

NASA Contractor Report 3133

# Nonmetallic Materials Handbook

Volume 1 - Epoxy Materials

Stanley E. Podlaseck

CONTRACT NAS1-15133  
MAY 1979

DEPARTMENT OF DEFENSE  
PLASTICS TECHNICAL EVALUATION CENTER  
ARRADCOM, DOVER, N. J. 07801

19960229 005

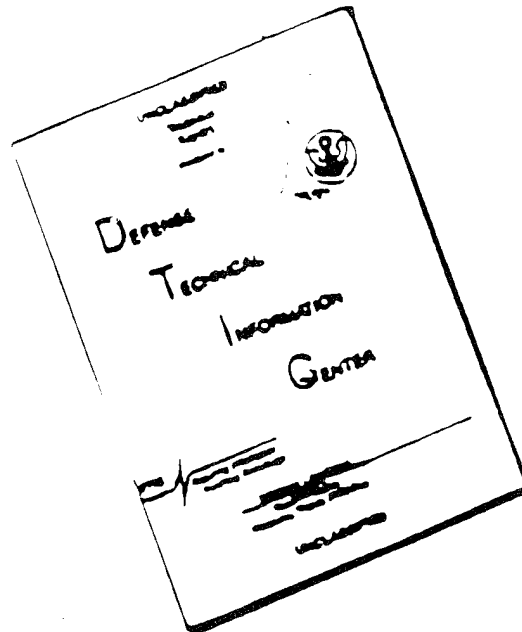
**NASA**

DISTRIBUTION STATEMENT A

Approved for public release;  
Distribution Unlimited

PLASTEC 32869

# DISCLAIMER NOTICE



THIS DOCUMENT IS BEST  
QUALITY AVAILABLE. THE COPY  
FURNISHED TO DTIC CONTAINED  
A SIGNIFICANT NUMBER OF  
PAGES WHICH DO NOT  
REPRODUCE LEGIBLY.

NASA Contractor Report 3133

# Nonmetallic Materials Handbook

Volume 1 - Epoxy Materials

Stanley E. Podlaseck  
*Littleton, Colorado*

Prepared for  
Langley Research Center  
under Contract NAS1-15133

**NASA**  
National Aeronautics  
and Space Administration

**Scientific and Technical  
Information Office**

1979

BUY QUALITY INSULONED 1

Table of Contents

	<u>Page</u>
1. Tests . . . . .	vi
2. Material Test Index . . . . .	viii
3. Application Index . . . . .	xii
4. Introduction . . . . .	1
5. Discussion of Test Methods	
I. Thermochemical Tests . . . . .	2
II. Physical Property Tests . . . . .	8
III. Qualification Criteria for Viking Materials. . . .	10

6. Data Section

<u>Material</u>	<u>Manufacturer</u>	
Ablefilm 501-1	Ablestik Labs . . . . .	15
Ablefilm 535-1	Ablestik Labs . . . . .	18
ADX-41	Hysol . . . . .	20
Armstrong A2/ACT E	Armstrong . . . . .	23
Bacon FA13/BA-39	Bacon Industries. . . . .	26
BC-328A/BC-328C	Dolph . . . . .	29
BLH-EPY 500	Baldwin-Lima-Hamilton . . . .	32
Bondmaster E645	National Starch and Chemical Corporation. . . . .	35
C7-4248	Hysol . . . . .	38
CMC-15 Bonding Film	Circuit Material Co. . . . .	41
Coating G2735 on Electromagnetic Core	Magnetics Corp. . . . .	44
Coating S8993-8Q2 on Electromagnetic Core	Magnetics Corp. . . . .	46
Conductive Epoxy 5504A	E. I. DuPont. . . . .	48
Conductive Epoxy 8294	E. I. DuPont. . . . .	51
E-300 Insulating Film	Dyna-Therm Corp.. . . . .	54
EA901/B3	E. V. Roberts . . . . .	57
EA956	Hysol . . . . .	60
EA9320	Hysol . . . . .	62
EA9414	Hysol . . . . .	65
Eccobond 56C/Cat 11	Emerson and Cuming, Inc.. . .	68
Eccocoat EP-3	Emerson and Cuming, Inc.. . .	71
Eccoseal 1207/20	Emerson and Cuming, Inc.. . .	74
Eccostock R-25	Emerson and Cuming, Inc.. . .	77
ECF-550	Epoxy Coating Co. . . . .	80

	<u>Page</u>
EG818T	Mica Corp. . . . . 83
Epocast 203	Furane Plastics, Inc. . . . . 86
Epon 815/A	Ceilmate/Eastman. . . . . 89
Epon 828/Cat 2/Flex 871	Shell Chemical Co. . . . . 91
Epon 828/MPDA/120 Fiberglass	
Cloth	Shell Chemical Co. . . . . 94
Epon 828/Versamid 125	Shell Chemical Co. . . . . 97
Epon 929/B	Hysol . . . . . 100
Epo-Tek H43	Epoxy Technology, Inc. . . . . 102
Epo-Tek H72	Epoxy Technology, Inc. . . . . 105
Epo-Tek 417	Epoxy Technology, Inc. . . . . 108
Epo-Tek 417	Epoxy Technology, Inc. . . . . 111
Epoxy 450 Tubing	3M Co. . . . . 114
ES-222	Polyscientific. . . . . 117
FM-40	American Cyanamic Co. . . . . 120
FM-96 Supported Film	American Cyanamid Co. . . . . 123
High Temp 221	High Temp Resins. . . . . 127
HT435 Film Adhesive	American Cyanamid Co. . . . . 130
Hysol AS-7-4315	Hysol . . . . . 133
Hysol C9-4183/H2-3561	Hysol . . . . . 136
Hysol R9/H2	Hysol . . . . . 139
Impregnant 3-BA-4	Bacon Industries. . . . . 142
Ink, Cat-L-Ink 50-100, -Cat. 20	Wornow Process Paint. . . . . 145
Ink, Cat-L-Ink 50-300-9	Wornow Process Paint. . . . . 148
Ink, Cat-L-Ink 50-407-9	Wornow Process Paint. . . . . 151
Ink, M-9-N/Cat A	Wornow Process Paint. . . . . 154
Ink, Markem 7224	Markem Corp. . . . . 157
Ink, M-O-N, Black	Wornow Process Paint. . . . . 160
Ink, Red, 50-507-9	Wornow Process Paint. . . . . 163
Ink, Yellow, 50-202-9	Wornow Process Paint. . . . . 166
Laminate, Epoxy/Glass 102-21	Mica Corp. . . . . 169
Laminate, Mil-P-13949 FL-GFN	Fortin. . . . . 172
Laminate, E-787	U.S. Polymeric, Inc. . . . . 174
Laminate, G-10 FR Clad	Norplex . . . . . 176
Laminate, G-10 FR Unclad	Norplex . . . . . 179
Laminate, L-P-509 GR G-11	Formica Corp. . . . . 182
LCA-4V/BA-5	Bacon Industries. . . . . 184
Lefkowied 46LM 52	Leffingwell . . . . . 187
MF500F-124 Microwave Absorber	Emerson and Cuming, Inc. . . . . 190
Paint, Cat-A-Lac 473-3-1/ x304	Finch Paint . . . . . 193
Paint, Brolite Gloss Black Enamel	Andrew Brown. . . . . 195

	<u>Page</u>
Paint, Brolite Gloss White	
Enamel	
Paint, Nextel 401-C10	Andrew Brown ..... 198
Scotchcast 241	3M Co. .... 201
Scotchcast 583 Tape	3M Co. .... 204
Skyspar A423/66	3M Co. .... 207
SMRD 100F-90	Andrew Brown ..... 209
Stycast 36D	General Electric ..... 212
Stycast 1263/Cat. 31	Emerson and Cuming, Inc. .... 215
Stycast 2651/Cat. 9	Emerson and Cuming, Inc. .... 218
Stycast 2651/Cat. 11	Emerson and Cuming, Inc. .... 221
Torr Seal A/B	Emerson and Cuming, Inc. .... 224
Trucast 111M/901	Varian Associates ..... 227
Trucast 111M/902	Fenwal, Inc. .... 230
	Fenwal, Inc. .... 233

## TESTS

1. Vacuum TGA	V70/23P
2. Mass spectra of volatiles	V70/23P
3. Nitrogen TGA	V70/23P
4. DTA	V70/23P
5. Isothermal weight loss in nitrogen	V70/22P
6. Vacuum condensables	V70/22P
7. Corona resistance	ASTM D1868
8. Dielectric strength	ASTM D149
9. Dielectric constant	ASTM D150; ASTM 1673
10. Dissipation factor	ASTM D150
11. Insulation resistance	ASTM D257
12. Surface and volume resistivity	ASTM D257
13. Adhesion	FTMS 141 Method 6304.1
14. Bearing strength	FTMS 406 Method 1051
15. Bend test	FTMS 141 Method 6304.1
16. Compression set	ASTM D395
17. Compression strength	ASTM D695; ASTM 1621; ASTM C165
18. Creep	ASTM D674
19. Dimensional stability	ASTM C548; ASTM C356
20. Emissivity and absorptivity	V71/96P; V71/97P
21. Flexibility	FTMS 141 Method 6221
22. Flexure	ASTM D790
23. Hardness	FTMS 601 Method 3021 ASTM D785 and D2240
24. Lap Shear	ASTM D1002
25. Moisture resistance	ASTM D570
26. Peel	ASTM D1876
27. Knot breaking strength	(MMC) STM F420
28. Scratch	FTMS 141 Method 6304.1
29. Solvent resistance	ASTM D471
30. Specific gravity	ASTM D792

Tests (Cont'd)

31. Tear	ASMT D624
32. Tensile	ASTM D412; ASTM D638 FTMS 191 Method 4102
33. Thermal conductivity	ASTM C177
34. Thermal expansion	ASTM D696
35. Water absorption	FTMS 406 Method 7031



Material Test Index

NAME	TESTS PERFORMED*																																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
Ablefilm 501-1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ablefilm 535-1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ADX-41	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Armstrong A2/Act E	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Bacon FA13/BA-39	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
BC-328A/BC-328C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BLH-EPY 500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Bondmaster E645	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C7-4248	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CMC-15 Bonding Film	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Coating G2735 on Electromagnetic core	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Coating S8993-8Q2 on Electromagnetic core	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Conductive Epoxy 504A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Conductive Epoxy 8294	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
E300 Insulating Film	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EA901/B3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EA956	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EA9320	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EA9414	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eccobond 56C/Cat. 11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eccocoat EP-3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eccoseal 1207/20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eccostock R-25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ECF-550	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EG818T	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Epocast 203	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

\*Numbers refer to tests listed on pp. iv and v.



Material Test Index

NAME	TESTS PERFORMED*																																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35			
Laminate, Epoxy/Glass 102-21	X	X																																				
Laminate, Mil-P-13949 FL-GFN	X	X																																				
Laminate, E-787	X	X																																				
Laminate, G-10 FR Clad	X	X																																				
Laminate, G-10 FR Unclad	X	X																																				
Laminate, L-P-509, GR G-11	X	X																																				
LCA-4V-BA-5	X	X																																				
Lefkowied 46LM 52	X	X																																				
MF500F-124 Microwave Absorber	X	X																																				
Paint, Cat-A-Lac 473-3-1/x304	X	X																																				
Paint, Broilite Gloss Black Enamel	X	X																																				
Paint, Broilite Gloss White Enamel	X	X																																				
Paint, Nextel 401-C10	X	X																																				
Scotchcast 241	X	X																																				
Scotchcast 583 Tape	X	X																																				
Skyspar A423/66	X	X																																				
SMRD 100F-90	X	X																																				
Stycast 36D	X	X																																				
Stycast 1263/Cat. 31	X	X																																				
Stycast 2651/Cat. 9	X	X																																				
Stycast 2651/Cat. 11	X	X																																				

\*Numbers refer to tests listed on pp. iv and v.

Material Test Index

NAME	TESTS PERFORMED*																																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
Torr Seal A/B	X																																						
Trucast 111M/901	X																																						
Trucast 111M/902	X																																						

\*Numbers refer to tests listed on pp. iv and v.

## Application Index

	<u>Page</u>
<b>ADHESIVES:</b>	
Ablefilm 501-1 .....	15
Ablefilm 535-1 .....	18
Armstrong A2/Act E .....	23
Bacon FA13/BA-39 .....	26
BLH-EPY 500 .....	32
Bondmaster E645 .....	35
CMC-15 Bonding Film .....	41
EA901/B3 .....	57
EA956 .....	60
EA9320 .....	62
EA9414 .....	65
Eccobond 56C/Cat.11 .....	68
ECF-550 .....	80
Epocast 203 .....	86
Epon 815/A .....	89
Epon 828/Versamid 125 .....	97
Epo-Tek H43 .....	102
Epo-Tek H72 .....	105
Epo-Tek 417 .....	108
Epo-Tek 417 .....	111
FM-40 .....	120
FM-96 Supported Film .....	123
HT435 Film Adhesive .....	130
Hysol AS-7-4315 .....	133
LCA-4V/BA-5 .....	184
Lefkowied 46LM 52 .....	187
<b>COATING, FINISHES, INKS:</b>	
ADX-41 .....	21
C7-4248 .....	38
Coating G2735 on Electromagnetic Core .....	44
Coating S8993-8Q <sub>2</sub> on Electromagnetic Core .....	46
Eccocoat EP-3 .....	71
Hysol C9-4183/H2-3561 .....	136
Ink, Cat-L-Ink 50-100-Cat. 20 .....	145
Ink, Cat-L-Ink 50-300-9 .....	148
Ink, Cat-L-Ink 50-407-9 .....	151
Ink, M-9-N/Cat. A .....	154
Ink, Markem 7224 .....	157
Ink, M-O-N, Black .....	160

## Application Index (Continued)

	<u>Page</u>
Ink, 50-507-9, Red .....	163
Ink, 50-202-9, Yellow .....	166
Paint, Cat-A-Lac 473-3-1/x304 .....	193
Paint, Brolite Gloss Black Enamel .....	195
Paint, Brolite Gloss White Enamel .....	198
Paint, Nextel 401-C10 .....	201
Skyspar A423/66 .....	209
<b>ELECTRICAL INSULATION:</b>	
BC-328A/BC-328C .....	29
E300 Insulating Film .....	54
<b>ENCAPSULANTS AND SEALANTS:</b>	
Conductive Epoxy 5504A .....	48
Conductive Epoxy 8294 .....	51
EA9414 .....	65
Eccoseal 1207/20 .....	74
Epon 815/A .....	89
Epon 828/Cat. 2/Flex 871 .....	91
Epon 929 .....	100
ES-222 .....	117
High Temp 221 .....	127
Hysol AS-7-4315 .....	133
Hysol R9/H2 .....	139
Impregnant 3-BA-4 .....	142
Scotchcast 241 .....	204
SMRD 100F-90 .....	212
Stycast 36D .....	215
Stycast 1263/Cat. 31 .....	218
Stycast 2651/Cat. 9 .....	221
Stycast 2651/Cat. 11 .....	224
Torr Seal A/B .....	227
Trucast 111M/901 .....	230
Trucast 111M/902 .....	233
<b>LAMINATES, COMPOSITES:</b>	
EG818T .....	83
Epon 828/MPDA/120 Fiberglass Cloth .....	94

Application Index (Continued)

	<u>Page</u>
Epoxy 450 Tubing .....	114
Laminate, Epoxy/Glass 102-21 .....	169
Laminate, Mil-P-13949 FL-GFN.....	172
Laminate, E-787.....	174
Laminate, G-10 FR Clad .....	176
Laminate, G-10, FR Unclad .....	179
Laminate, L-P-509 GR G-11.....	182
TAPE:	
Scotchcast 583 Tape .....	207
THERMAL INSULATION:	
Eccostock R-25 .....	77
MISCELLANEOUS:	
MF 500F-124 Microwave Absorber.....	190

## INTRODUCTION

This handbook is a compilation of chemical and physical property test data obtained during qualification and receiving inspection testing of nonmetallic materials for the Viking Mars Lander (NAS1-9000) program at the Denver Division of Martin Marietta Corporation. The compilation presented here is unique in that all tests have been carried out by one group of test personnel. This familiarity with all test procedures and materials minimizes the possibility of unintentional modifications of test techniques and misinterpretation of data and their presentation.

The information presented has, as a minimum, thermochemical data showing degradation as a function of temperature from room temperature through 773°K (500°C). These data include activation energies for thermal degradation, rate constants, and exo- and/or endotherms. Thermal degradations carried out under vacuum include mass spectral data taken simultaneously during the decomposition. Many materials have supporting data such as condensation rates of degassed products and isothermal weight loss. Changes in mechanical, electrical and thermal properties after exposure to 408°K (135°C) in nitrogen for times ranging from 380 to 570 hours are included for many materials.

Over 400 organic/polymeric materials were considered for use throughout the Viking Mars lander capsule program. Considering the variety of mechanical, electrical and thermal property measurements required, conventional vacuum tests techniques would be prohibitive from the standpoint of both cost and schedule. Unique facilities for determining physical properties in-situ were developed to handle the environmental exposure and material qualification test requirements established for the Viking Mars lander capsule. Since the capsule was almost completely inactive during cruise from Earth to Mars and few mechanical or electrical stresses are developed during this phase, the thermal vacuum environment was the only simulation required. The system developed separated the environmental conditioning from testing and provided for transfer of specimens between conditioning and testing chambers without exposure to atmosphere. It is described later.



