

TEST REPORT N°2014B VEC 21635-1a

Including 13 pages + 1 annex
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Mons, June 4th, 2014

REQUESTED BY : **AGC Glass Europe SA**
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REFERENCE OF THE REQUEST : Order n°450552412

CONCERNED MANUFACTURER : **AGC Glass Europe SA**
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NUMBER OF SAMPLES AND IDENTIFICATION : **Smart 51/33 – Tremco Proglaze II**

PURPOSE OF THE REQUESTED : Tests according to EOTA – ETAG 002
Mechanical Performances *

SAMPLES RECEIVED ON : 28/04/2014

TESTING DATE : From 08/05/2014

REMARKS : * Test under BELAC accreditation

 Notified body (Id.N°1174)
according to Regulation (EU) No 305/2011 - Construction products

TECHNICAL REPORT
ADHESION PERFORMANCES ACCORDING TO ETAG 002
GUIDELINE (2012)

SAMPLES

Samples were prepared by Tremco on 14/02/2014 and 03/04/2014 (see annex 1)

SMART 51/33 NT+ Proglaze II+ SMART 51/33 T

Batch A/B : 13125405/14015847 and 13125408/14015847

Number of samples prepared : 63+75

RESULTS

The tests were conducted in compliance with the methods described in the "Guideline for European Technical Approval for Structural Sealant Glazing System (SSGS)" ETAG n° 002.

Définitions :

K_x = Stiffness of the sample at x% elongation in the initial state

$K_{x,c}$ = Stiffness of the sample at x% elongation after conditioning
 $= 100 \cdot \sigma_x / x$

$R_{u,5}$ = the characteristic breaking stress giving 75% confidence that 95% of the test result will be higher than this value
 $= X_{mean} - \tau_{\alpha\beta} \cdot S$

S = standard deviation of the serie under consideration

$X_{mean,n}$ = the average breaking stress, either under tension or shear in the initial state

$X_{mean,c}$ = the average breaking stress, either under tension or shear after conditioning

$\Delta X_{mean} = X_{mean,c} / X_{mean,n}$

Mechanical performances

5.1.4.1. INITIAL TESTS – INITIAL MECHANICAL STRENGTH

5.1.4.1.1. TENSION – RUPTURE*

a) Results for 10 samples conditioned at +23°C

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	571	0.11	0.18	0.24	0.28	0.32	0.82	154	100C
2	588	0.09	0.17	0.22	0.27	0.30	0.88	184	100C
3	565	0.10	0.18	0.23	0.28	0.32	0.84	161	100C
4	569	0.08	0.16	0.22	0.27	0.31	0.92	190	100C
5	563	0.10	0.18	0.23	0.28	0.32	0.80	136	100C
6	549	0.10	0.18	0.24	0.29	0.33	0.95	168	100C
7	616	0.08	0.16	0.22	0.26	0.30	0.78	170	100C
8	581	0.08	0.16	0.22	0.26	0.30	0.86	197	100C
9	590	0.09	0.17	0.23	0.27	0.31	0.81	145	100C
10	562	0.08	0.16	0.22	0.27	0.31	0.92	175	100C
Average	575	0.09	0.17	0.23	0.27	0.31	0.86	168	
Standard deviation	19	0.01	0.01	0.01	0.01	0.01	0.06	20	
Minimum	549	0.08	0.16	0.22	0.26	0.30	0.78	136	
Maximum	616	0.11	0.18	0.24	0.29	0.33	0.95	197	

(*) xC: x% cohesive

$$K_{12,5} = 1.60$$

$$R_{u,5} = 0.73$$

b) Results for 5 samples conditioned at -20°C

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	588	0.09	0.18	0.24	0.29	0.33	0.99	190	100C
2	644	0.07	0.14	0.20	0.24	0.28	0.76	186	100C
3	554	0.09	0.18	0.23	0.28	0.32	0.93	172	100C
4	567	0.07	0.17	0.23	0.27	0.31	0.98	198	100C
5	555	0.09	0.17	0.23	0.28	0.32	1.02	202	100C
Average	581	0.08	0.17	0.23	0.27	0.31	0.94	190	
Standard deviation	37	0.01	0.02	0.02	0.02	0.02	0.10	12	
Minimum	554	0.07	0.14	0.20	0.24	0.28	0.76	172	
Maximum	644	0.09	0.18	0.24	0.29	0.33	1.02	202	

