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TEST REPORT N°2013B VEC 18674-1

Including 13 pages + 1 annex
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Mons, September 04th, 2013

REQUESTED BY : **AGC Glass Europe - R&D Centre**
2 rue de l'Aurore
B-6040 Jumet
Belgium

REFERENCE OF THE REQUEST : Order 450434334

CONCERNED MANUFACTURER : **AGC GLASS EUROPE**
Chaussée de la Hulpe, 166
1170 BRUXELLES
BELGIUM


NUMBER OF SAMPLES AND IDENTIFICATION : **SMART 30 - DC 3362 HD**

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

SAMPLES RECEIVED ON : 07/05/2013

TESTING DATE : From 12/06/2013

REMARKS : * Test under BELAC accreditation

 Notified body (Id.N°1174)
**according to ART.18 of the « Construction Products Directive » CPD
89/106/EEC**

TECHNICAL REPORT
ADHESION PERFORMANCES ACCORDING TO ETAG 002
GUIDELINE

SAMPLES

Samples were prepared by Dow Corning on 13/12/2012 (see annex 1)

SMART 30 T – DC 3362HD – SMART 30 NT

Batch : A : N13121203 / B : 0006937135

Number of samples prepared : 90

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	596	0.35	0.64	0.85	1.02	1.17	1.32	33	100C
2	600	0.39	0.66	0.86	1.03	1.18	1.30	32	100C
3	602	0.41	0.68	0.87	1.04	1.18	1.34	33	100C
4	584	0.26	0.64	0.87	1.05	1.21	1.38	33	100C
5	598	0.37	0.65	0.86	1.04	1.19	1.37	34	100C
6	604	0.38	0.69	0.89	1.06	1.21	1.30	30	100C
7	618	0.21	0.59	0.81	0.99	1.15	1.30	32	100C
8	594	0.35	0.67	0.88	1.05	1.19	1.22	27	100C
9	596	0.37	0.68	0.90	1.08	1.23	1.37	32	100C
10									
Average	599	0.34	0.66	0.87	1.04	1.19	1.32	32	
Standard deviation	9	0.07	0.03	0.03	0.03	0.02	0.05	2	
Minimum	584	0.21	0.59	0.81	0.99	1.15	1.22	27	
Maximum	618	0.41	0.69	0.90	1.08	1.23	1.38	34	

(*) xC: x% cohesive / xA: x% adhesive

Ru,5 = 1.22

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	597	0.44	0.77	0.99	1.17	1.31	1.44	32	100C
2	620	0.46	0.77	0.97	1.15	1.29	1.54	39	100C
3	596	0.52	0.86	1.07	1.26	1.41	1.66	39	100C
4	596	0.51	0.84	1.07	1.25	1.39	1.48	32	100C
5	584	0.46	0.77	0.98	1.16	1.31	1.57	39	100C
Average	599	0.48	0.80	1.02	1.20	1.34	1.54	36	
Standard deviation	13	0.03	0.04	0.05	0.05	0.05	0.08	4	
Minimum	584	0.44	0.77	0.97	1.15	1.29	1.44	32	
Maximum	620	0.52	0.86	1.07	1.26	1.41	1.66	39	

(*) xC: x% cohesive / xA : x% adhesive

$$Ru,5 = 1.34$$

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

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	584	0.38	0.70	0.94	1.14	1.18	1.26	24	100C
2	601	0.37	0.68	0.89	0.99	-	1.01	19	100C
3	590	0.34	0.67	0.90	1.09	1.08	1.20	24	100C
4	601	0.37	0.68	0.90	1.10	1.26	1.26	25	100C
5	590	0.26	0.63	0.87	1.07	1.21	1.22	25	100C
Average	593	0.34	0.67	0.90	1.08	1.18	1.19	23	
Standard deviation	7	0.05	0.03	0.03	0.06	0.08	0.10	3	
Minimum	584	0.26	0.63	0.87	0.99	1.08	1.01	19	
Maximum	601	0.38	0.70	0.94	1.14	1.26	1.26	25	

