Coating Longevity through Proper Surface Preparation

In the eighth edition of Dr. Prepper, we'll continue to examine of why proper surface preparation is paramount and how the Bristle Blaster delivers uniquely high levels of surface preparation.

Poor surface preparation and coating application can lead to premature coating degradation, particularly through a loss of adhesion and a greater risk of corrosion.

There have been appropriate, well-defined standards available for many years, but these are not always applied, or at least not always correctly applied.

So, what should you take into account in your efforts for proper and successful surface preparation?

No.8

Paper edition

1. OBJECTIVE AND METHODS OF PREPARATION

Dr Prepper undertook an investigation to examine the surface preparation of the Bristle Blaster in comparison with grit blasting and conventional rotating wire brushes. We selected 3 different starting surfaces for our investigation - “mill scale”, “rust” and “cold rolled” - uncoated steel. Prepared surfaces were characterized by the degree of preparation and a range of roughness parameters. Coated coupons according to DIN EN ISO 12944-6:1998 were exposed to various levels of corrosion in accordance with the C3, medium term of protection, corrosivity category.

Bristle Blaster Electric Type

THREE DIFFERENT STARTING POINTS

The first tool selected for the investigation was the Monti Bristle Blaster electric type 3200. With this tool we examined it with different belt configurations to examine the roughing potential. In the first case the 23mm carbon steel belt was used alone while in the second case we used 2 x 11mm belts side by side. The idle speed of the tool used was 3200 RPM. For surface preparation, either 1 brush with a width of 23mm was used alone or 2 brushes with a width 11mm were used side by side.

For the grit blasting, a mixture of angular cast iron pellets with a grain size of 0.1 to 1.0mm were used with a jet pressure of approximately 6 bar.

For the testing, we employed coupons of 150 x 100 mm with a material thickness of 3mm. For starting points A and C we used hot-rolled stell S 235 JR and for the cold-rolled steel DC 01.

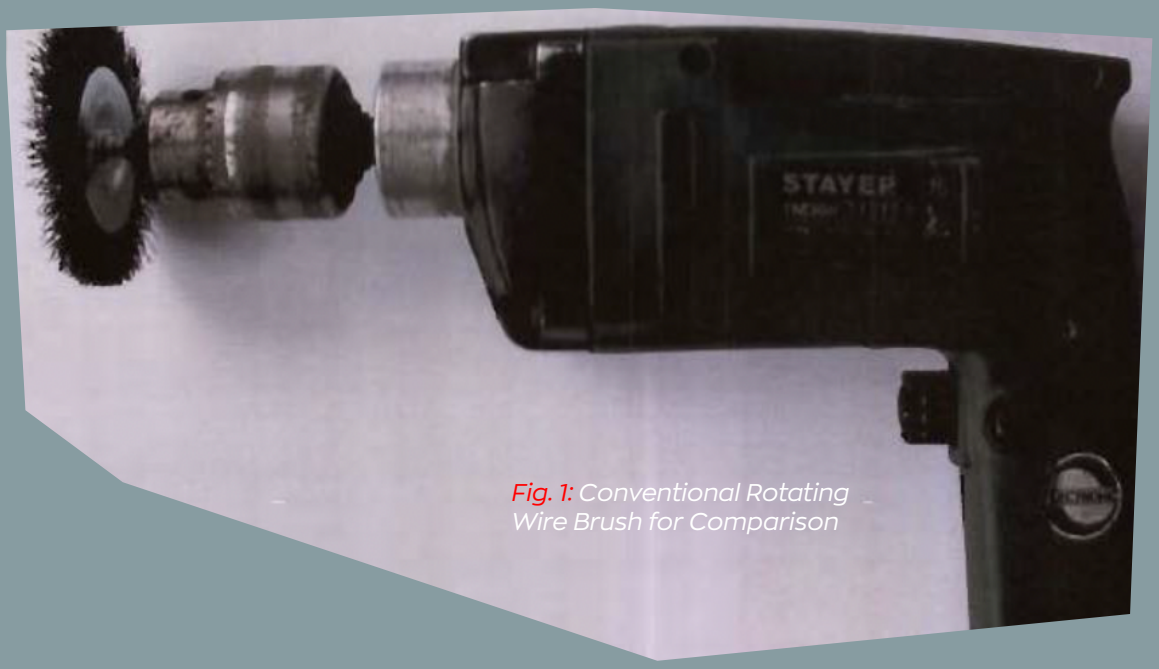

Fig. 1: Conventional Rotating Wire Brush for Comparison

The third method employed was an electrically driven hand drill using a conventional rotating wire brush with a diameter of 75mm and width of 8-10mm. The rotational speed was 600 RMP (see Figure 1).

