

TEST REPORT N°2012B VEC 15047a

Including 13 pages + 1 annex
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Mons, May 7th, 2012

REQUESTED BY : **AGC Glass Europe - R&D Centre**
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B-6040 Jumet
Belgium

REFERENCE OF THE REQUEST : Koen Bulckaen – offer 04/2011

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


NUMBER OF SAMPLES AND IDENTIFICATION : **Colorbel / Lacobel T + DC 993**

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

SAMPLES RECEIVED ON : 08/02/2012

TESTING DATE : From 29/02/2012

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 Belgium on 27/01/2012 (80 samples) and 10/02/2012 (20 samples) (see annex 1)

Colorbel RAL 9006 Metal Grey+ DC993+ Lacobel T crisp white

Batch A/B : N1070701103/0006565961

Number of samples prepared : 100

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	605	0.17	0.34	0.45	0.55	0.64	1.47	89	605
2	651	0.13	0.29	0.41	0.50	0.59	1.29	79	651
3	630	0.16	0.32	0.42	0.51	0.59	1.11	66	630
4	625	0.18	0.32	0.43	0.52	0.60	1.17	70	625
5	615	0.15	0.29	0.40	0.49	0.57	1.14	69	615
6	602	0.19	0.35	0.45	0.54	0.62	1.23	72	602
7	607	0.11	0.23	0.36	0.45	0.53	1.02	66	607
8	612	0.20	0.34	0.45	0.54	0.62	1.19	69	612
9	616	0.13	0.24	0.33	0.41	0.49	1.27	97	616
10	Broken								Broken
Average	618	0.16	0.30	0.41	0.50	0.58	1.21	75	
Standard deviation	15	0.03	0.04	0.04	0.05	0.05	0.13	11	
Minimum	602	0.11	0.23	0.33	0.41	0.49	1.02	66	
Maximum	651	0.20	0.35	0.45	0.55	0.64	1.47	97	

(*) xC: x% cohesive

$$K_{12,5} = 0.34$$

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

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	564	0.19	0.34	0.45	0.55	0.63	1.58	186	100%C
2	578	0.12	0.28	0.39	0.49	0.58	1.73	156	100%C
3	624	0.12	0.25	0.36	0.44	0.52	1.52	129	100%C
4	614	0.16	0.29	0.39	0.47	0.55	1.54	180	100%C
5	627	0.11	0.25	0.36	0.46	0.54	1.31	175	100%C
Average	601	0.14	0.28	0.39	0.48	0.56	1.54	165	
Standard deviation	29	0.03	0.04	0.04	0.04	0.04	0.15	23	
Minimum	564	0.11	0.25	0.36	0.44	0.52	1.31	129	
Maximum	627	0.19	0.34	0.45	0.55	0.63	1.73	186	

(*) xC: x% cohesive

$$R_{u,5} = 1.17$$

$$\Delta X_{\text{mean}} = 1.27$$

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	Bad curing								
2	641	0.11	0.23	0.34	0.42	0.50	0.90	103	100%C
3	632	0.13	0.26	0.36	0.45	0.53	1.00	115	100%C
4	620	0.10	0.21	0.32	0.41	0.49	0.81	94	100%C
5	614	0.10	0.22	0.32	0.42	0.50	0.95	99	100%C
Average	627	0.11	0.23	0.34	0.43	0.51	0.92	103	
Standard deviation	12	0.01	0.02	0.02	0.02	0.02	0.08	9	
Minimum	614	0.10	0.21	0.32	0.41	0.49	0.81	94	
Maximum	641	0.13	0.26	0.36	0.45	0.53	1.00	115	

(*) xC: x% cohesive

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

$$\Delta X_{\text{mean}} = 0.76$$

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	622	0.08	0.12	0.16	0.19	0.22	0.80	138	100C
2	605	0.07	0.11	0.14	0.18	0.21	0.86	125	100C
3	636	0.06	0.11	0.15	0.18	0.21	0.77	128	100C
4	613	0.03	0.08	0.12	0.15	0.18	0.67	120	100C
5	620	0.05	0.09	0.12	0.15	0.18	0.72	128	100C
6	634	0.04	0.09	0.12	0.16	0.19	0.70	114	100C
7	638	0.06	0.10	0.13	0.16	0.19	0.65	113	100C
8	586	0.06	0.11	0.15	0.18	0.21	0.80	115	100C
9	606	0.07	0.11	0.14	0.17	0.20	0.74	128	100C
10	611	0.06	0.10	0.14	0.17	0.20	0.74	115	100C
Average	617	0.06	0.10	0.14	0.17	0.20	0.75	122	
Standard deviation	16	0.01	0.01	0.01	0.01	0.01	0.06	8	
Minimum	586	0.03	0.08	0.12	0.15	0.18	0.65	113	
Maximum	638	0.08	0.12	0.16	0.19	0.22	0.86	138	