(*) xC: x% cohesive / xA: x% adhesive

$$Ru,5 = 0.94$$

$$\Delta X_{mean} = 0.90$$

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	592	0.12	0.21	0.27	0.33	0.36	0.91	86	100C
2	588	0.07	0.18	0.25	0.31	0.37	0.90	84	100C
3	596	0.07	0.18	0.25	0.32	0.37	0.83	86	100C
4	585	0.06	0.15	0.23	0.29	0.35	0.78	87	100C
5	594	0.07	0.18	0.25	0.31	0.37	0.79	81	100C
6	594	0.09	0.18	0.25	0.31	0.37	0.81	71	100C
7	598	0.09	0.20	0.27	0.33	0.39	0.80	89	100C
8	581	0.08	0.19	0.26	0.32	0.38	0.85	76	100C
9	592	0.12	0.22	0.29	0.35	0.40	0.84	86	100C
10									100C
Average	591	0.09	0.19	0.26	0.32	0.37	0.83	83	
Standard deviation	5	0.02	0.02	0.02	0.02	0.02	0.05	6	
Minimum	581	0.06	0.15	0.23	0.29	0.35	0.78	71	
Maximum	598	0.12	0.22	0.29	0.35	0.40	0.91	89	

(*) xC: x% cohesive / xA: x% adhesive

Ru,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	606	0.02	0.05	0.13	0.20	0.27	0.96	90	100C
2	589	0.08	0.22	0.30	0.37	0.43	1.00	91	100C
3	583	0.06	0.17	0.27	0.34	0.40	1.00	103	100C
4	586	0.06	0.14	0.21	0.30	0.37	1.01	100	100C
5	593	0.12	0.21	0.29	0.36	0.42	0.99	98	100C
Average	591	0.07	0.16	0.24	0.31	0.38	0.99	96	
Standard deviation	9	0.04	0.07	0.07	0.07	0.06	0.02	6	
Minimum	583	0.02	0.05	0.13	0.20	0.27	0.96	90	
Maximum	606	0.12	0.22	0.30	0.37	0.43	1.01	103	

(*) xC: x% cohesive / xA: x% adhesive

$$R_{u,5} = 0.94$$

$$\Delta X_{\text{mean}} = 1.19$$

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	587	0.11	0.20	0.27	0.34	0.40	0.65	47	85C15A NT
2	590	0.03	0.07	0.13	0.19	0.26	0.77	77	100C
3	587	0.11	0.21	0.29	0.35	0.41	0.66	49	100C
4	585	0.04	0.07	0.10	0.18	0.26	0.75	70	100C
5	585	0.09	0.19	0.26	0.33	0.39	0.70	58	90C10A NT
Average	587	0.08	0.15	0.21	0.28	0.34	0.71	60	
Standard deviation	2	0.04	0.07	0.09	0.09	0.08	0.05	13	
Minimum	585	0.03	0.07	0.10	0.18	0.26	0.65	47	
Maximum	590	0.11	0.21	0.29	0.35	0.41	0.77	77	

(*) xC: x% cohesive / xA: x% adhesive

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

$$\Delta X_{\text{mean}} = 0.86$$

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 : 45.0°C ± 0.1°C
- Conductivity of the water : 6.2 µs

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

SMART 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	584	0.34	0.57	0.73	0.87	0.99	1.08	32	80C20A NT
2	584	0.34	0.56	0.72	0.86	0.99	1.20	37	100C
3	592	0.33	0.55	0.72	0.86	0.99	1.20	37	100C
4	611	0.31	0.53	0.69	0.83	0.96	1.10	34	100C
5	604	0.12	0.38	0.57	0.72	0.85	1.04	36	100C
Average	595	0.29	0.52	0.69	0.83	0.96	1.12	35	
Standard deviation	12	0.09	0.08	0.07	0.06	0.06	0.07	2	
Minimum	584	0.12	0.38	0.57	0.72	0.85	1.04	32	
Maximum	611	0.34	0.57	0.73	0.87	0.99	1.20	37	