(*) xC: x% cohesive

$$R_{u,5} = 0.69$$

$$\Delta X_{\text{mean}} = 1.09$$

c) Results for 5 samples conditioned at +80°C

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	567	0.07	0.15	0.21	0.25	0.29	0.83	137	100C
2	580	0.07	0.15	0.21	0.25	0.29	0.85	142	100C
3	559	0.07	0.15	0.21	0.26	0.30	0.84	127	100C
4	559	0.04	0.10	0.17	0.22	0.27	0.84	143	100C
5	580	0.04	0.13	0.20	0.26	0.31	0.84	130	100C
Average	569	0.06	0.14	0.20	0.25	0.29	0.84	136	
Standard deviation	11	0.02	0.02	0.02	0.02	0.01	0.01	7	
Minimum	559	0.04	0.10	0.17	0.22	0.27	0.83	127	
Maximum	580	0.07	0.15	0.21	0.26	0.31	0.85	143	

(*) xC: x% cohesive

$$R_{u,5} = 0.81$$

$$\Delta X_{\text{mean}} = 0.98$$

5.1.4.1.2. SHEAR – RUPTURE*

a) Results for 10 samples conditioned at +23°C

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	569	0.03	0.05	0.07	0.08	0.10	0.74	246	100C
2	580	0.02	0.04	0.06	0.05	0.07	0.66	253	100C
3	570	0.01	0.02	0.03	0.04	0.07	0.66	222	100C
4	561	0.03	0.06	0.07	0.09	0.11	0.71	249	100C
5	583	0.03	0.04	0.07	0.08	0.10	0.72	256	100C
6	576	0.02	0.04	0.06	0.08	0.10	0.67	226	100C
7	574	0.02	0.04	0.06	0.08	0.09	0.66	228	100C
8	586	0.03	0.04	0.06	0.08	0.09	0.74	238	100C
9	572	0.02	0.03	0.05	0.06	0.08	0.75	241	100C
10	582	0.02	0.03	0.05	0.06	0.07	0.74	249	100C
Average	575	0.02	0.04	0.06	0.07	0.09	0.71	241	
Standard deviation	8	0.01	0.01	0.01	0.02	0.01	0.04	12	
Minimum	561	0.01	0.02	0.03	0.04	0.07	0.66	222	
Maximum	586	0.03	0.06	0.07	0.09	0.11	0.75	256	

(*) xC: x% cohesive

Ru,5 = 0.63

b) Results for 5 samples conditioned at -20°C

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	580	0.03	0.04	0.05	0.07	0.08	0.68	255	100C
2	574	0.02	0.03	0.04	0.06	0.07	0.79	290	100C
3	565	0.03	0.06	0.08	0.10	0.11	0.82	274	100C
4	554	0.02	0.03	0.04	0.05	0.06	0.91	302	100C
5	581	0.01	0.02	0.04	0.05	0.07	0.74	265	100C
Average	571	0.02	0.04	0.05	0.07	0.08	0.79	277	
Standard deviation	11	0.01	0.02	0.02	0.02	0.02	0.09	19	
Minimum	554	0.01	0.02	0.04	0.05	0.06	0.68	255	
Maximum	581	0.03	0.06	0.08	0.10	0.11	0.91	302	

(*) xC: x% cohesive

$$R_{u,5} = 0.57$$

$$\Delta X_{\text{mean}} = 1.11$$

c) Results for 5 samples conditioned at +80°C

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	603	0.02	0.03	0.05	0.07	0.09	0.60	247	100C
2	568	0.02	0.03	0.04	0.06	0.08	0.83	286	100C
3	597	0.02	0.04	0.06	0.08	0.10	0.73	227	100C
4	573	0.03	0.05	0.07	0.08	0.10	0.81	236	100C
5	580	0.02	0.02	0.04	0.06	0.08	0.72	230	100C
Average	584	0.02	0.03	0.05	0.07	0.09	0.74	245	
Standard deviation	15	0.00	0.01	0.01	0.01	0.01	0.09	24	
Minimum	568	0.02	0.02	0.04	0.06	0.08	0.60	227	
Maximum	603	0.03	0.05	0.07	0.08	0.10	0.83	286	

(*) xC: x% cohesive

$$R_{u,5} = 0.52$$

$$\Delta X_{\text{mean}} = 1.04$$

5.1.4.2. RESIDUAL MECHANICAL STRENGTH AFTER ARTIFICIAL AGEING

5.1.4.2.1 IMMERSION IN WATER AT HIGH TEMPERATURE WITH SOLAR RADIATION*

a) *Conditioning :*

- Duration : 2 x 21 days
- Water temperature : 45°C ± 0.1°C
- Conductivity of the water : 11 µs

b) *Results of the traction test after the artificial ageing :*

SMART 51/30 T

After 21 days :