2. PREPARATION

The bristle blasting method was assessed for surface preparation in acordance with ISO8501-1.
In detail, the following results were obtained for different initial states (see Table 1 and Figures 3 to 14 in the Appendix):

BRISTLE BLAST ROUGHING (23MM WIDE BELT)

SIMILAR TO Sa 2 ½

(FOR A: THIN MILL SCALE, C: RUST)

SIMILAR TO Sa 3

(FOR COLD-ROLLED, UNCOATED)

BRISTLE BLAST ROUGHING (2 X 11MM WIDE BELTS)

SIMILAR TO Sa 2 ½

(FOR A: THIN MILL SCALE, C: RUST)

SIMILAR TO Sa 3

(FOR COLD-ROLLED, UNCOATED)

In contrast, and depending on the initial state of the coupon, conventional rotating wire brushing left either cinder or rust residues behind on the coupon surface.

The Bristle Blaster left no residue on the surface after treatment.

Table 1: Degree of Surface Preparation Achieved

Preparation	Version	Initial State	Degree of Preparation
Bristle Blast Roughing wide, 23 mm	AM	A	similar to Sa 2 ½
Bristle Blast Roughing narrow, 2 x 11 mm	AN	A	similar to Sa 2 ½
Grit Blasting	AS	A	Sa 2 ½
Rotating Wire Brush	AT	A	St 3 surface-wide mill scale residue
Bristle Blast Roughing, wide, 23 mm	CM	C	similar to Sa 2 ½
Bristle Blast Roughing narrow, 2 x 11 mm	CN	C	similar to Sa 2 ½
Grit Blasting	CS	C	Sa 2 ½
Rotating Wire Brush	CT	C	St 3 surface-wide mill scale residue
Bristle Blast Roughing wide, 23 mm	KM	K	similar to Sa 3
Bristle Blast Roughing narrow, 2 x 11 mm	KN	K	similar to Sa 3
Grit Blasting	KS	K	Sa 3
Rotating Wire Brush	KT	K	St 3

A: (Thin) Mill scale
C: Rust
Cold-Rolled -- Uncoated (K)

3. ROUGHNESS AFTER SURFACE PREPARATION

To characterize the roughness profile, different roughness indicators were used in accordance with DIN EN ISO 4287, which describe roughening in both the vertical and the horizontal direction:

Rz maximum height of the profile (roughness)

Ra arithmetic mean of the profile (roughness)

RPc peak value (horizontal roughening)

RSm mean groove width (horizontal roughening)

Table 2: Roughness of Prepared Surfaces

Preparation	Version	Initial State	Rz µm	Ra µm	RPc Peaks/cm	RSm µm
Bristle Blast Roughing wide, 23 mm	AM	A	74 ± 7.6	11.1 ± 1.4	21 ± 1	458 ± 36
Bristle Blast Roughing narrow, 2 x 11 mm	AN	A	54 ± 1.6	8.6 ± 0.5	23 ± 1	426 ± 23
Grit Blasting	AS	A	75 ± 6.5	11.9 ± 1.0	26 ± 2	374 ± 29
Rotating Wire Brush	AT	A	7.3 ± 0.9	1.1 ± 0.1	17 ± 3	593 ± 606 2.5-625
Bristle Blast Roughing, wide, 23 mm	CM	C	92 ± 9.3	14.4 ± 1.6	20 ± 3	495 ± 82
Bristle Blast Roughing narrow, 2 x 11 mm	CN	C	61 ± 9.9	9.4 ± 1.3	22 ± 2	431 ± 38
Grit Blasting	CS	C	69 ± 9.9	1.11 ± 1.1	30 ± 2	328 ± 30
Rotating Wire Brush	CT	C	24 ± 4.4	3.5 ± 0.4	11 ± 2	234 ± 595 80-595
Bristle Blast Roughing wide, 23 mm	KM	K	87 ± 4.5	14.1 ± 1.1	22 ± 1	438 ± 28
Bristle Blast Roughing narrow, 2 x 11 mm	KN	K	84 ± 7.6	13.4 ± 1.2	24 ± 1	410 ± 31
Grit Blasting	KS	K	74 ± 7.8	11.2 ± 1.3	27 ± 3	365 ± 42
Rotating Wire Brush	KT	K	8.9 ± 1.4	1.3 ± 0.2	32 ± 5	306 ± 45

Initial States:
A: (Thin) Mill scale
C: Rust
Cold-Rolled -- Uncoated (K)

Measurement Conditions:

Lc:	2.5 mm
Lt:	15 mm
Measuring Instrument/Type:	Hommel Tester T 1000 Radially relative to the Monti
Sampling:	Brushes, 8 per sheet

"Bristle Blasting roughness compares favourably to grit blasting."