(*) xC: x% cohesive / xA: x% adhesive

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

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	588	0.42	0.63	0.79	0.93	1.06	1.24	35	100C
2	574	0.40	0.59	0.75	0.89	1.01	1.17	34	100C
3	583	0.38	0.60	0.77	0.92	1.05	1.23	35	100C
4	580	0.38	0.61	0.79	0.93	1.07	1.25	36	100C
5	581	0.43	0.63	0.79	0.94	1.06	1.24	36	100C
Average	581	0.40	0.61	0.78	0.92	1.05	1.23	35	
Standard deviation	5	0.02	0.02	0.02	0.02	0.02	0.03	1	
Minimum	574	0.38	0.59	0.75	0.89	1.01	1.17	34	
Maximum	588	0.43	0.63	0.79	0.94	1.07	1.25	36	

(*) xC: x% cohesive / xA: x% adhesive

$\Delta X_{\text{mean}} = 0.93$

SMART 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	606	0.32	0.55	0.71	0.85	0.97	1.12	34	100C
2	593	0.33	0.55	0.72	0.87	1.00	1.22	38	100C
3	596	0.29	0.53	0.70	0.84	0.97	1.18	37	100C
4	579	0.35	0.58	0.74	0.88	1.00	1.12	33	100C
5	589	0.33	0.57	0.74	0.88	1.01	1.16	34	100C
Average	592	0.32	0.56	0.72	0.86	0.99	1.16	35	
Standard deviation	10	0.02	0.02	0.02	0.02	0.02	0.04	2	
Minimum	579	0.29	0.53	0.70	0.84	0.97	1.12	33	
Maximum	606	0.35	0.58	0.74	0.88	1.01	1.22	38	

(*) xC: x% cohesive / xA: x% adhesive

$$\Delta X_{\text{mean}} = 0.88$$

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	585	0.42	0.64	0.80	0.94	1.04	1.11	32	15C85A
2	583	0.42	0.62	0.79	0.93	1.06	1.20	33	100C
3	584	0.45	0.66	0.82	0.95	1.08	1.18	32	100C
4	604	0.42	0.63	0.79	0.93	1.06	1.14	29	100C
5	591	0.44	0.64	0.80	0.94	1.07	1.19	33	100C
Average	639	0.15	0.29	0.40	0.49	0.56	0.87	48	
Standard deviation	22	0.01	0.02	0.02	0.03	0.03	0.15	7	
Minimum	613	0.13	0.26	0.36	0.44	0.51	0.61	37	
Maximum	663	0.16	0.30	0.41	0.51	0.59	1.00	55	

(*) xC: x% cohesive / xA: x% adhesive

$$\Delta X_{\text{mean}} = 0.88$$

5.1.4.2.2 HUMIDITY AND NaCl ATMOSPHERE*

a) *Conditioning :*

- Duration : 480 hours
- NaCl concentration : 48.5 g/l
- pH : 6.7

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	0.49	0.72	0.90	1.05	1.18	1.24	29	100C
2	573	0.41	0.68	0.87	1.03	1.17	1.33	33	100C
3	592	0.43	0.66	0.85	1.01	1.13	1.20	30	100C
4	607	0.36	0.61	0.80	0.97	1.11	1.31	36	100C
5	607	0.39	0.63	0.82	0.98	1.13	1.27	32	100C
6	607	0.45	0.69	0.87	1.02	1.16	1.27	31	100C
7	597	0.45	0.68	0.86	1.02	1.16	1.36	36	100C
8	595	0.39	0.64	0.84	1.00	1.15	1.32	34	100C
9	604	0.41	0.67	0.86	1.02	1.16	1.35	35	100C
10	593	0.36	0.60	0.79	0.95	1.09	1.21	32	100C
Average	597	0.41	0.66	0.85	1.01	1.14	1.29	33	
Standard deviation	10	0.04	0.04	0.03	0.03	0.03	0.06	3	
Minimum	573	0.36	0.60	0.79	0.95	1.09	1.20	29	
Maximum	607	0.49	0.72	0.90	1.05	1.18	1.36	36	

