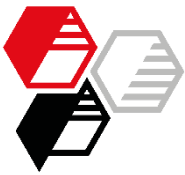




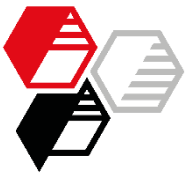
Powder coating:

Polyester / primid for outdoor coatings (RAL 7016)



Contents

- Introduction
- Experimental
- Results
 - Color / gloss / haze / surface texture
 - Mandrel bending / cross cut test / cupping test / impact test
 - Sodium hydroxide test / water spot resistance
 - Humidity test / acetic salt spray test
 - Artificial weathering UV-B / outdoor exposure Florida
- Summary
- Appendix
 - Preparation and additional information about testings



Status Quo

INTRODUCTION

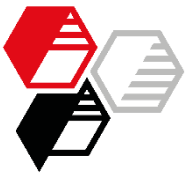
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- Earlier studies exhibit **Neuburg Siliceous Earth** as suitable filler with positive effects in powder coatings (epoxy and hybrid based). The optical and mechanical properties were maintained or even improved.
- A variety of application specific trials as well as a special series of tests in the powder coating domain (polyester/TGIC) prove the excellent corrosion protection by using **Neuburg Siliceous Earth** due to its unique structure.



Objective

INTRODUCTION

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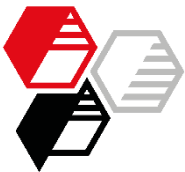
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Thus the question comes up if **Neuburg Siliceous Earth** is capable of substituting the common used fillers in the field of powder coatings in the areas of facades. The optical and mechanical properties, especially the demanded resistances of the international quality regulations (GSB) need to be attained or even improved furthermore.

- This is investigated in an anthracite gray standard polyester/hydroxyalkylamide (Primid) formulation



Base Formulation

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INTRODUCTION

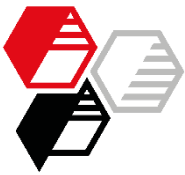
EXPERIMENTAL

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	Description	[%]
Crylcoat 2618-3	Polyester resin	75.0
Primid XL 552	Hydroxyalkylamide, crosslinker	3.6
Ceraflour 991	Polyethylene wax, micronized	0.3
Pigments for RAL 7016	Titanium dioxide, pigments red, blue, yellow, black	6.94
BYK 3900P	Anti-crater and leveling additive	1.0
Benzoin	Leveling agent	0.4
Filler		12.76
Total		100



Formulation Variations

HOFFMANN
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Filler

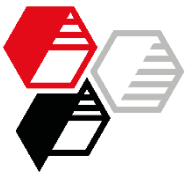
12.76

High Gloss (60°: ~ 90 GU):

- Blanc fixe (Reference)
- **Aktifit PF 115** (for high gloss)
- **Silfit Z 91** (calcined product with outstanding mechanical properties)

Medium gloss / standard in facade sector (60°: ~ 75 GU):

- Aluminum hydroxide (Reference)
- **Sillitin V 88** (standard product for light matting)



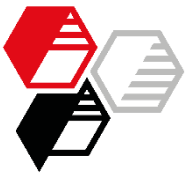
Filler Characteristics

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MINERAL®

Filler	Description	Surface Treatment	Color L*	Color b*
--------	-------------	-------------------	----------	----------

Blanc fixe	Barium Sulfate precipitated	none	96.5	0.3
Aktifit PF 115	Calcined Neuburg Siliceous Earth	special amino silane	94.5	0.5
Silfit Z 91	Calcined Neuburg Siliceous Earth	none	95.8	0.6

ATH	Synthetic Aluminum hydroxide	none	95.0	2.2
Sillitin V 88	Neuburg Siliceous Earth	none	93.7	3.0



Filler Characteristics

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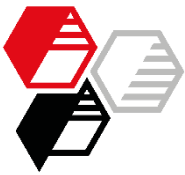
RESULTS

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Filler	Density [g/cm ³]	Oil absorption [g/100g]	BET [m ² /g]	d ₅₀	d ₉₇
Blanc fixe	4.4	37	4.0	1.1	4.3
Aktifit PF 115	2.6	~ 55	8.0	2.0	9.3
Silfit Z 91	2.6	55	8.0	2.0	9.0

ATH	2.4	26	2.5	12.7	37
Sillitin V 88	2.6	45	8.3	4.7	16



Curing Conditions

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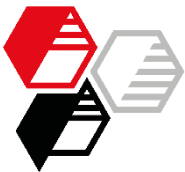
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10 min PMT 180°C for all formulations!

The polyester resin requires a curing time of 10 minutes at a peak metal temperature of 180 °C.

Despite the filler addition, neither the curing time nor the curing temperature had to be increased.



Color L*

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CIE, Aluminum chromated, DFT 70-80 µm

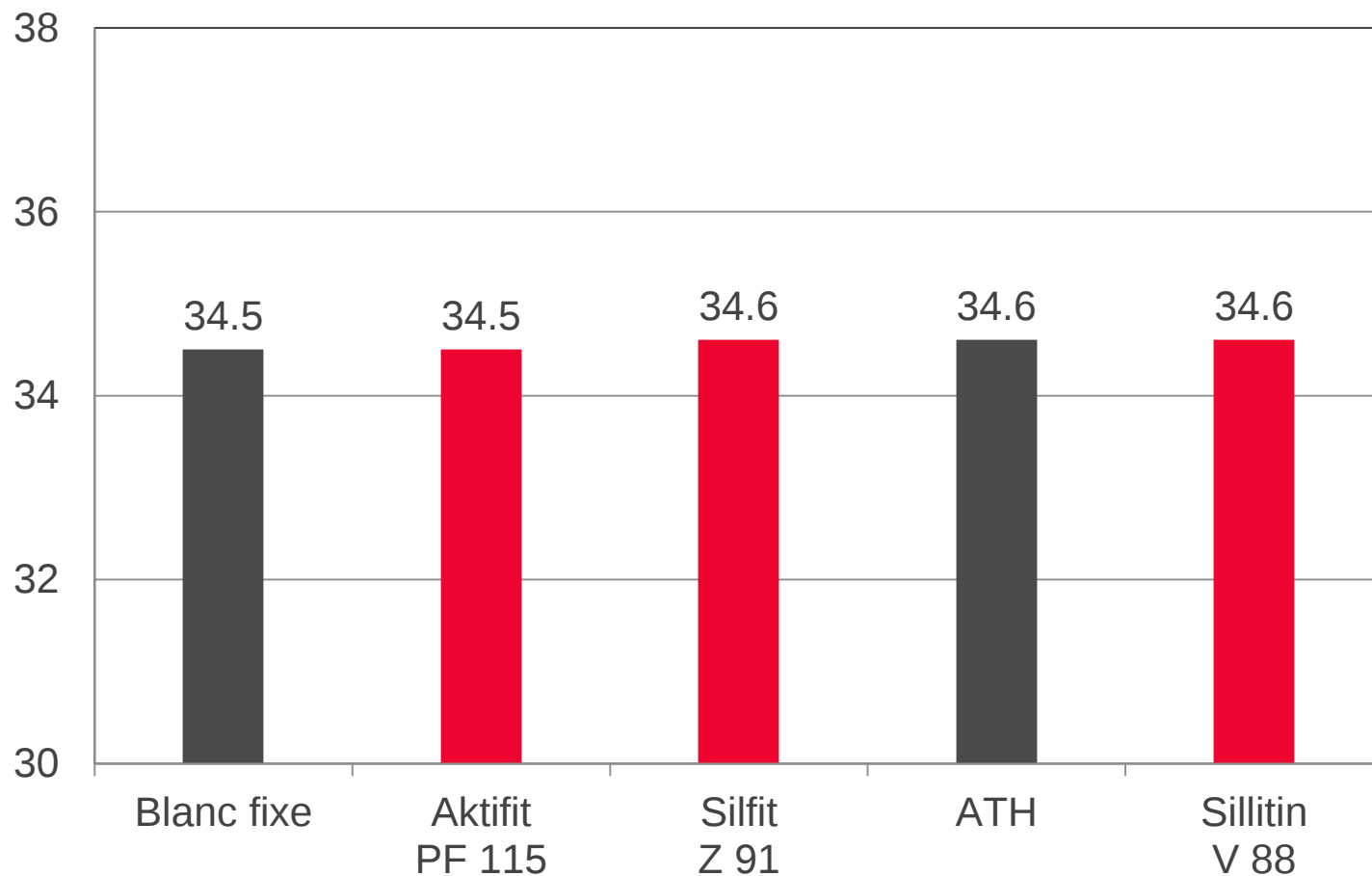
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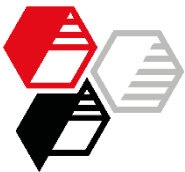
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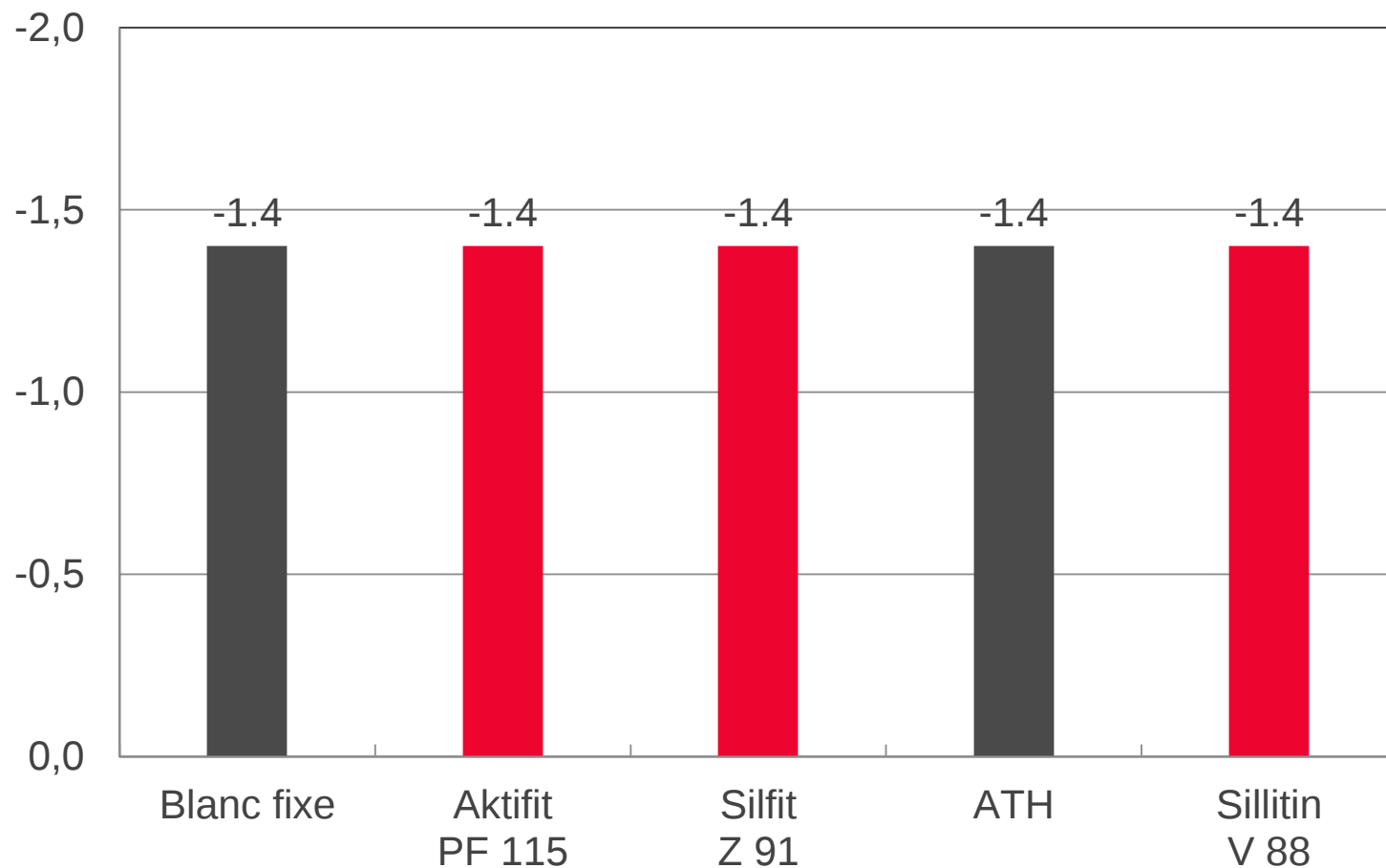
APPENDIX

