

TEST REPORT N°2014B VEC 21635-2a

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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BELGIUM


NUMBER OF SAMPLES AND IDENTIFICATION : **Smart 51/33 – Tremco JS 562**

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+ JS 562+ SMART 51/33 T

Batch A/B : 13104914/13084344

Number of samples prepared : 73+72

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	561	0.09	0.17	0.24	0.28	0.33	1.01	192	100C
2	562	0.09	0.17	0.23	0.28	0.33	0.87	161	100C
3	579	0.08	0.16	0.21	0.26	0.30	0.78	160	100C
4	560	0.09	0.17	0.23	0.27	0.31	0.82	153	100C
5	615	0.09	0.18	0.24	0.29	0.33	0.91	200	100C
6	573	0.08	0.15	0.21	0.25	0.29	0.79	151	100C
7	563	0.10	0.18	0.23	0.28	0.32	0.81	147	100C
8	545	0.10	0.18	0.23	0.28	0.31	0.87	162	100C
9	576	0.06	0.16	0.22	0.27	0.31	0.91	168	100C
10	573	0.07	0.15	0.21	0.26	0.30	0.95	194	100C
Average	571	0.09	0.17	0.23	0.27	0.31	0.87	169	
Standard deviation	18	0.01	0.01	0.01	0.01	0.01	0.07	19	
Minimum	545	0.06	0.15	0.21	0.25	0.29	0.78	147	
Maximum	615	0.10	0.18	0.24	0.29	0.33	1.01	200	

(*) xC: x% cohesive

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

$$R_{u,5} = 0.72$$

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	559	0.09	0.17	0.23	0.27	0.31	0.84	155	100C
2	574	0.09	0.18	0.23	0.28	0.32	1.06	203	100C
3	577	0.10	0.19	0.24	0.29	0.33	1.05	204	100C
4	558	0.10	0.19	0.25	0.30	0.34	1.06	180	100C
5	576	0.07	0.16	0.22	0.27	0.31	1.05	204	100C
Average	569	0.09	0.18	0.23	0.28	0.32	1.01	189	
Standard deviation	9	0.01	0.01	0.01	0.01	0.01	0.10	22	
Minimum	558	0.07	0.16	0.22	0.27	0.31	0.84	155	
Maximum	577	0.10	0.19	0.25	0.30	0.34	1.06	204	

(*) xC: x% cohesive

$$R_{u,5} = 0.76$$

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

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	564	0.07	0.16	0.22	0.27	0.31	1.03	189	100C
2	569	0.06	0.14	0.20	0.25	0.29	0.85	135	100C
3	566	0.08	0.16	0.22	0.26	0.30	0.91	143	100C
4	552	0.06	0.14	0.20	0.25	0.29	0.71	101	100C
5	551	0.08	0.16	0.22	0.27	0.31	0.86	134	100C
Average	560	0.07	0.15	0.21	0.26	0.30	0.87	140	
Standard deviation	8	0.01	0.01	0.01	0.01	0.01	0.12	32	
Minimum	551	0.06	0.14	0.20	0.25	0.29	0.71	101	
Maximum	569	0.08	0.16	0.22	0.27	0.31	1.03	189	

(*) xC: x% cohesive

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

$$\Delta X_{\text{mean}} = 1.00$$

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	589	0.03	0.05	0.07	0.08	0.10	0.64	226	100C
2	566	0.02	0.04	0.07	0.08	0.10	0.80	265	100C
3	566	0.02	0.04	0.06	0.08	0.09	0.78	250	100C
4	580	0.03	0.05	0.07	0.09	0.10	0.73	227	100C
5	587	0.02	0.04	0.06	0.08	0.10	0.82	265	100C
6	581	0.02	0.04	0.06	0.07	0.09	0.74	255	100C
7	568	0.02	0.03	0.04	0.06	0.06	0.71	240	100C
8	583	0.02	0.03	0.04	0.05	0.07	0.73	250	100C
9	581	0.03	0.05	0.07	0.08	0.10	0.60	265	100C
10	585	0.02	0.05	0.07	0.08	0.10	0.74	227	100C
Average	579	0.02	0.04	0.06	0.08	0.09	0.73	247	
Standard deviation	9	0.00	0.01	0.01	0.01	0.01	0.07	16	
Minimum	566	0.02	0.03	0.04	0.05	0.06	0.60	226	
Maximum	586	0.03	0.06	0.07	0.09	0.11	0.75	256	

