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Ensuring Quality in Coatings for Exterior Architectural Applications

Philipp Mader, Managing Director

GSB International e.V.

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Coating of Aluminium and Steel Parts for Windows and Facades - the Importance of Quality Assurance

Service life	• Expected to perform for decades
Customer expectations	• Coating often serves as defining aesthetic of the building
Consequences of defects	• Substantial costs
Environmental exposure	• Harsh conditions such as UV radiation and corrosive atmospheres


Source: IGP Pulvertechnik AG / Alexander Bernhard Architekturfotografie

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A Quality Assurance System Covering the Entire Coating Process Chain

- The GSB was founded as a Quality Association in 1977.
- Quality assurance system was developed and has been continuously developed since then
- Ultimately, a quality assurance system was developed that covers **the entire coating process chain – from pre-treatment, through the coating materials used, to the coating companies.**
- **GSB certification scope: Powder coating on aluminium, steel and galvanised steel; liquid paint on aluminium (chemically crosslinking paint systems for curing processes)**

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Part 1 of the Coating Process Chain: Surface Pretreatment / Surface Preparation

Aluminium

- Pre-anodising
- GSB-approved chromium-free or chromium VI-free process
- Yellow and green chromating in accordance with EN 12487

Steel

- Iron and zinc phosphating
- GSB-approved chromium-free or chromium(VI)-free process
- Blasting

Galv. Steel

- Zinc phosphating
- GSB-approved chromium-free or chromium(VI)-free process
- Sweeping
- Yellow and green chromating based on EN 12487

Fact check: Most of the GSB coating companies use GSB-certified chromium-free or chromium VI-free processes.

*See GSB QR AL 631 – 5 / GSB QR ST 663 – 6

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Part 1 of the Coating Process Chain: GSB Approved Pre-treatment Chemicals

- Various laboratory tests to check **adhesion and corrosion resistance**
- Tests on **sample sheets** in labs and under real conditions
- **Severe climatic test conditions** for the samples in the Netherlands in Hoek van Holland.
- The tests are carried out **by external accredited independent testing institutes** and **the samples for the final stages of approval are manufactured by a GSB certified coater.**
- **Further annual monitoring tests** in the lab are carried out


Source: fem Forschungsinstitut Edelmetalle + Metallchemie

*See GSB QR AL 631 – 2 / GSB QR ST 663 – 2

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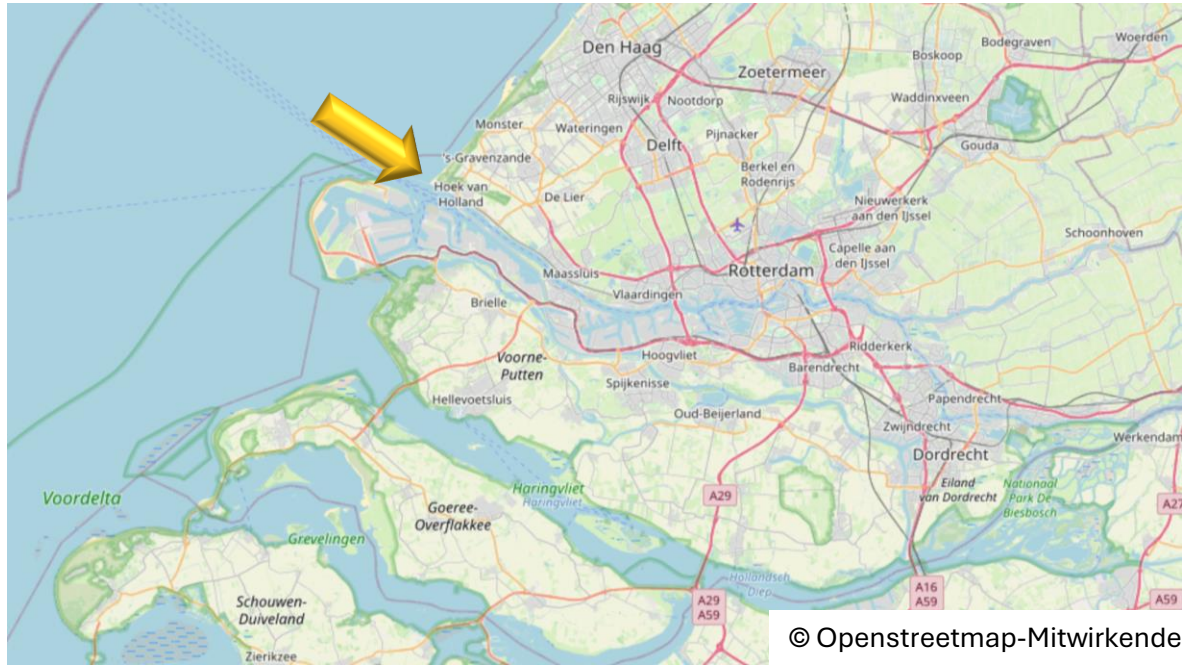