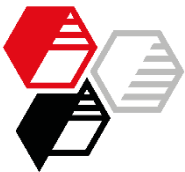




Color a*

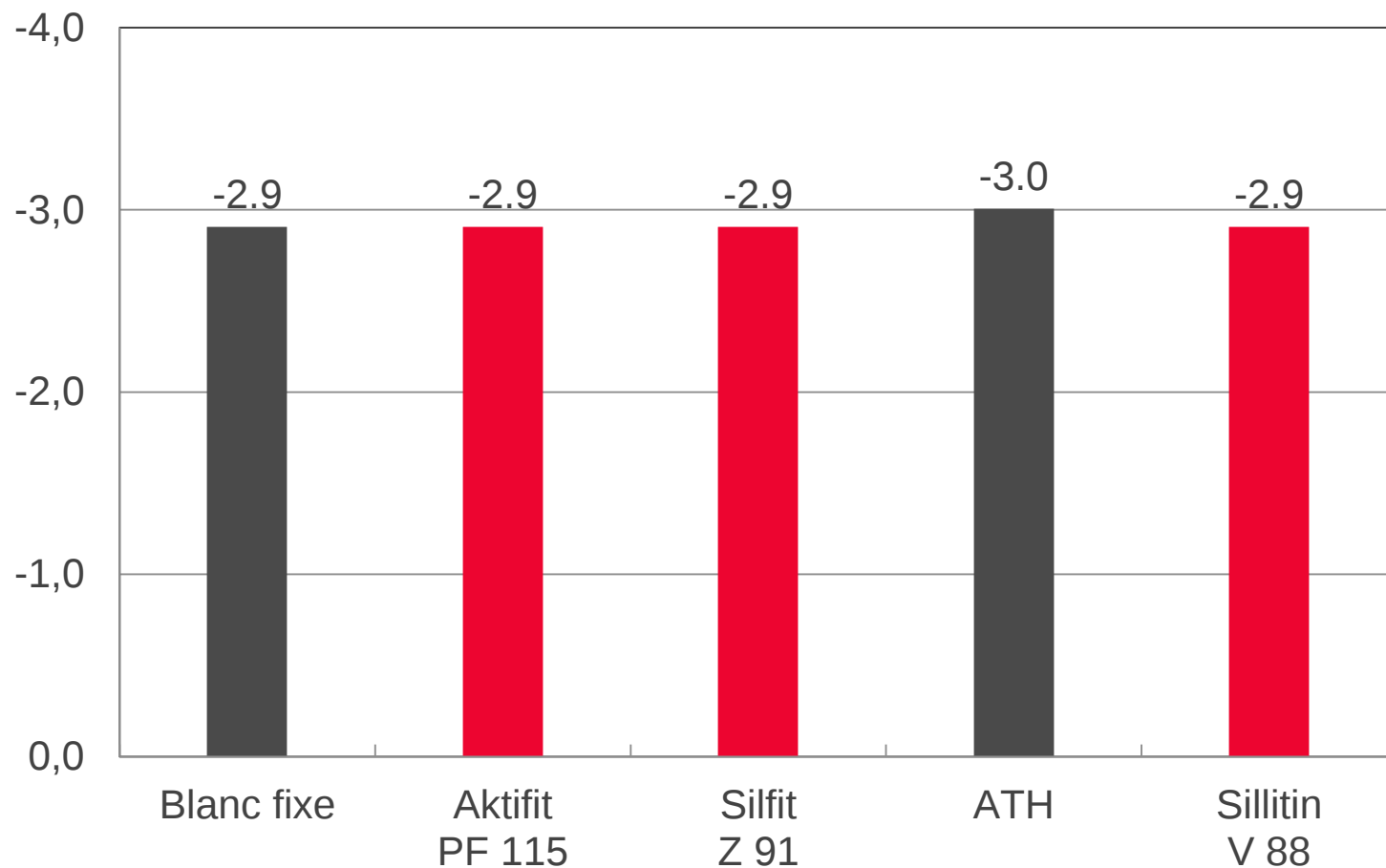
CIE, Aluminum chromated, DFT 70-80 µm

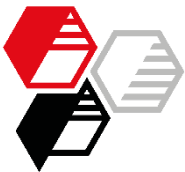




Color b*

CIE, Aluminum chromated, DFT 70-80 µm





Gloss 60°

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Aluminum chromated, DFT 70-80 µm