(*) xC: x% cohesive

Ru,5 = 0.58

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	570	0.02	0.04	0.05	0.07	0.08	0.63	216	100C
2	591	0.03	0.06	0.08	0.09	0.11	0.97	328	100C
3	575	0.03	0.06	0.08	0.09	0.11	0.93	339	100C
4	550	0.03	0.06	0.08	0.10	0.12	0.93	289	100C
5	578	0.03	0.05	0.06	0.08	0.09	0.75	281	100C
Average	573	0.03	0.05	0.07	0.09	0.10	0.84	291	
Standard deviation	15	0.00	0.01	0.01	0.01	0.02	0.15	49	
Minimum	550	0.02	0.04	0.05	0.07	0.08	0.63	216	
Maximum	591	0.03	0.06	0.08	0.10	0.12	0.97	339	

(*) xC: x% cohesive

$$R_{u,5} = 0.47$$

$$\Delta X_{\text{mean}} = 1.15$$

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	569	0.02	0.03	0.04	0.06	0.08	0.86	257	100C
2	563	0.02	0.04	0.06	0.07	0.09	0.72	253	100C
3	584	0.02	0.03	0.05	0.06	0.07	0.69	223	100C
4	566	0.03	0.04	0.06	0.08	0.10	0.72	222	100C
5	579	0.02	0.04	0.06	0.08	0.10	0.81	240	100C
Average	572	0.02	0.04	0.05	0.07	0.09	0.76	239	
Standard deviation	9	0.00	0.01	0.01	0.01	0.01	0.07	16	
Minimum	563	0.02	0.03	0.04	0.06	0.07	0.69	222	
Maximum	584	0.03	0.04	0.06	0.08	0.10	0.86	257	

(*) xC: x% cohesive

$$R_{u,5} = 0.59$$

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

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	557	0.05	0.11	0.15	0.18	0.21	1.13	442	100C
2	567	0.05	0.10	0.14	0.17	0.19	0.92	328	100C
3	592	0.04	0.10	0.15	0.18	0.21	0.97	301	100C
4	579	0.06	0.10	0.14	0.17	0.20	0.95	328	100C
5	577	0.05	0.11	0.15	0.18	0.21	0.95	321	100C
Average	574	0.05	0.10	0.15	0.18	0.20	0.98	344	
Standard deviation	13	0.01	0.01	0.01	0.01	0.01	0.08	56	
Minimum	557	0.04	0.10	0.14	0.17	0.19	0.92	301	
Maximum	592	0.06	0.11	0.15	0.18	0.21	1.13	442	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 1.13$$

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	571	0.05	0.09	0.12	0.15	0.17	0.81	543	100C
2	573	0.07	0.10	0.12	0.15	0.17	0.74	420	100C
3	567	0.06	0.10	0.12	0.15	0.17	0.76	426	100C
4	560	0.06	0.10	0.12	0.15	0.17	0.77	402	100C
5	570	0.06	0.10	0.12	0.14	0.16	0.76	431	100C
Average	568	0.06	0.10	0.12	0.15	0.17	0.77	445	
Standard deviation	5	0.01	0.00	0.00	0.00	0.00	0.03	56	
Minimum	560	0.05	0.09	0.12	0.14	0.16	0.74	402	
Maximum	573	0.07	0.10	0.12	0.15	0.17	0.81	543	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 0.89$$

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	545	0.06	0.12	0.16	0.19	0.22	1.08	402	100C
2	555	0.06	0.11	0.15	0.18	0.21	0.98	317	100C
3	574	0.05	0.10	0.14	0.17	0.19	1.05	417	100C
4	560	0.05	0.10	0.14	0.17	0.20	0.99	406	100C
5	564	0.05	0.10	0.14	0.17	0.20	0.95	319	100C
Average	560	0.05	0.11	0.15	0.18	0.20	1.01	372	
Standard deviation	11	0.01	0.01	0.01	0.01	0.01	0.05	50	
Minimum	545	0.05	0.10	0.14	0.17	0.19	0.95	317	
Maximum	574	0.06	0.12	0.16	0.19	0.22	1.08	417	

(*) 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	548	0.05	0.08	0.11	0.14	0.15	0.74	475	100C
2	490	0.05	0.09	0.12	0.15	0.17	0.75	359	100C
3	615	0.04	0.08	0.11	0.14	0.16	0.78	518	100C
4	580	0.05	0.08	0.11	0.14	0.15	0.69	382	100C
5	566	0.04	0.07	0.10	0.13	0.15	0.73	412	100C
Average	560	0.05	0.08	0.11	0.14	0.16	0.74	429	
Standard deviation	46	0.01	0.01	0.01	0.01	0.01	0.03	66	
Minimum	490	0.04	0.07	0.10	0.13	0.15	0.69	359	
Maximum	615	0.05	0.09	0.12	0.15	0.17	0.78	518	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 0.85$$

