

## | APPLICATION NOTES

### **Arlon Products Meet NASA Outgassing Requirements**

Rancho Cucamonga, CA – Arlon recently updated data on their high performance laminate products that have successfully completed NASA testing for outgassing and total condensable volatiles according to ASTM E-595-93 (Standard Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment) and thus can be considered for critical space applications.

#### **What do these tests tell you?**

%TML (Total Mass Loss) is the total amount of material that outgases from a conditioned sample expressed as a percent of the initial sample mass. For example if a sample weighing 100 grams loses a half gram of mass during the test, the %TML is 0.5%. In many instances the total mass lost will consist of absorbed water, which in moderate quantities will dissipate in the vacuum of space and not be problematic. If some of the mass loss is not water, then another test (%CVMC) is more critical.

%CVMC (Collected Volatile Condensable Materials) represents the percentage of the weight of the sample that will outgas from the sample then condense on a collector

plate. One obvious example of the significance of this in space applications is in sophisticated optical systems deployed in space where condensable materials could seriously degrade performance. As you can see in the table below, Arlon's materials have extremely low %CVMC, indicating that only a negligible part of the mass loss is other than water vapor.

%WVR (Water Vapor Regain) is a measure of how much water will be reabsorbed by the material after being re-exposed to 50% RH at 23oC for 24 hours. While this is not a specific space requirement, it does provide a valuable insight into the degree of need for desiccation and/or drying of materials during the fabrication process.

What does this information mean to you as a designer of space-based electronics systems (beyond the obvious that it is a requirement for any NASA program)? Historically a TML of 1.00% and a CVMC of 0.1% have been used as screening levels for space materials. This testing ensures that these materials have been screened by NASA and selected for space applications. These selection

criteria are based on many years of experience and represent a degree of confidence based on experience.

What does this test data does not tell you? The test method is a screening test for materials done under specific conditions. The ASTM test method cautions that "The use of materials that are deemed acceptable in accordance with this test does not ensure that the system or component will remain uncontaminated.

Therefore subsequent functional, developmental and qualification tests should be used as necessary to ensure that the material's performance is satisfactory."

For example, Arlon's 85NT nonwoven aramid polyimide product (which has a %TML of 1.57% and thus is outside the NASA "accept" parameters) has already been used in commercial space applications and is being qualified in other space programs based on performance, despite being high in total mass loss (all of which is water). In such a case the selection of material needs to be based on the designer's knowledge of the material and application and sufficient reliability testing to ensure function.

**Current Arlon products which have completed NASA/ASTM E595-93 testing are:**

<b>Product</b>	<b>Description</b>	<b>%TML</b>	<b>%CVCM</b>	<b>%WVR</b>
33N	UL-94 V0 Polyimide Glass	0.52	0.00	0.21
35N	UL-94V1 Polyimide Glass	0.42	0.01	0.26
EP-2	Enhanced Filled Polyimide	0.79	0.00	0.43
85N	Polyimide Glass	0.78	0.01	0.27
85NT	Poly Nonwoven Aramid	1.91	0.00	0.93
55NT/RT	Epoxy Nonwoven Aramid	1.32	0.00	0.58
37N	Low-Flow Poly	0.77	0.00	0.39
38N	Low-Flow Poly	0.71	0.00	0.34
47N	No-Flow Epoxy	0.62	0.01	0.15
45N	Multifunctional Epoxy	0.24	0.01	0.01
25N	Low Loss Laminate	0.17	0.01	0.02
25FR	UL-94 V0 Low Loss	0.24	0.00	0.07
91ML	Hi Tg Tc 1.0 W/m-K	0.27	0.00	0.18
92ML	Hi Tg Tc 2.0 W/m-K	0.29	0.00	0.18
AD1000	High Dk Ceramic/PTFE	0.01	0.00	0.00
AD300C	Woven glass/Ceramic/PTFE	0.02	0.00	0.01
AD350A	Woven glass/Ceramic/PTFE	0.02	0.00	0.02
AD450	Woven glass/ceramic/PTFE	0.01	0.00	0.01
AD600	High Dk Ceramic/PTFE	0.02	0.00	0.01
CLTE-XT	Ceramic/PTFE Stable Dk	0.02	0.00	0.01
CLTE	Ceramic/PTFE Stable Dk	0.02	0.00	0.00
AR350	PTFE woven glass	0.04	0.01	0.03
AR-600	PTFE/Ceramic Laminate	0.02	0.00	0.00
CuClad 217	Woven glass/PTFE	0.01	0.01	0.00
CuClad 233	Woven glass/PTFE	0.01	0.01	0.00
CuClad 250	Woven glass/PTFE	0.01	0.00	0.00
DiClad 522	Woven Glass/PTFE	0.01	0.00	0.00
DiClad 527	Woven Glass/PTFE	0.02	0.00	0.01
DiClad 870	Woven Glass/PTFE	0.02	0.00	0.01
DiClad 880	Woven Glass/PTFE	0.01	0.01	0.01
IsoClad 917	Nonwoven Glass/PTFE	0.02	0.00	0.02
IsoClad 933	Nonwoven Glass/PTFE	0.03	0.00	0.02
TC600	Thermally Conductive PTFE	0.02	0.00	0.00



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