

# CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2007  
 DateRun: 08/20/2007  
 Experimenters: Jason Marshall  
 ClientType: Optical Manufacturer  
 ProjectNumber: Project #1  
 Substrates: Glass/Quartz  
 PartType: Part  
 Contaminants: None  
 Cleaning Methods: Immersion/Soak  
 Analytical Methods: Gravimetric

Purpose: To evaluate glass samples for acid resistance.

Experimental Procedure: Glass samples were delivered polished to the specified polishing conditions. Each glass sample was weighed using a analytical balance. One sample of each glass type were hung by platinum wire into 0.5 mol/liter Nitric Acid at 25 deg C for the length of times specified: 0.1 hour, 1 hour, 10 hours or 100 hours (in the supplied standards, a second set of time intervals were given, 10 minutes, 100 minutes, 16 hours and 100 hours. Readings will be taken at the 100 minutes and 16 hours in addition to the 1 and 10 hours).

After this treatment, the samples were weighed again and the loss of the mass of the sample were calculated. Calculation of the time  $t_{0.1}$  in hours, necessary to etch a surface layer a depth of 0.1  $\mu\text{m}$  was done using the following formula:

$$t_{0.1} = (tedS)/[(m1-m2)*100]$$

where:

$t_{0.1}$  = the time (min) necessary to etch a surface layer to a depth of 0.1  $\mu\text{m}$

$t_e$  = the time (min) for attach in the experiment

$d$  = the specific gravity of the sample

$S$  = the surface area ( $\text{cm}^2$ ) of the sample

$m1$  = the mass (mg) of the sample before the test

$m2$  = the mass (mg) of the sample after the test

Acid Resistance Class PR 1 2 3 4 5

Time  $t_{0.1}$  needed to etch to a depth of 0.1 $\mu\text{m}/\text{min}$  >100 10-100 1-10 0.1-1 <0.1

In addition, changes in the surface of the sample following the treatment are qualitatively evaluated with the naked eye. Additional classification numbers are given according to the second table.

Additional Number Changes in the Surface

.0 No visible changes

.1 Clear, but irregular surface (wavy, pockmarked)

.2 Interference colors (slight selective leaching)

.3 Tenacious thin whitish layer (stronger selective)

.4 Loosely adhering thick layer (surface crust)

Results: The target weight loss of 0.0010 grams (1 mg) was met by sample D after 60 minutes, for sample B after 100 minutes, for sample A after 10 hours, C and 2 after the 100 hours. All samples had no visible change at the point when they lost the 0.0010 grams.

The tables list the amount of weight loss after each time interval.

time (te)	0.1 hour		
sample id	m1	m2	m1-m2
A	3.8238	3.8231	0.0007
B	3.855	3.8546	0.0004
C	3.8182	3.818	0.0002
D	4.1163	4.1157	0.0006
1	6.3684	6.3683	0.0001
2	1.2347	1.2339	0.0008
3	1.2177	1.2175	0.0002
4	1.2542	1.2541	0.0001
time (te)	1 hour		
sample id	m1	m2	m1-m2
A	3.8238	3.823	0.0008

# CLEANING LABORATORY EVALUATION SUMMARY

B	3.855	3.8544	0.0006
C	3.8182	3.8178	0.0004
D	4.1163	4.1151	0.0012
1	6.3684	6.3678	0.0006
2	1.2347	1.2338	0.0009
3	1.2177	1.2173	0.0004
4	1.2542	1.254	0.0002

Calculation of t0.1

Sample	Classification	density	surface area	time	t0.1		
		(d)	(S)	d*S	(te)	te*d*S	te*d*S/[(m1-m2)*100]
A	SR2.0	3.22	45.662	147.032	10	1470.3	11310

time (te)	16.7 hours			
sample id	m1	m2	m1-m2	
C	3.8182	3.8175	0.0007	
1	6.3684	6.3678	0.0006	
2	1.2347	1.2338	0.0009	
3	1.2177	1.2173	0.0004	
4	1.2542	1.254	0.0002	
time (te)	100 hours			
sample id	m1	m2	m1-m2	
C	3.8182	3.8169	0.0013	>0.00010
1	6.3684	6.3677	0.0007	
2	1.2347	1.2336	0.0011	>0.00010
3	1.2177	1.2173	0.0004	
4	1.2542	1.254	0.0002	

Calculation of t0.1

Sample	Classification	density	surface area	time	t0.1		
		(d)	(S)	d*S	(te)	te*d*S	te*d*S/[(m1-m2)*100]
C	SR1.0	2.76	45.7	126.03	100	12602	96944
2	SR1.0	2.23	42.3	94.39	100	9438	85809

Comparison of Glass Types

Sample	Class	Sample	Class	Notes
A	SR2.0	1	SR1.0	Did not exceed 1 mg
B	SR3.0	2	SR1.0	
C	SR1.0	3	SR1.0	Did not exceed 1 mg
D	SR4.0	4	SR1.0	Did not exceed 1 mg

Summary:

Conclusion:

Three supplied samples, 1, 3 and 5, did not exceed the 1 mg weight loss and would be classified as SR1.0 as no visual degradation was observed. In addition, samples 2 and C only exceed the 1 mg level after 100 hours of soaking and would be classified as SR1.0. Sample A was classified as SR2.0, sample B as SR3.0 and sample D as SR4.0.