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*See GSB QR AL 631 – 2 / GSB QR ST 663 – 2

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Part 2 of the Coating Process Chain: GSB Approved Coating Materials

- Various laboratory tests to check **UV-resistance, corrosion protection and mechanical performance**
- Tests on sample panels **in labs** and **under real conditions**
- **The test sheets are placed in the sun of Florida, to expose them to the high UV-radiation.**
  - High and constant solar radiation by >300 sun days/year
  - Radiation direction almost vertical during equal length of day
  - Actual test duration depends on measured radiation
- The test plates are placed there for up to 10 years.
- The tests are carried out **by external accredited testing institutes** and **the samples are taken from GSB Coaters whenever possible.**
- Further, annual monitoring tests are carried out.

Source: Q-Lab Corporation
Q-Lab.com

*See GSB QR AL 631 – 4 / GSB QR ST 663 – 4

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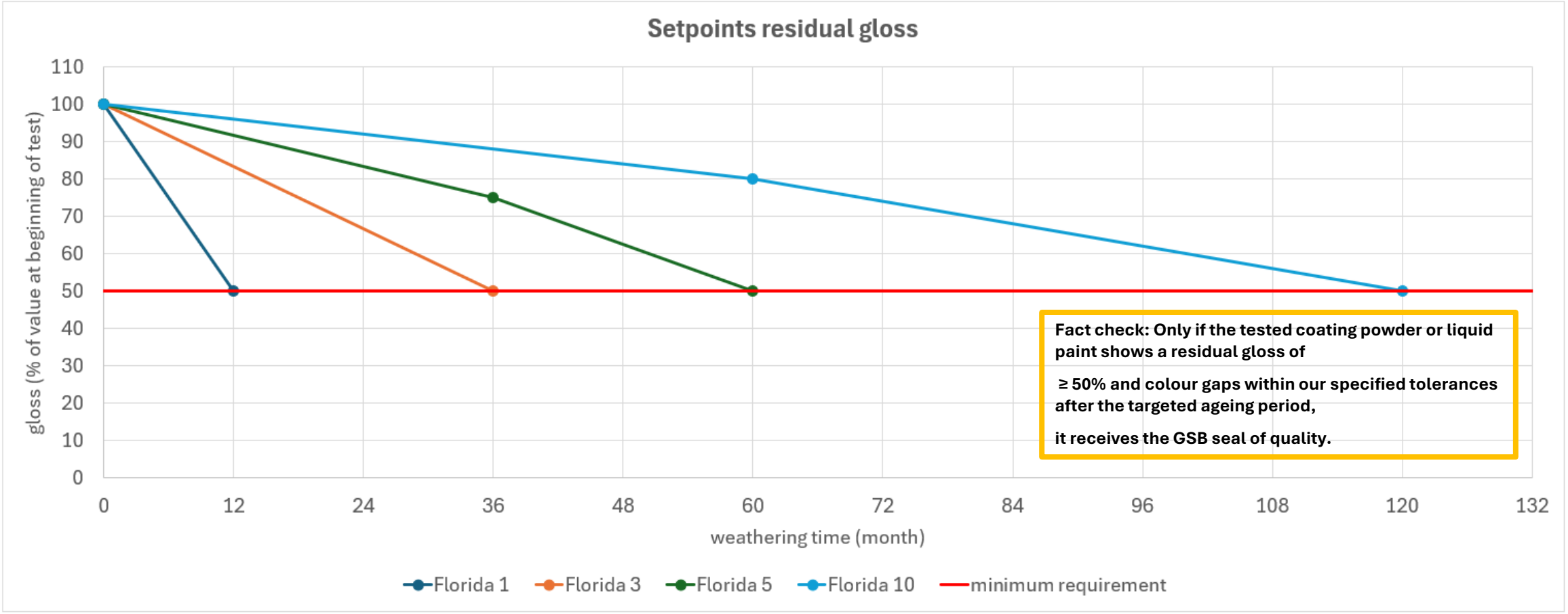
Part 2 of the Coating Process Chain: GSB Approved Coating Materials