## DISCUSSION OF TEST METHODS

### I. Thermochemical Data

A. TGA: Thermogravimetric analysis (TGA) is the continuous weighing of a sample while it is being heated at a fixed heating rate, e.g.,  $10^{\circ}\text{K}/\text{min}$ . During this process,

the sample loses weight continuously, beginning and ending at temperatures peculiar to the sample material. Figure 1 is a schematic of the system used.

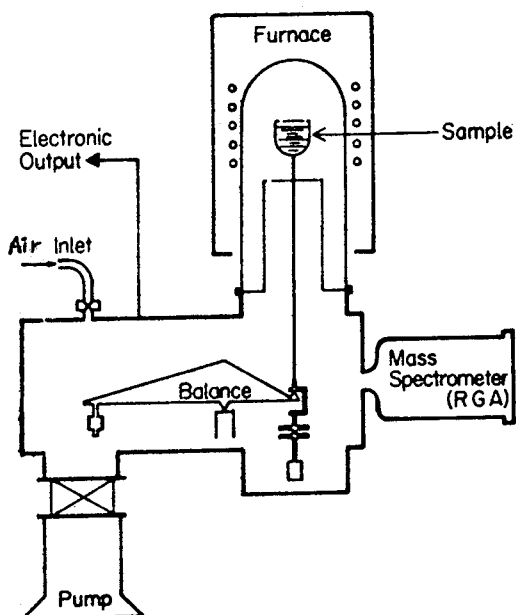


Figure 1  
Schematic of TGA-RGA  
Apparatus

Figure 2 shows the TGA curve for a silicone. This material thermally decomposes in a two-step process; the dotted line depicts the end of the first reaction. The second reaction may be the decomposition of the product of the first reaction or it may be different component of the original material.

The simple first-order kinetic equation

$$\frac{dx}{dt} = \frac{k_T}{(a_0 - x)} \quad (1)$$

has been found to be adequate for describing the decompositions. In this equation,  $k_T$  is the rate constant at temperature  $T$ ,  $dx/dt$  is the rate of weight loss,  $x$  is the weight loss, and  $a_0$  is the initial amount of the "active component". The active component is that portion of the original weight of the sample that participates in decomposition. For decompositions with a simple TGA curve, the active component is taken as the total weight loss. For polymers where the TGA shows the degradation to be more than a one-step decomposition as in Figure 2, the initial weight of the active component  $a_0$  is taken as that portion of sample weight participating in the step. In Figure 2, these are designated as  $(a_0)_1$  for the first de-

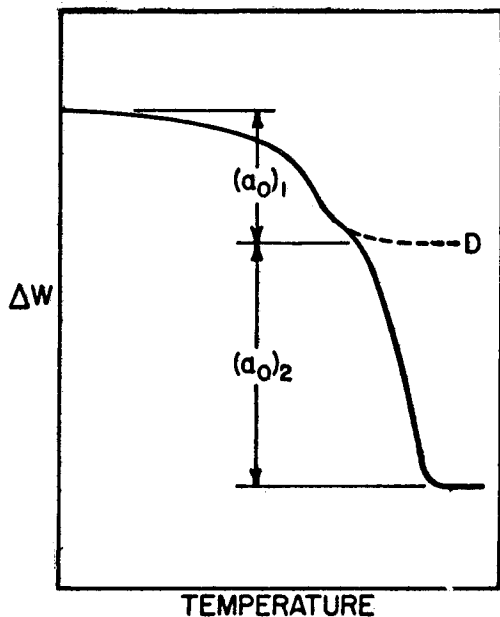


Figure 2  
TGA Curve for a Silicone

composition and  $(a_0)_2$  for the second step. In utilizing equation (1), the thermoanalyzer yields  $dx/dt$  from the DTG output, which is the electronically determined slope of the TGA,  $x$  is obtained from the TGA curve, and  $a_0$  as described.

The rate constant is given by the "Arrhenius relationship"

$$k = A \exp \frac{-E}{(RT) \text{ time}^{-1}} \quad (2)$$

where  $A$  is a constant, usually called the frequency factor,  $R$  is the universal gas constant,  $T$  is the absolute temperature, and  $E$  is an energy term known as the activation energy of the process. If the rate constants, experimentally determined at several temperatures, from Equation (1) are plotted against the reciprocal of absolute temperature ( $^{\circ}\text{K}$ ), the result is the Arrhenius relationship depicted in Figure 3. The slope of this plot yields the activation energy of the decomposition. Figure 3 shows the results obtained for the first reaction step of the decomposition for the silicone depicted in Figure 2. The points on the plot are representative of the very large number of data points available from the TGA-DTG output of the thermoanalyzer. The larger slope is the activation energy for the decomposition of the polymer associated with  $(a_0)_1$ . The smaller slope results from degassing of "solvent" such as unreacted monomer, catalyst,

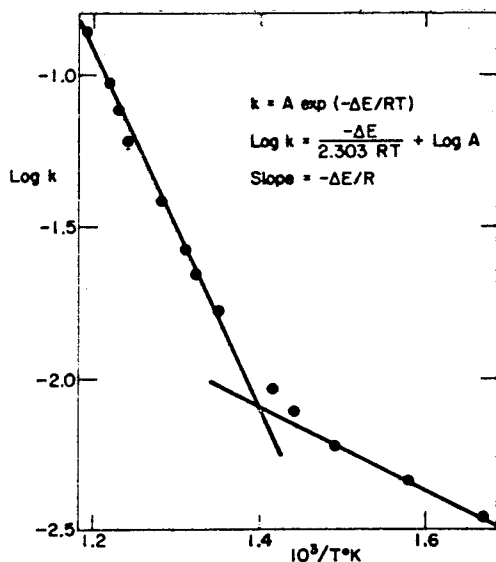


Figure 3  
Arrhenius Relationship  
Obtained from TGA Curve

etc. At the lower temperatures of the TGA test where this slope appears,  $x$  in Equation (1) is predominantly "solvent" loss whereas the amount of "solvent" is so small with respect to the amount of polymer that it does not affect  $a_0$  for the polymer degradation. Thus, when the "solvent" is degassed during the early stages of the TGA test, the Arrhenius relationship reverts to that for the degradation of the polymer itself.

Integration of the rate equation, Equation (1), yields

$$a_0 - x = a_0 e^{-kt} \quad (3)$$

where  $t$  is time. Then

$$\frac{a_0 - x}{a_0} = e^{-kt} \text{ is the fraction remaining.} \quad (4)$$

Thus, when  $k$  is determined for a particular temperature, one can get the fraction of material remaining after a time,  $t$ ,

$$1 - e^{-kt} \times 100 = \% \text{ weight loss.} \quad (5)$$

As an example consider the question, what is the time required for a 1% weight loss at 423°K (150°C) for a silicone such as that depicted in Figure 2? From information given for the material in the Data Section, we find that

$$k_T = 0.8 \exp \left( \frac{-6720}{RT^{\circ}K} \right) \text{ min}^{-1}$$

Therefore

$$k_{423^{\circ}K (150^{\circ}C)} = 0.8 \exp \left( \frac{-6720}{1.98 \times 423} \right) = 2.63 \times 10^{-4} \text{ min}^{-1}.$$

For 1% weight loss, the fraction remaining is 0.99 so  $e^{-kt} =$

0.99, from which we find that  $kt = 0.01$ . Thus the time required is

$$t = \frac{0.01}{2.63 \times 10^{-4}} = 38 \text{ min.} = 2.3 \times 10^3 \text{ s.}$$

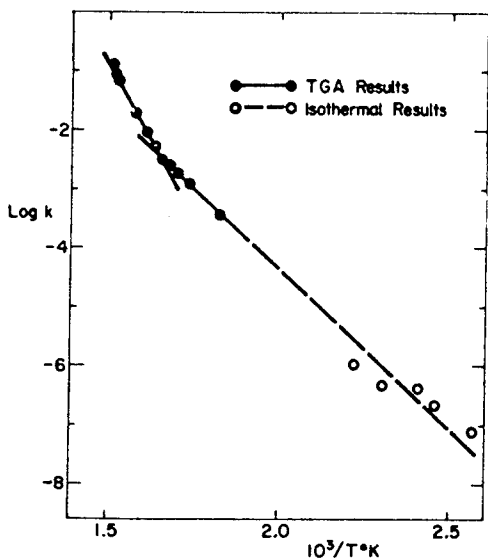


Figure 4  
Arrhenius Relationship  
Comparing TGA and Iso-  
thermal Results for  
Dacron

Figure 4 compares TGA results on approximately 10 mg of Dacron parachute material with an isothermal decomposition on approximately 4 gm of material at near normal use temperatures. The excellent agreement with the prediction of TGA is evident. It should be noted that the TGA is able to predict rate constants at some 300°K lower temperature on realistically sized samples. Predictive capability has been found for all materials so compared (see "Prediction of Polymer Degradation Kinetics at Moderate Temperatures from TGA Measurements", H. Papazian, J. Appl. Polym. Sci., 16, 2503, 1972).

When the cure and postcure of two different batches of the same polymer are carried out in the same manner, the TGA curves are identical.

TGA tests were run at heating rates of 10°K/min for both the vacuum and nitrogen tests. Samples were prepared as small particles scraped or cut to size to approximately 10 mg of total weight. Samples were preconditioned prior to TGA tests in several ways and are discussed for each material in the data section. For the nitrogen TGA tests, the flow rate of the nitrogen was 5.2 l/hr. During vacuum TGA tests, mass spectra were taken at 1-minute intervals (i.e., every 10°K).

The TGA data in this document are presented in graphical form, similar to Figure 2, giving weight loss vs. temperature from ambient to 773°K (500°C). A second curve having 10 times the sensitivity of the standard TGA curve is used to give an

accurate display of the first 10% of weight loss. This will give details of the early portion of the decomposition, which may be of importance in determining low temperature degassing, water absorption, etc.

B. Mass Spectra - Mass spectrometry, sometimes referred to as residual gas analysis (RGA) or evolved gas analysis (EGA), has been used to qualitatively characterize the volatile species as they are generated during the TGA test.

When a volatilized molecule enters the ionization chamber (or region) of a mass spectrometer, it is impacted by energetic (70-eV) electrons. The molecule is thereby fragmented into its mass spectrum. This mass spectrum is characterized by masses and their intensities. For example,  $H_2O$  is fragmented into masses 18 ( $H_2O^+$ ), 17 ( $OH^+$ ), 16 ( $O^+$ ) in the intensity ratio 18 = 100, 17 = 26, 16 = 6. Whenever a mass spectrum is observed with the masses 18, 17, and 16 in the intensity ratio 100, 26, and 6, it may be identified as water.

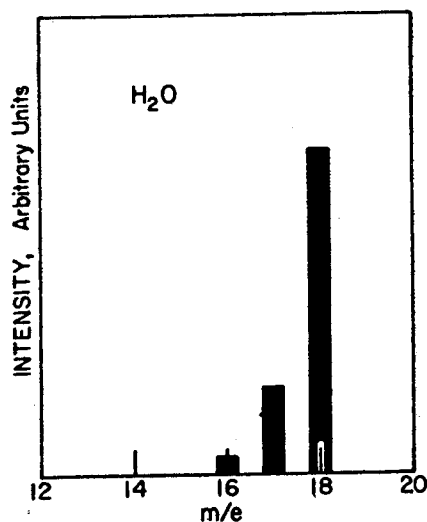


Figure 5  
Mass Spectrum of Water

Figure 5 depicts the mass spectrum of  $H_2O$  obtained with 70-eV electrons. The abscissa is labeled  $m/e$  to be consistent with the usual presentations. The ratio of mass-to-charge,  $m/e$ , is what is actually measured in the mass spectrometer. Since it is unusual for the charge  $e$  to be equal to 2, the  $m/e$  ratio is usually the mass number or mass fragment. For simple molecules the analysis is quite simple. With increasing molecular weight and therefore increasing complexity of the molecule, the complexity increases accordingly. In mixtures of such molecules, as are present in most polymeric systems, the analysis is exceedingly difficult. However, mass spectra used in conjunction with TGA data permit determination as to whether samples from

two different batches are identical. This permits comparison of materials and how they were processed.

Mass spectra can also be useful in determining degassing prior to thermal decomposition. For example, one can determine

how much H<sub>2</sub>O, solvent, unreacted monomer, etc., remain in the material after processing, e.g., cure, postcure.

On all TGA tests under vacuum, mass spectra are taken at 1-minute intervals, i.e., every 10°K. Since it is impractical to present these voluminous data, approximately five temperatures are chosen along important parts of the TGA curve and mass spectra at these temperatures are presented in tabular form.

C. DTA: Differential thermal analysis (DTA) indicates the heat changes taking place during the decomposition. An exotherm indicates a release of heat, and an endotherm indicates the absorption of heat. This information is useful in determining the mechanism of the decomposition reaction.

DTA curves are obtained simultaneously with the TGA under nitrogen and are presented in graphical form for each material.

D. Isothermal Weight Loss in Nitrogen: The purpose of this test was to simulate the Viking lander sterilization conditions.

Samples were preconditioned for 24 hours at 296°K (23°C) in 45% RH for a baseline condition. Approximately 2 to 5 gm of sample was weighed and placed in a gastight system at 408°K (135°C). Nitrogen flowing at 5.2 l/hr. was passed over the sample for 100 hrs. (3.6 x 10<sup>5</sup>s) after which the sample was weighed to determine the weight loss.

E. Condensible Outgassing: In many situations it is important to know what products of outgassing from a material are condensible, thereby leading to contamination of, for example, optical surfaces.

Condensible degassing rates onto a gold-plated quartz substrate cooled to 148°K (-125°C) were determined using a quartz crystal microbalance (QCMB). In this test, a 2 to 5 gm sample was placed in a small vacuum furnace and the temperature was elevated to 325°K (52°C) (max mass lander temperature anticipated). The furnace was then sealed except for a small orifice above which the cooled QCMB was located. The condensation rate was monitored continuously until a constant deposition rate was established, the time ranging from 1 to 4 days.

Figure 6 is a schematic diagram of the test apparatus.

The results are presented in tabular form showing condensation rate (as % of original sample weight per day),

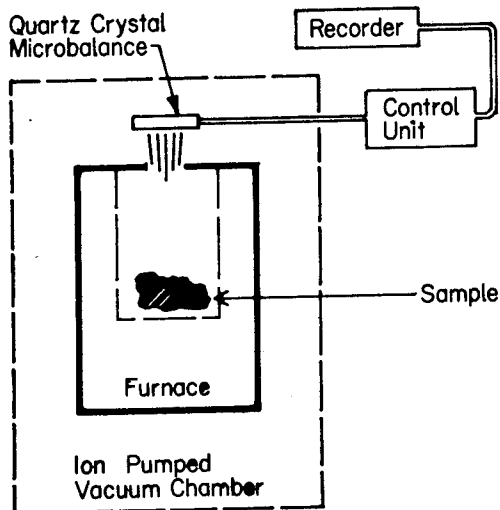


Figure 6  
Schematic of Condensible  
Outgassing Products

temperature of the sample, and the duration of vacuum exposure prior to outgassing tests.

## II. Physical Property Tests

Twenty-nine different physical properties have been measured, each material being tested for its particular use. These tests are listed in Table 1 on Pages iv and v. Points at which property determinations were made include before and after heat compatibility and after a 1-month thermal vacuum exposure, with some data at 3-, 6-, and 14-month thermal vacuum exposures. The results for any material are presented in tabular form showing the property measured against the parameter of interest and the ASTM or FTMS designation for the test procedure.

The thermal vacuum exposures were carried out in individual canisters. Four canisters were coupled directly to 50 l/s ion pumps and the remaining 28 were connected to 7-canister plenums, with each plenum attached to a 400 l/s ion pump. Each system was capable of maintaining pressures in the  $10^{-7}$  to  $10^{-8}$  torr range.

Two 63.5 mm high vacuum valves between the canister and vacuum plenum permitted the canister to be removed from the pumping system and transferred to the test chamber without altering the pressure in the canister or plenum. A recirculating hot water heater maintained canister temperatures between ambient and  $339^{\circ}\text{K}$  ( $66^{\circ}\text{C}$ ).

The test chamber was constructed of 300 series stainless steel and consisted of two individual vacuum chambers separated by a .61 m sliding gate valve. The main chamber was a nominal 1.5 m in diameter and 2.1 m long. The airlock chamber was .61 m in diameter and .61 m long, and a full opening door at the other end provided easy access to the chamber.

The .56 m<sup>2</sup> chamber view window had three tempered glass

sections each laminated of two layers of 19 mm thick glass. Twenty-nine flanges on the main chamber ranged in size from a 38 to 203 mm tube size. The flanges were fitted with feed-throughs for high voltage, coaxial, high current, instrumentation, liquid nitrogen, and nude ion gages.

Three master/slave manipulators enabled access to over 90% of the chamber while it was evacuated. The manipulators were similar to those used in nuclear installations and each consisted of four major parts--the master arm, the slave arm, the seal tube assembly, and the tongs. Tong configurations could be changed remotely using a special fixture. The manipulators provided six degrees of freedom and had electric indexing in two axes for displacement of the master arm relative to the slave arm. All other motions were mechanical, with a one-to-one force ratio between the master arm and the slave arm except for the friction of the motion rods within the seal tube assembly. Figure 7 shows the chamber and manipulators.