Specifically, the following results for the initial states A, C and cold-rolled were obtained using new bristle blaster brushes (see Table 2):

Bristle Blast Roughing
(23MM WIDE)
Rz: *74 - 92 µm (exceeding by 60 µm)*
RPc: *20-22 peaks/cm*

Bristle Blast Roughing
(2 X11 MM WIDE)
Rz: *60 µm reached twice (61 - 84 µm), once 54 µm*
RPc: *22-24 peaks/cm*

Comparison:

GRIT BLASTING
Rz: *69 - 75 µm (exceeding by 60 µm)*
RPc: *26 - 30 peaks/cm*

ROTATING WIRE BRUSH
Rz: *7 - 24 µm*
RPc: *11-32 peaks/cm*

The Bristle Blaster using 23mm or 2 x 11mm belts achieved roughness profiles very similar to grit blasting, although there was some inconsistency with the 2 x 11mm belts. Both surface roughness Rz and peak count RPc were also substantially similar.

The conventional rotating wire brush on the other hand only produced a roughness Rz of 7-24 um. As such, this method only meets the requirements for coating with restrictions.

4. LEVEL OF EXPOSURE OF COATED COUPONS TO CORROSION

4.1 Coating System and Required Parameters

The surface preparation methods were tested on coating systems having a total thickness of 60 um, which is suitable for the C3 medium-term corrosivity category. And tolerates a surface preparation by manual mechanic methods:

Primer

Epoxy resin esters, recommended coating thickness: 80 µm
Penetrating Agent

Topcoat

Alkyl acrylate, synthetic resin combination, recommended coating thickness: 80 µm

According to DIN EN ISO 12944-6:1998, the following parameters are required for artificial corrosion exposure:

Cross-cut parameter (DIN EN ISO 2409):	0 or 1
Pull-off test (DIN EN ISO 4624):	no fracture to the underground (A/B) permitted (except for pull-off values of 5 MPa and more)
Degree of blistering (DIN EN ISO 4628-2):	0 (SO)
Degree of rust (DIN EN ISO 4628-3):	Ri 0
Degree of cracking (DIN EN ISO 4628-4):	0 (SO)
Degree of flaking (DIN EN ISO 4628-5):	0 (SO)
Corrosion at the scribe (DIN EN ISO 4628-8):	1 mm (maximum value)

The sample coupons were prepared individually on the front only by blasting or brushing.

4.2 Exposure to Continuous Condensation According to DIN EN ISO 6270-1

The following results were obtained after exposing coated coupons to continuous condensation according to DIN EN ISO 6270-1 over a term of 120 hours (see Table 3 and 4):

- Preparation Methods: bristle blast roughening, blasting, grit blasting, rotating wire brushing
- Initial States: A (thin mill scale), cold-rolled (K)

RESULTS

Cross-cut parameter:	failed (except A Sa 2 ½, blasting)
Fracture of adhesion A/B:	passed (generally no adhesive failure of the coating)
Degree of blistering:	passed
Degree of rusting:	passed
Degree of cracking:	passed
Degree of flaking:	passed

Regardless of the preparation method and the initial state, largely similar results were obtained after 120 hours of continuous exposure to condensation (DIN EN ISO 6270-1).

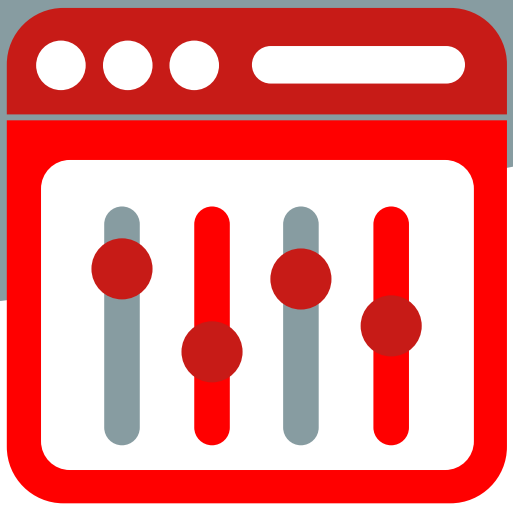

Table 3: Exposure of Coated Coupons to Continuous Condensation according to DIN EN ISO 6270-1 (120 h)

