

SMI, Inc.

SCIENTIFIC MATERIAL INTERNATIONAL

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Date: 11-Jan-1999

SMI/REF: 9810014

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Report of Test

Four test samples of each of the following materials were provided for use in testing:

- | | |
|------------------------|----------------------|
| 1. Copper 110 | 7. Galvanized Steel |
| 2. Steel 1010 | 8. Nylon 616 |
| 3. Stainless steel 303 | 9. PVC |
| 4. Brass 360 | 10. Electronic board |
| 5. Bronze 905 | 11. Relay/terminal |
| 6. Aluminum 6061 | 12. Contact Terminal |

Test Procedure:

1. Each sample was marked and the weight recorded.
2. Samples were divided into 4 groups. Each group included one sample of each material.
3. Samples (except group 4) were put into a discharge space.
4. Aerosol was discharged into the space at a rate of 100 g/m³. The space was kept closed for 30 minutes.
5. Samples were removed from the space.
6. Group 2 samples were cleaned with compressed air.
7. Group 3 samples were cleaned with water.
(Group 1 samples were not cleaned)
8. Each sample was weighed.
9. All samples (Groups 1, 2, 3, and 4) were placed in a humidity chamber at 95 percent relative humidity at 100°F for 30 days.
10. Each sample was weighed again.
11. Photos of all samples of each material were taken.
12. Visual observations and weight comparisons are as follows:

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GROUP 1

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Group 1: Not cleaned after exposure to aerosol

Material	Weight (grams)			Total Weight Change (g)	Observations
	Initial	After Aerosol Exposure	After Humidity Exposure		
Copper 110	13.1419	13.1425	13.1439	+ 0.0020	Tarnish
Steel 1010	11.5125	11.5129	11.5132	+ 0.0007	10 - 15 rust spots (< 1 mm) on each side
SS 303	22.4087	22.4090	22.4090	+ 0.0003	No visible corrosion
Brass 360	3.2335	3.2347	3.2357	+ 0.0022	Tarnish
Bronze 905	35.7743	35.7752	35.7761	+ 0.0018	Green tarnish on top edge only, otherwise no visible corrosion
Aluminum 6061	3.9974	3.9973	3.9981	+ 0.0007	No visible corrosion
Galvanized Steel	6.9077	6.9080	6.9107	+ 0.0030	Slight oxidation
PC Board (small)	45.9262	45.9463	46.0150	+ 0.0888	No visible corrosion
PC Board (large)	170.5698	170.5656	170.7014	+ 0.1316	No visible corrosion
Nylon 616	17.3026	17.3136	17.7025	+ 0.3999	No visible corrosion
PVC	6.0279	6.0306	6.0488	+ 0.0209	No visible corrosion
Relay contact	10.7245	10.7273	10.7364	+ 0.0119	No visible corrosion
Terminal	37.9139	37.9691	38.7334	+ 0.8195	Slight residue / corrosion on screws

“+” indicates weight gain

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GROUP 2

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Group 2: Cleaned with compressed air

Material	Weight (grams)			Total Weight Change (g)	Observations
	Initial	After Aerosol Exposure	After Humidity Exposure		
Copper 110	13.3769	13.3776	13.3792	+ 0.0023	Completely tarnished on one side; only top of second side
Steel 1010	11.5466	11.5473	11.5472	+ 0.0006	10 - 15 rust spots (< 1 mm) on one side
SS 303	23.5342	23.5339	23.5337	+ 0.0005	No visible corrosion
Brass 360	2.5355	2.5354	2.5363	+ 0.0008	Tarnished
Bronze 905	36.8306	36.8314	36.8328	+ 0.0022	Green tarnish on top edge only, otherwise no visible corrosion
Aluminum 6061	3.9546	3.9547	3.9549	+ 0.0003	No visible corrosion
Galvanized Steel	6.7723	6.7726	6.7764	+ 0.0041	Slight oxidation
PC Board (small)	45.0380	45.0505	45.1188	+ 0.0808	No visible corrosion
PC Board (large)	169.2509	169.2437	169.3872	+ 0.1363	No visible corrosion
Nylon 616	17.0752	17.0858	17.4443	+ 0.3691	No visible corrosion
PVC	6.2411	6.2290	6.2474	+ 0.0063	No visible corrosion
Relay contact	10.4289	10.4308	10.4398	+ 0.0109	No visible corrosion
Terminal	37.9751	38.0244	38.7737	+ 0.7986	Slight residue / corrosion on screws

“+” indicates weight gain

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GROUP 3

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Group 3: Cleaned with water

Material	Weight (grams)			Total Weight Change (g)	Observations
	Initial	After Aerosol Exposure	After Humidity Exposure		
Copper 110	13.3351	13.3353	13.3354	+ 0.0003	No visible corrosion
Steel 1010	11.4763	11.4763	11.4765	+ 0.0002	1 rust spot (< 1 mm) on one side
SS 303	22.5560	22.5560	22.5556	0.0004	1 rusted area (\approx 1 cm x 2 mm)
Brass 360	3.3833	3.3834	3.3834	+ 0.0001	No visible corrosion
Bronze 905	36.0800	36.0800	36.0793	0.0007	No visible corrosion
Aluminum 6061	3.9976	3.9976	3.9978	+ 0.0002	No visible corrosion
Galvanized Steel	6.9073	6.9074	6.9099	+ 0.0026	Slight oxidation
PC Board (small)	45.0026	45.0052*	45.0487	+ 0.0461	No visible corrosion
PC Board (large)	Not applicable				
Nylon 616	17.3184	17.3283	17.7357	+ 0.4173	No visible corrosion
PVC	5.9760	5.9734	5.9920	+ 0.0160	No visible corrosion
Relay contact	11.5009	11.5034*	11.5125	+ 0.0116	Slight corrosion on one contact at top
Terminal	37.9830	38.0310*	38.7671	+ 0.7841	No visible corrosion

“+” indicates weight gain

* These components were cleaned with a commercially available Freon-type aerosol circuit board cleaner “ELECTRONIC SOLV” instead of water.