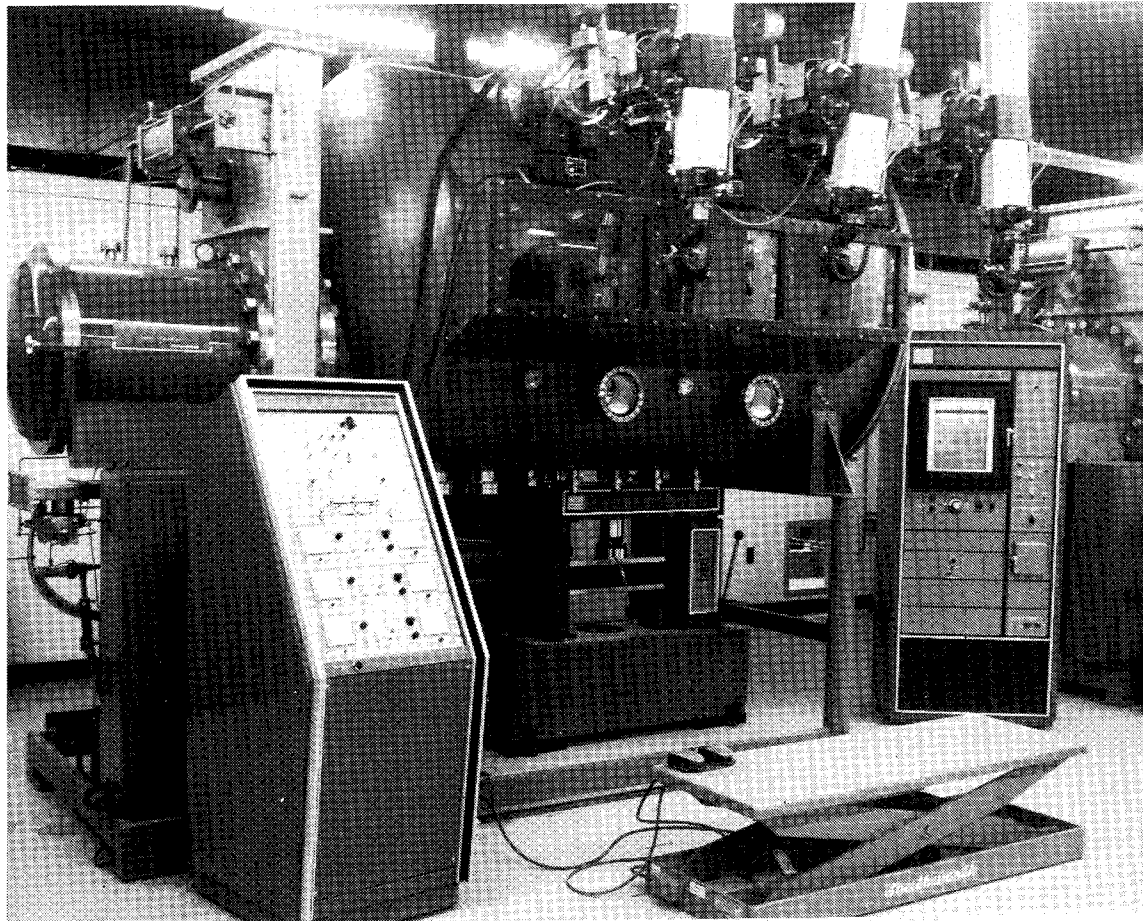


Figure 7.-Master-Slave Manipulator Test Chamber.



A 4,500 kg universal test machine was coupled to the main chamber. The columns were shock isolated from the chamber with bellows, and the moving crosshead pull rod was attached to a bellows with a 35 cm stroke capability. Tensile, compression, flexure, and shear tests have been performed in this chamber. Electrical property tests, including dielectric strength, dielectric constant, and surface and volume resistivity, have been accomplished with the aid of special fixturing developed for use in vacuum with the master/slave manipulators. Thermal expansion measurements of heat shield materials have been made using fixtures designed to be handled with manipulators. Heating and cooling of test specimens was provided by radiant heaters (quartz lamps) and liquid nitrogen-cooled shrouds.

### III. Qualification Criteria Used for Viking Materials

All proposed materials were given a screening TGA. There were no criteria for this test except judgment as to thermal stability. This judgment was based on how much weight loss occurred at the sterilization temperature and the temperature of the beginning of major decomposition of the material.

Once a material passed screening, qualification of the material for the Viking program was undertaken. The material was subjected to tests of (1) isothermal weight loss in N<sub>2</sub> and (2) condensible outgassing. If the isothermal weight loss was greater than 1%, the material was rejected. If the condensible outgassing rate was greater than  $1 \times 10^{-4}\%$ /day, the material was rejected. If the material passed these criteria, it was permitted to undergo the physical property qualification tests that depended on the proposed use of the material. The criteria for the physical property qualification were determined by the design parameters for the material.

A TGA-RGA analysis was carried out as a baseline for comparison with all subsequent lots or batches of material. Rejection of an incoming sample occurred if:

- 1) The TGA curve of the new sample presented a total mismatch with the baseline curve;
- 2) The TGA weight loss in the temperature range between 298°K (25°C) and 408°K (135°C) was more than 2% of the baseline TGA;
- 3) The RGA data showed major mass fragments different from

the baseline major mass fragments;

4) The RGA data between 298°K (25°C) and 408°K (135°C) showed mass fragments greater than  $m/e = 44$  not present in the baseline RGA;

5) When the onset of major degradation varies more than 50 to -20°K from the baseline onset;

6) When the total weight loss (through major degradation) of composites indicates a filler content variation of greater than 5%.

During the course of the program changes in technical direction eliminated or modified some qualification tests so that not all materials reported here have the same data available.

Use of trade names or names of manufacturers in this report does not constitute an official endorsement of such products or manufacturers, either expressed or implied, by the National Aeronautics and Space Administration, nor does it imply that the materials are necessarily the only ones or the best ones available for the purpose.

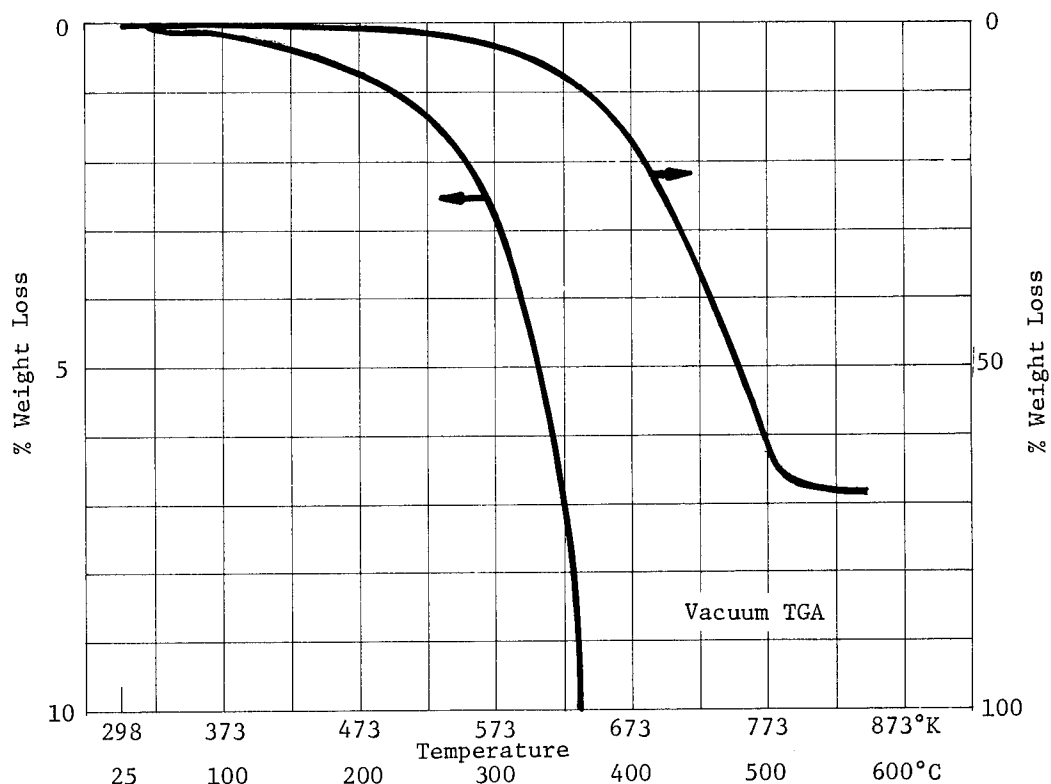
DATA SECTION

Chemical Characterization Summary

Mix Ratio: As received film

Cure: 3 hrs. at 347°K (73°C), 1 hr. at 408°K (135°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 298°K (25°C) - 548°K (275°C)

$a_0 = 7.6\%$  of initial weight

$$k = 1.9 \times 10^5 \exp \left( \frac{-16800}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$8.3 \times 10^5$	
373°K (100°C)	$2.4 \times 10^4$	
423°K (150°C)	$1.6 \times 10^3$	

Isothermal weight loss in nitrogen-0.85%

Number and Relative Peak Intensity

Temperature, °K (°C)

Ablefilm 501-1

m/e	298 (25)	473 (200)	573 (300)	698 (425)	773 (500)		
14		1180	1427	5589	1543		
15	1202	624	1224	14082	1779		
16	585	3660	3789	6427	3890		
17	3978	9380	9271	11079	8290		
18	11584	28021	27218	31973	22965		
19	35873	149	174	549	122		
20	156	292	284	374	263		
21	296						
22							
23							
24			101	604	106		
25		62	275	2183	319		
26	52	287	1392	8873	1493		
27	239	530	1895	11145	1866		
28	504						
29	12958	12442	14709	31474	14268		
30	241	300	1284	22941	1879		
31	738	734	868	5385	1006		
32			139	4510	357		
33	3294	2893	2774	2886	2432		
34							
35		40	111				
36			284	559	112		
37			41	2756	253		
38		46	194	4690	429		
39			269	14195	1437		
40	2301	2244	2342	7614	2535		
41	81	93	393	6987	932		
42	64	90	414	5735	646		
43	88	126	1043	22943	1574		
44	767	870	1304	5849	1008		
45		52	129	3858	346		
46				304			
47			45	749	48		
48			41	142			
49			109	731	92		
50		47	198	3044	395		
51			95	3042	446		
52			110	1107	205		
53			90	1993	268		
54			93	492	77		
55			341	3033	288		
56			390	1023	154		
57			100	1835	192		
58			90	2696	278		
59			40	1635	133		
60			60	416	47		
61			43	922	88		
62				1275	134		
63				2420	289		
64	44	45		806	102		
65				5647	425		
66	51	53	70	7237	428		
67			47	693	80		
68			56	367	50		
69			81	328	66		
70				206			
71				217			
72				570	46		
73				607	60		
74				891	90		
75				427	62		
76				322	51		
77			45	2195	398		
78			50	845	181		
79			42	1154	203		
80				294	54		
81				150			
82				93			
83				98			
84	67	73	72	138	59		
85				146			
86				144			
87				369			
88				57			
89				405	67		
90				378	69		
91				1381	337		
92			49	262	74		
93				421	42		
94				9932	492		
95				731	43		
96				96			
97				43			
98				51			
99				66			
100				87			
101				147			
102				124			
103				367	67		
104				102			
105				316	94		
106				89	42		
107				1630	305		
108				851	163		
109				79			
110							
111							
112							
113							
114				54			
115				225			
116				77			
117				130			
118				109			
119				397			
120				153			
121				805	118		
122				226	45		
123							
124							
125							
126							
127							

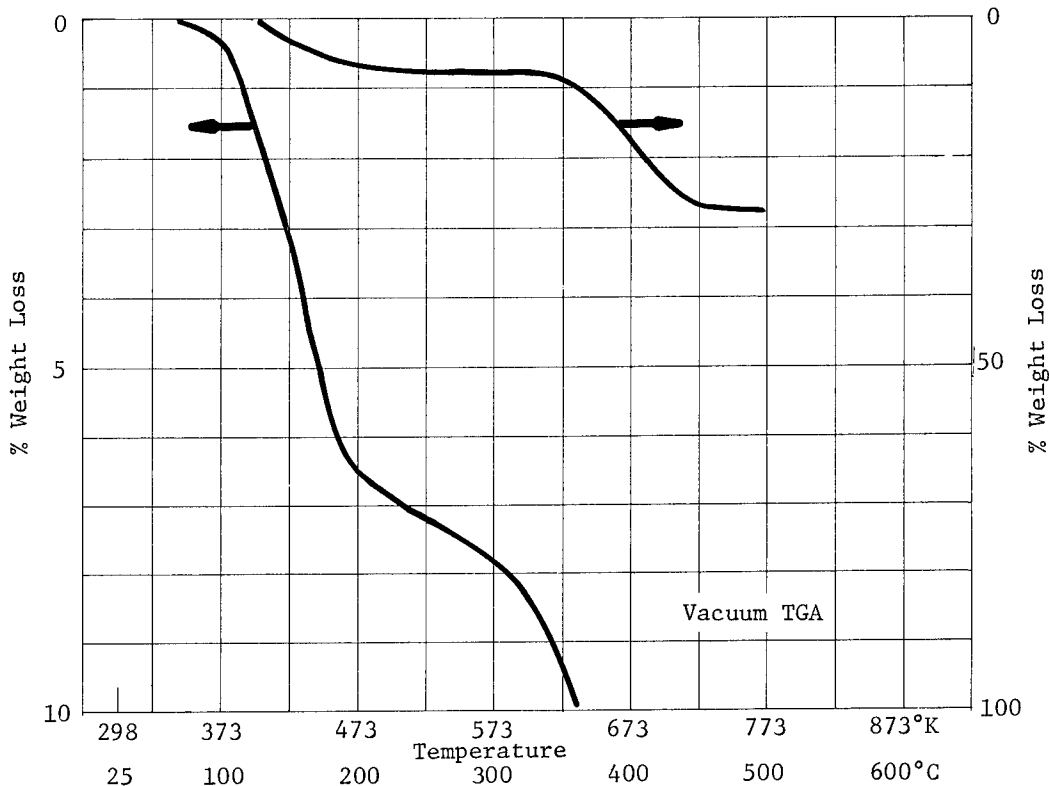
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Ablefilm 501-1	
	298 (25)	473 (200)	573 (300)	698 (425)	773 (500)		
128				42			
129	82	73	68	80	52		
130							
131	55	61	54	213	64		
132	67	67	62	135	57		
133				164			
134				280			
135				122			
136				172			
137							
138							
139							
140							
141							
142							
143							
144							
145				50			
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: As received film  
 Cure: 2 hrs. at 398°K (125°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-723°K (450°C)

$a_0 = 19.5\%$  of initial weight

$$k = 1.65 \times 10^{11} \exp\left(\frac{-36600}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.5 \times 10^{13}$	
373°K (100°C)	$1.2 \times 10^{10}$	
423°K (150°C)	$3.3 \times 10^7$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ablefilm 535-1