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	597	0.07	0.14	0.19	0.23	0.26	0.86	225	100C
2	580	0.09	0.15	0.19	0.23	0.26	0.96	282	100C
3	580	0.07	0.14	0.18	0.22	0.25	0.78	187	100C
4	579	0.09	0.15	0.20	0.24	0.27	0.93	234	100C
5	586	0.06	0.14	0.20	0.24	0.27	1.09	270	100C
6	607	0.05	0.13	0.18	0.23	0.26	1.09	288	100C
7	586	0.05	0.13	0.18	0.21	0.25	0.87	219	100C
8	568	0.08	0.15	0.20	0.24	0.27	0.98	234	100C
9	569	0.05	0.13	0.19	0.23	0.26	1.04	271	100C
10	577	0.08	0.15	0.20	0.25	0.28	0.94	209	100C
Average	583	0.07	0.14	0.19	0.23	0.26	0.95	242	
Standard deviation	12	0.02	0.01	0.01	0.01	0.01	0.10	34	
Minimum	568	0.05	0.13	0.18	0.21	0.25	0.78	187	
Maximum	607	0.09	0.15	0.20	0.25	0.28	1.09	288	

(*) xC: x% cohesive

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

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	575	0.09	0.15	0.19	0.22	0.25	0.84	210	100C
2	574	0.08	0.14	0.19	0.23	0.26	1.02	257	100C
3	584	0.09	0.14	0.18	0.22	0.24	0.86	239	100C
4	577	0.09	0.15	0.20	0.23	0.26	1.04	311	100C
5	568	0.06	0.13	0.18	0.22	0.25	1.03	283	100C
6	576	0.06	0.13	0.18	0.22	0.25	0.93	265	100C
7	573	0.08	0.15	0.20	0.23	0.26	1.01	270	100C
8	584	0.08	0.14	0.18	0.21	0.24	0.89	245	100C
9	568	0.07	0.13	0.18	0.21	0.24	0.88	234	100C
10	580	0.09	0.15	0.19	0.22	0.25	0.91	273	100C
Average	576	0.08	0.14	0.19	0.22	0.25	0.94	259	
Standard deviation	6	0.01	0.01	0.01	0.01	0.01	0.08	29	
Minimum	568	0.06	0.13	0.18	0.21	0.24	0.84	210	
Maximum	584	0.09	0.15	0.20	0.23	0.26	1.04	311	

(*) xC: x% cohesive

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

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	574	0.05	0.09	0.12	0.15	0.17	0.91	456	100C
2	581	0.05	0.09	0.13	0.16	0.18	1.22	567	100C
3	561	0.05	0.09	0.12	0.14	0.16	0.82	378	100C
4	586	0.05	0.10	0.13	0.15	0.17	0.92	439	100C
5	576	0.05	0.09	0.13	0.15	0.17	0.81	493	100C
6	584	0.05	0.09	0.12	0.14	0.16	0.81	389	100C
7	625	0.04	0.08	0.12	0.14	0.16	0.91	466	100C
8	572	0.05	0.09	0.12	0.15	0.17	1.03	493	100C
9	578	0.04	0.08	0.11	0.14	0.16	0.94	502	100C
10	574	0.04	0.09	0.12	0.15	0.17	0.99	505	100C
Average	581	0.05	0.09	0.12	0.15	0.17	0.94	469	
Standard deviation	17	0.00	0.01	0.01	0.01	0.01	0.12	56	
Minimum	561	0.04	0.08	0.11	0.14	0.16	0.81	378	
Maximum	625	0.05	0.10	0.13	0.16	0.18	1.22	567	

(*) xC: x% cohesive

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

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	0.87	-	$\sigma_{12.5} = 0.20$ $K_{12.5} = 1.60$	0.72	100C
		-20°C	1.01	1.16		0.76	100C
		+80°C	0.87	1.00		0.57	100C
5.1.4.1.2	Shear	+23°C	0.73	-		0.58	100C
		-20°C	0.84	1.15		0.47	100C
		+80°C	0.76	1.04		0.59	100C
5.1.4.2.1	H ₂ O at 45°C + UV T	500 h	0.98	1.13			100C
		1000 h	0.77	0.89	$\sigma_{12.5,c} = 0.11$ $K_{12.5,c} = 0.88$ $K_{12.5,c}/K_{12.5} = 0.55$		100C
5.1.4.2.1	H ₂ O at 45°C + UV NT	500 h	1.01	1.16			100C
		1000 h	0.74	0.85	$\sigma_{12.5,c} = 0.10$ $K_{12.5,c} = 0.80$ $K_{12.5,c}/K_{12.5} = 0.50$		100C
5.1.4.2.2	H ₂ O + NaCl	480h	0.95	1.09			100C
5.1.4.2.3	H ₂ O + SO ₂	20 cycles	0.94	1.08			100C
5.1.4.2.4	Cleaning product	21 days	0.94	1.08			100C

x_C = x% cohesive

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Glazing and Components - INISMa