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	571	0.08	0.13	0.17	0.19	0.22	0.99	397	100C
2	575	0.08	0.13	0.16	0.19	0.21	0.99	338	100C
3	565	0.07	0.13	0.16	0.19	0.22	1.08	366	100C
4	626	0.08	0.12	0.16	0.19	0.22	0.95	343	100C
5	Broken								100C
Average	584	0.08	0.13	0.16	0.19	0.22	1.00	361	
Standard deviation	28	0.01	0.01	0.01	0.00	0.01	0.06	27	
Minimum	565	0.07	0.12	0.16	0.19	0.21	0.95	338	
Maximum	626	0.08	0.13	0.17	0.19	0.22	1.08	397	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 1.16$$

After 42 days :

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	622	0.06	0.10	0.13	0.15	0.17	0.82	540	100C
2	649	0.06	0.09	0.12	0.14	0.16	0.74	550	100C
3	558	0.06	0.10	0.12	0.14	0.16	0.83	546	100C
4	546	0.06	0.09	0.12	0.14	0.16	0.78	479	100C
5	560	0.06	0.09	0.12	0.14	0.16	0.77	481	100C
Average	587	0.06	0.09	0.12	0.14	0.16	0.79	519	
Standard deviation	46	0.00	0.01	0.00	0.00	0.00	0.04	36	
Minimum	546	0.06	0.09	0.12	0.14	0.16	0.74	479	
Maximum	649	0.06	0.10	0.13	0.15	0.17	0.83	550	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 0.92$$

SMART 51/30 NT

After 21 days :

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	620	0.07	0.12	0.16	0.19	0.21	0.98	326	100C
2	589	0.08	0.13	0.17	0.20	0.23	1.09	418	100C
3	581	0.08	0.13	0.16	0.19	0.21	0.96	350	100C
4	566	0.07	0.12	0.16	0.18	0.21	0.97	356	100C
5	573	0.08	0.13	0.17	0.20	0.22	1.07	370	100C
Average	586	0.08	0.13	0.16	0.19	0.22	1.01	364	
Standard deviation	21	0.01	0.01	0.01	0.01	0.01	0.06	34	
Minimum	566	0.07	0.12	0.16	0.18	0.21	0.96	326	
Maximum	620	0.08	0.13	0.17	0.20	0.23	1.09	418	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 1.17$$

After 42 days :

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	565	0.06	0.10	0.12	0.14	0.16	0.81	448	100C
2	560	0.06	0.09	0.12	0.15	0.17	0.83	447	100C
3	541	0.07	0.10	0.13	0.15	0.17	0.83	407	100C
4	567	0.06	0.09	0.12	0.14	0.16	0.81	443	100C
5	558	0.06	0.10	0.12	0.15	0.16	0.81	545	100C
Average	558	0.06	0.10	0.12	0.15	0.16	0.82	458	
Standard deviation	10	0.00	0.01	0.00	0.01	0.01	0.01	51	
Minimum	541	0.06	0.09	0.12	0.14	0.16	0.81	407	
Maximum	567	0.07	0.10	0.13	0.15	0.17	0.83	545	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 0.95$$

5.1.4.2.2 HUMIDITY AND NaCl ATMOSPHERE*

a) *Conditioning :*

- Duration : 480 hours
- NaCl concentration : 51.3 g/l
- pH : 6.4

b) *Results of the traction test after the artificial ageing :*

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	574	0.10	0.15	0.19	0.23	0.26	0.98	238	100C
2	559	0.09	0.15	0.19	0.22	0.25	0.91	224	100C
3	617	0.06	0.13	0.18	0.22	0.26	0.83	199	100C
4	576	0.06	0.14	0.18	0.22	0.25	0.87	221	100C
5	557	0.07	0.14	0.19	0.23	0.26	1.01	268	100C
6	611	0.06	0.13	0.17	0.21	0.24	0.88	235	100C
7	580	0.07	0.14	0.19	0.24	0.27	0.96	262	100C
8	576	0.08	0.14	0.18	0.22	0.25	0.93	256	100C
9	579	0.08	0.15	0.19	0.23	0.27	0.99	259	100C
10	585	0.09	0.15	0.20	0.24	0.27	0.91	218	100C
Average	581	0.08	0.14	0.19	0.23	0.26	0.93	238	
Standard deviation	19	0.01	0.01	0.01	0.01	0.01	0.06	23	
Minimum	557	0.06	0.13	0.17	0.21	0.24	0.83	199	
Maximum	617	0.10	0.15	0.20	0.24	0.27	1.01	268	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 1.08$$