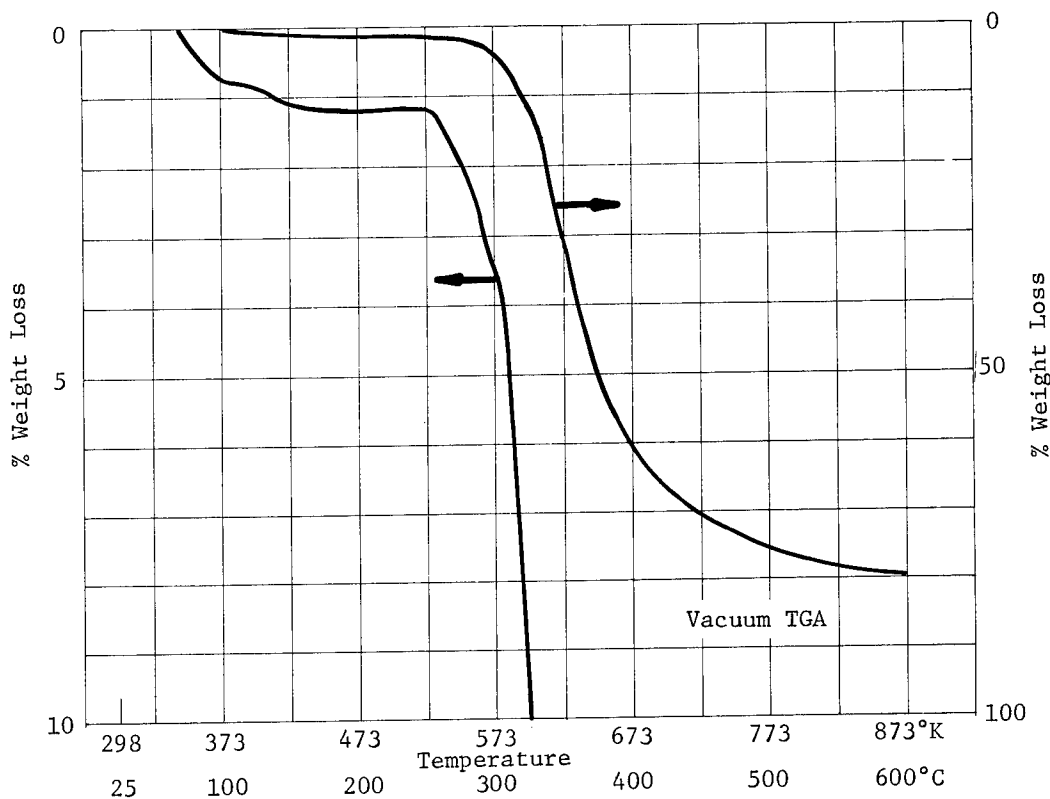
m/e	298 (25)	423 (150)	523 (250)	673 (400)	773 (500)		
14	488	1016	885	1589	1411		
15	283	388	364	1531	872		
16	1110	2146	2220	3100	2692		
17	5805	6829	6929	7063	7387		
18	21843	24913	30973	31343	27728		
19		46	70	81	55		
20	154	135	260	288	198		
21							
22				56			
23							
24				174	57		
25		129	94	945	293		
26	566	918	985	4336	1862		
27	763	1073	1243	5187	2594		
28	27325	37148	39496	48912	48514		
29	750	1033	1170	6189	2951		
30	347	491	586	1700	899		
31	107	117	131	1256	461		
32	4533	5586	5977	5609	6739		
33							
34							
35				148			
36				1281	158		
37				2229	340		
38	50		68	6643	1179		
39	104	165	233	6623	4187		
40	2336	3194	3602	2289	927		
41	166	202	168	2669	601		
42	169	139	183	5517	2831		
43	1182	1442	1725	6537	2007		
44	756	1247	1965	868	330		
45	45	96	55	87			
46				302			
47							
48				253			
49				1317	215		
50		73	41	1247	197		
51			40	434	40		
52				606	80		
53				196	41		
54				1361	122		
55				414	96		
56				587	144		
57			74	528	168		
58				73			
59				59			
60				212			
61				352			
62				629			
63				144			
64				1629	77		
65				2536	63		
66				281			
67				105			
68							
69							
70							
71							
72	48		49	62			
73							
74				93			
75							
76				47			
77				140			
78							
79				71			
80							
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91				55			
92							
93				79			
94				1251			
95				53			
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							



Chemical Characterization Summary

Mix Ratio: One Component  
 Cure: 4 hrs. at 394°K (121°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C)-773°K (500°C)

$a_0 = 51.9\%$  of initial weight

$$k = 1.2 \times 10^{13} \exp\left(\frac{-39200}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.0 \times 10^{13}$	
373°K (100°C)	$5.5 \times 10^9$	
423°K (150°C)	$1.0 \times 10^7$	

Number and Relative Peak Intensity

Temperature, °K (°C)

ADX-41

m/e	298 (25)	573 (300)	623 (350)	673 (400)	873 (600)		
14	663	1384	2474	1907	1653		
15	76	2701	6344	4293	5126		
16	1287	18097	13064	7934	8909		
17	9029	28455	26147	17286	10225		
18	35287	62942	64982	47448	35312		
19	140	138	293	240	94		
20	84	112	178	147	168		
21							
22		507	76				
23							
24		84	584	514	43		
25		472	2815	2630	215		
26	103	3772	15382	14868	1902		
27	300	5812	20115	20094	3656		
28	21774	46144	50066	44544	29088		
29	333	3234	9006	7815	1371		
30	231	6369	6369	3460	764		
31	146	4552	3759	2112	247		
32	5974	5886	5751	5867	5659		
33			40	92			
34							
35		40	42				
36		72	564	663	61		
37		606	4097	4270	139		
38		1410	7670	8149	423		
39	61	5214	24535	28055	1739		
40	438	3804	9474	9033	1240		
41	106	2832	10252	11453	1009		
42	78	7381	8750	5843	669		
43	149	3338	9763	7910	828		
44	939	100238	31839	13755	2292		
45	46	2363	2042	1261	166		
46		410	338	285	42		
47			778	569			
48		44	199	230			
49		195	2157	2230			
50		1586	11642	13623	72		
51		1598	15292	19563	585		
52		1676	10106	10595	660		
53		976	10890	11052	637		
54		608	4645	4444	482		
55		372	5580	5478	227		
56	49	681	1877	1405	339		
57		391	1364	906	136		
58		849	1021	834	118		
59		257	438	244	44		
60		57	603	514			
61			1947	2034	49		
62		62	3094	3771	106		
63		175	5774	6705	306		
64		170	2383	2724	117		
65		612	11246	12980	442		
66		951	11211	10811	357		
67		977	3376	3374	88		
68		122	1640	1532	57		
69		40	346	404	47		
70		63	309	264			
71		50	98	108	43		
72		56	100	139			
73		87	558	647	45		
74			2143	2939	41		
75			1243	1681	50		
76			1223	1898	50		
77		202	11705	15925	311		
78		263	7444	10906	523		
79		850	7045	8930	159		
80		417	8674	6865	445		
81	41	426	3129	2677	132		
82		57	725	658			
83			71	105			
84			109	86			
85			81	119			
86			114	170			
87			135	235			
88			54	57			
89			1305	2087			
90			1576	2129			
91		64	7844	17798	584		
92		185	2174	4948	295		
93		629	2204	2135	47		
94		847	15025	13825	345		
95		94	1597	1277	44		
96			152	173			
97							
98				57			
99			54	43			
100							
101				62			
102			367	732			
103			2644	4496			
104		43	4933	7698	49		
105			1312	2754	47		
106		78	919	1333	42		
107			9426	11639	104		
108		1143	7144	8087	92		
109			4503	3330	206		
110		55	195	149			
111							
112							
113							
114							
115							
116			218	518			
117			46	133			
118			57	765			
119			398	620			
120			342	127			
121			112	187			
122		58	1527	2018			
123		114	1880	2025	40		
124			580	382			
125							
126							
127							

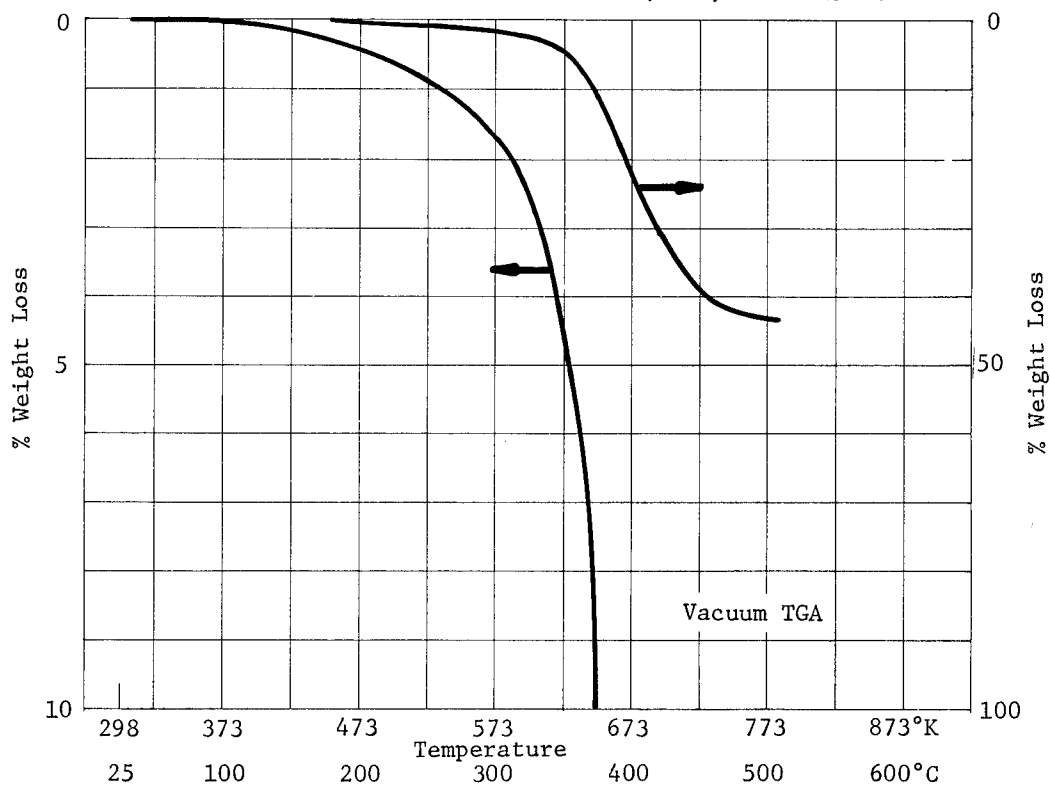
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)				ADX-41	
	298 (25)	573 (300)	623 (350)	673 (400)	873 (600)	
128				44		
129				43		
130				47		
131				81		
132			55			
133						
134			45	54		
135						
136			60	79		
137			162	153		
138						
139						
140						
141						
142						
143						
144						
145						
146						
147						
148						
149						
150						
151						
152						
153						
154						
155						
156						
157						
158						
159						
160						
161						
162						
163						
164						
165						
166						
167						
168						
169						
170						
171						
172						
173						
174						
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						

Chemical Characterization Summary

Mix Ratio: 100 pbw of A2 Resin to 6 pbw of Activator E  
 Cure: 4 hrs. at 405°K (132°C)

- TGA Preconditioning: 100 hrs. at 398°K (100°C) in N<sub>2</sub> atmosphere  
 24 hrs. at 296°K (23°C) and 45% RH



- Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-773°K (500°C)

$a_0 = 33.5\%$  of initial weight

$$k = 4.7 \times 10^9 \exp\left(\frac{-30800}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$9.8 \times 10^{10}$	$2.0 \times 10^7$
373°K (100°C)	$1.6 \times 10^8$	$2.9 \times 10^5$
423°K (150°C)	$1.1 \times 10^6$	$1.2 \times 10^4$

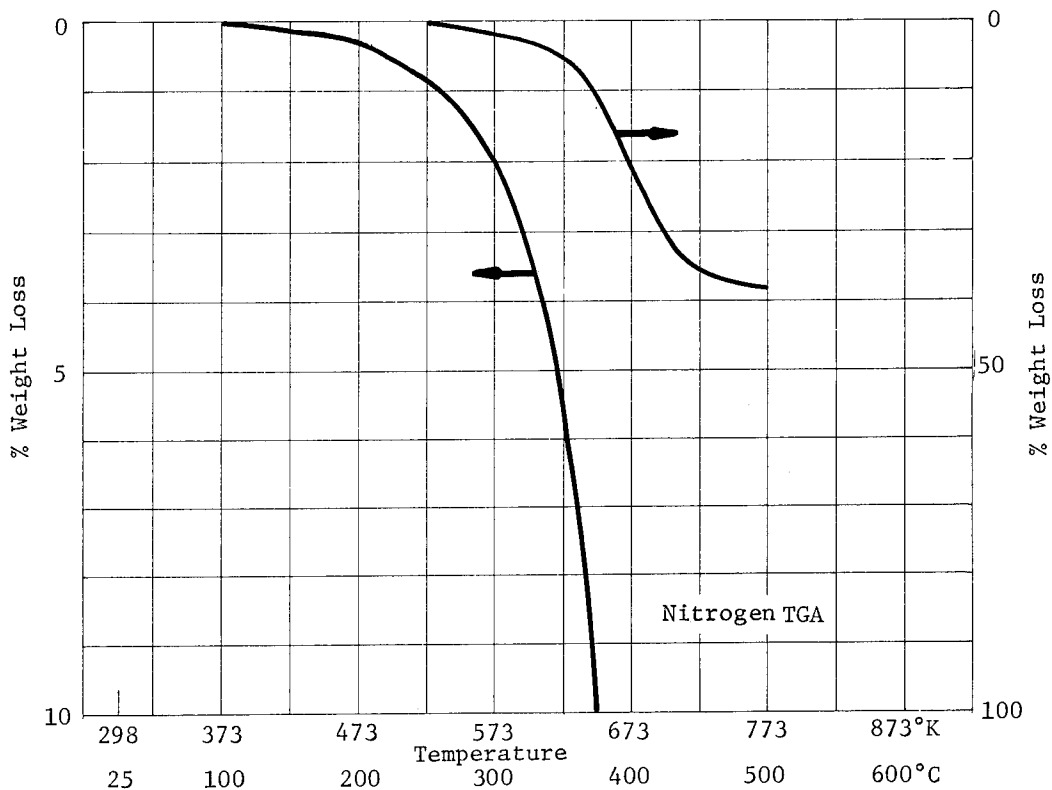
Armstrong A2/Act. E

Chemical Characterization Summary

Mix Ratio: 100 pbw A2 Resin to 6 pbw Activator E

Cure: 4 hours at 405°K (132°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C) - 773°K (500°C)

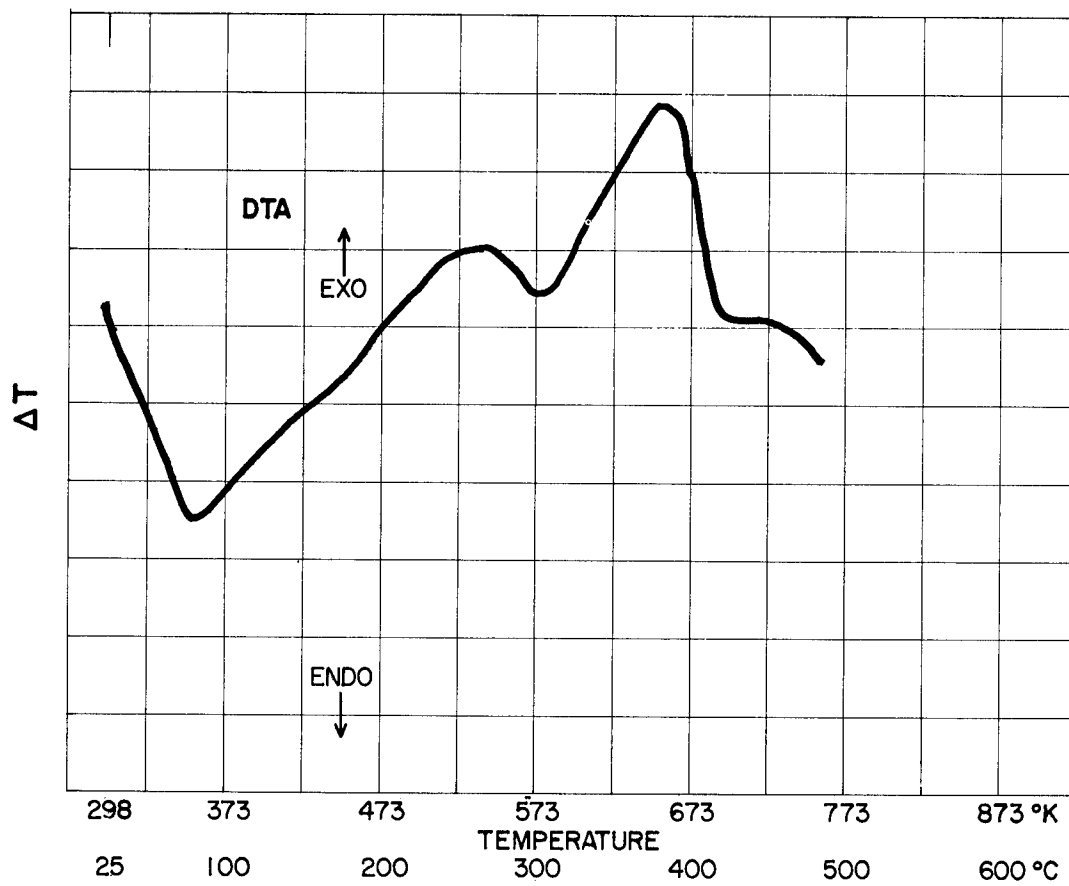
$a_0$  = 31.7% of initial weight

$$k = 1.35 \times 10^6 \exp\left(\frac{-20,100}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)		$2.0 \times 10^7$
373°K (100°C)		$2.9 \times 10^5$
423°K (150°C)		$1.2 \times 10^4$

Armstrong A2/Act. E



Number and Relative Peak Intensity

Temperature, °K (°C)