GU

100

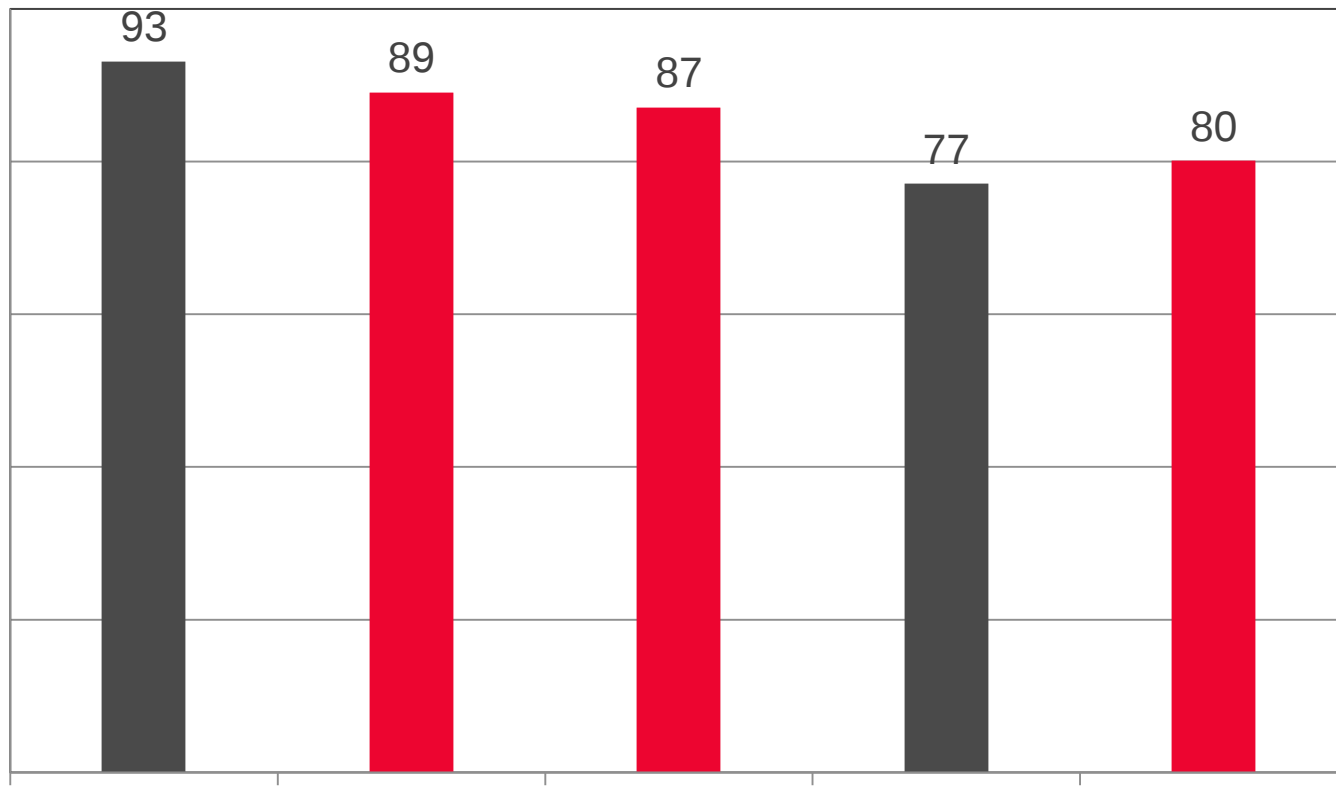
80

60

40

20

0



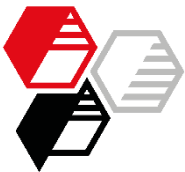
Blanc fixe

Aktifit
PF 115

Silfit
Z 91

ATH

Sillitin
V 88



Gloss 20°

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Aluminum chromated, DFT 70-80 µm

GU

100

80
77

65

53

40

41

40
20
0

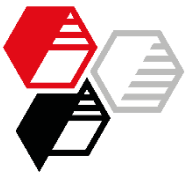
Blanc fixe

Aktifit
PF 115

Silfit
Z 91

ATH

Sillitin
V 88



Haze

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Aluminum chromated, DFT 70-80 μm

HU

500

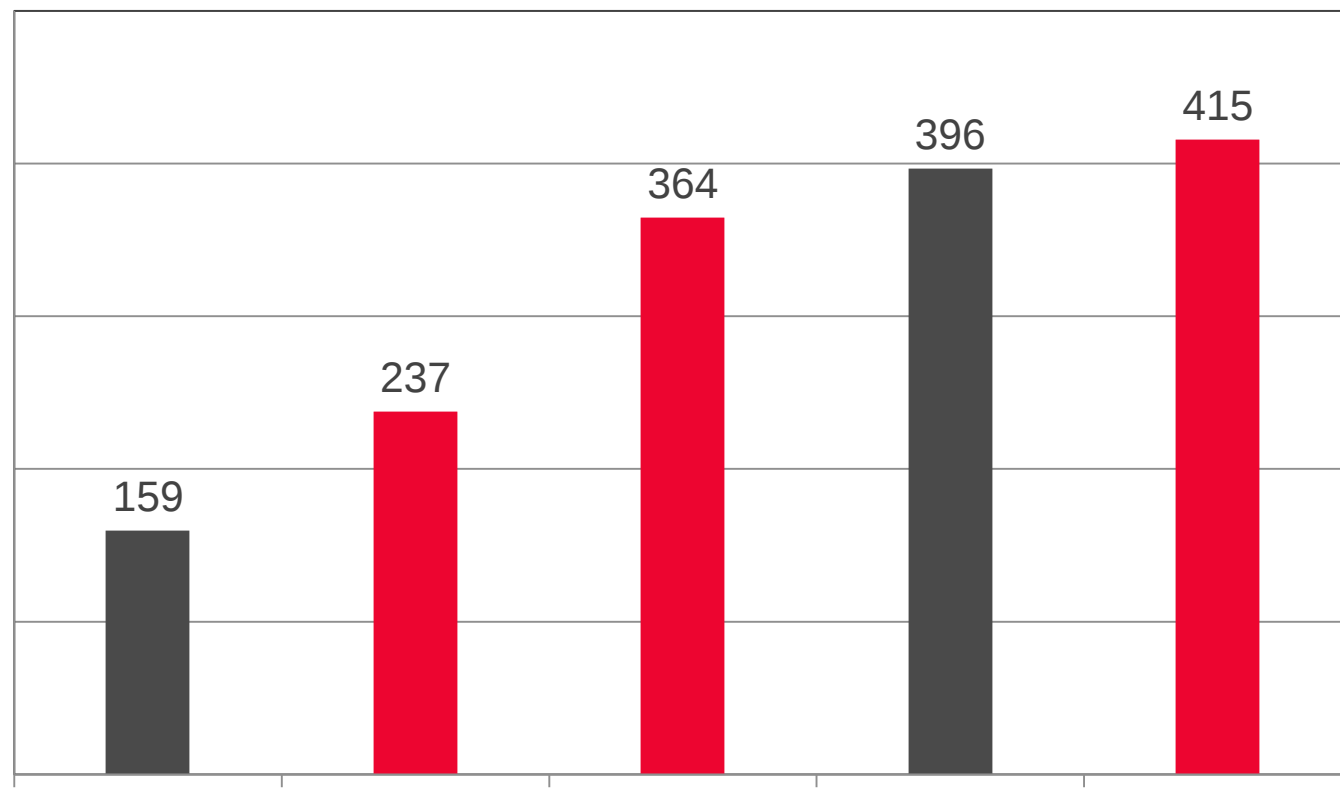
400

300

200

100

0



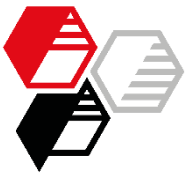
Blanc fixe

Aktifit
PF 115

Silfit
Z 91

ATH

Sillitin
V 88



Surface Appearance / Texture

Evaluation by Microscope

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Aluminum chromated, DFT 70-80 μm

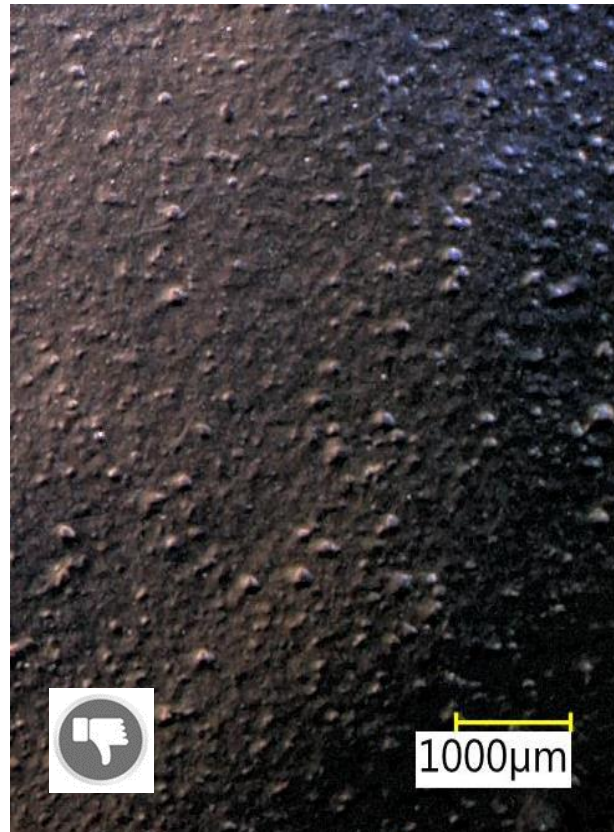
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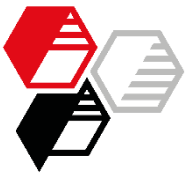
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Blanc fixe



Aktifit PF 115

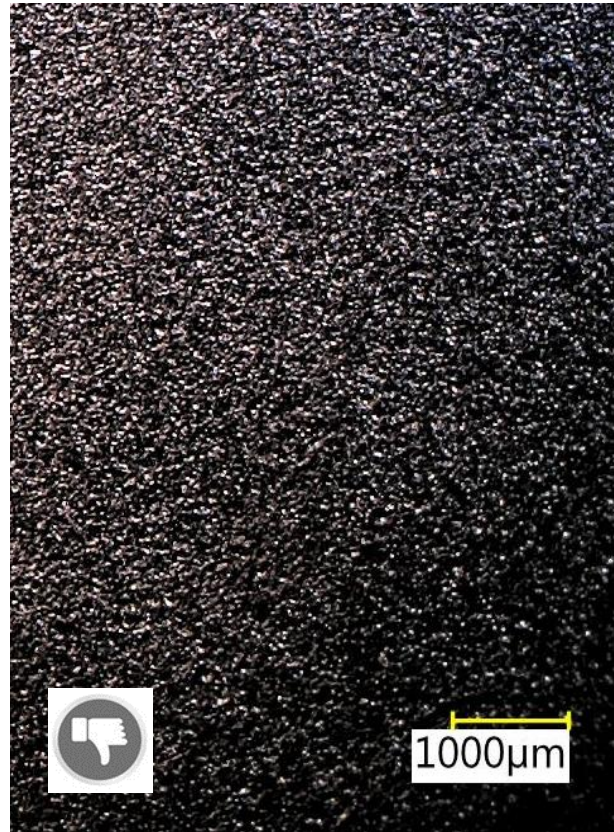


Surface Appearance / Texture

Evaluation by Microscope

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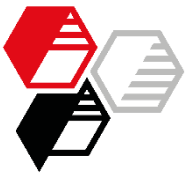
Aluminum chromated, DFT 70-80 μm