(*) xC: x% cohesive

Ru,5 = 0.62

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	591	0.06	0.10	0.14	0.17	0.20	1.27	186	100% C
2	663	0.06	0.11	0.14	0.18	0.21	0.95	156	100% C
3	603	0.06	0.11	0.14	0.17	0.19	0.79	129	100% C
4	603	0.04	0.09	0.13	0.16	0.19	1.02	180	100% C
6	614	0.01	0.03	0.06	0.10	0.13	0.96	175	100% C
Average	615	0.05	0.09	0.12	0.16	0.18	1.00	165	
Standard deviation	28	0.02	0.03	0.03	0.03	0.03	0.17	23	
Minimum	591	0.01	0.03	0.06	0.10	0.13	0.79	129	
Maximum	663	0.06	0.11	0.14	0.18	0.21	1.27	186	

(*) xC: x% cohesive

$$R_{u,5} = 0.58$$

$$\Delta X_{\text{mean}} = 1.33$$

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	594	0.04	0.08	0.12	0.15	0.18	0.53	39	100% C
2	674	0.06	0.10	0.13	0.16	0.19	0.56	54	100% C
3	630	0.05	0.09	0.13	0.16	0.19	0.67	60	100% C
4	633	0.03	0.08	0.12	0.16	0.19	0.55	48	100% C
5	663	0.04	0.08	0.12	0.15	0.17	0.58	57	100% C
Average	639	0.04	0.09	0.12	0.16	0.18	0.58	52	
Standard deviation	31	0.01	0.01	0.01	0.01	0.01	0.05	8	
Minimum	594	0.03	0.08	0.12	0.15	0.17	0.53	39	
Maximum	674	0.06	0.10	0.13	0.16	0.19	0.67	60	

(*) xC: x% cohesive

$$R_{u,5} = 0.46$$

$$\Delta X_{\text{mean}} = 0.77$$

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 ± 0.5°C
- Conductivity of the water : 2.7 µs

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

Lacobel 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	617	0.13	0.24	0.31	0.37	0.43	1.13	108	100C
2	609	0.12	0.23	0.31	0.37	0.43	1.11	103	100C
3	610	0.10	0.20	0.28	0.35	0.40	1.12	108	100C
4	626	0.12	0.23	0.30	0.36	0.42	1.06	101	100C
5	626	0.12	0.22	0.29	0.34	0.39	1.02	99	100C
Average	617	0.12	0.22	0.30	0.36	0.41	1.09	104	
Standard deviation	8	0.01	0.02	0.01	0.01	0.02	0.05	4	
Minimum	609	0.10	0.20	0.28	0.34	0.39	1.02	99	
Maximum	626	0.13	0.24	0.31	0.37	0.43	1.13	108	

(*) xC: x% cohesive

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

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	613	0.14	0.24	0.32	0.38	0.44	1.20	111	100C
2	590	0.16	0.28	0.36	0.42	0.48	1.15	92	100C
3	641	0.11	0.19	0.26	0.32	0.37	1.16	122	100C
4	620	0.14	0.24	0.31	0.37	0.42	0.73	56	100C
5	600	0.14	0.24	0.32	0.38	0.43	1.04	93	100C
Average	613	0.14	0.24	0.31	0.37	0.43	1.06	95	
Standard deviation	20	0.02	0.03	0.04	0.04	0.04	0.19	25	
Minimum	590	0.11	0.19	0.26	0.32	0.37	0.73	56	
Maximum	641	0.16	0.28	0.36	0.42	0.48	1.20	122	

(*) xC: x% cohesive

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

Colorbel

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	0.14	0.24	0.32	0.38	0.44	1.04	90	100C
2	610	0.12	0.23	0.30	0.36	0.41	1.00	91	100C
3	606	0.12	0.22	0.29	0.35	0.41	1.10	108	100C
4	602	0.15	0.26	0.33	0.40	0.45	1.09	125	100C
5	609	0.13	0.24	0.31	0.37	0.42	1.06	100	100C
Average	600	0.13	0.24	0.31	0.37	0.43	1.06	103	
Standard deviation	16	0.01	0.01	0.02	0.02	0.02	0.04	15	
Minimum	571	0.12	0.22	0.29	0.35	0.41	1.00	90	
Maximum	610	0.15	0.26	0.33	0.40	0.45	1.10	125	

(*) xC: x% cohesive

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

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	Bad curing								
2	622	0.11	0.21	0.28	0.34	0.40	0.94	92	100C
3	597	0.11	0.22	0.29	0.35	0.40	0.87	90	100C
4	615	0.13	0.23	0.30	0.36	0.41	0.97	92	100C
5	618	0.10	0.21	0.28	0.33	0.39	0.93	90	100C
Average	613	0.11	0.22	0.29	0.35	0.40	0.93	91	
Standard deviation	11	0.01	0.01	0.01	0.01	0.01	0.04	1	
Minimum	597	0.10	0.21	0.28	0.33	0.39	0.87	90	
Maximum	622	0.13	0.23	0.30	0.36	0.41	0.97	92	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 0.77$$