5.1.4.2.3 HUMIDITY AND SO₂ ATMOSPHERE*

a) *Conditioning :*

- Duration : 20 cycles
- 0.2l SO₂

b) *Results of the traction test after the artificial ageing :*

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	581	0.07	0.14	0.19	0.22	0.25	1.00	283	100C
2	579	0.07	0.13	0.18	0.21	0.25	0.96	266	100C
3	579	0.10	0.14	0.18	0.21	0.24	0.87	254	100C
4	585	0.08	0.14	0.19	0.22	0.25	0.96	282	100C
5	589	0.08	0.14	0.19	0.23	0.26	0.86	212	100C
6	580	0.08	0.14	0.18	0.21	0.24	0.85	229	100C
7	615	0.08	0.14	0.18	0.21	0.24	0.97	321	100C
8	580	0.09	0.15	0.19	0.23	0.26	0.98	270	100C
9	589	0.08	0.14	0.19	0.22	0.25	1.02	293	100C
10	586	0.07	0.13	0.17	0.21	0.24	1.01	306	100C
Average	586	0.08	0.14	0.18	0.22	0.25	0.95	272	
Standard deviation	11	0.01	0.01	0.01	0.01	0.01	0.06	33	
Minimum	579	0.07	0.13	0.17	0.21	0.24	0.85	212	
Maximum	615	0.10	0.15	0.19	0.23	0.26	1.02	321	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 1.10$$

5.1.4.2.4 Facade cleaning product*

a) *Conditioning :*

- Duration : 21 days
- Temperature : 45.0°C ± 0.1C
- Cleaning product : Extran (5% on water)

b) *Results of the traction test after the artificial ageing :*

Sample number	Section (mm ²)	Limited to 5% stretch. (N/mm ²)	Limited to 10 % stretch. (N/mm ²)	Limited to 15% stretch. (N/mm ²)	Limited to 20% stretch. (N/mm ²)	Limited to 25% stretch. (N/mm ²)	Limit of breakage (N/mm ²)	Stretch on breaking (%)	Type of breakage (*)
1	605	0.04	0.08	0.12	0.14	0.17	0.77	343	100C
2	577	0.05	0.10	0.14	0.17	0.19	0.94	384	100C
3	556	0.05	0.10	0.14	0.18	0.20	0.92	352	100C
4	569	0.05	0.10	0.13	0.16	0.18	0.93	470	100C
5	623	0.04	0.08	0.12	0.15	0.18	0.84	368	100C
6	566	0.04	0.08	0.11	0.14	0.16	0.92	535	100C
7	581	0.04	0.08	0.12	0.14	0.17	0.95	537	100C
8	596	0.05	0.10	0.13	0.16	0.18	0.91	420	100C
9	579	0.05	0.09	0.12	0.15	0.17	0.90	462	100C
10	586	0.05	0.09	0.12	0.15	0.17	0.82	411	100C
Average	584	0.05	0.09	0.13	0.15	0.18	0.89	428	
Standard deviation	20	0.01	0.01	0.01	0.01	0.01	0.06	71	
Minimum	556	0.04	0.08	0.11	0.14	0.16	0.77	343	
Maximum	623	0.05	0.10	0.14	0.18	0.20	0.95	537	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 1.03$$

SUMMARY

ETAG GUIDELINE TEST NUMBER	TEST	TEST CONDI- TIONS	CRITERIA				
			X _{mean} Mpa	ΔX_{mean} ≥ 0.75	K _{12.5} For $0 \leq x\% \leq 12.5$ $0.5 \leq K_{x,c}/K_x \leq 1.10$	R _{u,5}	TYPE OF BREAKAGE ($\geq 90\% C$)
5.1.4.1.1	Tension	+23°C	0.86	-	$\sigma_{12.5} = 0.20$ $K_{12.5} = 1.60$	0.73	100C
		-20°C	0.94	1.09		0.69	100C
		+80°C	0.84	0.98		0.82	100C
5.1.4.1.2	Shear	+23°C	0.71	-		0.63	100C
		-20°C	0.79	1.11		0.57	100C
		+80°C	0.74	1.04		0.52	100C
5.1.4.2.1	H ₂ O at 45°C + UV T	500 h	1.00	1.16			100C
		1000 h	0.79	0.92	$\sigma_{12.5,c} = 0.11$ $K_{12.5,c} = 0.88$ $K_{12.5,c}/K_{12.5} = 0.55$		100C
5.1.4.2.1	H ₂ O at 45°C + UV NT	500 h	1.01	1.17			100C
		1000 h	0.82	0.95	$\sigma_{12.5,c} = 0.11$ $K_{12.5,c} = 0.88$ $K_{12.5,c}/K_{12.5} = 0.55$		100C
5.1.4.2.2	H ₂ O + NaCl	480h	0.93	1.08			100C
5.1.4.2.3	H ₂ O + SO ₂	20 cycles	0.95	1.10			100C
5.1.4.2.4	Cleaning product	21 days	0.89	1.03			100C

$xC = x\%$ cohesive

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Glazing and Components - INISMa