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GROUP 4

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Group 4: No exposure to Aerosol; no cleaning

Material	Weight (grams)			Total Weight Change (g)	Observations
	Initial	After Aerosol Exposure	After Humidity Exposure		
Copper 110	13.1420		13.1424	+ 0.0004	Very slight tarnish
Steel 1010	11.5383		11.5390	+ 0.0007	20 - 30 rust areas; corrosion on edges
SS 303	23.2911		23.2907	0.0004	No visible corrosion
Brass 360	3.2548		3.2551	+ 0.0003	No visible corrosion
Bronze 905	37.2077		37.2073	0.0004	No visible corrosion; slight discoloration on one edge
Aluminum 6061	4.0048		4.0047	0.0001	No visible corrosion
Galvanized Steel	6.9412		6.9418	+ 0.0006	Slight oxidation
PC Board (small)	44.2042		44.2730	+ 0.0688	No visible corrosion
PC Board (large)	Not applicable				
Nylon 616	17.2422		17.6415	+ 0.3993	No visible corrosion
PVC	6.1121		6.1319	+ 0.0198	No visible corrosion
Relay contact	10.6398		10.6490	+ 0.0092	No visible corrosion
Terminal	37.9559		38.6292	+ 0.6733	No visible corrosion

“+” indicates weight gain

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TOTAL WEIGHT CHANGE

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Material	Weight Change Comparison (grams)			
	Group 1	Group 2	Group 3	Group 4
Copper 110	+ 0.0020	+ 0.0023	+ 0.0003	+ 0.0004
Steel 1010	+ 0.0007	+ 0.0006	+ 0.0002	+ 0.0007
SS 303	+ 0.0003	+ 0.0005	0.0004	0.0004
Brass 360	+ 0.0022	+ 0.0008	+ 0.0001	+ 0.0003
Bronze 905	+ 0.0018	+ 0.0022	0.0007	0.0004
Aluminum 6061	+ 0.0007	+ 0.0003	+ 0.0002	0.0001
Galvanized Steel	+ 0.0030	+ 0.0041	+ 0.0026	+ 0.0006
PC Board (small)	+ 0.0888	+ 0.0808	+ 0.0461	+ 0.0688
PC Board (large)	+ 0.1316	+ 0.1363	---	---
Nylon 616	+ 0.3999	+ 0.3691	+ 0.4173	+ 0.3993
PVC	+ 0.0209	+ 0.0063	+ 0.0160	+ 0.0198
Relay contact	+ 0.0119	+ 0.0109	+ 0.0116	+ 0.0092
Terminal	+ 0.8195	+ 0.7986	+ 0.7841	+ 0.6733

- Group 1 = not cleaned after aerosol exposure
- Group 2 = cleaned with compressed air after aerosol exposure
- Group 3 = cleaned with water after aerosol exposure
- Group 4 = not exposed to aerosol

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Conclusion:

Specimens submitted for testing were separated into four groups as follows:

- Group 1 specimens were not cleaned after exposure to aerosol.
- Group 2 specimens were cleaned with compressed air after exposure to aerosol
- Group 3 specimens were cleaned with water after exposure to aerosol
- Group 4 specimens were not exposed to aerosol

Copper 110: Exhibited varying degrees of tarnish on all specimens except that which was cleaned with water after exposure to the aerosol (Group 3).

Steel 1010: Isolated areas of corrosion consisting of at least 10 rust spots were present on all specimens except the Group 3 specimen, which had only one rusted area. The worst corrosion was present on the Group 4 specimen.

SS303: No visible corrosion on any specimen.

Brass 360: Group 1 and Group 2 specimens exhibited tarnish. No visible corrosion or tarnish present on Group 3 or Group 4 specimens.

Bronze 905: A greenish tarnish was noticeable on the top edge of Group 1 and Group 2 specimens. Group 3 had no visible corrosion and Group 4 had only slight discoloration on one edge.

Aluminum 6061: No visible corrosion on any specimen.

Galvanized Steel: Slight oxidation was evident on all specimens.

PC boards: Neither the large or small boards exhibited corrosion on any specimen.

Nylon 616: No visible corrosion on any specimen.

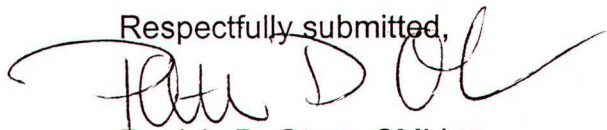
PVC: No visible corrosion on any specimen.

Relay contact: Slight corrosion of one contact visible in Group 3. No visible corrosion on any other specimen.

Terminal: Slight residue or corrosion was present on the Group 1 and Group 2 specimens. No corrosion evident on the Group 3 or Group 4 specimens.

None of the specimens exhibited corrosion worse than that encountered in Group 4. There were slight differences in the amount of tarnish between the exposed and the Group 4 Brass 360 specimens as well as slight differences in corrosion or residue between the exposed and the Group 4 relay contacts and terminals.

Respectfully submitted,



Patricia D. Otero, SMI Inc.