5.1.4.2.2 HUMIDITY AND NaCl ATMOSPHERE*

a) *Conditioning :*

- Duration : 480 hours
- NaCl concentration : 51.6 g/l
- pH : 6.6

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	620	0.11	0.23	0.32	0.40	0.46	1.12	90	100C
2	601	0.13	0.25	0.33	0.40	0.46	1.17	103	100C
3	600	0.14	0.26	0.34	0.41	0.48	1.23	102	100C
4	609	0.10	0.19	0.27	0.37	0.49	1.20	93	100C
5	603	0.16	0.27	0.35	0.42	0.49	1.16	103	100C
6	612	0.11	0.23	0.32	0.39	0.46	1.22	108	100C
7	617	0.13	0.23	0.32	0.38	0.45	1.17	101	100C
8	620	0.15	0.27	0.36	0.43	0.49	1.19	95	100C
9	638	0.08	0.20	0.30	0.37	0.44	1.17	107	100C
10	612	0.15	0.26	0.35	0.42	0.48	1.21	104	
Average	613	0.13	0.24	0.33	0.40	0.47	1.18	101	
Standard deviation	11	0.03	0.03	0.03	0.02	0.02	0.03	6	
Minimum	600	0.08	0.19	0.27	0.37	0.44	1.12	90	
Maximum	638	0.16	0.27	0.36	0.43	0.49	1.23	108	

(*) xC: x% cohesive

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

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	623	0.04	0.16	0.27	0.35	0.42	1.13	89	100C
2	621	0.13	0.24	0.33	0.41	0.48	0.95	69	100C
3	618	0.10	0.22	0.32	0.40	0.47	1.18	89	100C
4	623	0.13	0.25	0.34	0.41	0.48	1.20	91	100C
5	622	0.16	0.26	0.35	0.42	0.49	1.11	79	100C
6	602	0.07	0.21	0.31	0.39	0.46	1.08	87	100C
7	613	0.16	0.26	0.35	0.42	0.48	1.20	95	100C
8	614	0.10	0.24	0.34	0.42	0.49	1.22	93	100C
9	Broken								100C
10	626	0.16	0.27	0.36	0.43	0.50	1.10	78	100C
Average	618	0.12	0.23	0.33	0.41	0.47	1.13	86	
Standard deviation	7	0.04	0.03	0.03	0.02	0.02	0.08	9	
Minimum	602	0.04	0.16	0.27	0.35	0.42	0.95	69	
Maximum	626	0.16	0.27	0.36	0.43	0.50	1.22	95	

(*) xC: x% cohesive

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

5.1.4.2.4 Facade cleaning product*

a) *Conditioning :*

- Duration : 21 days
- Temperature : 44.5°C ± 0.5°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	608	0.10	0.19	0.26	0.31	0.37	1.05	124	100C
2	607	0.09	0.18	0.25	0.31	0.36	1.00	111	100C
3	622	0.08	0.17	0.24	0.30	0.36	1.04	149	100C
4	641	0.10	0.21	0.28	0.35	0.40	1.04	125	100C
5	603	0.05	0.14	0.22	0.28	0.33	1.00	145	100C
6	609	0.09	0.18	0.25	0.32	0.37	0.97	119	100C
7	620	0.06	0.14	0.22	0.29	0.35	1.01	181	100C
8	616	0.09	0.18	0.25	0.31	0.36	0.99	129	100C
9	615	0.06	0.14	0.23	0.30	0.35	0.95	104	100C
10	601	0.09	0.19	0.26	0.32	0.37	1.06	123	100C
Average	614	0.08	0.17	0.25	0.31	0.36	1.01	131	
Standard deviation	12	0.02	0.02	0.02	0.02	0.02	0.04	22	
Minimum	601	0.05	0.14	0.22	0.28	0.33	0.95	104	
Maximum	641	0.10	0.21	0.28	0.35	0.40	1.06	181	

(*) xC: x% cohesive

$$\Delta X_{\text{mean}} = 0.83$$

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	1.21	-	0.34	0.94	100C
		-20°C	1.54	1.27		1.17	100C
		+80°C	0.92	0.76		0.72	100C
5.1.4.1.2	Shear	+23°C	0.75	-		0.62	100C
		-20°C	1.00	1.33		0.58	100C
		+80°C	0.58	0.77		0.46	100C
5.1.4.2.1	H ₂ O + UV on Lacobel T face at 45°C	500 h	1.09	0.90			100C
		1000 h	1.06	0.88	K _{12.5,c} /K _{12.5} = 0.78		100C
5.1.4.2.1	H ₂ O + UV on Colorbel face at 45°C	500 h	1.06	0.88			100C
		1000 h	0.93	0.77	K _{12.5,c} /K _{12.5} = 0.70		100C
5.1.4.2.2	H ₂ O + NaCl	480h	1.18	0.98			100C
5.1.4.2.3	H ₂ O + SO ₂	20 cycles	1.13	0.93			100C
5.1.4.2.4	Cleaning product	21 days	1.01	0.83			100C

*x*C = *x*% cohesive

D. LIBERT
Head of Department

Glazing and Components - INISMa