ATH



Sillitin V 88



Mechanical Properties

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Steel (Q-Panel R 48), DFT 70-80 µm

	Mandrel Bending Test	Cross Cut Test (2 mm)	Cupping Test
Blanc fixe	all 0 mm	all GT 0	all > 10 mm
Aktifit PF 115			
Silfit Z 91			
ATH			
Sillitin V 88			

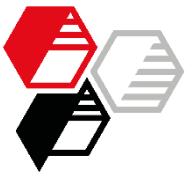
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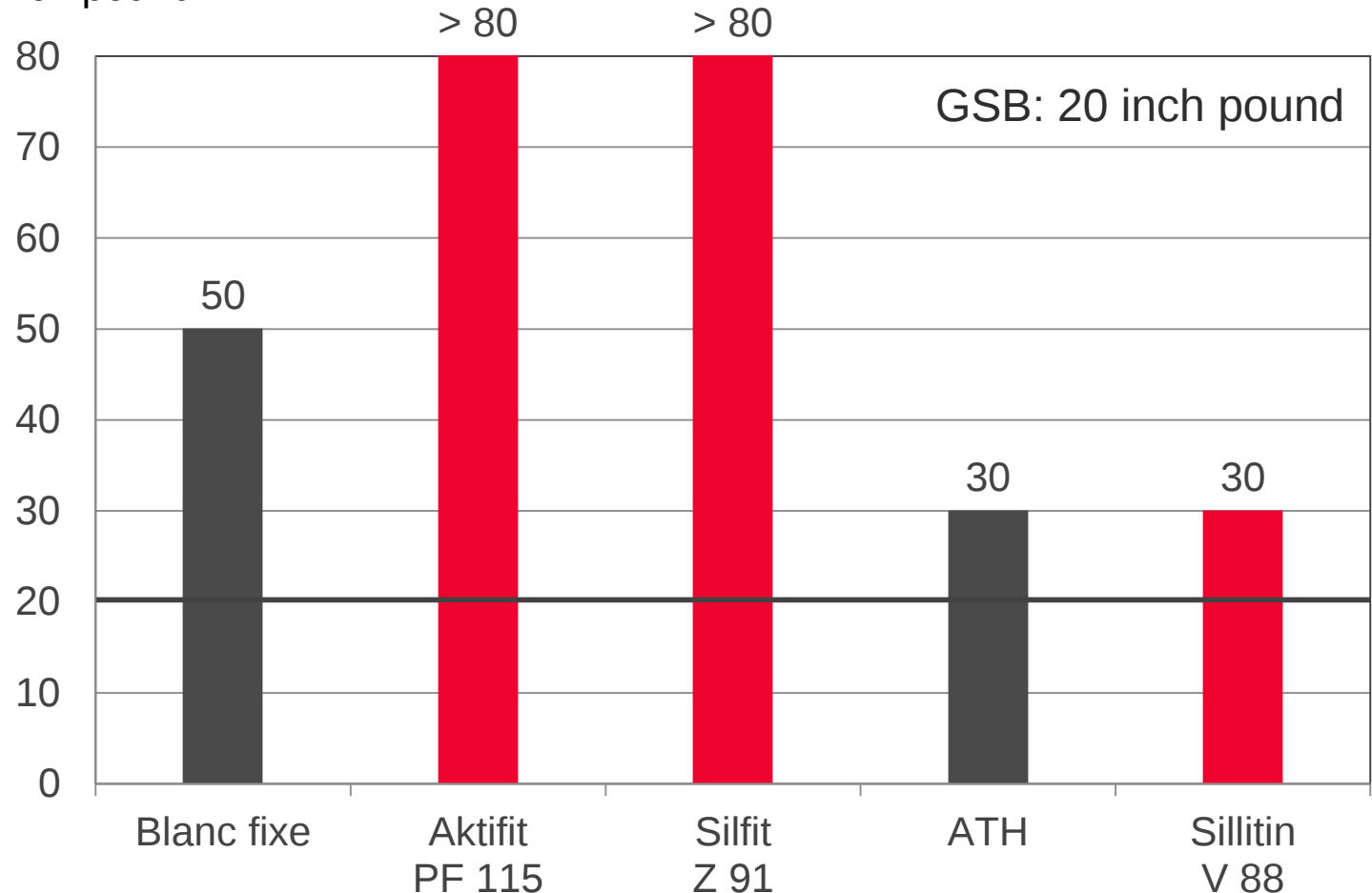
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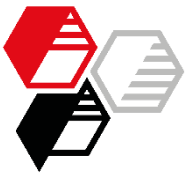


Reverse Impact Test

Steel, 1 h after baking, impact: 2 lbs, Ø 15.9 mm

inch pound



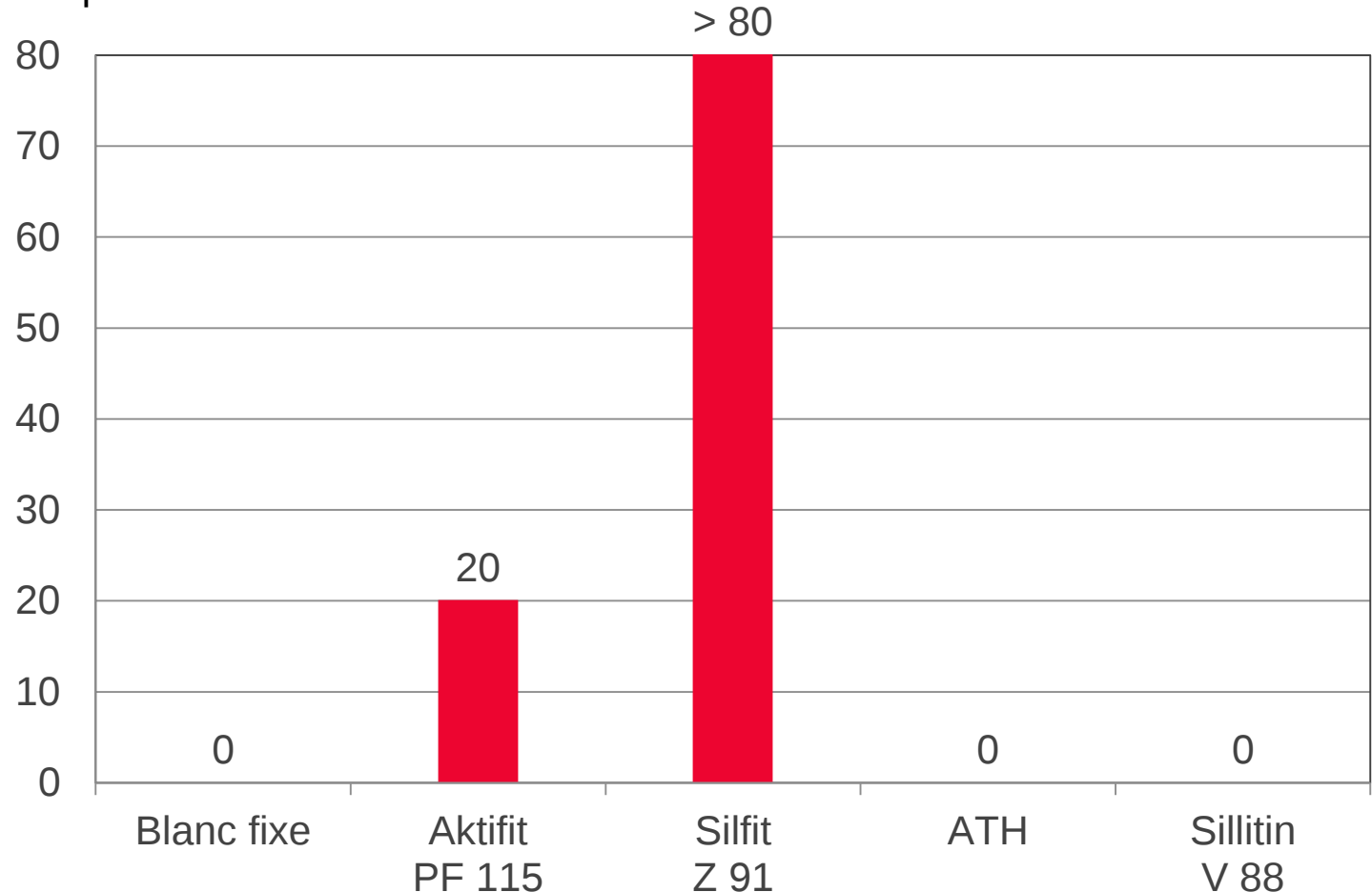


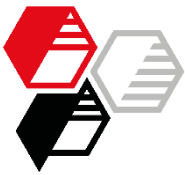
Reverse Impact Test

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Steel, 3 d after baking, impact: 2 lbs, Ø 12.7 mm

inch pound





Direct Impact Test

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Steel, 1 h after baking, with 80 inch lbs, Ø 15.9 mm (cracks: yes/no?)

INTRODUCTION

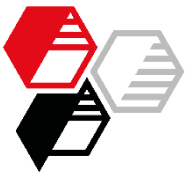
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Direct Impact Test

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Steel, 3 d after baking, with 80 inch lbs, Ø 12.7 mm (cracks: yes/no?)