Review/Preparation	Sample No.	AM	AS	AT
Bonding Strength				
Cross - Cut (24 h)	4, 18, 25	1-2	2-3	1
	7, 21, 36	1	1	3
	8, 22, 40	2	1	1-2
	6, 24, 37 blank sample	3	2	3
Adhesive Strength (unilateral, 24 h) MPa	4, 18, 25	4.8 ± 0.4	5.0	5.0
	7, 21, 36	5.0	5.0	4.5 ± 0.7
	8, 22, 40	5.0	4.8 ± 0.4	5.3 ± 0.4
	6, 24, 37 blank sample	3.8 ± 0.6	3.7 ± 0.3	3.7 ± 0.3
Fracture Pattern (Pull-Off Test) %	4, 18, 25	100C; 90C 10B	80B 20C	90B 10C
	7, 21, 36	90C 10Y/Z; 100C	80B 20C; 10B 90C	80B 20C; 100B
	8, 22, 40	10B 90C	20B 60C 20Y/Z; 10B 90C	10B 90C; 100B
	6, 24, 37 blank sample	100B	100B	100B
Visual Inspection				
Degree of Blistering:	4, 18, 25	0	0	0
	7, 21, 36	0	0	0
	8, 22, 40	0	0	0
	6, 24, 37 blank sample			
Degree of Rust Ri	4, 18, 25	0	0	0
	7, 21, 36	0	0	0
	8, 22, 40	0	0	0
	6, 24, 37 blank sample			
Degree of Cracking:	4, 18, 25	0	0	0
	7, 21, 36	0	0	0
	8, 22, 40	0	0	0
	6, 24, 37 blank sample			
Degree of Flaking:	4, 18, 25	0	0	0
	7, 21, 36	0	0	0
	8, 22, 40	0	0	0
	6, 24, 37 blank sample			
Coating Thickness µm	4, 18, 35	155 ± 12	176 ± 10	199 ± 11
	7, 21, 36	158 ± 5	178 ± 18	178 ± 6
	8, 22, 40	152 ± 8	174 ± 10	188 ± 13
	6, 24, 37 blank sample	151 ± 12	191 ± 7	204 ± 11

Initial State: A (Thin) mill scale
Preparation: M (Bristle Blast Roughing), S (Blasting), T (Rotating Wire Brush)

Table 4: Exposure of Coated Coupons to Continuous Condensation according to DIN EN ISO 6270-1 (120 h)

Review/Preparation	Sample No.	KM	KS	KT
Bonding Strength				
Cross-Cut (24 h)	14, 28, 44	2	2	3
	15, 29, 46	2-3	3	2
	16, 31, 48	2-3	3	3
	9, 30, 45 blank sample	3	3	3
Adhesive Strength (unilateral, 24 h) MPa	14, 28, 44	5.0	4.8 ± 0.4	4.0
	15, 29, 46	4.5	4.8 ± 0.4	3.5
	16, 31, 48	4.8 ± 0.4	4.8 ± 0.4	4.0
	9, 30, 45 blank sample	3.5 ± 0.5	3.7 ± 0.3	3.5 ± 0.5
Fracture Pattern (Pull-OffTest)	14, 28, 44	50B 50C; 30B 70C	80B 20C; 90B 10C	90B 10C
	15, 29, 46	70B 30C	20B 80C	40B 60C; 50B 50C
	16, 31, 48	70B 30C	80B 20C; 70B 30C	100B
	9, 30, 45 blank sample	100B	100B	100B
Visual Inspection				
Degree of Blistering:	14, 28, 44	0	0	0
	15, 29, 46	0	0	0
	16, 31, 48	0	0	0
	9, 30, 45 blank sample			
Degree of Rust Ri	14, 28, 44	0	0	0
	15, 29, 46	0	0	0
	16, 31, 48	0	0	0
	9, 30, 45 blank sample			
Degree of Cracking:	14, 28, 44	0	0	0
	15, 29, 46	0	0	0
	16, 31, 48	0	0	0
	9, 30, 45 blank sample			
Degree of Flaking:	14, 28, 44	0	0	0
	15, 29, 46	0	0	0
	16, 31, 48	0	0	0
	9, 30, 45 blank sample			
Coating Thickness µm	14, 28, 44	167 ± 9	196 ± 5	189 ± 4
	15, 29, 46	172 ± 6	171 ± 9	203 ± 9
	16, 31, 48	176 ± 10	180 ± 14	214 ± 10
	9, 30, 45 blank sample	159 ± 11	165 ± 5	193 ± 14

Initial State: Cold-Rolled (K)
Preparation: M (Bristle Blast Roughing), S (Grit Blasting), T (Rotating Wire Brush)

4.3 Exposure to Neutral Salt Mist According to DIN EN ISO 9227

The following results were obtained after exposure of coated coupons to neutral salt mist according to DIN EN ISO 9227 over duration of 240 hours (see Tables 5 and 6):

- Preparation Method: bristle blast roughening, grit blasting, rotating wire brushing
- Initial States: A (thin mill scale), cold-rolled (K)

RESULTS

- Cross-cut parameter: failed
- Fracture of adhesion A/B: passed (generally no adhesive fracture)
- Degree of blistering: passed
- Degree of rusting: passed
- Degree of cracking: passed
- Degree of flaking: passed

- Corrosion at the scribe (maximum value)
  - Bristle Blast Roughing: partially passed
  - Grit Blasting: partially passed
  - Conventional Brushing: passed

- Delamination at the scribe (mean)
  - Bristle Blast Roughing: 7 - 10 mm
  - Grit Blasting: A: 8 - 10 mm, cold-rolled: 4 - 5 mm
  - Conventional Brushing: 13 - 20 mm

Regardless of the preparation method and the initial state, largely similar results were obtained after 240 hours of exposure to neutral salt mist (DIN EN ISO 9227). Delamination at the scribe is an exception. This value increases with conventional brushing by about two times up to 20 mm.