(*) xC: x% cohesive / xA: x% adhesive

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

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	601	0.42	0.64	0.82	0.97	1.09	1.23	34	100C
2	604	0.37	0.62	0.80	0.96	1.08	1.17	31	100C
3	591	0.34	0.57	0.75	0.89	0.99	1.02	28	100C
4	600	0.42	0.65	0.83	0.98	1.11	1.21	31	100C
5	579	0.40	0.64	0.83	0.99	1.13	1.29	33	100C
6	569	0.43	0.68	0.87	1.03	1.17	1.28	31	100C
7	556	0.36	0.63	0.83	1.00	1.15	1.34	34	100C
8	556	0.51	0.75	0.94	1.09	1.21	1.27	30	100C
9	610	0.48	0.69	0.86	1.01	1.13	1.19	29	100C
10	596	0.43	0.66	0.83	0.98	1.11	1.16	28	100C
Average	586	0.42	0.65	0.84	0.99	1.12	1.22	31	
Standard deviation	20	0.05	0.05	0.05	0.05	0.06	0.09	2	
Minimum	556	0.34	0.57	0.75	0.89	0.99	1.02	28	
Maximum	610	0.51	0.75	0.94	1.09	1.21	1.34	34	

(*) xC: x% cohesive / xA: x% adhesive

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

5.1.4.2.4 Facade cleaning product*

a) *Conditioning :*

- Duration : 21 days
- Temperature : 45.6°C ± 0.9°C
- 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	604	0.33	0.54	0.72	0.87	1.01	1.25	36	100C
2	574	0.47	0.68	0.85	1.00	1.13	1.32	33	100C
3	579	0.48	0.71	0.88	1.03	1.17	1.44	39	100C
4	585	0.47	0.67	0.84	0.98	1.10	1.23	35	100C
5	609	0.34	0.58	0.75	0.90	1.03	1.34	42	100C
6	592	0.39	0.64	0.82	0.98	1.11	1.40	41	100C
7	602	0.42	0.63	0.79	0.94	1.06	1.31	40	100C
8	603	0.38	0.61	0.78	0.93	1.06	1.32	39	100C
9	585	0.41	0.64	0.81	0.96	1.10	1.37	40	100C
10	587	0.38	0.61	0.79	0.93	1.07	1.27	37	100C
Average	592	0.41	0.63	0.80	0.95	1.08	1.33	38	
Standard deviation	12	0.05	0.05	0.05	0.05	0.05	0.07	3	
Minimum	574	0.33	0.54	0.72	0.87	1.01	1.23	33	
Maximum	609	0.48	0.71	0.88	1.03	1.17	1.44	42	

(*) xC: x% cohesive / xA: x% adhesive

$$\Delta X_{\text{mean}} = 1.01$$

SUMMARY

ETAG GUIDELINE TEST NUMBER	TEST	TEST CONDITIO NS	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	1.32	-	$\sigma_{12.5} = 0.72$ K _{12.5} = 5.72	1.22	100C
		-20°C	1.54	1.17		1.34	100C
		+80°C	1.19	0.90		0.94	100C
5.1.4.1.2	Shear	+23°C	0.83	-		0.73	100C
		-20°C	0.99	1.19		0.94	100C
		+80°C	0.71	0.86		0.59	95C
5.1.4.2.1	H ₂ O + UV SMART- 30 T face at 45°C	500 h	1.12	0.85			96C
		1000 h	1.23	0.93	$\sigma_{12.5,c} = 0.67$ K _{12.5,c} = 5.38 K _{12.5,c} /K _{12.5} = 0.94		100C
5.1.4.2.1	H ₂ O + UV SMART- 30 NT face at 45°C	500 h	1.16	0.88			100C
		1000 h	1.16	0.88	$\sigma_{12.5,c} = 0.70$ K _{12.5,c} = 5.56 K _{12.5,c} /K _{12.5} = 0.97		83C
5.1.4.2.2	H ₂ O + NaCl	480h	1.29	0.98			100C
5.1.4.2.3	H ₂ O + SO ₂	20 cycles	1.22	0.92			100C
5.1.4.2.4	Cleaning product	21 days	1.33	1.01			90C

(*) xC: x% cohesive

D. LIBERT
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RC MONS : 130.828 - Registration : 08/02/01

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TEST REPORT N°2013B VEC 18674-1