INTRODUCTION

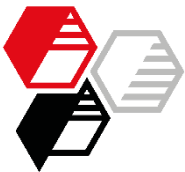
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Sodium Hydroxide Test (2N)

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GSB: no visible color change after 60 minutes

ΔE

0,5

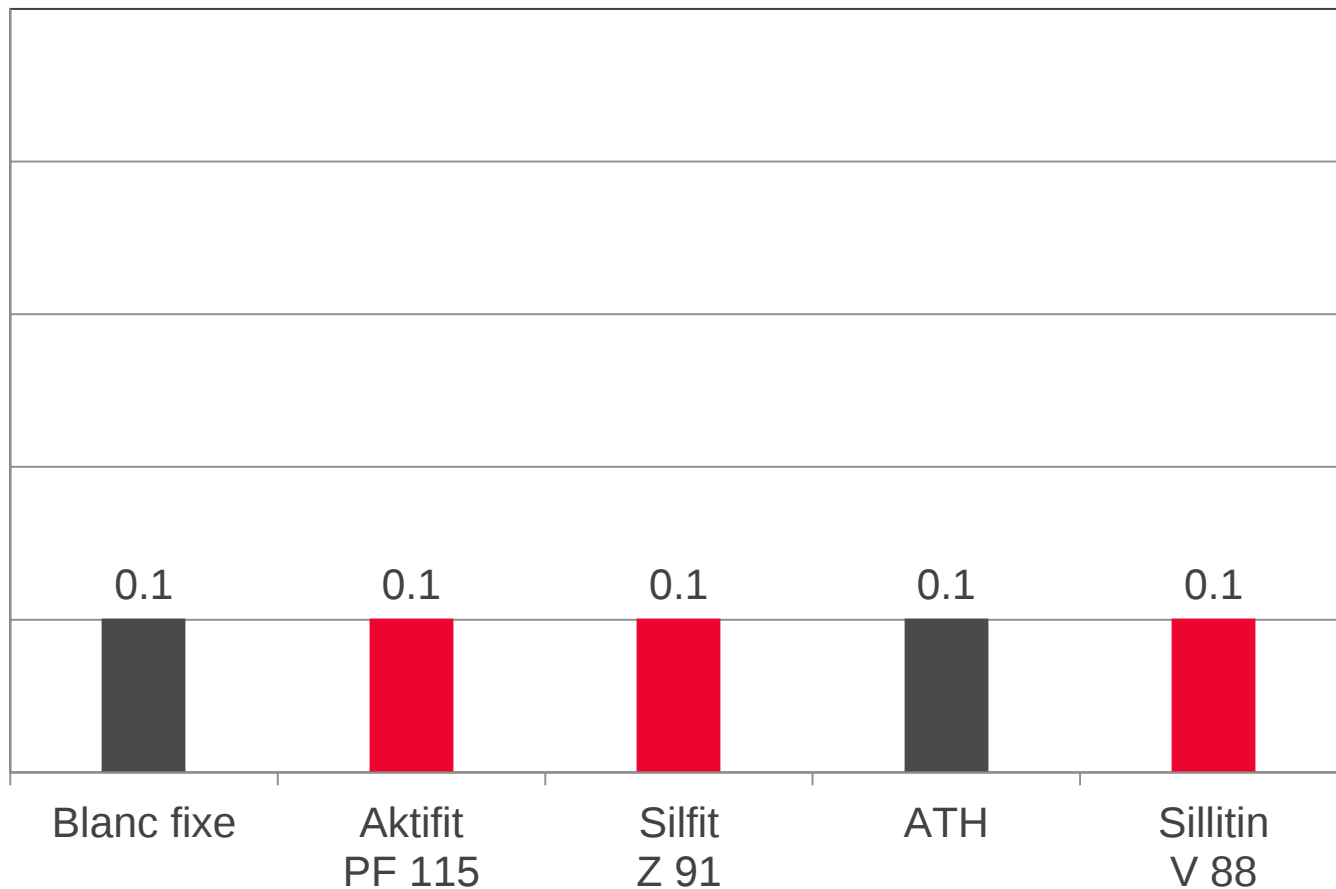
0,4

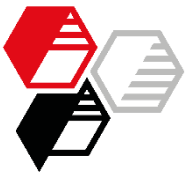
0,3

0,2

0,1

0,0



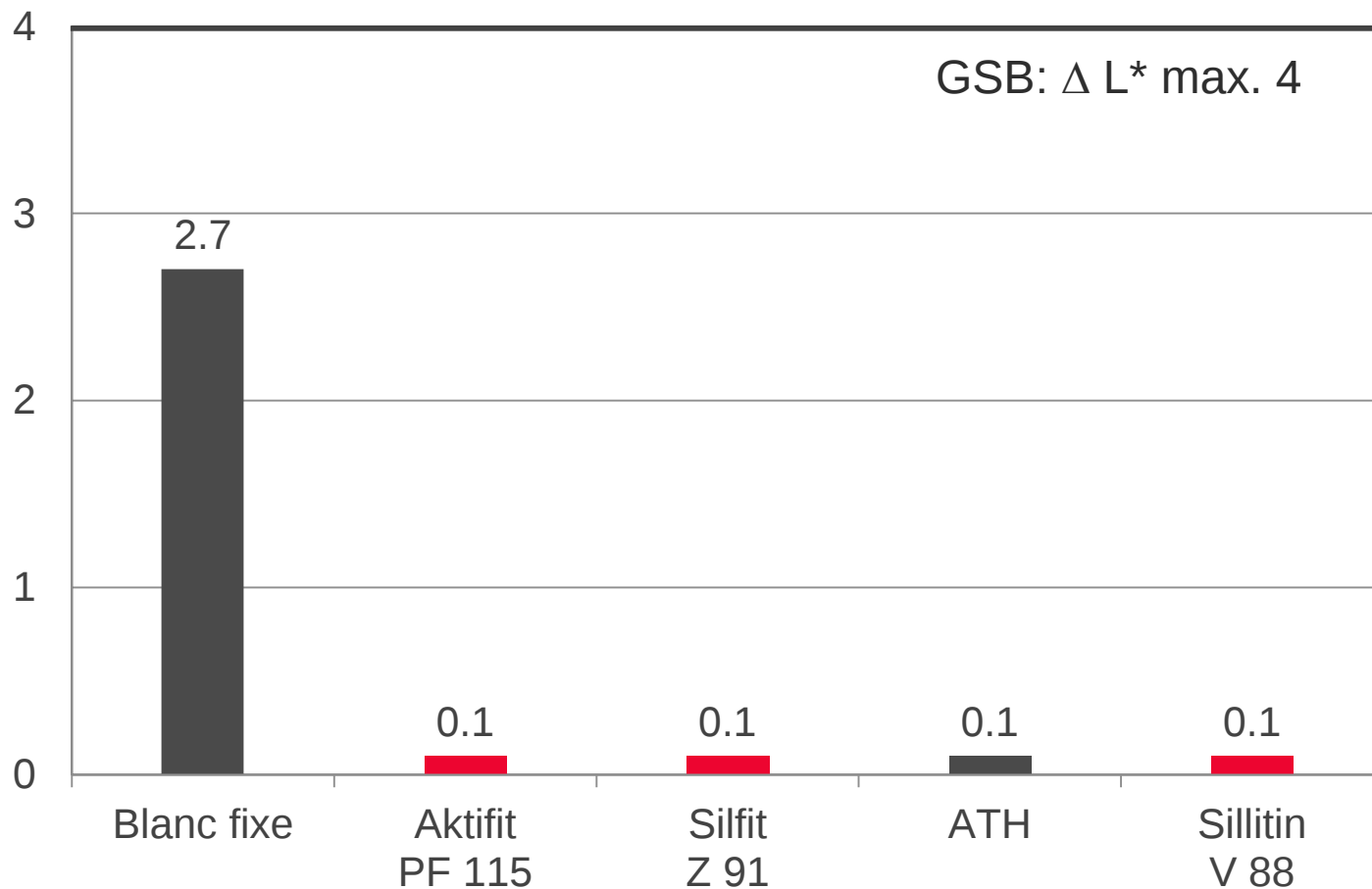


Water Spot Resistance

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Deionized H₂O + 4 h at 58°C

ΔL^*



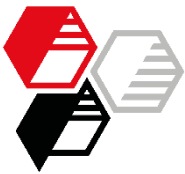
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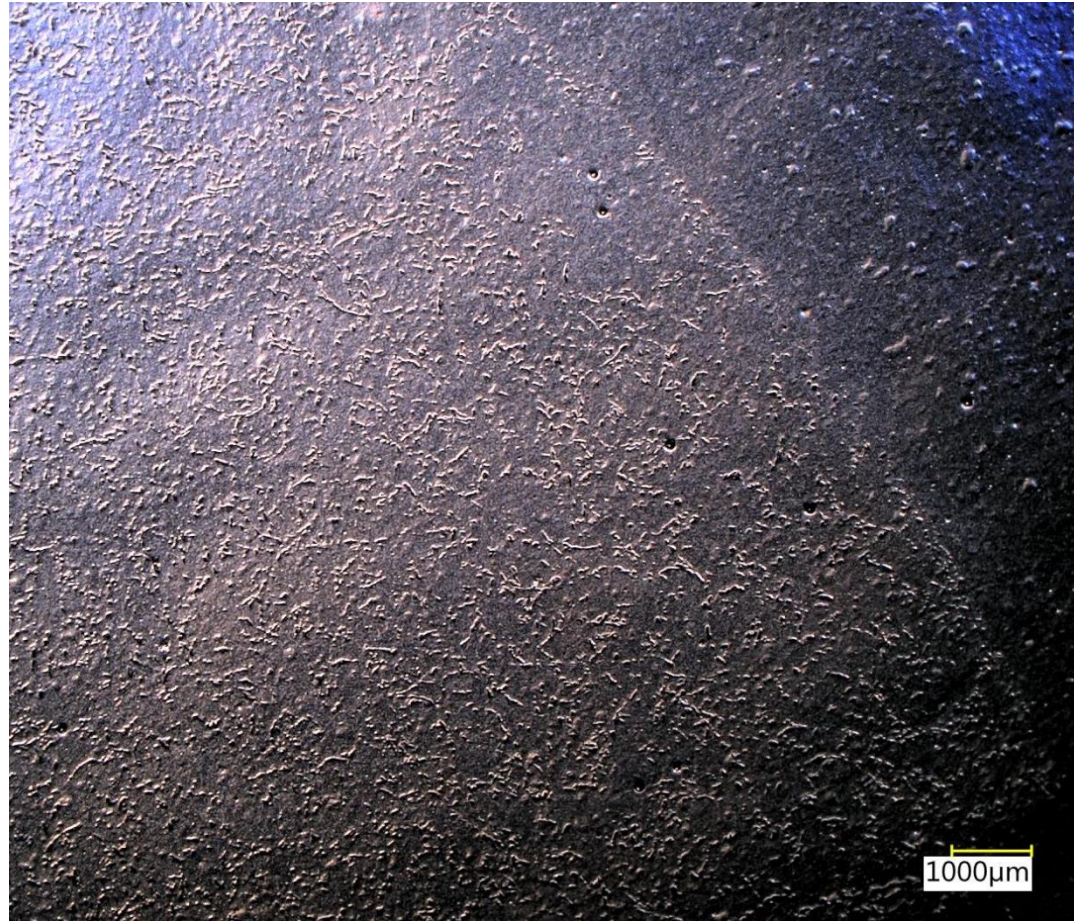
