

Low Outgassing Characteristics of Rogers Laminates Approved for Spacecraft Applications

RT/duroid® composites of PTFE with inorganic fiber filler and TMM® temperature stable hydrocarbon composites, have outstanding resistance to outgassing, according to data compiled by NASA test procedure SP-R-0022A. Reinforced PTFE laminates and PTFE composites are thermally stable and have universal outgassing characteristics. Similarly, TMM temperature stable laminates are highly crosslinked hydrocarbons which do not evolve gases or by-products at elevated temperatures. Test data shown in the table (back page) were obtained on specimens etched free of copper foil.

The test procedure² consists of vacuum heating 100 to 300 mg specimens in a copper enclosure, with exit port at 125°C for 24 hours with a chrome-plated collector maintained at 25°C located 12.7 mm from the exit port. The Total Mass Loss (TML), Collected Volatile Condensable Materials (CVCM) and Water Vapor Recovered (WVR) are expressed as a % of the original specimen mass. In general, materials exhibiting a TML of less than 1.0% and CVCM less than 0.1% are considered “low outgassing” and suitable for space applications. Note that all Rogers laminate materials listed meet these requirements.

References:

1. William A. Campbell, Jr. and Richard S. Marriott of Goddard Space Flight Center, Greenbelt, MD, “OUTGASSING DATA FOR SPACECRAFT MATERIALS”, NASA Reference Publication 1124, August 1987.

Note: The database of RP1124 is updated weekly and may be accessed or downloaded from the NASA website at <http://epims.gsfc.nasa.gov/og/>.

2. ANSI/ASTM E595-84 “Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment”, American Society for Testing and Materials, Annual Book of Standards.

| NASA Outgassing Results 125°C, ≤10 ⁻⁶ torr | | | |
|---|---------------------|-------------------------|---------------------------|
| Product | "Total Mass Loss %" | "Collected Volatiles %" | "Water Vapor Recovered %" |
| AD350A™ | 0.02 | 0.00 | 0.02 |
| CLTE™ | 0.02 | 0.00 | 0.00 |
| CLTE-AT™ | 0.04 | 0.00 | 0.00 |
| CLTE-MW™ | 0.02 | 0.00 | 0.01 |
| CLTE-X™ | 0.02 | 0.00 | 0.01 |
| COOLSPAN® | 0.22 | 0.02 | 0.05 |
| CuClad® 217 | 0.01 | 0.01 | 0.00 |
| CuClad 233 | 0.01 | 0.01 | 0.00 |
| CuClad 250 | 0.01 | 0.00 | 0.00 |
| CuClad 6250 | 0.32 | 0.05 | 0.00 |
| CuClad 6700 | 0.13 | 0.01 | 0.02 |
| DiClad® 880 | 0.02 | 0.00 | 0.01 |
| DiClad 870 | 0.01 | 0.01 | 0.01 |
| DiClad 527 | 0.02 | 0.00 | 0.01 |
| IM™ -880 | 0.01 | 0.01 | |
| IM-870 | 0.01 | 0.01 | |
| IM-300 | 0.01 | 0.01 | |
| IsoClad® 917 | 0.02 | 0.00 | 0.02 |
| IsoClad 933 | 0.03 | 0.00 | 0.02 |
| MAGTREX® | 0.02 | 0.02 | 0.02 |
| RO3003™ | 0.10 | <0.01 | <0.01 |
| RO3006™ | 0.02 | 0.03 | 0.01 |

| NASA Outgassing Results 125°C, ≤10 ⁻⁶ torr | | | |
|---|---------------------|-------------------------|---------------------------|
| Product | "Total Mass Loss %" | "Collected Volatiles %" | "Water Vapor Recovered %" |
| RO3010™ | <0.01 | <0.01 | <0.01 |
| RO3210™ | 0.00 | 0.01 | 0.01 |
| RO4003C™ | 0.06 | 0.00 | 0.02 |
| RO4350B™ | 0.12 | 0.02 | 0.02 |
| RO4360G2™ | 0.16 | 0.01 | 0.03 |
| RO4450F™ | 0.37 | 0.05 | 0.02 |
| RO4450T™ | 0.21 | 0.01 | 0.03 |
| RO4460G2™ | 0.29 | <0.01 | 0.04 |
| RO4730G3™ | 0.12 | <0.01 | 0.05 |
| RO4835™ | 0.02 | <0.01 | 0.04 |
| RT/duroid® 5870 | 0.02 | <0.01 | 0.01 |
| RT/duroid 5880 | 0.01 | <0.01 | 0.02 |
| RT/duroid 5880LZ | 0.01 | 0.01 | 0.02 |
| RT/duroid 6002 | 0.03 | <0.01 | <0.01 |
| RT/duroid 6006 | 0.01 | <0.01 | <0.01 |
| RT/duroid 6010.2LM | 0.02 | <0.01 | <0.01 |
| RT/duroid 6202 | 0.02 | <0.01 | <0.01 |
| RT/duroid 6202PR | 0.02 | 0.01 | 0.02 |
| RT/duroid 6035HTC | 0.01 | <0.01 | <0.01 |
| SpeedWave® Pre-preg | 0.08 | 0.01 | 0.10 |
| TMM® 3 | 0.04 | 0.00 | 0.03 |
| TMM 4 | 0.07 | 0.00 | 0.02 |
| TMM 10 | 0.06 | 0.00 | 0.04 |

Note: Reporting the WVR (water vapor recovered) value is optional according to https://outgassing.nasa.gov/og_desc.html

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