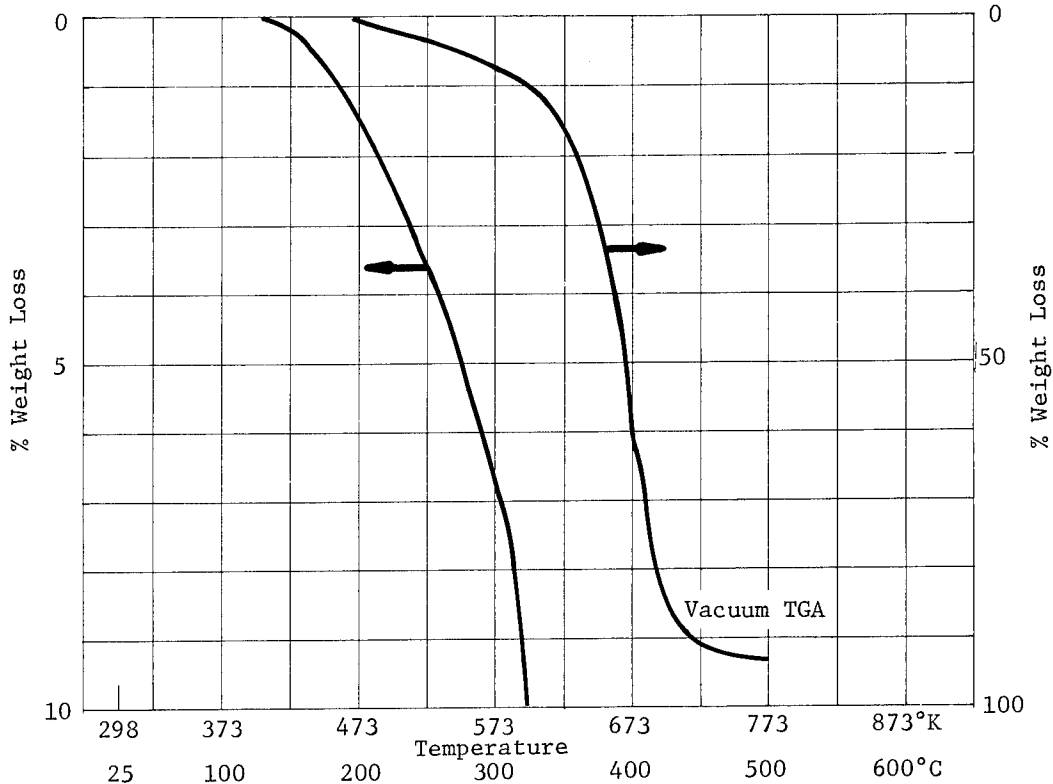
Armstrong A2/ACT E

m/e	298 (25)	473 (200)	573 (300)	623 (350)	673 (400)	773 (500)	
14	640	711	852	1801	1687	835	
15	152	204	915	5120	3785	958	
16	1889	1703	2243	4121	3079	2338	
17	12597	10066	14019	15917	12297	8506	
18	46861	36645	51976	55781	43809	30465	
19		47	64	95	102	42	
20	101	92	107	131	126	81	
21							
22							
23							
24				170	130		
25		93	174	976	746	92	
26	63	766	1513	6075	4278	764	
27	89	1689	2387	10170	5279	1133	
28	10671	12070	13590	25141	18781	11625	
29	72	1445	1912	7493	5234	725	
30		78	1893	11796	2109	266	
31			707	1601	1157	56	
32	2759	2502	2487	2515	2555	2284	
33							
34							
35							
36				61	86		
37				414	866	67	
38			70	936	1897	131	
39			323	4205	7145	923	
40	1030	1086	1329	3267	3877	1397	
41			526	4082	3123	432	
42			765	6443	2305	232	
43		51	372	2935	4922	369	
44	144	174	1498	9622	2517	363	
45			136	916	435	43	
46			51	74	49		
47				41	162		
48							
49		117	60	198	156		
50			69	972	1564	136	
51		46	101	989	1554	164	
52			65	893	608	75	
53			45	588	1062	102	
54			58	481	193		
55			41	643	1359	107	
56			264	2204	607	54	
57			62	682	533	48	
58			1111	7120	735	55	
59			46	571	58		
60				40	40		
61				44	140		
62				85	293		
63				180	850	63	
64		436	126	317	165		
65				610	2227	127	
66		106	63	752	2578	88	
67				273	239		
68				155	111		
69				80	62		
70				303	195		
71				141			
72			173	1699	146		
73			79	646	66		
74				55	115		
75					70		
76							
77				181	794	112	
78				137	141		
79				251	370	68	
80				126	130		
81				63			
82				49	40		
83							
84				158			
85							
86			195	614			
87				83			
88							
89					50		
90							
91				110	218	51	
92				61	43		
93				134	45		
94				505	1763	47	
95					47		
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106							
107					54		
108					49		
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 13.5 pbw Activator  
 Cure: 4 hrs. at 366°K (93°C), 20 hrs. at 425°K (152°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-723°K (450°C)

$a_0 = 89.6\%$  of initial weight

$$k = 2.79 \times 10^9 \exp\left(\frac{-30700}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.4 \times 10^{11}$	
373°K (100°C)	$2.3 \times 10^8$	
423°K (150°C)	$1.7 \times 10^6$	



Number and Relative Peak Intensity

Temperature, K (°C)

Bacon FA13/BA39

m/e	298 (25)	473 (200)	573 (300)	673 (400)	823 (550)		
14	427	488	620	3801	807		
15	93	254	1003	11501	2091		
16	1439	1491	1360	4715	3161		
17	8105	6561	5611	11388	5389		
18	28997	23435	21815	41786	18541		
19		79		374	50		
20		68	61	293	54		
21							
22				672			
23				4046			
24							
25			135		176		
26	79	93	1509	17628	1926		
27	336	297	1896	32742	2242		
28	17605	16143	21726	62718	22158		
29	94	158	2585	29938	1809		
30	69	129	684	6775	490		
31	66	40	455	11737	283		
32	4706	4133	3996	4674	3744		
33				74			
34							
35							
36			65	1201			
37			421	8390	149		
38			878	14205	303		
39			3290	46782	1708		
40	1485	1490	1999	15870	1947		
41			850	14545	696		
42			1668	12452	492		
43			2267	48984	1635		
44			1941	17911	1144		
45	258	562	130	5078	105		
46				333			
47				1522			
48				235			
49			83	2235	41		
50		183	777	9173	329		
51			413	9143	556		
52		52	239	3564	153		
53			1399	11818	292		
54			167	2639			
55			236	8052	209		
56			96	2855	113		
57			120	5718	64		
58			743	3473	66		
59			88	999			
60				782			
61				1831			
62				2752	40		
63				5632	233		
64				1664			
65				14485	417		
66			55	18225	383		
67			67	2508	44		
68			45	1169			
69			83	942			
70			52	258			
71				180			
72				708			
73				383			
74				2316			
75				665			
76				371			
77				4622	324		
78				1278	96		
79				2424	99		
80				626			
81			921	4396			
82			718	4724	52		
83				230			
84			47	183			
85				211			
86				204			
87				324			
88							
89				452			
90				299			
91				2947	548		
92				332	100		
93				1006			
94			58	23319	466		
95			580	4868			
96			489	3033			
97				190			
98			55	103			
99							
100							
101				43			
102				57			
103				567			
104							
105				245			
106							
107				1978	59		
108				758			
109				40			
110							
111							
112							
113							
114							
115							
116				85			
117							
118							
119							
120				406			
121				59			
122				1370			
123				107			
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

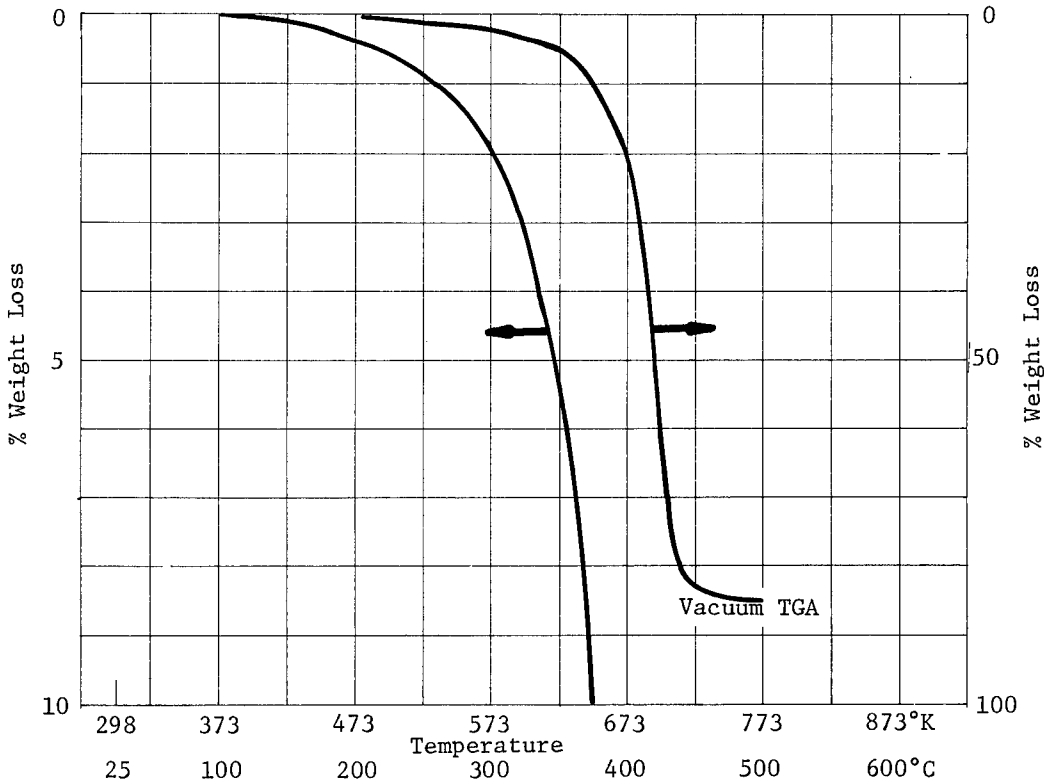
Bacon FA13/BA39

m/e	298 (25)	473 (200)	573 (300)	673 (400)	823 (550)		
128							
129							
130							
131							
132				53			
133							
134							
135				117			
136							
137				44			
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: As received  
 Cure: 15 min. at 339°K (66°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 408°K (135°C)-773°K (500°C)

$a_0 = 90.2\%$  of initial weight

$$k = 1.93 \times 10^5 \exp \left( \frac{-20200}{1.98 T^{\circ}\text{K}} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.6 \times 10^8$	
373°K (100°C)	$2.3 \times 10^6$	
423°K (150°C)	$9.2 \times 10^4$	

Number and Relative Peak Intensity

Temperature, °K (°C)

BC-328A/BC-328C

m/e	298 (25)	573 (300)	623 (350)	673 (400)	723 (450)	773 (500)
14	2527	2651	4045	14603	10890	2681
15	663	1822	5602	34831	26700	2912
16	3320	3009	4060	15030	15720	5347
17	12957	8972	9555	10084	9000	7538
18	47092	32075	33307	35064	35610	25356
19	174			216		294
20	212	167	216	340		220
21						
22				319		
23						
24			62	1302		
25		100	659	5062	2850	388
26	259	1134	3101	15456	12720	2653
27						
28	38989	36419	58506	88350	115560	43060
29	888	3672	13795	77016	61111	2647
30				1844		298
31						
32	9689	8215	8181	7349	5330	6805
33		792	562			
34						
35						
36						44
37				301		336
38					470	
39					1930	2322
40	2625	2281	2731	5074	322	2557
41		105				284
42						217
43						
44	540	3292	10894	100000	108210	8691
45			143	1878	900	118
46				154		195
47						
48						
49						139
50			68	1418		1802
51			75	1485	6480	2216
52			45	282	460	859
53			41	166		194
54				46		
55			53	258		81
56			139	325		
57				55		
58				40		
59						
60						
61						94
62				48		129
63				116		542
64			48	95		
65			167	403		758
66			134	500		522
67						
68				130		
69						
70				44		
71				47		
72						
73						
74				132		222
75				44		69
76						
77				1931	8870	2148
78				577	1640	2308
79				58		242
80				68		
81						
82						
83						
84						
85						
86						
87						
88						
89						44
90						
91				136		85
92						1609
93						539
94			245	428		673
95						
96						
97						
98						
99						
100						
101						
102						
103						
104						
105				54		
106				1595	6530	958
107				57		80
108				41		700
109						276
110						
111						
112						
113						
114						
115						
116						
117						
118						
119						
120						
121						
122						
123				304	1990	296
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

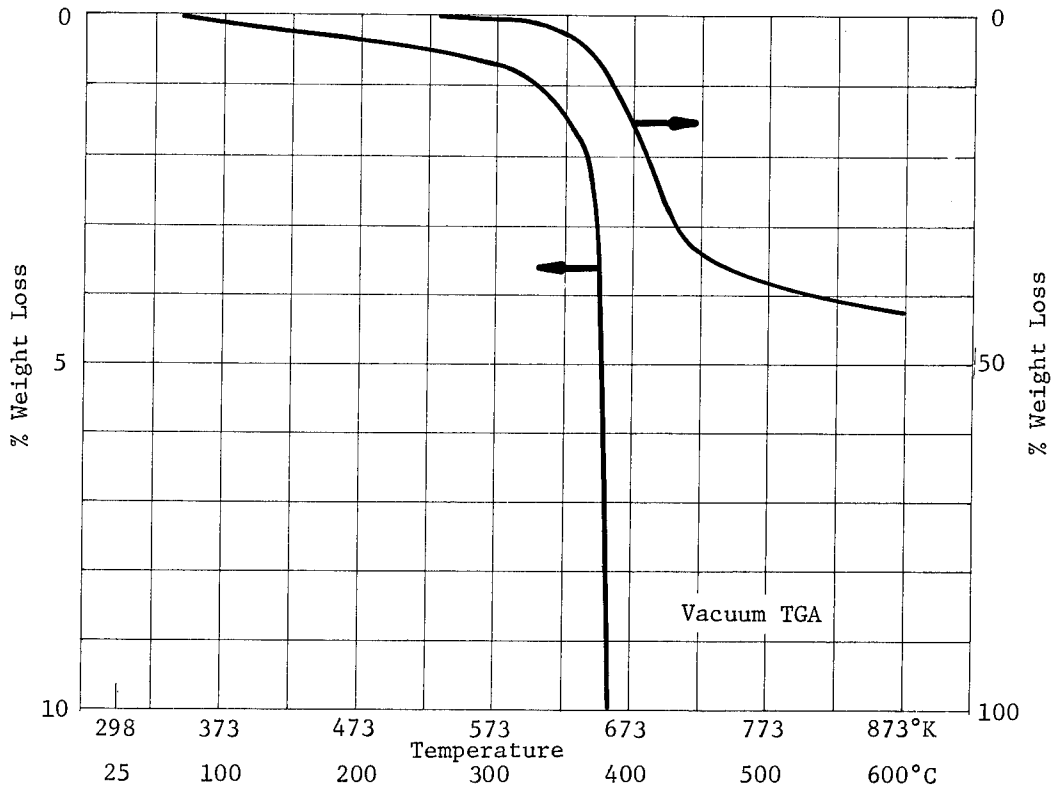
BC-328A/BC-328C

m/e	298 (25)	573 (300)	623 (350)	673 (400)	723 (450)	773 (500)	
128							
129							
130	76	56	60	213		53	
131							
132	103	42	42	224		54	
133	94	51	67	230		106	
134							
136				61			
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 1 pbw resin to 1 pbw activator  
 Cure: 4 hrs. at 394°K (121°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 573°K (300°C)-773°K (500°C)

$a_0 = 49.6\%$  of initial weight

$$k = 5.9 \times 10^5 \exp\left(\frac{-22600}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.3 \times 10^9$	
373°K (100°C)	$2.0 \times 10^7$	
423°K (150°C)	$5.4 \times 10^5$	

Number and Relative Peak Intensity

Temperature, °K (°C)

BLH-RPY 500

m/e	298 (25)	573 (300)	673 (400)	773 (500)	873 (600)
14	1268	1689	5482	2604	4206
15	277	398	9769	3813	10716
16	3781	3841	18053	9887	16052
17	16152	16107	51860	16115	19228
18	57067	53332	100580	55496	57887
19	122	142	550	134	144
20	299	302	975	419	440
21					
22			571	195	57
23					
24		51	1056	242	211
25		252	3878	1019	868
26	48	1337	18579	4602	4471
27	223	2132	23914	5056	4196
28	513	23222	97835	52703	54711
29	21701	1323	23795	2640	2072
30	331	991	4753	1856	1733
31	896	122	5051	363	276
32		4559	5731	4690	4717
33	4831		104		55
34			96		
35			64		
36		44	969	191	219
37		98	4594	1405	1452
38		95	7314	2698	2824
39	115	194	20094	7963	7661
40	3520	3568	14893	7552	8003
41	76	134	9166	1256	794
42	42	96	7683	827	472
43	101	241	21638	1717	930
44	839	2765	93454	31070	12086
45		55	3636	665	491
46			749	267	204
47			902	336	277
48			209	101	88
49			1297	673	759
50		44	5336	3634	4188
51		44	4540	4166	4497
52			1731	1952	2341
53		70	3191	1855	1098
54			768	376	219
55		430	5530	1213	909
56		587	3775	128	101
57		46	2774	61	77
58			3980	99	53
59			299	51	
60			841	176	128
61			962	593	497
62			1707	1142	1041
63			3425	2221	2154
64		58	1001	527	533
65			6295	3314	3242
66			8189	3710	2951
67			934	270	215
68			532	152	94
69			254	55	
70			148		
71			104		
72			245	55	
73			360	176	166
74			1294	634	589
75			592	339	280
76			1384	482	491
77			3099	3277	2264
78			1276	3061	5142
79			1854	1708	1118
80			595	498	258
81			268	122	51
82			103		
83			62		40
84			82		
85			99	40	42
86			124	48	79
87			117	64	52
88			56		
89			614	530	369
90			741	660	412
91			1055	2399	4547
92			256	785	2364
93			502	269	234
94			10057	4261	3251
95			688	255	202
96			134		
97			44		
98			51		
99			40		
100			54		
101			44		
102			101	75	
103			318	173	113
104			584	118	68
105			207	341	210
106			41	272	288
107			2240	2184	942
108			1638	1522	753
109			119	84	51
110			48		
111					
112			45		
113					
114			43		
115			129	100	40
116				40	
117			58	43	
118			181	78	49
119			129	60	
120			80	67	
121			384	329	51
122			202	303	61
123			50		
124					
125					
126					
127			40		