Table 5: Exposure of Coated Coupons to Neutral Salt Mist According to DIN EN ISO 9227 (240 h)

Review/Preparation	Sample No.	AM	AS	AT
Bonding Strength				
Cross-Cut (24 h)	2, 19, 33	2	4	5
	3, 20, 34	2	5	5
	5, 23, 38	4	5	5
	6, 24, 37 blank sample	3	2	3
Adhesive Strength (unilateral, 24 h) MPa	2, 19, 33	5.0	3.8 ± 0.4	4.0 ± 0.7
	3, 20, 34	5.0 ± 0.7	4.3 ± 0.4	3.5 ± 0.7
	5, 23, 38	5.0	4.0	4.0
	6, 24, 37 blank sample	3.8 ± 0.6	3.7 ± 0.3	3.7 ± 0.3
Fracture Pattern (Pull-Off Test) %	2, 19, 33	100B	100B	100B
	3, 20, 34	100B	100B	100B
	5, 23, 38	100B	100B	100B
	6, 24, 37 blank sample	100B	100B	100B
Visual Inspection				
Degree of Blistering:	2, 19, 33	0	0	0
	3, 20, 34	0	0	0
	5, 23, 38	0	0	0
	6, 24, 37 blank sample			
Degree of Rust Ri	2, 19, 33	0	0	0
	3, 20, 34	0	0	0
	5, 23, 38	0	0	0
	6, 24, 37 blank sample			
Degree of Cracking:	2, 19, 33	0	0	0
	2, 20, 34	0	0	0
	5, 23, 38	0	0	0
	6, 24, 37 blank sample			
Degree of Flaking:	2, 19, 33	0	0	0
	3, 20, 34	0	0	0
	5, 23, 38	0	0	0
	6, 24, 37 blank sample			
Scribe				
Mean Rusting at the Scribe mm	2, 19, 33	0.7 ± 0.4	0.5 ± 0.5	0.9 ± 0.3
	3, 20, 34	0.8 ± 0.4	0.6 ± 0.5	0.7 ± 0.2
	5, 23, 38	0.9 ± 0.5	0.5 ± 0.3	0.6 ± 0.1
	6, 24, 37 blank sample			
Maximum Rusting at the Scribe mm	2, 19, 33	2	2	1
	3, 20, 34	2	2	1
	5, 23, 38	2	1	0.8
	6, 24, 37 blank sample			
Mean Delamination at the Scribe mm	2, 19, 33	7 ± 0.8	9 ± 1.3	17 ± 0.8
	3, 20, 34	9 ± 0.6	10 ± 0.7	17 ± 1.3
	5, 23, 38	10 ± 1.1	8 ± 0.4	13 ± 0.8
	6, 24, 37 blank sample			
Scribe mm	2, 19, 33	8	10	19
	3, 20, 34	10	11	19
	5, 23, 38	12	9	14
	6, 24, 37 blank sample			
Coating Thickness µm	2, 19, 33	165 ± 9	187 ± 9	191 ± 14
	3, 20, 34	173 ± 11	185 ± 5	191 ± 11
	5, 23, 38	170 ± 6	187 ± 14	184 ± 8
	6, 24, 37 blank sample	151 ± 12	191 ± 7	204 ± 11

Initial State: A (Thin) Cinder
Preparation: M (Bristle Blast Roughing), S (Grit Blasting), T (Rotating Wire Brush)

Table 6: Exposure of Coated Coupons to Neutral Salt Mist According to DIN EN ISO 9227 (240 h)