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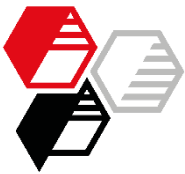
Water Spot Resistance

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Color change (eyeing with the microscope)



Blanc fixe



Humidity Test 1000 hours

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GSB: no visible color change

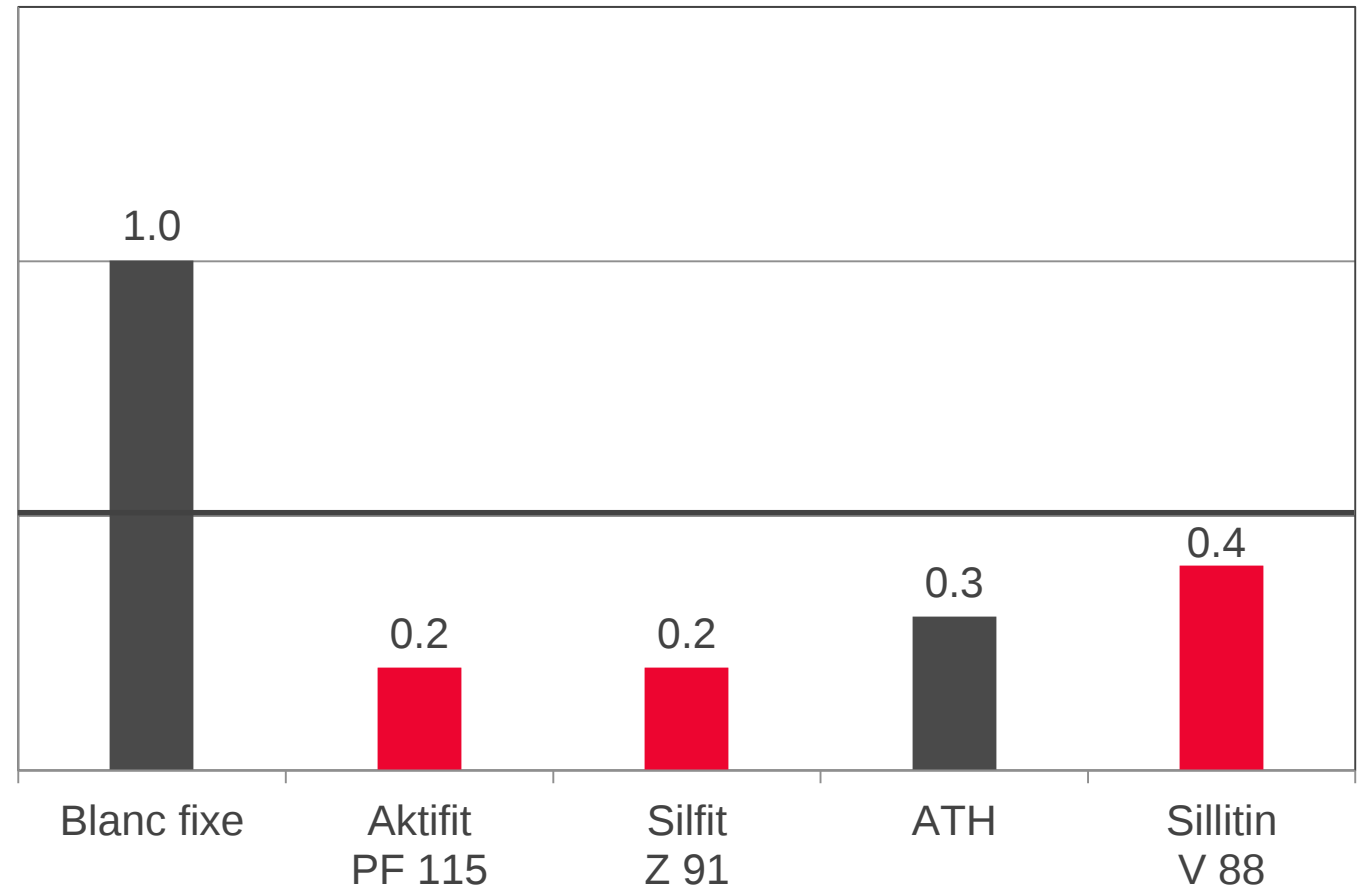
ΔE

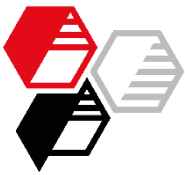
1,5

1,0

0,5

0,0





Salt Spray Test (acetic) 1000 hours

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Aluminum chromated
Delamination at scribe

completely

2.3 mm

1.8 mm

completely

1.5 mm



No Blistering: 0 (S0)