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

BLH-EPY 500

m/e	298(25)	573 (300)	673(400)	773 (500)	873(600)		
128			47		71		
129			52				
130			53				
131			455	270	47		
132			230	154	43		
133			84				
134			158				
135			62				
136			99	42			
137							
138							
139							
140							
141							
142							
143							
144							
145				148			
146				100			
147							
148'			63				
149			41				
150							
151							
152							
153							
154							
155							
156							
157							
158							
159			45				
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182			92				
183			55				
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

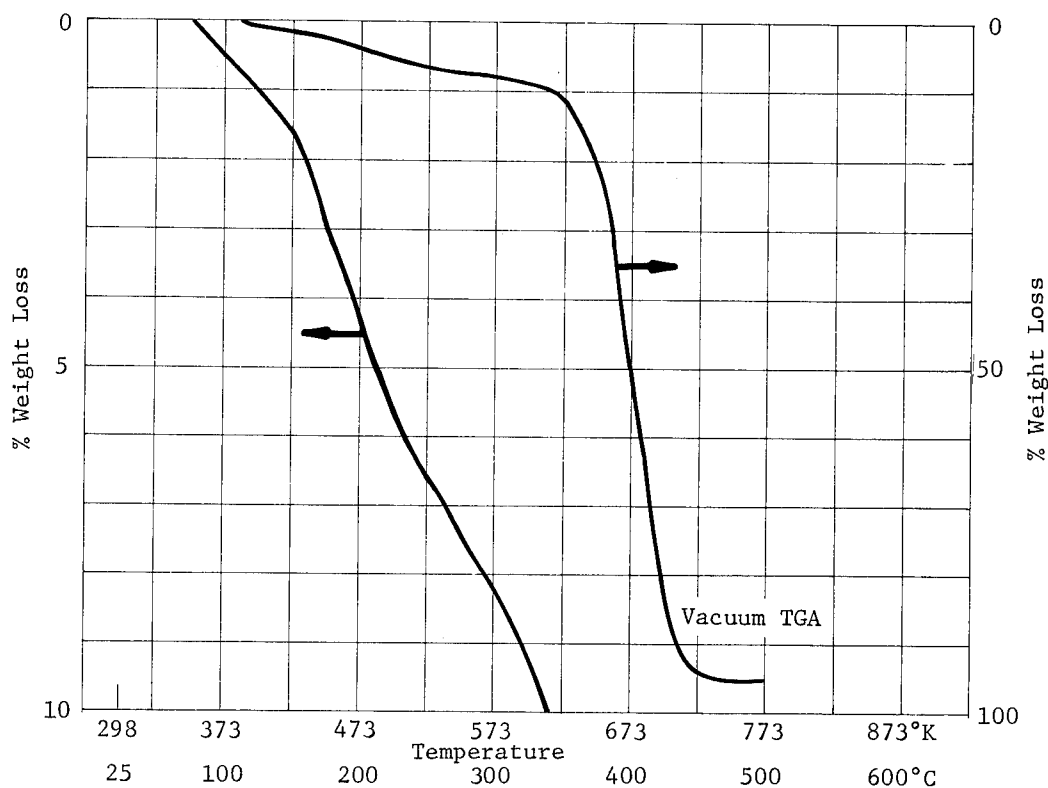


Chemical Characterization Summary

Mix Ratio: 10 pbw resin to 3 pbw activator

Cure: 6 hrs. at 408°K (135°C), 54 hrs. at 396°K (123°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 543°K (270°C) - 723°K (450°C)

$a_0 = 90.2\%$  of initial weight

$$k = 1.1 \times 10^{12} \exp\left(\frac{-38,900}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.6 \times 10^{14}$	
373°K (100°C)	$4.5 \times 10^{10}$	
423°K (150°C)	$8.8 \times 10^7$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Bondmaster E645

m/e	298 (25)	423 (150)	523 (250)	623 (350)	673 (400)	823 (550)
14	1964	5011	2943	2952	6150	3269
15	661	24686	7802	5880	16935	5679
16	4343	5576	8556	13989	14769	7842
17	18259	17432	20104	27999	29290	14909
18	66916	58810	50685	69563	94018	48574
19	3254	5334	3179	2698	1947	919
20	991	934	908	1304	1556	972
21						
22				208	357	
23						
24		57			397	73
25		439	105	317	2370	458
26	206	3849	1343	2657	13838	2985
27	719	10074	3296	5714	27344	5962
28	39883	52021	41199	52685	82158	45941
29	572	42394	12355	5831	31615	5903
30	821	5926	2541	4344	10773	2532
31	104	28244	7662	1780	10099	1252
32	7948	8316	7646	7222	8471	7099
33		1077	268		382	
34					43	
35				73		
36				221	1343	118
37		104		1055	11459	942
38		53		2354	22707	1922
39		248	143	7262	72026	7402
40	73	5025	4654	8707	34999	7229
41	4570	876	405	3522	18193	2984
42	98	3883	1327	7862	21724	2267
43	47	20464	6322	5796	28804	4440
44	121	5501	3037	48223	73197	5041
45	1321	100681	33613	3849	9472	1248
46		4834	1115	254	1588	103
47		10671	2628	562	5960	287
48		180		57	359	
49				464	3168	182
50				3454	17153	2002
51				2286	20374	3159
52				2314	7861	1052
53				1497	14443	1603
54				1228	4889	452
55		68		2055	20190	1925
56		63		2122	7160	705
57		229	60	1293	9455	751
58		9936	2629	2204	5418	667
59		583	159	987	3104	371
60		149		361	2512	130
61		161		463	5563	463
62				680	9779	1047
63				1344	18550	2311
64				700	6444	585
65				4178	51483	4385
66				6063	68191	4445
67				1272	7828	555
68				1002	5541	351
69				405	2115	127
70				271	1807	69
71				258	1043	43
72				84	779	45
73		445	80	181	1889	87
74		56		339	5742	592
75		263	46	176	3204	454
76		7775	1831	248	2544	334
77		264	72	879	15490	3744
78		61	47	880	5773	1386
79				1664	10311	1678
80				1012	6995	435
81				610	3837	203
82				340	1593	65
83				114	999	47
84				138	873	
85				102	616	55
86					533	59
87					580	123
88		59			163	
89				113	3931	747
90				48	3029	544
91				570	16653	4943
92		78		753	3606	1004
93				2150	7891	686
94				12940	100690	8404
95				1385	13211	866
96				140	1174	51
97				154	412	
98					268	
99					188	
100					199	
101					487	
102					870	192
103				78	3489	1022
104				51	1061	282
105				175	3760	1237
106				433	1826	665
107				1007	17932	4201
108				1568	8402	1687
109				425	2240	103
110				62	342	
111				62	468	
112					82	
113					67	
114					71	
115				65	2762	679
116					700	154
117				49	1447	437
118				151	2023	423
119				275	13462	2074
120				143	3492	731
121				279	9814	2889
122				370	2707	600
123				135	678	
124					81	
125					130	
126						
127					111	

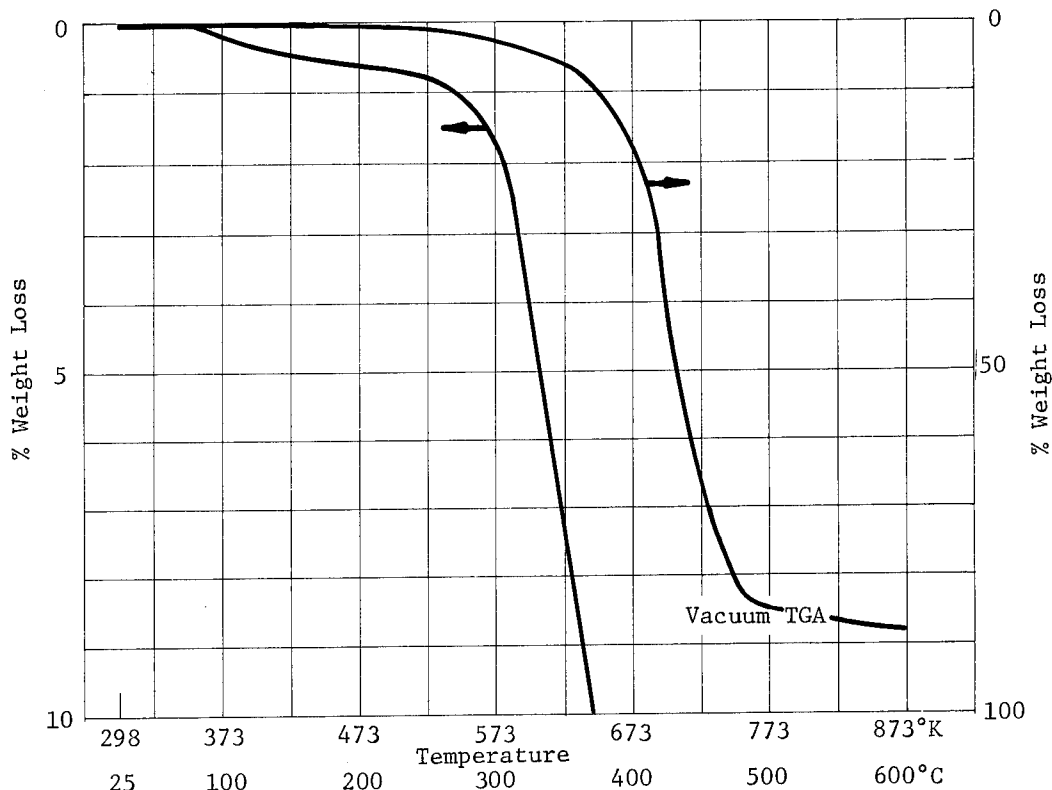
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Bondmaster 8645	
	298 (25)	423 (150)	523 (250)	623 (350)	673 (400)	823 (550)	
128					349	127	
129					313	89	
130					161		
131				210	2818	1101	
132				142	1416	538	
133				153	4101	657	
134				399	14285	1916	
135				766	9135	1408	
136				85	3319	659	
137					328		
138							
139							
140							
141							
142							
143					48		
144					101		
145					684	206	
146					336	90	
147					548	119	
148					527	51	
149					214		
150				64	1533	203	
151					102		
152							
153							
154							
155							
156							
157					87		
158					104		
159					327	47	
160					139		
161					239		
162					105		
163					91		
164							
165							
166							
167							
168							
169							
170							
171					110		
172					199		
173					244		
174					125		
175					115		
176					63		
177					112		
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191					409		
192					49		
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: **One component**  
 Cure: 6 hrs. at 449°K (176°C)

1. TGA Preconditioning: 100 hrs. at 398°K (125°C)



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-623°K (350°C)

$a_0 = 11\%$  of initial weight

$$k = 1.5 \times 10^{13} \exp\left(\frac{-38300}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.3 \times 10^{12}$	
373°K (100°C)	$1.4 \times 10^9$	
423°K (150°C)	$2.8 \times 10^6$	

Isothermal weight loss in nitrogen - 0.29%

Vacuum condensible degassing rate -  $4.5 \times 10^{-5} \%$ /day

Number and Relative Peak Intensity

Temperature, °K (°C)

C7-4248

m/e	298 (25)	423 (150)	548 (275)	698 (425)	798 (525)		
14	470	451	609	6085	1321		
15	76	67	239	16431	2854		
16	2480	2467	2605	8245	5368		
17	9872	9179	9288	16954	8268		
18	33845	30753	30650	57568	25659		
19				410			
20	50	48	54	318	92		
21							
22							
23							
24				367	51		
25			50	2619	216		
26			250	13795	1733		
27	101	106	557	21211	2166		
28	9803	9801	11739	49035	14027		
29		65	929	30455	1131		
30	523	577	665	6136	964		
31			51	7539	87		
32	3025	3067	3014	3974	2861		
33				143			
34							
35							
36				300			
37				3594	85		
38				6820	182		
39			73	24520	1264		
40	626	661	788	9704	1244		
41			81	16179	442		
42			67	10628	251		
43			137	29320	599		
44	244	286	740	17302	902		
45				4275	73		
46				252			
47				585			
48				69			
49				506	44		
50				3797	281		
51				4271	394		
52				1298	150		
53				2842	184		
54				509			
55				8107	151		
56				2633	51		
57				2796	53		
58			69	3280	64		
59				918			
60				286			
61				544			
62				1051	70		
63				2712	161		
64				601	45		
65				6404	247		
66				7545	85		
67				761			
68				318			
69				247			
70				148			
71				130			
72				239			
73				337			
74				587			
75				232			
76				182			
77				2765	347		
78				698	66		
79				967	124		
80				159			
81				85			
82				70			
83				57			
84				557			
85				101			
86				61			
87				156			
88							
89				160			
90				146			
91				1065	263		
92				132			
93				158			
94				7422	68		
95				291			
96							
97							
98							
99							
100							
101							
102							
103				78			
104							
105				45	40		
106							
107				411	60		
108				116			
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

TABLE 1 COMPRESSIVE STRENGTH (ASTM D695)

Exposure	Ultimate Stress			Samples Tested
	Pa x 10 <sup>-7</sup> (PSI x 10 <sup>-4</sup> )			
	High	Low	Average	
Baseline	27.7 (40.2)	22.4 (32.4)	25.1 (36.4)	5
Heat Compatibility (1)	28.6 (41.4)	26.8 (38.9)	27.6 (40.0)	5
Heat Compatibility Plus 30 Day Thermal Vacuum (1) (2)	26.8 (38.8)	24.7 (35.8)	26.1 (37.8)	5

(1) Heat compatibility - 379 hours at 408°K (135°C) in N<sub>2</sub> atmosphere.

(2) Thermal vacuum - tested at 1 x 10<sup>-5</sup> torr after 30 days at 338°K (65°C) and 1 x 10<sup>-6</sup> torr.

TABLE 2 DIELECTRIC STRENGTH, DIELECTRIC CONSTANT AND DISSIPATION FACTOR (ASTM D149, D150)

Exposure	Dielectric Strength, Volts/MM (Volts/Mil)	Dielectric Constant K	Dissipation Factor D <sub>x</sub>
Baseline	9.13 x 10 <sup>4</sup> (2320)	3.1	.027
Heat Compatibility (1)	9.17 x 10 <sup>4</sup> (2328)	3.1	.027
Heat Compatibility Plus 30 Day Thermal Vacuum (1) (2)	7.61 x 10 <sup>4</sup> (1934)	3.0	.025

(1) Heat compatibility - 379 hours at 408°K (135°C) in N<sub>2</sub> atmosphere.

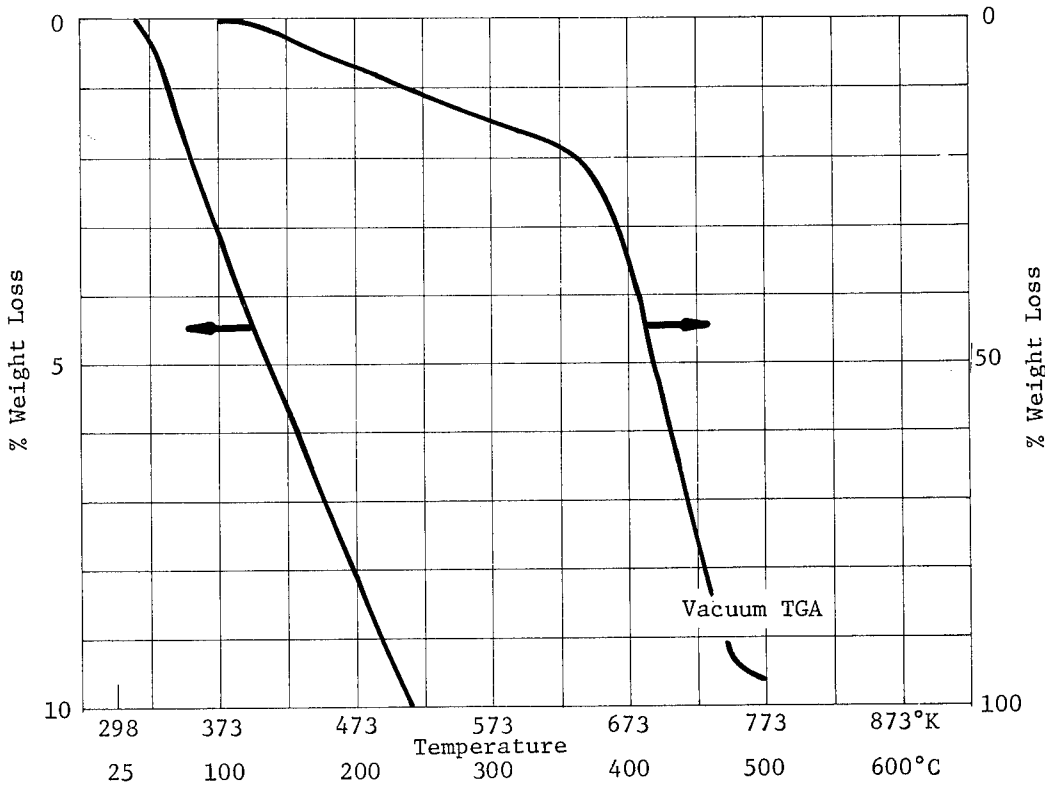
(2) Thermal vacuum - tested at 1 x 10<sup>-5</sup> torr after 30 days at 338°K (65°C) and 1 x 10<sup>-6</sup> torr.