Including 13 pages + 1 annex
Page 1/13

Mons, September 04th, 2013

REQUESTED BY : **AGC Glass Europe - R&D Centre**
2 rue de l'Aurore
B-6040 Jumet
Belgium

REFERENCE OF THE REQUEST : Order 450434334

CONCERNED MANUFACTURER : **AGC GLASS EUROPE**
Chaussée de la Hulpe, 166
1170 BRUXELLES
BELGIUM


NUMBER OF SAMPLES AND IDENTIFICATION : **SMART 30 - DC 3362 HD**

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

SAMPLES RECEIVED ON : 07/05/2013

TESTING DATE : From 12/06/2013

REMARKS : * Test under BELAC accreditation

 Notified body (Id.N°1174)
**according to ART.18 of the « Construction Products Directive » CPD
89/106/EEC**

TECHNICAL REPORT
ADHESION PERFORMANCES ACCORDING TO ETAG 002
GUIDELINE

SAMPLES

Samples were prepared by Dow Corning on 13/12/2012 (see annex 1)

SMART 30 T – DC 3362HD – SMART 30 NT

Batch : A : N13121203 / B : 0006937135

Number of samples prepared : 90

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	596	0.35	0.64	0.85	1.02	1.17	1.32	33	100C
2	600	0.39	0.66	0.86	1.03	1.18	1.30	32	100C
3	602	0.41	0.68	0.87	1.04	1.18	1.34	33	100C
4	584	0.26	0.64	0.87	1.05	1.21	1.38	33	100C
5	598	0.37	0.65	0.86	1.04	1.19	1.37	34	100C
6	604	0.38	0.69	0.89	1.06	1.21	1.30	30	100C
7	618	0.21	0.59	0.81	0.99	1.15	1.30	32	100C
8	594	0.35	0.67	0.88	1.05	1.19	1.22	27	100C
9	596	0.37	0.68	0.90	1.08	1.23	1.37	32	100C
10									
Average	599	0.34	0.66	0.87	1.04	1.19	1.32	32	
Standard deviation	9	0.07	0.03	0.03	0.03	0.02	0.05	2	
Minimum	584	0.21	0.59	0.81	0.99	1.15	1.22	27	
Maximum	618	0.41	0.69	0.90	1.08	1.23	1.38	34	

(*) xC: x% cohesive / xA: x% adhesive

Ru,5 = 1.22

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	597	0.44	0.77	0.99	1.17	1.31	1.44	32	100C
2	620	0.46	0.77	0.97	1.15	1.29	1.54	39	100C
3	596	0.52	0.86	1.07	1.26	1.41	1.66	39	100C
4	596	0.51	0.84	1.07	1.25	1.39	1.48	32	100C
5	584	0.46	0.77	0.98	1.16	1.31	1.57	39	100C
Average	599	0.48	0.80	1.02	1.20	1.34	1.54	36	
Standard deviation	13	0.03	0.04	0.05	0.05	0.05	0.08	4	
Minimum	584	0.44	0.77	0.97	1.15	1.29	1.44	32	
Maximum	620	0.52	0.86	1.07	1.26	1.41	1.66	39	

(*) xC: x% cohesive / xA : x% adhesive

$$Ru,5 = 1.34$$

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

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	584	0.38	0.70	0.94	1.14	1.18	1.26	24	100C
2	601	0.37	0.68	0.89	0.99	-	1.01	19	100C
3	590	0.34	0.67	0.90	1.09	1.08	1.20	24	100C
4	601	0.37	0.68	0.90	1.10	1.26	1.26	25	100C
5	590	0.26	0.63	0.87	1.07	1.21	1.22	25	100C
Average	593	0.34	0.67	0.90	1.08	1.18	1.19	23	
Standard deviation	7	0.05	0.03	0.03	0.06	0.08	0.10	3	
Minimum	584	0.26	0.63	0.87	0.99	1.08	1.01	19	
Maximum	601	0.38	0.70	0.94	1.14	1.26	1.26	25	