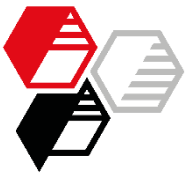
Blanc fixe

Aktifit
PF 115

Silfit
Z 91

ATH

Sillitin
V 88

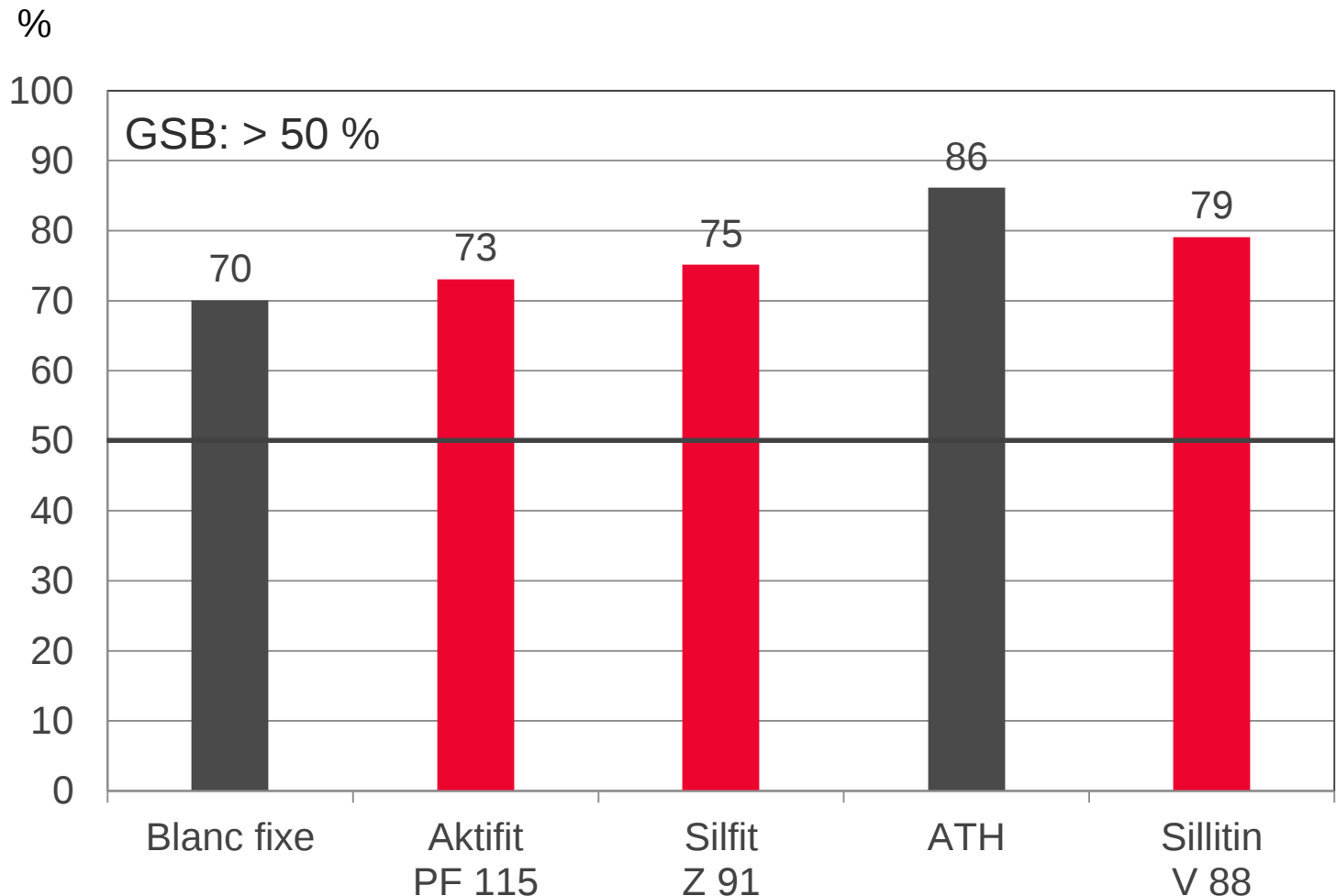


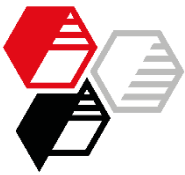
Artificial Weathering

QUV B (313 nm), 300 hours

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Remaining gloss 60°

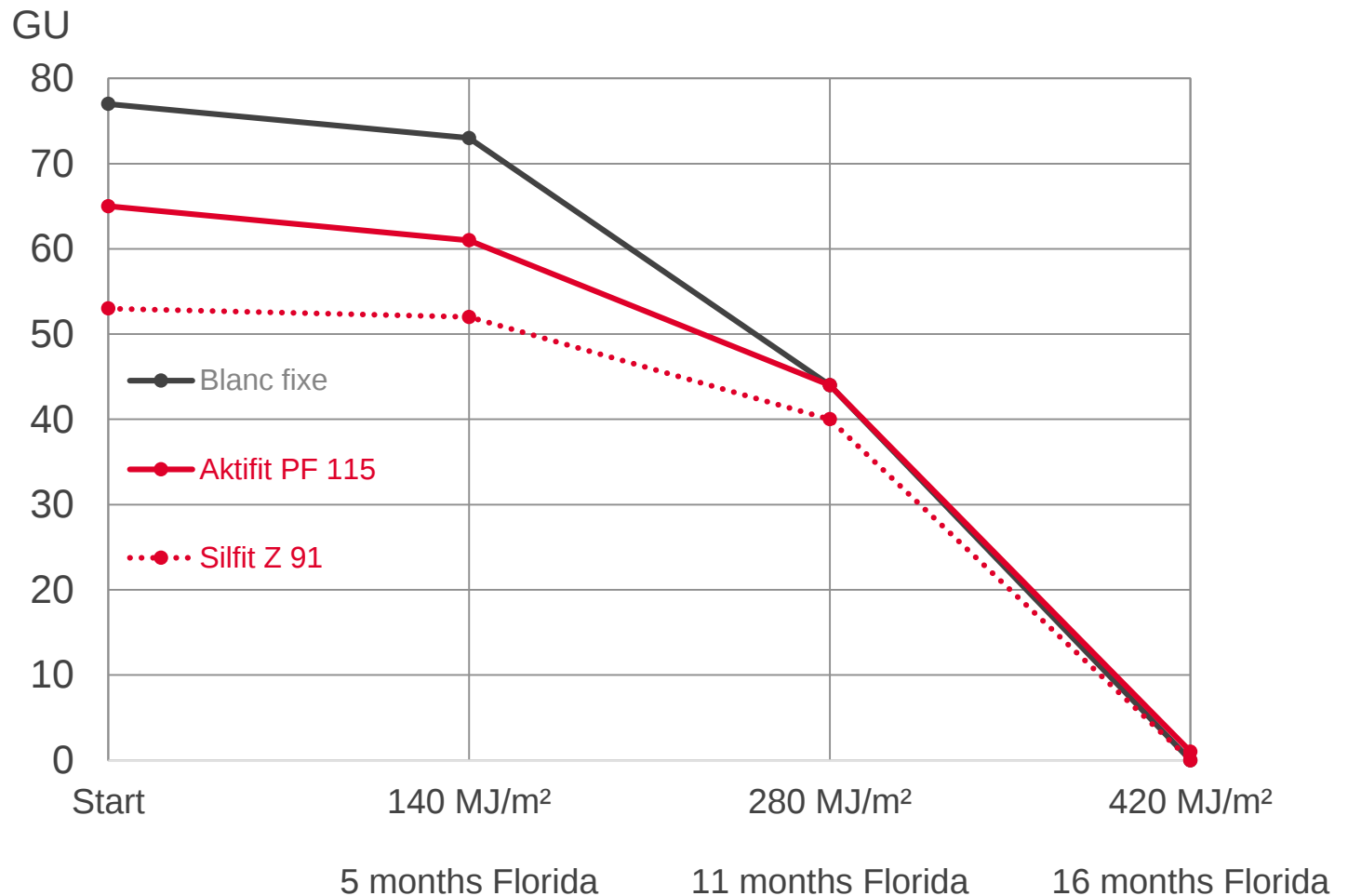


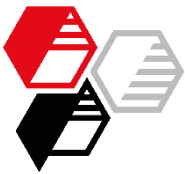


Outdoor Exposure Florida Gloss 20°

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Gloss reduction at 20° angel over the time for the high gloss section

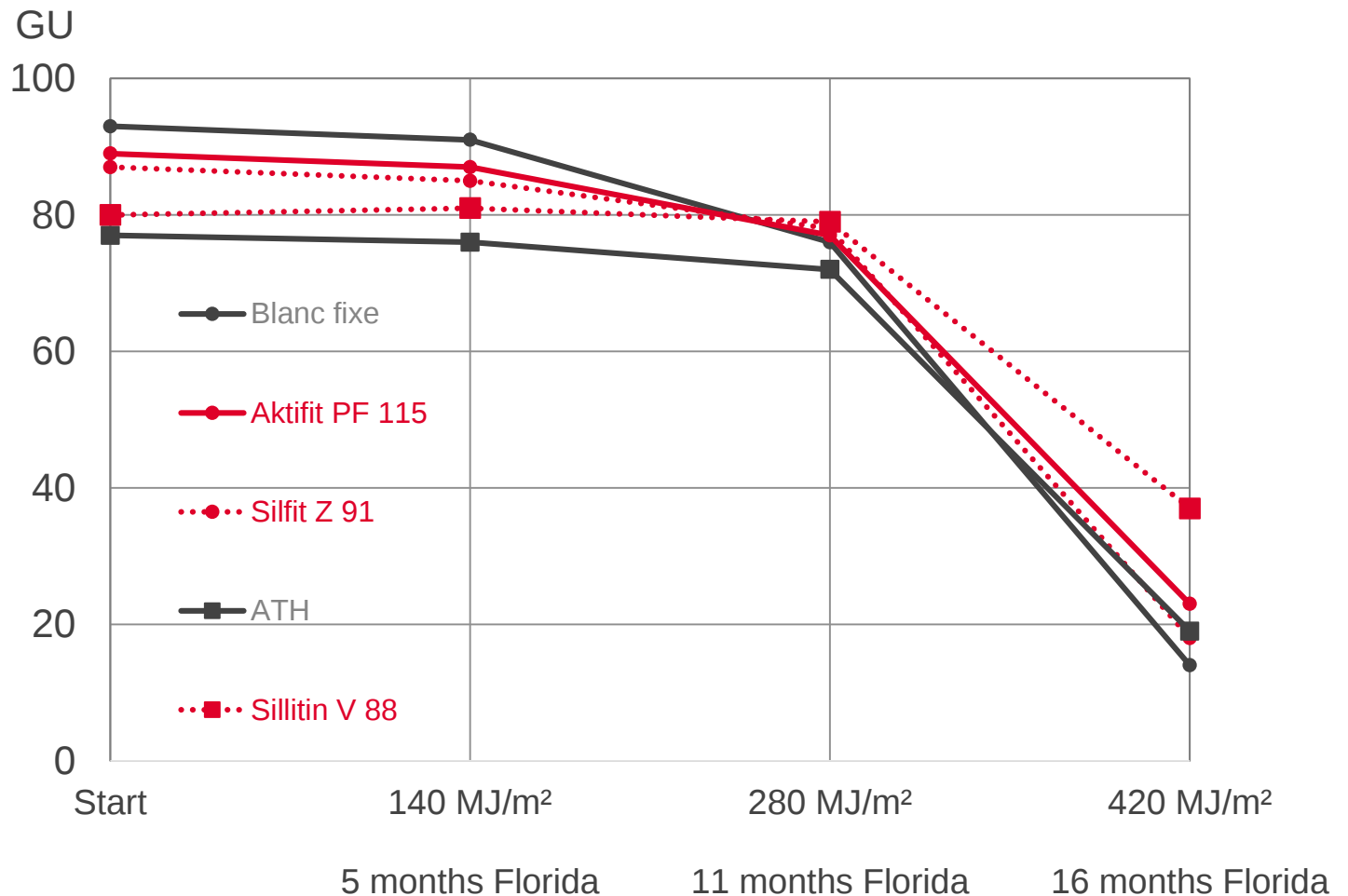


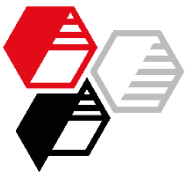


Outdoor Exposure Florida Gloss 60°

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Gloss reduction at 60° angle over the time