CMC-15 Bonding Film

Chemical Characterization Summary

Mix Ratio: Pre-preg  
 Cure: 1 hr. at 450°K (177°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C) - 773°K (500°C)

$a_o = 82.3\%$  of initial weight

$$k = 1.68 \times 10^{12} \exp \left( \frac{-40400}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$9.8 \times 10^{14}$	
373°K (100°C)	$2.1 \times 10^{11}$	
423°K (150°C)	$3.2 \times 10^8$	

Number and Relative Peak Intensity

Temperature, °K (°C)

QMC-15 Bonding Film

m/e	298 (25)	423 (150)	623 (350)	723 (450)	823 (550)		
14	2585	3128	4765	7076	3472		
15	453	2419	5849	11448	2600		
16	6404	6876	9089	11594	7016		
17	17520	16354	18568	17501	12421		
18	47219	43499	48462	46493	31266		
19	238	284	328	577	201		
20	122	139	170	188	101		
21							
22							
23							
24			249	677	79		
25		111	1056	2818	410		
26	179	872	3874	11048	1908		
27		1837	4810	11968	2543		
28	14284	20239	26802	44437	20351		
29	212	2965	10571	21691	2846		
30	1475	2794	4175	5906	2400		
31		683	4092	2348			
32	4712	5410	5852	5477	4709		
33				216			
34							
35			87				
36			170		62		
37		50	617	5899	409		
38			915	10774	860		
39			2209	29653	2443		
40	1273	1938	2608	11839	2223		
41	52			4254	819		
42		1795					
43	66	2219	7348	17495	1711		
44	864	3726	11544	7513	2019		
45		1560	1040	975	230		
46		45	81				
47		53	76	1331	41		
48			101				
49							
50		71	842	8698	894		
51		60	508	8612	974		
52			481		454		
53		48	346	4694	432		
54					66		
55		105	662	5796	436		
56		122	869	806	190		
57		240	582		129		
58		164	513	1985	168		
59		54	150				
60			102		40		
61			50				
62			102				
63			163	8189	738		
64			93				
65			347	20277	1131		
66			348	20002	891		
67			168	1840	109		
68			151	805	55		
69			72	158			
70			95	107			
71			91				
72			159	119	41		
73		777	69				
74			106	2505	222		
75				1408	126		
76		40					
77			129	6447	850		
78			139	3193	471		
79			159	3210	315		
80			150	791	85		
81			73	306	41		
82			61	73			
83			42	42			
84			48	69			
85				151			
86				245			
87				227			
88					50		
89				1594	220		
90							
91							
92			59	4443	1043		
93			68	1124	242		
94			500	28141	1206		
95			66	1947	73		
96				132			
97							
98				58			
99							
100				51			
101							
102							
103				1563	183		
104					87		
105				1195	293		
106							
107			54	5370	588		
108			92	2550	218		
109				261	43		
110				40			
111							
112							
113							
114							
115				1024	101		
116					65		
117				855	113		
118					135		
119				2011	148		
120							
121				4147	325		
122					62		
123				99			
124							
125							
126							
127				139			



Number and Relative Peak Intensity (Continued)

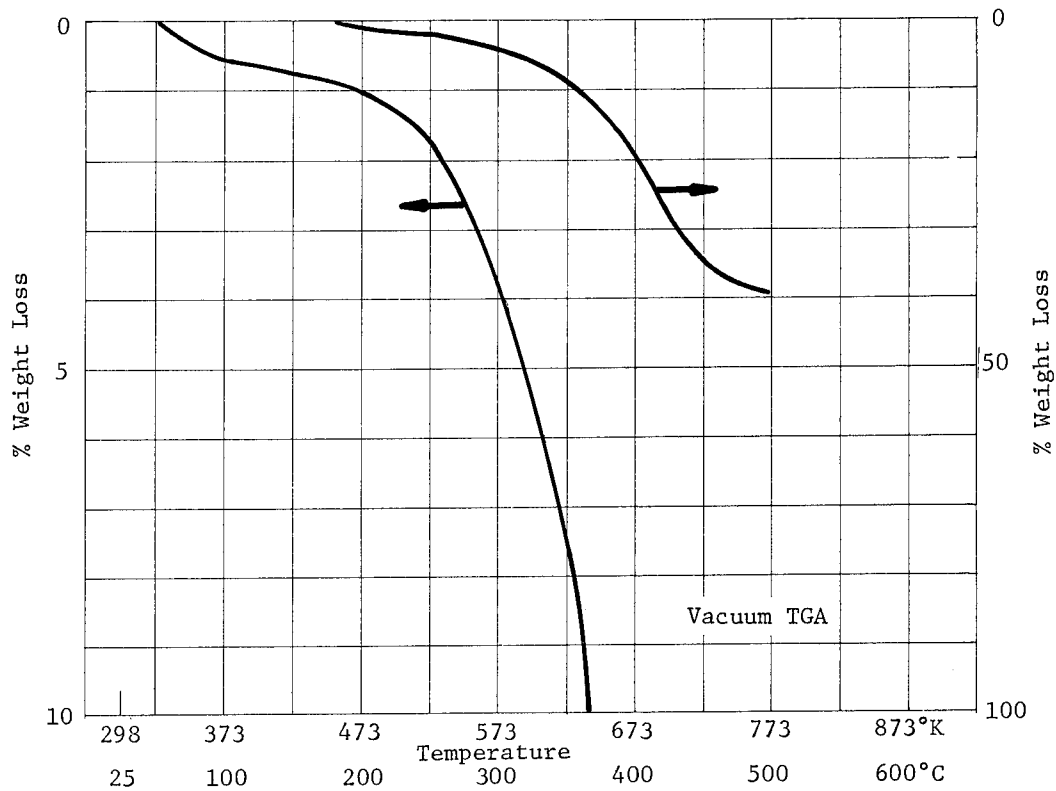
m/e	Temperature, ° K (°C)					CMC-15 Bonding Film	
	298 (25)	423 (150)	623 (350)	723 (450)	823 (550)		
128				221	50		
129				157	42		
130							
131				2439	319		
132				1642	162		
133				1741	66		
134				1722	118		
135					53		
136				1077	55		
137				100			
138							
139							
140							
141							
142							
143				44			
144							
145				466			
146				318			
147				295			
148'				347			
149							
150				222			
151							
152							
153							
154							
155							
156				44			
157				64			
158							
159				226			
160				109			
161				81			
162				80			
163							
164							
165							
166							
167							
168							
169							
170							
171							
172				94			
173				68			
174				86			
175				40			
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Coating G2735 on  
Electromagnetic Core

Chemical Characterization Summary

Mix Ratio: As Received  
Cure: As Received

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C)-843°K (570°C)

$a_0 = 43.0\%$  of initial weight

$$k = 5.1 \times 10^5 \exp \left( \frac{-20,100}{1.98 T^{\circ}\text{K}} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$5.3 \times 10^7$	
373°K (100°C)	$7.8 \times 10^5$	
423°K (150°C)	$3.1 \times 10^4$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Coating G2735 on Electromagnetic Core

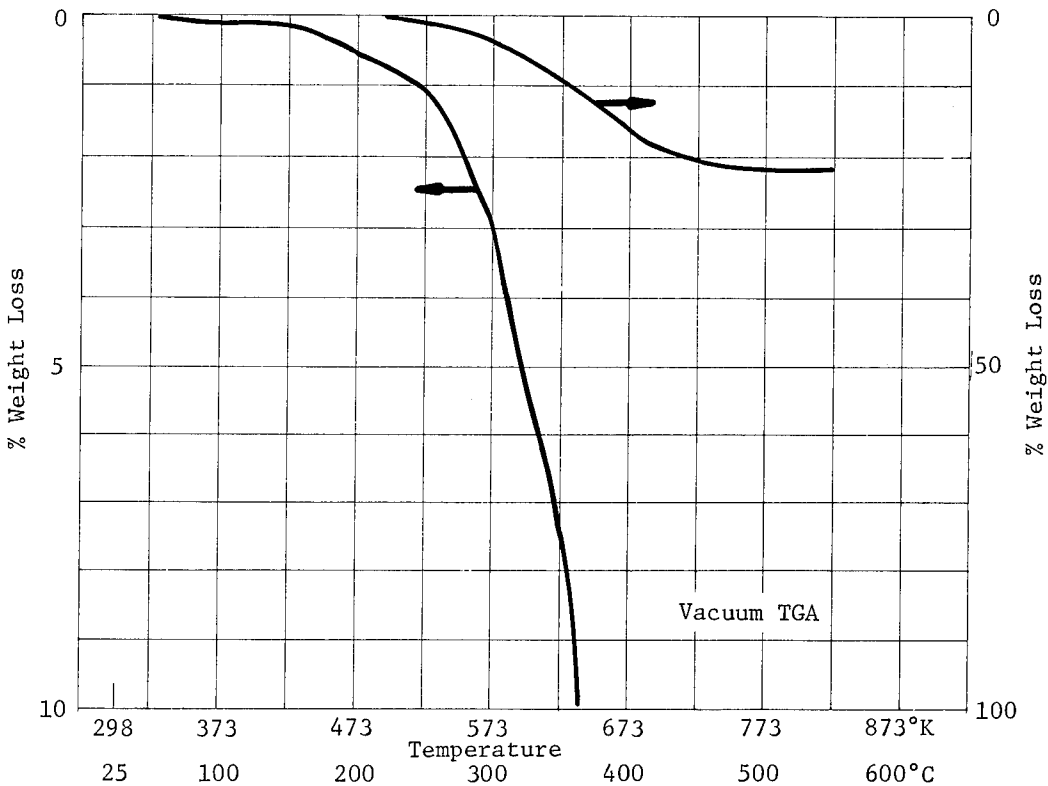
m/e	298 (25)	523 (250)	623 (350)	673 (400)	773 (500)		
14	552	519	1374	1963	1067		
15	75	171	2983	5009	2558		
16	2285	2149	6262	7480	4362		
17	19854	15268	17791	18370	12078		
18	75809	58611	67515	69374	45093		
19			22	43			
20	77	52	86	81	37		
21							
22				30			
23							
24			69	157	37		
25		48	539	1124	277		
26	37	608	3845	6367	2605		
27	35	321	4103	6595	3675		
28	1144	12988	22176	25634	15731		
29	83	150	3028	4513	2221		
30	43	29	159	200	203		
31			75	219	22		
32	2971	2486	2347	2397	2110		
33				22			
34							
35							
36			32	68			
37		65	456	1416	218		
38		159	734	2864	533		
39		667	2798	9920	3540		
40	596	726	1537	4716	1670		
41		51	1420	3605	2995		
42			935	2325	1287		
43		69	2434	6892	1505		
44	227	2108	14685	15707	2061		
45			90	128			
46				47			
47				287			
48				30			
49		41	158	332	31		
50		854	2241	2728	464		
51		992	220	2557	587		
52		763	1957	1203	165		
53			156	1140	291		
54			44	239	70		
55			1124	3227	853		
56			877	1126	312		
57			194	551	171		
58			127	692	25		
59							
60				26			
61				203			
62				425	67		
63		58	176	1282	210		
64				171	30		
65			42	3610	479		
66			31	4739	304		
67			44	601	163		
68			33	241	25		
69			28	117	55		
70				146	52		
71				47			
72							
73				41			
74		31	89	153			
75			38	69			
76		29	65	59			
77		282	909	845	300		
78		2565	4841	1985	76		
79		31	132	228	109		
80				24			
81				31			
82							
83							
84				23			
85							
86							
87							
88							
89							
90							
91				85	106		
92							
93				25			
94					134		
95							
96				2878			
97				50			
98							
99							
100							
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

Coating S8993-8Q<sub>2</sub>  
on Electromagnetic Core

Chemical Characterization Summary

Mix Ratio: As received  
Cure: As received

1. TGA Preconditioning: **None**



2. Activation Energy of Decomposition:

Over the Range: 473<sup>o</sup>K (200<sup>o</sup>C)-843<sup>o</sup>K (570<sup>o</sup>C)

a<sub>o</sub> = 16.6% of initial weight

$$k = 1.3 \times 10^7 \exp \left( \frac{-22300}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323 <sup>o</sup> K (50 <sup>o</sup> C)	6.5 x 10 <sup>7</sup>	
373 <sup>o</sup> K (100 <sup>o</sup> C)	6.1 x 10 <sup>5</sup>	
423 <sup>o</sup> K (150 <sup>o</sup> C)	1.7 x 10 <sup>4</sup>	

Number and Relative Peak Intensity

Temperature, °K (°C)

Coating S8993-80, on Electromagnetic Core

m/e	298 (25)	573 (300)	623 (350)	673 (400)	773 (500)
14	705	966	1569	889	737
15	119	1032	2319	871	555
16	2536	2299	2862	3015	2022
17	21139	13732	12748	12884	11125
18	80826	51569	46765	45202	40574
19	62	117	209	64	55
20	150	108	116	114	103
21		40			
22			49		
23					
24		79	161	59	53
25		222	792	197	128
26	75	1482	3757	1317	793
27	99	1398	3741	1841	1280
28	11353	16531	24677	15468	11135
29	101	3316	7763	2341	992
30	42	369	962	235	136
31		1000	2679	409	94
32	2961	2720	2621	2244	2236
33		96	317	52	42
34				42	46
35					
36		54	185	62	49
37		234	2416	332	103
38		275	3053	540	143
39		381	1775	1238	678
40	588	786	1185	889	735
41		336	1359	1536	979
42		287	900	586	353
43	46	914	2572	1186	522
44	248	2633	6519	5030	687
45		488	1515	127	52
46		46	63	49	
47		42	41		
48		44		42	42
49		138		149	65
50		1036		1429	197
51		85		170	113
52		90		123	77
53		55		103	86
54		40		77	88
55		67		218	190
56		61		216	177
57		171		285	121
58		283		98	66
59		44			
60		49			
61		55		54	43
62		43		47	43
63				43	49
64				41	44
65				45	55
66				54	53
67				49	82
68				40	52
69				68	61
70		43		125	56
71				51	
72				44	
73		62		60	
74		170		225	60
75		81		90	41
76		932		1061	134
77		63	78	51	
78			40	42	
79				48	
80					
81				46	
82					
83					
84					
85					
86					
87					
88					
89					
90					
91				40	
92					
93					
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104		73	102		
105					
106					
107					
108					
109					
110					
111					
112					
113					
114					
115					
116					
117					
118					
119					
120					
121					
122					
123					
124					
125					
126					
127					

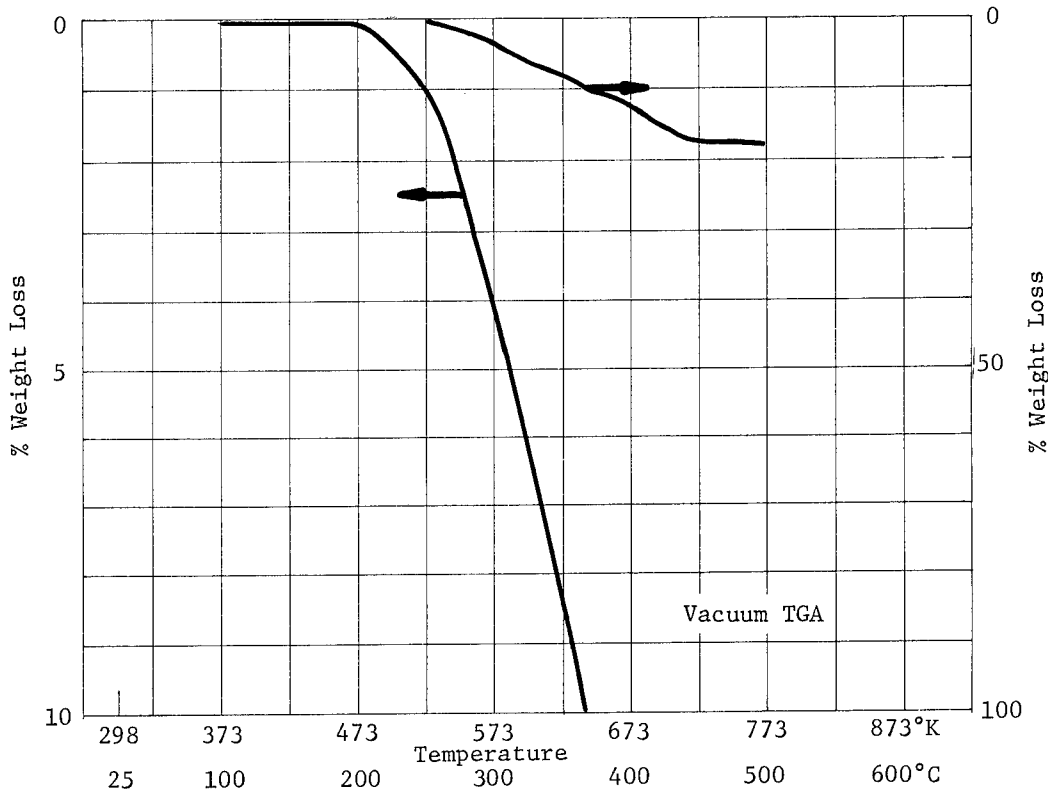
Conductive Epoxy 5504A

Chemical Characterization Summary

Mix Ratio: One component

Cure: 1 hr. at 422°K (149°C), 24 hrs. at 411°K (138°C) in vacuum

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C)-648°K (375°C)