(*) xC: x% cohesive / xA: x% adhesive

$$Ru,5 = 0.94$$

$$\Delta X_{mean} = 0.90$$

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	592	0.12	0.21	0.27	0.33	0.36	0.91	86	100C
2	588	0.07	0.18	0.25	0.31	0.37	0.90	84	100C
3	596	0.07	0.18	0.25	0.32	0.37	0.83	86	100C
4	585	0.06	0.15	0.23	0.29	0.35	0.78	87	100C
5	594	0.07	0.18	0.25	0.31	0.37	0.79	81	100C
6	594	0.09	0.18	0.25	0.31	0.37	0.81	71	100C
7	598	0.09	0.20	0.27	0.33	0.39	0.80	89	100C
8	581	0.08	0.19	0.26	0.32	0.38	0.85	76	100C
9	592	0.12	0.22	0.29	0.35	0.40	0.84	86	100C
10									100C
Average	591	0.09	0.19	0.26	0.32	0.37	0.83	83	
Standard deviation	5	0.02	0.02	0.02	0.02	0.02	0.05	6	
Minimum	581	0.06	0.15	0.23	0.29	0.35	0.78	71	
Maximum	598	0.12	0.22	0.29	0.35	0.40	0.91	89	

(*) xC: x% cohesive / xA: x% adhesive

Ru,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	606	0.02	0.05	0.13	0.20	0.27	0.96	90	100C
2	589	0.08	0.22	0.30	0.37	0.43	1.00	91	100C
3	583	0.06	0.17	0.27	0.34	0.40	1.00	103	100C
4	586	0.06	0.14	0.21	0.30	0.37	1.01	100	100C
5	593	0.12	0.21	0.29	0.36	0.42	0.99	98	100C
Average	591	0.07	0.16	0.24	0.31	0.38	0.99	96	
Standard deviation	9	0.04	0.07	0.07	0.07	0.06	0.02	6	
Minimum	583	0.02	0.05	0.13	0.20	0.27	0.96	90	
Maximum	606	0.12	0.22	0.30	0.37	0.43	1.01	103	

(*) xC: x% cohesive / xA: x% adhesive

$$R_{u,5} = 0.94$$

$$\Delta X_{\text{mean}} = 1.19$$

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	587	0.11	0.20	0.27	0.34	0.40	0.65	47	85C15A NT
2	590	0.03	0.07	0.13	0.19	0.26	0.77	77	100C
3	587	0.11	0.21	0.29	0.35	0.41	0.66	49	100C
4	585	0.04	0.07	0.10	0.18	0.26	0.75	70	100C
5	585	0.09	0.19	0.26	0.33	0.39	0.70	58	90C10A NT
Average	587	0.08	0.15	0.21	0.28	0.34	0.71	60	
Standard deviation	2	0.04	0.07	0.09	0.09	0.08	0.05	13	
Minimum	585	0.03	0.07	0.10	0.18	0.26	0.65	47	
Maximum	590	0.11	0.21	0.29	0.35	0.41	0.77	77	

(*) xC: x% cohesive / xA: x% adhesive

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

$$\Delta X_{\text{mean}} = 0.86$$

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 : 45.0°C ± 0.1°C
- Conductivity of the water : 6.2 µs

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

SMART 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	584	0.34	0.57	0.73	0.87	0.99	1.08	32	80C20A NT
2	584	0.34	0.56	0.72	0.86	0.99	1.20	37	100C
3	592	0.33	0.55	0.72	0.86	0.99	1.20	37	100C
4	611	0.31	0.53	0.69	0.83	0.96	1.10	34	100C
5	604	0.12	0.38	0.57	0.72	0.85	1.04	36	100C
Average	595	0.29	0.52	0.69	0.83	0.96	1.12	35	
Standard deviation	12	0.09	0.08	0.07	0.06	0.06	0.07	2	
Minimum	584	0.12	0.38	0.57	0.72	0.85	1.04	32	
Maximum	611	0.34	0.57	0.73	0.87	0.99	1.20	37	