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Part 2 of the Coating Process Chain: GSB Approved Coating Materials

RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab
1000	± 1	± 2	3003	± 2	± 6	5013	± 6	± 1	6034	± 2	± 2	1028	± 2	± 8	4003	± 2	± 7	6008	± 4	± 4	7024	± 3	± 3
1001	± 1	± 2	3004	± 4	± 4	5014	± 3	± 3	6035*	± 3	± 5	1032	± 2	± 5	4004	± 4	± 4	6009	± 4	± 4	7026	± 3	± 3
1002	± 1	± 2	3005	± 4	± 4	5015	± 3	± 3	6036*	± 3	± 5	1033	± 2	± 7	4005	± 3	± 5	6010	± 3	± 6	7030	± 1	± 1
1003	± 2	± 3	3007	± 4	± 4	5017	± 3	± 3				1034	± 2	± 7	4006	± 3	± 5	6011	± 2	± 3	7031	± 2	± 1
1004	± 2	± 5	3009	± 4	± 4	5018	± 3	± 5	7000	± 2	± 1	1035*	± 2	± 2	4007	± 4	± 5	6012	± 4	± 4	7032	± 1	± 1
1005	± 2	± 5	3011	± 2	± 6	5019	± 3	± 3	7001	± 2	± 1	1036*	± 2	± 4	4008	± 3	± 5	6013	± 2	± 3	7033	± 2	± 1
1006	± 2	± 7	3012	± 2	± 7	5020	± 3	± 5	7002	± 2	± 1	1037	± 2	± 7	4009	± 3	± 5	6014	± 4	± 4	7034	± 2	± 1
1007	± 2	± 7	3013	± 2	± 6	5021	± 3	± 3	7003	± 2	± 1				4010	± 3	± 5	6015	± 4	± 4	7035	± 1	± 1
1011	± 1	± 3	3014	± 3	± 5	5022	± 4	± 5	7004	± 2	± 1	2000	± 2	± 6	4011*	± 2	± 7	6016	± 3	± 5	7036	± 2	± 1
1012	± 1	± 3	3015	± 3	± 7	5023	± 3	± 3	7005	± 2	± 1	2001	± 2	± 6	4012*	± 2	± 6	6017	± 3	± 5	7037	± 2	± 1
1013	± 1	± 1	3016	± 2	± 6	5024	± 3	± 3	7006	± 2	± 1	2002	± 2	± 7				6018	± 2	± 3	7038	± 1	± 1
1014	± 1	± 2	3017	± 2	± 8	5025*	± 2	± 6	7008	± 3	± 3	2003	± 2	± 6	5000	± 3	± 3	6019	± 2	± 2	7039	± 2	± 1
1015	± 1	± 1	3018	± 2	± 8	5026*	± 2	± 6	7009	± 2	± 2	2004	± 2	± 6	5001	± 3	± 3	6020	± 3	± 4	7040	± 1	± 1
1016	± 2	± 7	3020	± 2	± 7				7010	± 2	± 2	2008	± 2	± 7	5002	± 3	± 4	6021	± 2	± 3	7042	± 1	± 1
1017	± 1	± 3	3022	± 2	± 7	6000	± 3	± 4	7011	± 2	± 1	2009	± 2	± 7	5003	± 3	± 3	6022	± 4	± 4	7043	± 3	± 3
1018	± 2	± 7	3027	± 2	± 7	6001	± 3	± 4	7012	± 2	± 1	2010	± 2	± 6	5004	± 6	± 1	6024	± 3	± 5	7044	± 1	± 1
1019	± 1	± 2	3031	± 2	± 7	6002	± 3	± 4	7013	± 2	± 1	2011	± 2	± 7	5005	± 3	± 3	6025	± 3	± 4	7045	± 1	± 1
1020	± 1	± 2	3032*	± 2	± 6	6003	± 3	± 4	7015	± 2	± 1	2012	± 2	± 6	5007	± 3	± 3	6026	± 3	± 4	7046	± 1	± 1
1021	± 2	± 7	3033*	± 2	± 6	6004	± 4	± 4	7016	± 3	± 3	2013*	± 2	± 4	5008	± 3	± 2	6027	± 2	± 2	7047	± 1	± 1
1023	± 2	± 7				6005	± 4	± 4	7021	± 5	± 3				5009	± 3	± 3	6028	± 4	± 4	7048*	± 3	± 1
1024	± 1	± 2	4001	± 3	± 5	6006	± 4	± 4	7022	± 3	± 2	3000	± 2	± 6	5010	± 4	± 5	6029	± 3	± 5			
1027	± 1	± 3	4002	± 3	± 5	6007	± 4	± 4	7023	± 2	± 1	3001	± 2	± 6	5011	± 6	± 1	6032	± 3	± 5	8000	± 2	± 2

RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab	RAL	ΔL*	ΔC* ab
3002	± 2	± 6	5012	± 3	± 3	6033	± 2	± 2
8002	± 3	± 3	8019	± 3	± 4	9004	± 4	± 1
8003	± 3	± 3	8022	± 4	± 4	9005	± 4	± 1
8004	± 3	± 3	8023	± 2	± 2	9006*	± 1	± 1
8007	± 3	± 4	8024	± 2	± 2	9007*	± 2	± 1
8008	± 3	± 4	8025	± 2	± 2	9010	± 1	± 1
8011	± 3	± 4	8028	± 4	± 4	9011	± 4	± 1
8012	± 3	± 4	8029*	± 2	± 4	9016	± 1	± 1
8014	± 3	± 4				9017	± 4	± 1
8015	± 3	± 4	9001	± 1	± 1	9018	± 1	± 1
8016	± 3	± 4	9002	± 1	± 1	9022*	± 1	± 1
8017	± 3	± 4	9003	± 1	± 1	9023*	± 2	± 1

Colour differences ΔL*, ΔC* after weathering

Colour is measured in accordance with ISO 11664-4, illuminant: D65/10° standard observer; measurement geometry 45/0. The colour differences table applies to the Florida 1, 3 and 5 coating classes. Florida 10 is in preparation.

Note: Colours marked with * are not part of the RAL 841 GL register. Colour charts for these colours are contained in the main RAL register RAL 840 HR. However, these should not be used as a model for decorative coatings

*See GSB QR AL 631 – 4 / GSB QR ST 663 – 4

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Excursus: Influences Sensory Impression “Colour” … Just some examples

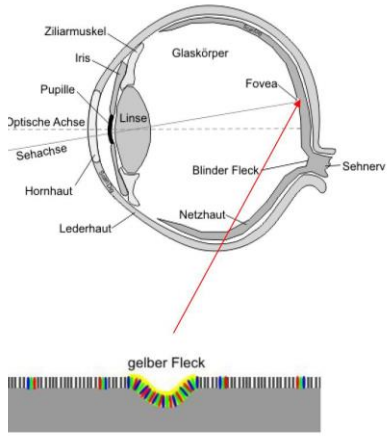
Physics

- **Absorption**
- **Reflection**
- **Scattering**
- **Surface finish**

Chemistry

- **The chemical formula of the colourants determines which wavelengths are scattered/absorbed.**
- **Physical parameters also influence colour (fine tuning): particle size and particle size distribution, surface, particle shape**

Physiology



Psychology

- **What does a person associate with a colour?**
- **Colours influence the person whoperceives them**
- **Sensations are influenced by colours**
- **Conversely, sensationsinfluence the perception of colours**

Source: IGP Pulvertechnik AG

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Part 3 of the Coating Process Chain: Coating Companies

- **Unannounced** audits **twice a year** by independent accredited testing institutes
- Our different seals of quality depend on: **quality level of the pre-treatment; laboratory equipment; Factory Production Control (FPC)**
- During testing, sample sheets are taken for corrosion testing.