Review/Preparation	Sample No.	KM	KS	KT
Bonding Strength				
Cross-Cut (24 h)	10, 25, 41	5	5	5
	11, 26, 42	4	3	5
	12, 27, 43	5	4	5
	9, 30, 45 blank sample	3	3	3
Adhesive Strength (unilateral, 24 h) MPa	10, 25, 41	3.8 ± 0.4	4.0	3.8 ± 0.4
	11, 26, 42	4.0	4.5	3.5 ± 0.7
	12, 27, 43	4.0	4.5 ± 0.7	3.8 ± 0.4
	9, 30, 45 blank sample	3.5 ± 0.5	3.7 ± 0.3	3.5 ± 0.5
Fracture Pattern (Pull-Off Test)	10, 25, 41	100B	100B	100B
	11, 26, 42	100B	100B	100B
	12, 27, 43	100B	100B	100B
	9, 30, 45 blank sample	100B	100B	100B
Visual Inspection				
Degree of Blistering (Quantity/Size)	10, 25, 41	0	0	0
	11, 26, 42	0	0	0
	12, 27, 43	0	0	0
	9, 30, 45 blank sample			
Degree of Rust Ri	10, 25, 41	0	0	0
	11, 26, 42	0	0	0
	12, 27, 43	0	0	0
	9, 30, 45 blank sample			
Degree of Cracking:	10, 25, 41	0	0	0
	11, 26, 42	0	0	0
	12, 27, 43	0	0	0
	9, 30, 45 blank sample			
Degree of Flaking:	10, 25, 41	0	0	0
	11, 26, 42	0	0	0
	12, 27, 43	0	0	0
	9, 30, 45 blank sample			
Scribe				
Mean Rusting at the Scribe mm	10, 25, 41	0.5 ± 0.3	0.4 ± 0.4	0.4 ± 0.3
	11, 26, 42	1 ± 0.9	0.3 ± 0.2	0.6 ± 0.4
	12, 27, 43	0.4 ± 0.2	0.5 ± 0.4	0.7 ± 0.4
	9, 30, 45 blank sample			
Maximum Rusting at the Scribe mm	10, 25, 41	1	1	0.8
	11, 26, 42	3	0.8	2
	12, 27, 43	0.8	1	1
	9, 30, 45 blank sample			
Mean Delamination at the Scribe mm	10, 25, 41	10 ± 0.7	5 ± 0.4	19 ± 1.4
	11, 26, 42	9 ± 0.5	4 ± 0.6	20 ± 0.7
	12, 27, 43	7 ± 0.3	5 ± 0.4	16 ± 0.7
	9, 30, 45 blank sample			
Maximum Delamination at the Scribe mm	10, 25, 41	11	5	21
	11, 26, 42	10	6	22
	12, 27, 43	7	6	17
	9, 30, 45 blank sample			
Coating Thickness µm	10, 25, 41	179 ± 13	184 ± 9	192 ± 13
	11, 26, 42	183 ± 14	185 ± 7	200 ± 8
	12, 27, 43	174 ± 4	199 ± 9	221 ± 12
	9, 30, 45 blank sample	159 ± 11	165 ± 5	193 ± 14

Initial State: Cold-Rolled (K)
Preparation: M (Bristle Blast Roughing), S (Grit Blasting), T (Rotating Wire Brush)

5. CONCLUSION

Both Bristle blast roughening and grit blasting achieved similar degrees of surface preparation largely corresponding to Sa 2½.

Bristle blasting using fresh belts led to a surface roughening normally between 60 and 80 µm. The surface roughness Rz corresponds to a medium degree of roughness (G) according to DIN EN ISO 8503-1 which ranges from 60-100µm.

Coated coupons prepared with bristle blast roughening behaved similar to those prepared with grit blasting after exposure to continuous condensation.

All methods tested compared favourably when subjected to salt mist. The degree of delamination of the coupon at the scribe however approximately doubled when prepared by the convention rotating brush method.

WE BELIEVE IN THE POWER OF INNOVATION

By preparing optimal surfaces, we make coatings work better. Montipower® has been innovating original surface preparation machinery, quality made in Germany, since 1987.

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Appendix 1 to UB 500/61/08

IMAGES OF THE PREPARED SURFACES

Fig. 3: A, Bristle Blast Roughing (with 23mm wide belt)

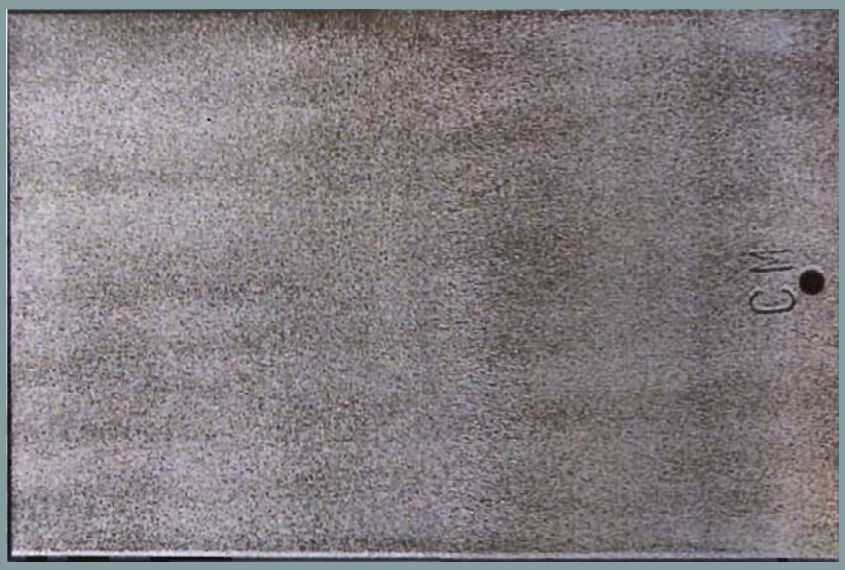

Fig. 4: C, Bristle Blast Roughing (with 23mm wide belt)