(*) xC: x% cohesive / xA: x% adhesive

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

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	588	0.42	0.63	0.79	0.93	1.06	1.24	35	100C
2	574	0.40	0.59	0.75	0.89	1.01	1.17	34	100C
3	583	0.38	0.60	0.77	0.92	1.05	1.23	35	100C
4	580	0.38	0.61	0.79	0.93	1.07	1.25	36	100C
5	581	0.43	0.63	0.79	0.94	1.06	1.24	36	100C
Average	581	0.40	0.61	0.78	0.92	1.05	1.23	35	
Standard deviation	5	0.02	0.02	0.02	0.02	0.02	0.03	1	
Minimum	574	0.38	0.59	0.75	0.89	1.01	1.17	34	
Maximum	588	0.43	0.63	0.79	0.94	1.07	1.25	36	

(*) xC: x% cohesive / xA: x% adhesive

$\Delta X_{\text{mean}} = 0.93$

SMART 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	606	0.32	0.55	0.71	0.85	0.97	1.12	34	100C
2	593	0.33	0.55	0.72	0.87	1.00	1.22	38	100C
3	596	0.29	0.53	0.70	0.84	0.97	1.18	37	100C
4	579	0.35	0.58	0.74	0.88	1.00	1.12	33	100C
5	589	0.33	0.57	0.74	0.88	1.01	1.16	34	100C
Average	592	0.32	0.56	0.72	0.86	0.99	1.16	35	
Standard deviation	10	0.02	0.02	0.02	0.02	0.02	0.04	2	
Minimum	579	0.29	0.53	0.70	0.84	0.97	1.12	33	
Maximum	606	0.35	0.58	0.74	0.88	1.01	1.22	38	

(*) xC: x% cohesive / xA: x% adhesive

$$\Delta X_{\text{mean}} = 0.88$$

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	585	0.42	0.64	0.80	0.94	1.04	1.11	32	15C85A
2	583	0.42	0.62	0.79	0.93	1.06	1.20	33	100C
3	584	0.45	0.66	0.82	0.95	1.08	1.18	32	100C
4	604	0.42	0.63	0.79	0.93	1.06	1.14	29	100C
5	591	0.44	0.64	0.80	0.94	1.07	1.19	33	100C
Average	639	0.15	0.29	0.40	0.49	0.56	0.87	48	
Standard deviation	22	0.01	0.02	0.02	0.03	0.03	0.15	7	
Minimum	613	0.13	0.26	0.36	0.44	0.51	0.61	37	
Maximum	663	0.16	0.30	0.41	0.51	0.59	1.00	55	

(*) xC: x% cohesive / xA: x% adhesive

$$\Delta X_{\text{mean}} = 0.88$$

5.1.4.2.2 HUMIDITY AND NaCl ATMOSPHERE*

a) *Conditioning :*

- Duration : 480 hours
- NaCl concentration : 48.5 g/l
- pH : 6.7

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	0.49	0.72	0.90	1.05	1.18	1.24	29	100C
2	573	0.41	0.68	0.87	1.03	1.17	1.33	33	100C
3	592	0.43	0.66	0.85	1.01	1.13	1.20	30	100C
4	607	0.36	0.61	0.80	0.97	1.11	1.31	36	100C
5	607	0.39	0.63	0.82	0.98	1.13	1.27	32	100C
6	607	0.45	0.69	0.87	1.02	1.16	1.27	31	100C
7	597	0.45	0.68	0.86	1.02	1.16	1.36	36	100C
8	595	0.39	0.64	0.84	1.00	1.15	1.32	34	100C
9	604	0.41	0.67	0.86	1.02	1.16	1.35	35	100C
10	593	0.36	0.60	0.79	0.95	1.09	1.21	32	100C
Average	597	0.41	0.66	0.85	1.01	1.14	1.29	33	
Standard deviation	10	0.04	0.04	0.03	0.03	0.03	0.06	3	
Minimum	573	0.36	0.60	0.79	0.95	1.09	1.20	29	
Maximum	607	0.49	0.72	0.90	1.05	1.18	1.36	36	