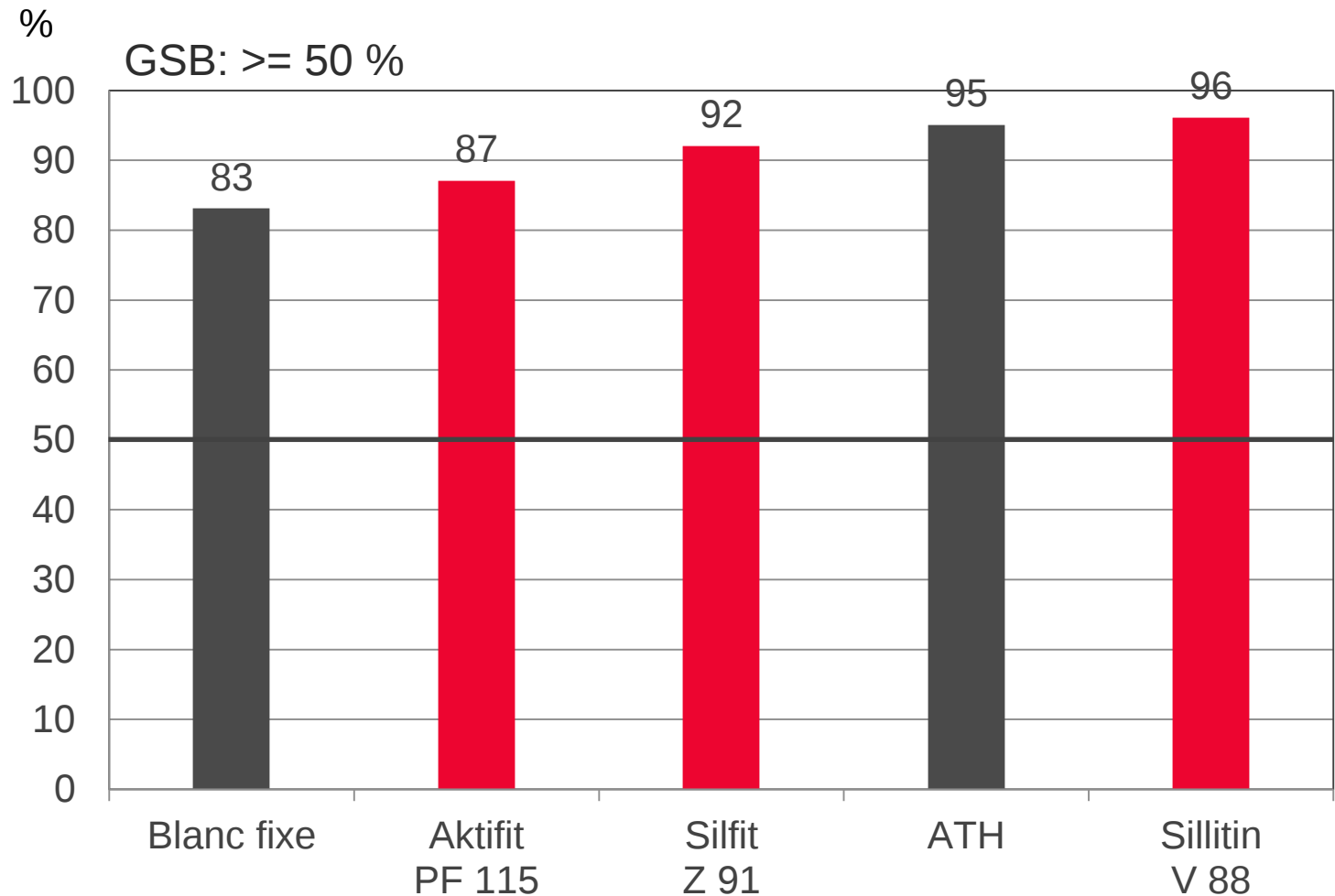


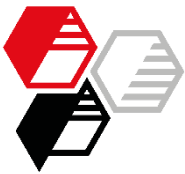
Outdoor Exposure Florida

280 MJ/m²

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Remaining gloss 60°



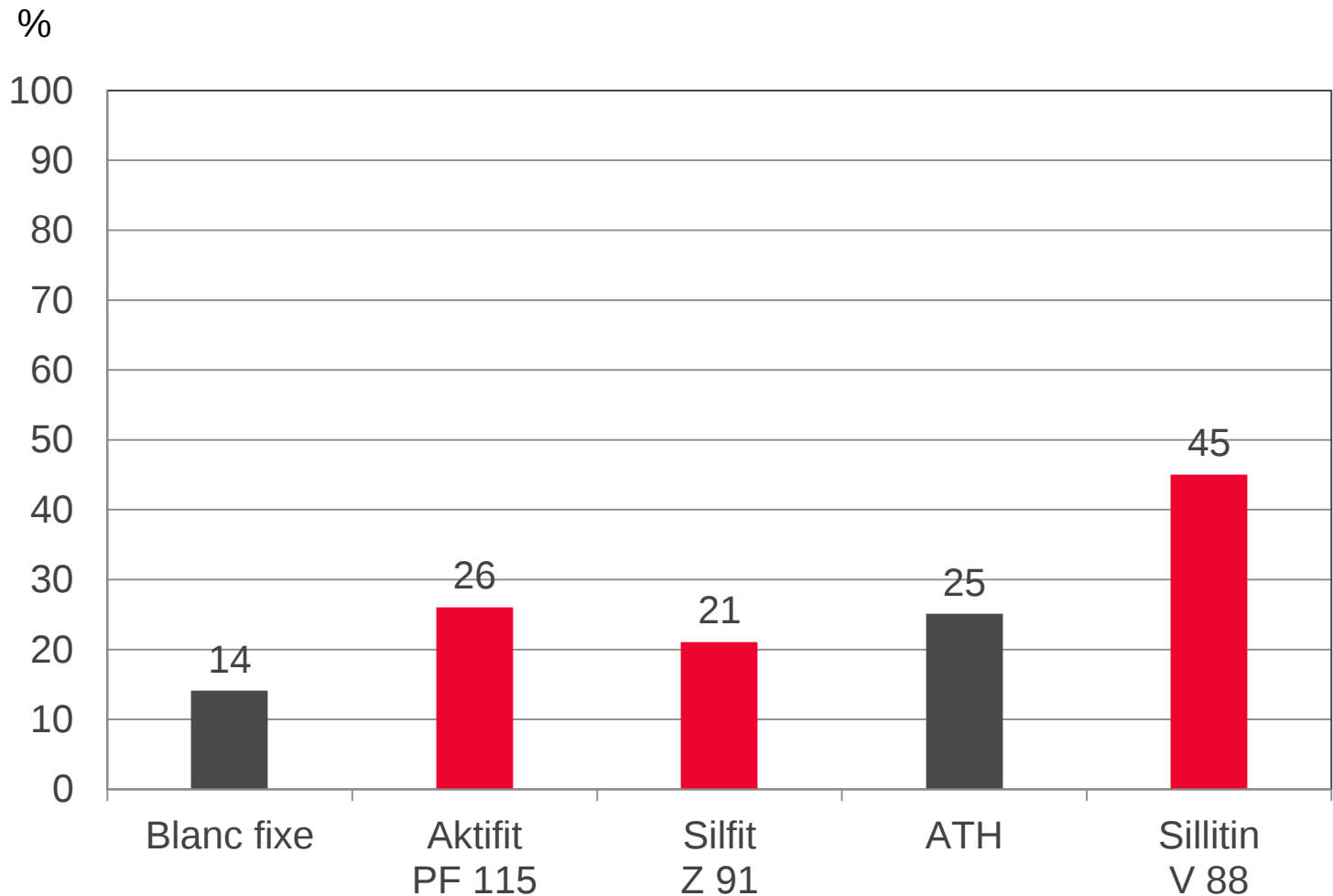


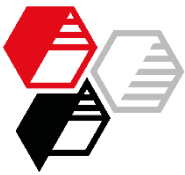
Outdoor Exposure Florida

420 MJ/m²

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Remaining gloss 60°





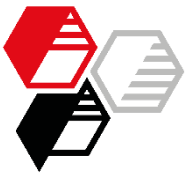
Summary

The use of **Neuburg Siliceous Earth** in an outdoor powder coating (PE/HAA) results, depending on the requested gloss level, in the following effects:

High gloss 60°: ~ 90 GU

The utilization of **Aktifit PF 115** or **Silfit Z 91** instead of Blanc fixe:

- glossy appearance with low haze is largely retained by using **Aktifit PF 115**
- + the surface appearance / texture is notably improved with the **Aktifit PF 115**
- + the flexibility of the coating is distinctly improved, especially when using **Silfit Z 91**
- + the anthracite gray color after water spot testing is fully retained, blushing is eliminated
- + the delamination after the acetic salt spray test is significantly reduced
- + the weatherability is slightly improved



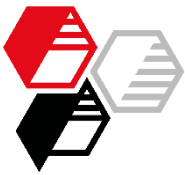
Summary

The use of **Neuburg Siliceous Earth** in an outdoor powder coating (PE/HAA) results, depending on the requested gloss level, in the following effects:

Medium gloss 60°: ~ 75 GU

The utilization of **Sillitin V 88** instead of Aluminum hydroxide:

- the water spot resistance remains comparable
- results in good matting in combination with excellent film appearance and optimum surface appearance / texture
- + the flexibility of the coating is improved (direct impact, after 1 hour)
- + the delamination after the acetic salt spray test is significantly reduced
- + the weatherability is slightly improved



We supply material for good ideas!

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E-mail: info@hoffmann-mineral.com

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