

# First Contact™ - Outgassing Data, Goddard Space Flight Center

## ASTM-E595-93 Standard Outgassing Test.

The outgassing test was performed according to the test procedures of the ... used as a screening technique to determine the volatile content of materials when exposed to a vacuum environment. The parameters to review are the average Total Mass Loss (TML), the average Water Vapor Regain (WVR), and the average Collecting Volatile Condensable Material (CVCM). Standard values for TML is 1.0%,... The CVCM should be 0.1%...the most important parameter is the CVCM because this value indicates the amount of constituents that will deposit on a cold surface.

...TML is 4.24%, this indicates...a large amount of water and solvents, which is expected... At the same time, the CVCM is 0.04% which is lower than the standard 0.1%. Overall, this is a great starting point.

The outgassing test was conducted at 125C for 24hours.

K.D.H. email to J.P.H.

Bar Position-CVCM Test Number	30418 (1)	30419 (2)	30420 (3)
Initial mass, holder and specimen, gm	0.310842	0.313964	0.311937
Mass of holder, gm	0.184033	0.186705	0.185026
Initial specimen mass @ 50%RH, gm	0.126809	0.127259	0.126911
Final mass, holder & specimen, gm	0.305390	0.308575	0.306640
Total mass loss, specimen, gm	0.005452	0.005389	0.005297
Percent TML, specimen	4.30%	4.23%	4.17%
Average value TML	***** *	<b>4.24%</b>	*****
Mass after 50%RH re-soak, 23 C, 24hr, gm	0.306411	0.308175	0.308177
Total mass, water vapor regain, gm	0.001561	0.001270	0.001537
Percent water vapor regain	1.23%	1.00%	1.21%
Average value WVR @ 50%RH	*****	<b>1.15%</b>	*****
Initial mass, collector, gm	1.688724	2.340035	1.720962
Final mass, collector, gm	1.688765	2.340090	1.721026
Collected mass – CVCM, gm	0.000041	0.000055	0.000064
Percent CVCM	0.03%	0.04%	0.05%
Average Value CVCM	*****	<b>0.04%</b>	*****

**Passed**



NASA Outgassing Materials Search Results  
<http://outgassing.nasa.gov/>



Data Last Updated: 12/13/2013

DISCLAIMER

Use of this search does not imply that a material listed here is NASA approved *even if it is in the "Low Outgassing" section or is selected for TML or CVCM attributes less than a specified amount*. Materials can have very different results depending on mix, cure, or changes in formulation over the years. Use of the NASA Outgassing Database is only a first step in fully researching the material of choice.

Material Name: **FIRST CONTACT POLYMER**

MATERIAL	% TML	% CVCM	CURE TIME	CURE TEMP	AT-MOS	% WVR	DATA REF	APPLICATION	MFR CODE
FIRST CONTACT POLYMER FILM	4.24	0.04				1.15	GSC30418	CLEANING FILM	PCT

Outgassing tests were performed according to ASTM-E595-93 Standard Outgassing Test and are published on the NASA outgassing website.<sup>1</sup> The Total Mass Loss was found to be 4.24% which indicates a large amount of water and solvents, as expected, as it fully dries. The Condensed Volatile Material is 0.04% which is lower than the standard 0.1%. The outgassing test was conducted at 125C for 24hours. At NASA's Jet Propulsion lab, another analysis was performed for the Laser Interferometric Gravity Observatory (LIGO). In this report, for the LIGO Interferometer group,<sup>13</sup> "glass test surfaces were pre-cleaned and tested to a level of less than 0.01 micrograms per square centimetre of molecular residue. The polymer solution was painted on to the clean glass and set for 2 hours. The material was then peeled off the surface. The surface was sampled using a dichloromethane swab/rinse. The low volatility residue (LVR) was analyzed using Diffuse Reflectance/ Fourier Transform Infrared (DRIFT/FTIR) spectroscopy. FTIR provides chemical functional group information for quantitative analysis and qualitative identification of materials. The analysis followed the ACL-120 procedure that complies with Mil-STD-1246C Notice 3 and is sensitive to the most stringent level (A/100)... The glass surface that was treated with First Contact™ (applied and removed) was very clean with less than 0.02 micrograms per square centimetre of molecular residue." These results have led to the qualification that surfaces treated with First Contact Polymers are "Space and UHV ready" with little or no organic surface contamination.

