Materials Engineering Branch

TIP*

No. 112 Stress Relief of Delrin

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For more than 20 years, Delrin, an acetal resin, has served in a growing number of spacecraft applications. It is available in several basic compositions (Delrin 100, 500, and 900) to meet a variety of application requirements. Delrin offers multiple benefits. It is strong and resilient, unaffected by moisture and is resistant to common solvents and chemicals. It has good wear resistance and low friction[1].

When considering the use of Delrin, the designer should be aware that Delrin stock might contain sufficient residual stress to result in distortion during machining or subsequent thermal cycling. For example, on one occasion a component in the Nimbus-D Gravity Gradient control unit was machined out of Delrin in the "as-received" condition. The component was then incorporated into the flight hardware without having performed a stress relief. During thermal vacuum testing of the control unit, the Delrin component distorted significantly resulting in failure of the drive mechanism.

To avoid such problems, the material should be stress relieved prior to machining according to the manufacturer's recommended procedure[2] since internal stresses may be generated by machining. It may also be necessary to perform stress relieving between the rough and final machining steps.

It should be noted that parts made from Delrin may be difficult to bond to other materials and to other Delrin components due to the physical properties of Delrin. Specifically, it is inert and its bonding characteristics are similar to Teflon. If bonding is required, it is recommended that an alternate material be selected. The Materials Engineering Branch can assist in material selection.

Delrin materials that have been tested and that have acceptable outgassing are included in Table 1. The proposed use of Delrin materials not included in Table 1 should be discussed with a member of the Materials Engineering Branch prior to use.

[1] For more information concerning the electrical, mechanical, and thermal properties of Delrin, the reader should contact the manufacturer DuPont.

[2] To stress relieve Delrin place it in an air circulating oven at 163°C±3°C. Hold at temperature for 30 minutes plus 5 additional minutes for each 40 mils thickness. Turn off temperature and allow the oven to cool to room temperature. CAUTION: Delrin melts at 175°C.

TABLE 1 Delrin Outgassing Data

Material	Description	Outgassing Reference	% TML	%CVCM
Delrin D500AF	Brown Molding Compound	GSFC16730	0.30	0.02
Delrin II 100NC10	Acetal White	GSFC16847	0.34	0.01
Delrin II 500NC10	Acetal White	GSFC16850	0.28	0.01
Delrin II 900NC10	Acetal White	GSFC16855	0.29	0.01
Delrin 100 NC10		SRI9201	0.58	0.06
Delrin 100 STNC10	White	GSFC16959	0.78	0.10
Delrin 107	Black	GSFC13380	0.62	0.01
Delrin 150NC10		SRI9202	0.56	0.06
Delrin 500CLNC10	White	GSFC16962	0.58	0.09
Delrin 500NC10		SRI9203	0.48	0.07
Delrin 507	Black	GSFC17978	0.37	0.02
Delrin 550 Rod	White	GSFC6953	0.39	0.02
Delrin 570NC-000	White w/glass	GSFC16919	0.33	0.02
Delrin 900NC10		SRI9206	0.56	0.08