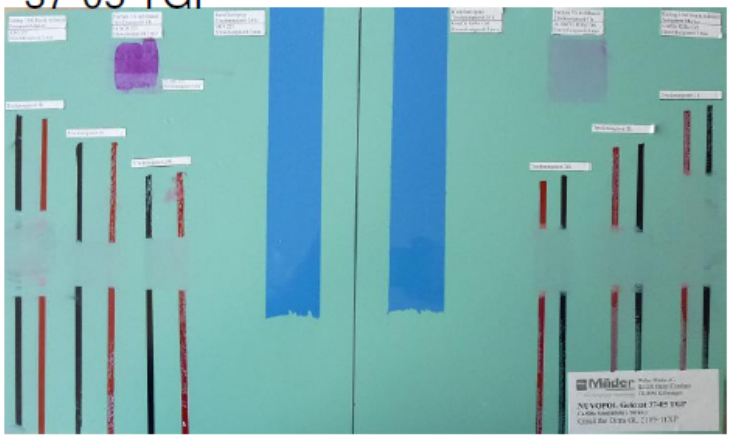
To check / avoid metamerie the samples must be tested min. with 2 wave lenght

Gel Coat Antigraffiti properties

37-03TGP

"HL 3" Gel coat with good antigraffiti properties for colored gel coat inside

37-05 TGP



"HL 3" Gel coat, with low smoke development flexible,(will be coated)

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Future Systems?

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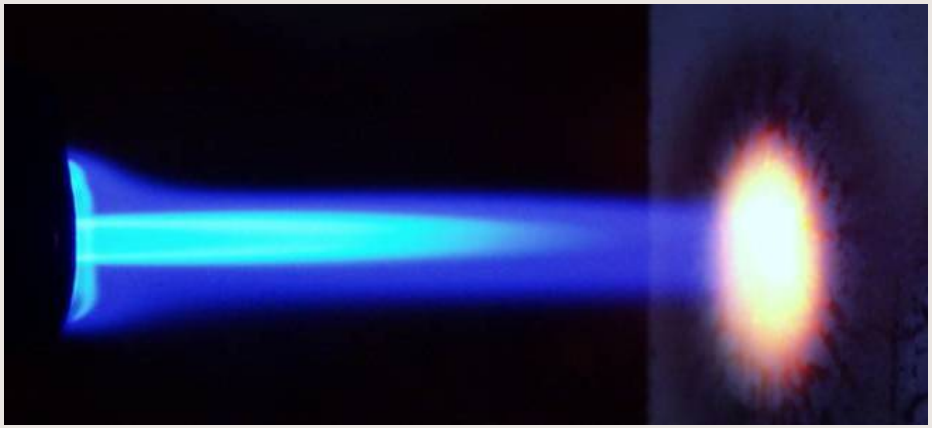
Mineral Composite System

NUVOGARD

Mäder Mineral Composite System

- **no Flame**
- **no Smoke**



Organic Matrix

Inorganic Matrix

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WHAT ADVANTAGES WITH MINERAL COMPOSITES?

- New material which combines the flexibility in design of resins with the properties of a ceramic.
- Ideal matrix for incombustible fibre reinforced composites.

Nuvogard Production process: Hand Lay-up

1

3 4

2

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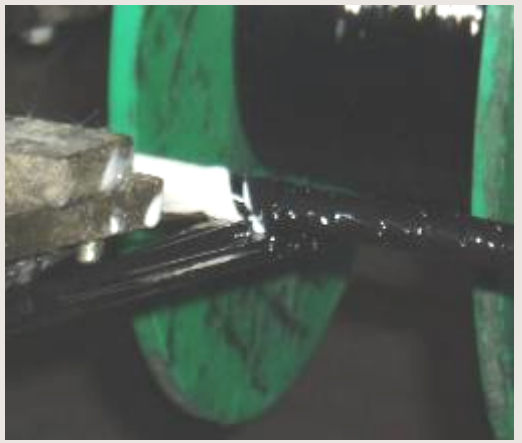
Production process: Pultrusion



MINERAL COMPOSITE - Power Plant Protection

The shield protects the other transformers in case of fire

MINERAL COMPOSITE - Power Plant Protection

Build up of shield panel

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More Informations

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Please come and see us at the Railway Interior stand 9325

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5 good Reasons for Mäder Composites and Coating Solutions:

- **Total Systems from single source: Gelcoats Resins, Coatings**
- **Easy processing Resins due to pat. Technology**
- **Total Solutions, also for new CEN/TS 45545 HL1, HL2, (Coating, Gelcoat, Resins), HL3**
- **State of the Art Coating Systems**
- **Our global network is ready to support you in your projects internationally**

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Thank you