Source: GSB International e.V.; ENVIRAL Oberflächenveredelung GmbH; ILF Magdeburg GmbH

*See GSB QR AL 631 – 5 / GSB QR ST 663 – 6

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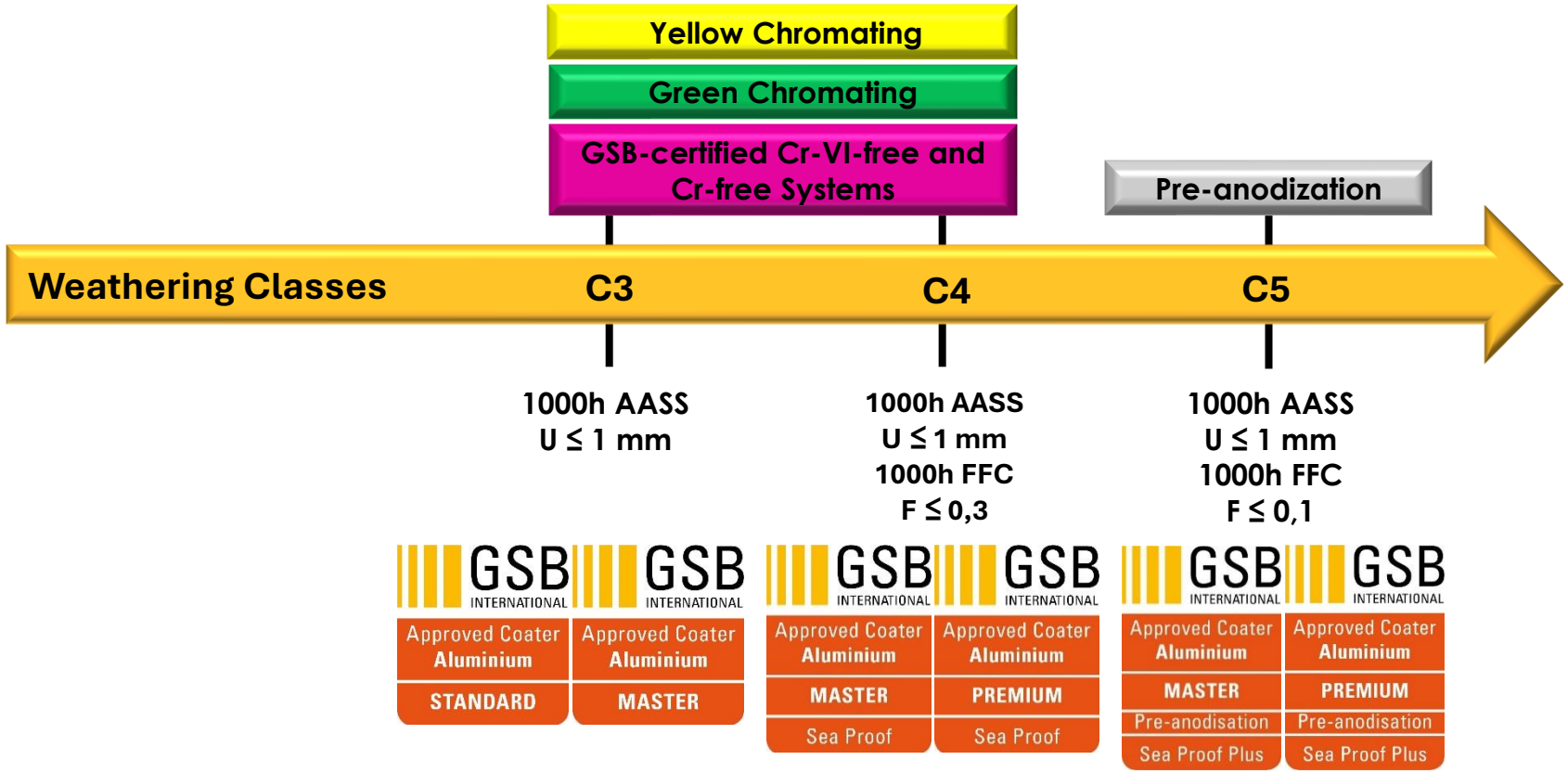
Part 3 of the Coating Process Chain: Coating Companies (Aluminium)



*Attribution based on DIN EN ISO 9223; see EN 1999-1-1 and EN 1090-3 for corrosion behavior and corrosion protection for aluminium in construction.U = dmax