Fig. 5: Cold-Rolled, Bristle Blast Roughing (with 23mm wide belt)

Appendix 1 to UB 500/61/08

IMAGES OF THE PREPARED SURFACES

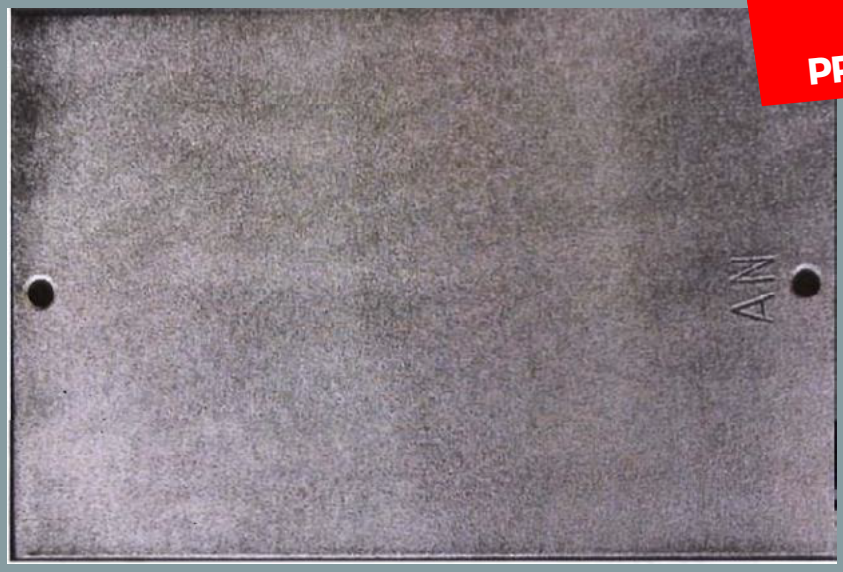

Fig. 6: A, Bristle Blast Roughing (with 2 x 11mm wide belts)

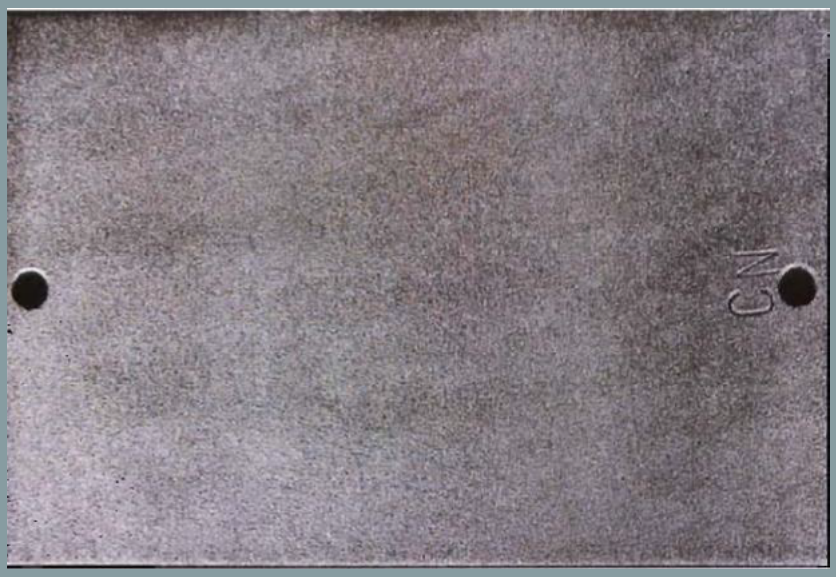

Fig. 7: C, Bristle Blast Roughing (with 2 x 11mm wide belts)

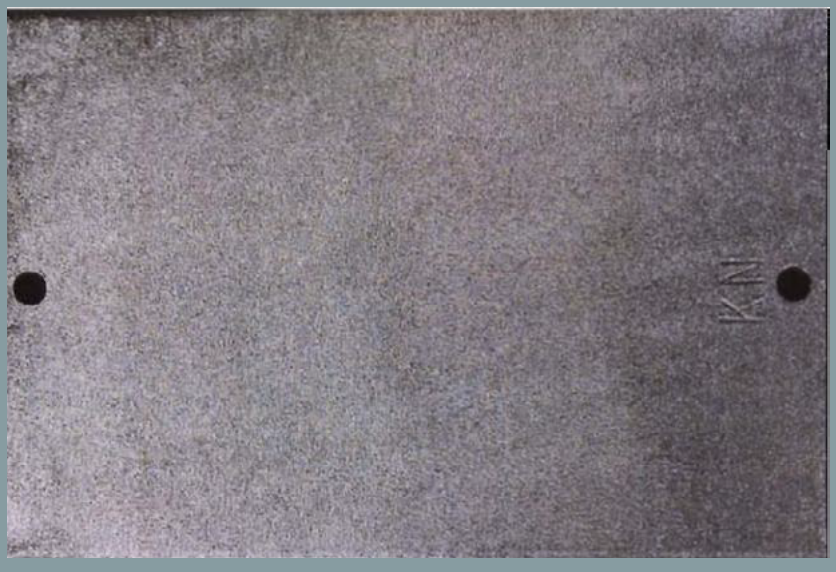

Fig. 8: Cold-Rolled, Bristle Blast Roughing (with 2 x 11mm wide belts)