(*) xC: x% cohesive / xA: x% adhesive

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

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	601	0.42	0.64	0.82	0.97	1.09	1.23	34	100C
2	604	0.37	0.62	0.80	0.96	1.08	1.17	31	100C
3	591	0.34	0.57	0.75	0.89	0.99	1.02	28	100C
4	600	0.42	0.65	0.83	0.98	1.11	1.21	31	100C
5	579	0.40	0.64	0.83	0.99	1.13	1.29	33	100C
6	569	0.43	0.68	0.87	1.03	1.17	1.28	31	100C
7	556	0.36	0.63	0.83	1.00	1.15	1.34	34	100C
8	556	0.51	0.75	0.94	1.09	1.21	1.27	30	100C
9	610	0.48	0.69	0.86	1.01	1.13	1.19	29	100C
10	596	0.43	0.66	0.83	0.98	1.11	1.16	28	100C
Average	586	0.42	0.65	0.84	0.99	1.12	1.22	31	
Standard deviation	20	0.05	0.05	0.05	0.05	0.06	0.09	2	
Minimum	556	0.34	0.57	0.75	0.89	0.99	1.02	28	
Maximum	610	0.51	0.75	0.94	1.09	1.21	1.34	34	

(*) xC: x% cohesive / xA: x% adhesive

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

5.1.4.2.4 Facade cleaning product*

a) *Conditioning :*

- Duration : 21 days
- Temperature : 45.6°C ± 0.9°C
- 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	604	0.33	0.54	0.72	0.87	1.01	1.25	36	100C
2	574	0.47	0.68	0.85	1.00	1.13	1.32	33	100C
3	579	0.48	0.71	0.88	1.03	1.17	1.44	39	100C
4	585	0.47	0.67	0.84	0.98	1.10	1.23	35	100C
5	609	0.34	0.58	0.75	0.90	1.03	1.34	42	100C
6	592	0.39	0.64	0.82	0.98	1.11	1.40	41	100C
7	602	0.42	0.63	0.79	0.94	1.06	1.31	40	100C
8	603	0.38	0.61	0.78	0.93	1.06	1.32	39	100C
9	585	0.41	0.64	0.81	0.96	1.10	1.37	40	100C
10	587	0.38	0.61	0.79	0.93	1.07	1.27	37	100C
Average	592	0.41	0.63	0.80	0.95	1.08	1.33	38	
Standard deviation	12	0.05	0.05	0.05	0.05	0.05	0.07	3	
Minimum	574	0.33	0.54	0.72	0.87	1.01	1.23	33	
Maximum	609	0.48	0.71	0.88	1.03	1.17	1.44	42	

(*) *x*C: *x*% cohesive / *x*A: *x*% adhesive

$$\Delta X_{\text{mean}} = 1.01$$

SUMMARY

ETAG GUIDELINE TEST NUMBER	TEST	TEST CONDITIO NS	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	1.32	-	$\sigma_{12.5}=0.72$ K _{12.5} = 5.72	1.22	100C
		-20°C	1.54	1.17		1.34	100C
		+80°C	1.19	0.90		0.94	100C
5.1.4.1.2	Shear	+23°C	0.83	-		0.73	100C
		-20°C	0.99	1.19		0.94	100C
		+80°C	0.71	0.86		0.59	95C
5.1.4.2.1	H ₂ O + UV SMART- 30 T face at 45°C	500 h	1.12	0.85			96C
		1000 h	1.23	0.93	$\sigma_{12.5,c}=0.67$ K _{12.5,c} = 5.38 K _{12.5,c} /K _{12.5} = 0.94		100C
5.1.4.2.1	H ₂ O + UV SMART- 30 NT face at 45°C	500 h	1.16	0.88			100C
		1000 h	1.16	0.88	$\sigma_{12.5,c}=0.70$ K _{12.5,c} = 5.56 K _{12.5,c} /K _{12.5} = 0.97		83C
5.1.4.2.2	H ₂ O + NaCl	480h	1.29	0.98			100C
5.1.4.2.3	H ₂ O + SO ₂	20 cycles	1.22	0.92			100C
5.1.4.2.4	Cleaning product	21 days	1.33	1.01			90C

(*) xC: x% cohesive

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Glazing and Components - INISMa