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Part 3 of the Coating Process Chain: Coating Companies (Aluminium)

Quality seal	AASS (1000h)	FFK* (1000h)	Corr.cat. (ISO 9223)	Pre treatment	laboratory equipment imposement
Standard	$d_{max} \leq 1$ mm	---	C3	conventional	Contact marks ≥ 2 mm permitted
Master	$d_{max} \leq 1$ mm	---	C3	conventional	
Master Sea Proof	$d_{max} \leq 1$ mm	$l_{max} \leq 2$ mm $F = H*l \leq 0,3$	C4	conventional	
Master Sea Proof Plus	$d_{max} \leq 1$ mm	$l_{max} \leq 2$ mm $F = H*l \leq 0,1$	C5	pre anodisation	
Premium Sea Proof	$d_{max} \leq 1$ mm	$l_{max} \leq 2$ mm $F = H*l \leq 0,3$	C4	conventional	Colour measuring Production journal
Premium Sea Proof Plus	$d_{max} \leq 1$ mm	$l_{max} \leq 2$ mm $F = H*l \leq 0,1$	C5	pre anodisation	Colour measuring Production journal

*No extensive release from adhesion permitted

*GSB QR AL 631 – 5

Source: GSB International e.V.
ENVIRAL Oberflächenveredelung GmbH
ILF Magdeburg GmbH

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Part 3 of the Coating Process Chain: Coating Companies (Steel/galv.Steel)

Seal	Substrate	Layer structure	NSS	Delamination at the T-cut	Degree of blistering
Standard	Steel	Single Layer	480 h	dmax ≤ 3 mm	0 S(0)
Standard	Steel	Double Layer	480 h	dmax ≤ 1mm	0 S(0)
Standard	Galv. Steel	Single Layer	480 h	dmax ≤ 8 mm	0 S(0)
Standard	Galv. Steel	Double Layer	480 h	dmax ≤ 8 mm	0 S(0)
Master	Steel	Single Layer	480 h	dmax ≤ 3 mm	0 S(0)
Master	Steel	Double Layer	720 h	dmax ≤ 1mm	0 S(0)
Master	Galv. Steel	Single Layer	480 h	dmax ≤ 5 mm	0 S(0)
Master	Galv. Steel	Double Layer	720 h	dmax ≤ 8 mm	0 S(0)
Premium	Steel	Single Layer	480 h	dmax ≤ 1mm	0 S(0)
Premium	Steel	Double Layer	1440 h	dmax ≤ 3 mm	0 S(0)
Premium	Galv. Steel	Single Layer	480 h	dmax ≤ 3 mm	0 S(0)
Premium	Galv. Steel	Double Layer	1440 h	dmax ≤ 8 mm	0 S(0)

*GSB QR ST 663 – 6

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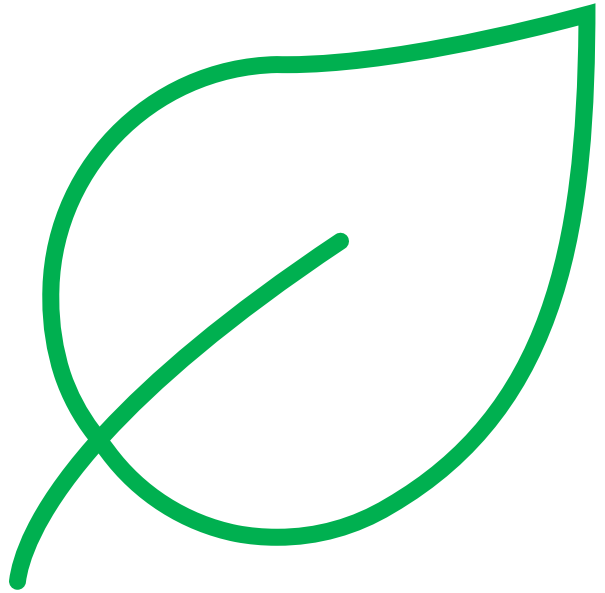
Sustainability Benefits

- Peace of mind for everyone involved
- Resources can be saved instead of having to be used for repairing quality deficiencies or premature failures
- Environmentally friendly pre-treatment processes
- Coating powders do not contain VOC
- Special working groups



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Thank you very much for your attention.

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