IMAGES OF THE PREPARED SURFACES

Fig. 9: A, Sa 2½, Grit Blasting

Fig. 10: C, Sa 2½, Grit Blasting

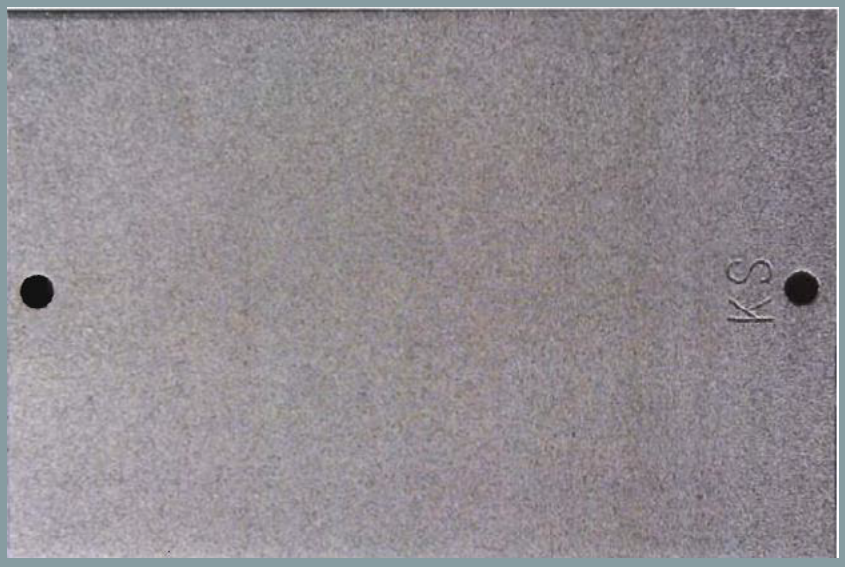

Fig. 11: Cold-Rolled, Sa3, Grit Blasting

IMAGES OF THE PREPARED SURFACES

Fig. 12: A, St 3 (Rotating Wire Brush), Surface-Wide mill scale Residue

Fig. 13: C, St 3 (Rotating Wire Brush), Surface-Wide Rust Residue

Fig. 14: Cold-Rolled, St 3 (Rotating Wire Brush)

Appendix 2

TO UB500/61/08

Table 7: Roughness of Surfaces After Bristle Blast Roughing at Different Intensities (Number of Brushing Operations)

Preparation	Version	Initial State	Number of Operations	Rz µm	Ra µm	RPc Peaks/cm	RSm µm
Bristle Blast Roughing wide, 23 mm	AM	A	1	36 ± 5.7	5.6 ± 0.9	22 ± 3	452 ± 65
			2	73 ± 7.6	11.1 ± 1.4	21 ± 1	458 ± 36
Bristle Blast Roughing wide, 23 mm	CM	C	1	50 ± 3.7	7.9 ± 0.6	20 ± 2	403 ± 65
			2	92 ± 9.3	14.4 ± 1.6	20 ± 3	495 ±82
Bristle Blast Roughing wide, 23 mm	KM	K	1	64 ± 6.0	10.1 ± 0.3	27 ± 3	361 ± 41
			2	87 ± 4.5	14.1 ± 1.1	22 ± 1	438 ± 28
Bristle Blast Roughing narrow 2 x 11 mm	AN	A	1	44 ± 4.1	6.5 ± 0.6	28 ± 3	355 ± 44
			2	54 ± 1.6	8.6 ± 0.5	23 ± 1	426 ± 23
Bristle Blast Roughing narrow 2 x 11 mm	CN	C	1	51 ± 2.2	7.5 ± 0.6	22 ± 2	437 ± 58
			2	61 ± 9.9	9.4 ± 1.3	22 ± 2	431 ± 38
Bristle Blast Roughing narrow 2 x 11 mm	KN	K	1	48 ± 8.3	7.0 ± 0.4	25 ± 1	392 ± 28
			2	84 ± 7.6	13.4 ± 1.2	24 ± 1	410 ± 31

A: (Thin) mill scale
C: Rust
Cold-Rolled -- Uncoated (K)

NOTE

One additional test was performed with used Bristle Blaster belts:

- A surface roughness of 40 µm Rz was almost always achieved
- A surface roughness of 60 pm Rz was obtained for only 1 variant (of 6).