1. <http://outgassing.nasa.gov/> search for First Contact.
2. Report LIGO-T060051-00-D R039, JPL ANALYTICAL CHEMISTRY LABORATORY, Analytical Chemistry and Materials Development Group 3531 Thermal and Propulsion Section 3530. March 2006.

\*\*\*\*\*  
 "Once applied to an optic surface, it is expected that [First Contact Polymer] can be left on the surface indefinitely. The material is inert, and has no known chemical reaction with either the optic or the environment. Silicon wafers coated with the material were examined with ESCA and showed no trend of degradation or residue for up to 8 months. Studies were not continued beyond 8 months, but it is expected to be compatible indefinitely."

— Lockheed Materials Specification, Lockheed Missiles and Space

\*\*\*\*\*

## Spacecraft Material Outgassing Data

<http://outgassing.nasa.gov/>

This compilation of outgassing data of materials intended for spacecraft use were obtained at the Goddard Space Flight Center (GSFC), utilizing equipment developed at Stanford Research Institute (SRI) under contract to the Jet Propulsion Laboratory (JPL).

SRI personnel developed an apparatus for determining the mass loss in vacuum and for collecting the outgassed products. Their report (Reference 1), which contained data from June 1964 to August 1967, served well as a foundation for selecting spacecraft materials with low outgassing properties. The apparatus was also constructed at GSFC and, based on the SRI data and GSFC data, a GSFC report (Reference 2) was published. That report included data for those materials meeting two criteria: a maximum total mass loss (TML) of 1.0 percent and maximum collected volatile condensable material (CVCM) of 0.10 percent.

After a series of tests and verification of procedures, an American Society for Testing and Materials (ASTM) Standard Test Method was developed, based upon this apparatus. The method, "Total Mass Loss (TML) and Collected Volatile Condensable Materials (CVCM) from Outgassing in a Vacuum Environment," is identified as E 595-77/84/90. The data developed through the years have been reported in References 3, 4, 5, 6, 7, 8, and 9 as a means of assisting in selecting materials for space flight use.

- See more at: <http://data.nasa.gov/spacecraft-material-outgassing-data/#sthash.d8xMuzqq.dpuf>

## How Clean is First Contact Polymer?

"... no residue that produced scattering was found on a fresh silicon wafer when the polymer [First Contact] was applied and then stripped off."

— Bennett, J. et al., *Applied Optics*, 39(16), 2737,2001

"There was no residue after any of the first contact cleanings, as there was after the drag wiping on the previous optic."

— See for example: "First Contact Application and Removal Procedure" or "Drag Wiping with Methanol vs First Contact," Caltech/MIT LIGO Doc. E1000079\_v5, T1000137\_v3

## Why FIRST CONTACT?

- **First Contact Solutions** consist of a blend of inert polymers in a blend of solvents carefully tuned so that the dried polymer peels with 1/10th the adhesion of scotch tape and minimizes thermal shock and stress to coatings.
- **First Contact** protects the precision surface when the film is left on, preventing scratching and becomes a barrier to water vapor as well as oxygen gas, corrosives and sulfur containing compounds. Protect your optics during installation and transportation. When ready to use, peel!
- **First Contact Polymer Solutions** come in a variety of colors as well as ESD free. Just choose the one that is best for your application.
- **First Contact** works beautifully on fused silica phase masks, diffractive optics, nano and microfluidic structures.

XPS	C 1s %	O 1s %	Si 2p %
After	17.8	57.4	20.6
Before	48.1	33.3	16.0

The table above shows XPS data taken on a clean glass substrate before and after cleaning with First Contact Polymer. The amount of carbon decreases substantially after polymer removal it is truly vacuum ready. Data taken at the Univ. of Iowa Central Microscopy Facility. ¶