$a_0 = 9.6\%$  of initial weight

$$k = 6.2 \times 10^4 \exp\left(\frac{-14900}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.3 \times 10^5$	
373°K (100°C)	$5.7 \times 10^3$	
423°K (150°C)	$5.2 \times 10^2$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Conductive Epoxy 5504A

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
14	837	807	942	1101	852		
15	319	341	941	1460	547		
16	2047	1787	1828	2007	1756		
17	8866	6805	6345	5944	5408		
18	30058	22940	20733	19360	17652		
19	84	83	100	105	76		
20	212	191	212	205	188		
21							
22							
23							
24			60	111	46		
25	64	56	184	337	115		
26	213	223	643	1329	492		
27	257	281	600	1129	516		
28	10051	9408	10943	12374	9592		
29	196	204	699	1833	416		
30	196	203	282	471	241		
31	61	71	2064	1109	129		
32	2372	2168		2427	1940		
33				41			
34							
35							
36							
37			67	138	47		
38		46	279	813	123		
39	83	97	358	1020	193		
40	1348	1311	542	1297	527		
41	87	98	1468	1730	1450		
42	77	80	574	1209	255		
43	92	128	285	379	164		
44	365	420	1570	1218	284		
45	44	47	770	1498	488		
46			198	329	105		
47				42			
48				71			
49			142	401	61		
50		75	853	2567	288		
51	43	42	180	423	205		
52			121	292	90		
53			95	225	115		
54		43	44	63	44		
55			104	313	132		
56			76	243	65		
57		48	128	363	76		
58		40	97	159	58		
59			52	95			
60				97	46		
61			62	155			
62			53	111	69		
63			72	161	118		
64	41			74	64		
65		46	117	282	228		
66	48	49	150	358	247		
67			49	73	62		
68			41	61	41		
69			199	412			
70			45	63			
71							
72			42	63			
73			90	245			
74			316	803	85		
75			156	471	60		
76		54	897	2889	168		
77		40	220	531	199		
78			62	105	86		
79			44	73	79		
80							
81							
82				53			
83							
84	68	68	78	77	69		
85				49			
86				44	40		
87							
88							
89					41		
90							
91			50	84	140		
92					50		
93				40			
94			276	650	320		
95			53	90	46		
96							
97							
98							
99				46			
100				118			
101			61				
102							
103							
104		44	601	1902	115		
105			74	191	54		
106							
107							
108			40	66	103		
109					49		
110							
111							
112							
113							
114							
115							
116							
117							
118							
119					50		
120							
121							
122					51		
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Conductive Epoxy 5504A	
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
128							
129	62	74	69	57	68		
130							
131	55	54	52	50	64		
132	56	59	64	63	62		
133					53		
134							
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148'			49	124			
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

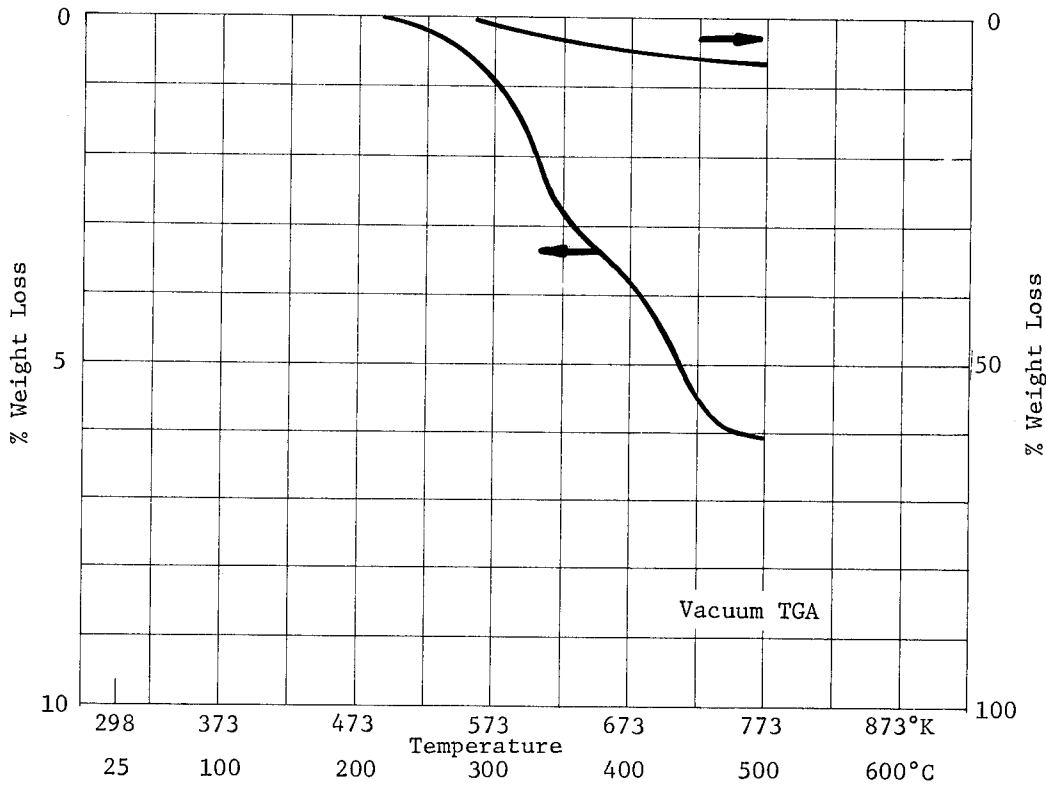


Conductive Epoxy 8294

Chemical Characterization Summary

Mix Ratio: One component  
 Cure: 1 hr. at 394°K (121°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C)-748°K (475°C)

$a_o = 3.31\%$  of initial weight

$$k = 3.5 \times 10^6 \exp\left(\frac{-19600}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.5 \times 10^6$	
373°K (100°C)	$5.8 \times 10^4$	
423°K (150°C)	$2.5 \times 10^3$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Conductive Epoxy 8294

m/e	298 (25)	473 (200)	573 (400)	673(400)	773(500)		
14	1042	937	1010	1087	967		
15	415	408	606	721	558		
16	3681	3252	3172	3197	3095		
17	13213	9603	9003	8316	7732		
18	41681	28384	26386	23865	21881		
19	115	115	111	123	111		
20	281	237	249	246	228		
21							
22							
23							
24				44			
25			118	135	62		
26	192	205	526	574	317		
27	392	407	696	728	522		
28	10599	9731	10285	10598	9616		
29	179	171	431	696	246		
30	766	758	793	874	784		
31		42	112	148	59		
32	3153	2804	2718	2670	2607		
33							
34							
35							
36			54	72	44		
37			171	200	48		
38			215	301	87		
39		56	271	697	240		
40	1789	1731	1823	1991	1773		
41	58	61	181	228	119		
42	47	44	138	177	77		
43	65	76	433	571	137		
44	614	628	1092	885	614		
45			75	92	47		
46							
47				54			
48							
49			91	92			
50			503	410	97		
51			96	231	104		
52			72	90	45		
53			57	119	40		
54							
55			79	170	49		
56			97	75			
57			81	69			
58				70			
59							
60							
61			48	70			
62				88			
63			50	150	55		
64			44	63			
65			70	347	89		
66			96	435	90		
67				59			
68							
69							
70							
71							
72							
73			54	43			
74			163	122			
75			91	69			
76			520	285	46		
77			120	174	85		
78				73	49		
79				61	40		
80							
81							
82							
83							
84	41	43	44	47	46		
85							
86							
87							
88							
89							
90							
91				95	61		
92							
93							
94			136	607	86		
95				56	42		
96							
97							
98							
99							
100							
101							
102							
103							
104			327	177			
105							
106							
107				61			
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121				43			
122							
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

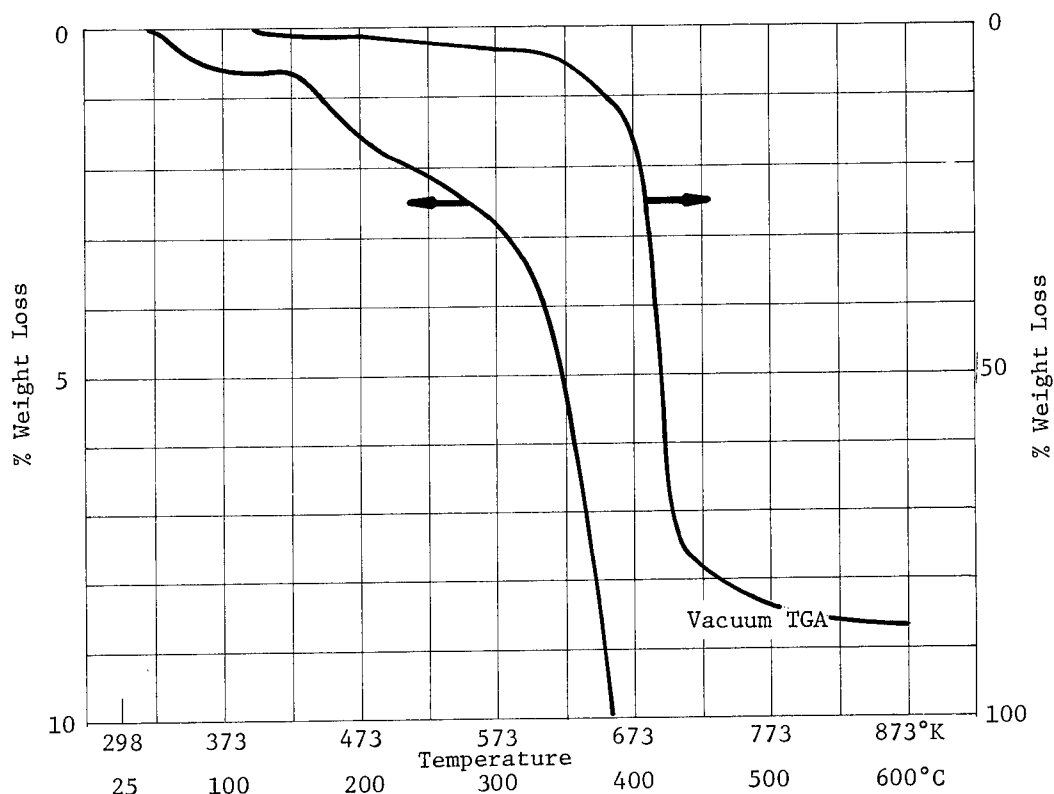
m/e	Temperature, °K (°C)					
	298 (25)			673 (400)		
128						
129						
130	41			41		
131						
132						
133						
134						
136						
137						
138						
139						
140						
141						
142						
143						
144						
145						
146						
147						
148						
149						
150						
151						
152						
153						
154						
155						
156						
157						
158						
159						
160						
161						
162						
163						
164						
165						
166						
167						
168						
169						
170						
171						
172						
173						
174						
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						

## E300 Insulating Film

### Chemical Characterization Summary

Mix Ratio: As received  
Cure: As received

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-773°K (500°C)

$a_0 = 7.9\%$  of initial weight

$$k = 1.10 \times 10^7 \exp\left(\frac{-25700}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.6 \times 10^{10}$	
373°K (100°C)	$7.4 \times 10^7$	
423°K (150°C)	$1.2 \times 10^6$	

Number and Relative Peak Intensity

Temperature, °K (°C)

E300 Insulating Film

m/e	298 (25)	423 (150)	573 (300)	673(400)	773(500)	823 (550)
14	1599	1622	2227	6983	3857	3794
15	1197	1150	2108	11559	6170	8853
16	7630	7528	9625	19723	11629	14600
17	28805	25788	28761	43589	25885	25862
18	97870	86136	83903	100463	84104	82619
19	615	570	658	910	507	323
20	682	744	739	1072	890	818
21						
22				319		
23						
24				928	289	316
25	66	47	46	4038	1185	1236
26	491	553	1165	19518	6766	6839
27	1120	1359	2223	24737	9840	9991
28	28694	28062	30937	74544	45467	47625
29	1022	1311	2721	22743	7920	7358
30	1514	1623	1983	8736	3267	3324
31	842	903	1815	10494	3500	3363
32	7063	6738	7000	8477	8068	7844
33				341	44	
34				49		
35						
36				1455	242	188
37				12556	1724	1280
38	50	51	68	212	3459	2563
39	222	226	721	23131	12224	8995
40	8124	8445	8637	64290	13450	12323
41	183	324	628	38210	3549	2938
42	104	146	950	11047	2163	1840
43	226	418	1956	13758	4615	4003
44	1387	1523	8504	16023	3922	3650
45	54	83	219	55026	2859	403
46				1164	163	112
47				5129	298	200
48				507	48	
49				3913	555	474
50		46	160	16243	3792	2803
51			144	16617	5214	4004
52			112	6325	1885	1425
53			71	10077	2508	1820
54			123	2745	497	307
55		62	192	13959	2258	1606
56	40	46	126	3321	589	464
57		66	70	6304	391	401
58				3239	424	462
59				710	159	103
60				1141	203	145
61				4332	646	472
62				7067	1346	974
63				13173	3214	2453
64				4392	1048	676
65			99	35966	5428	4077
66			210	50048	4885	3053
67			50	5122	586	342
68			71	2624	213	151
69			46	631	68	80
70				448	46	
71				295		
72				308	60	
73				1021	164	58
74				3385	692	529
75				1866	511	334
76				1431	443	326
77				5714	4224	2914
78				2772	1392	1278
79				4655	1887	1321
80				3241	337	254
81				1473	137	89
82				461		
83				219		
84				127		
85				226	48	
86				142	82	
87				127	126	79
88				128		
89				75	669	437
90				1327	536	334
91				4518	3738	3656
92				1319	599	785
93					508	326
94			205	68410	5428	3692
95				5328	312	256
96				325		
97				55		
98				44		
99						
100						
101				57	45	
102				208	185	109
103				735	879	473
104				178	271	126
105				882	1154	925
106				415	293	434
107				3310	2677	1982
108				2024	1101	846
109				410	58	
110				47		
111						
112						
113						
114						
115				523	428	206
116				45	105	57
117				205	307	123
118				486	280	125
119				2227	1195	669
120				493	380	229
121				1266	1429	927
122				371	333	199
123				67		
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

8300 Insulating Film

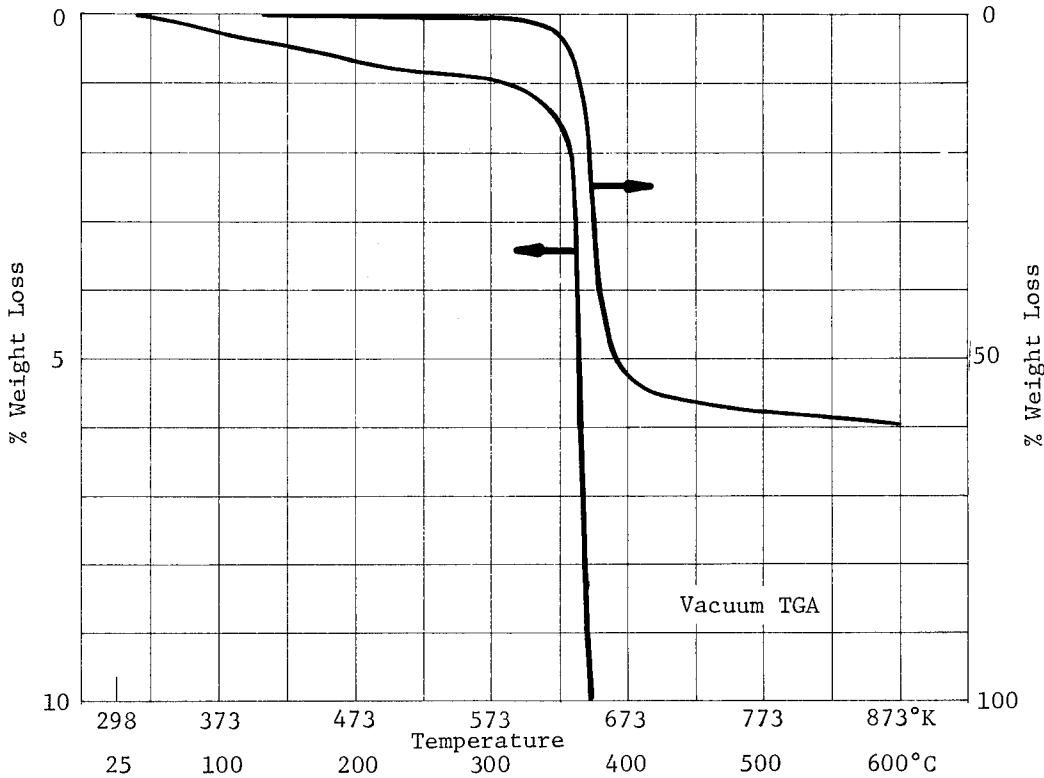
m/e				673 (400)	773 (500)	823 (550)	
128					55	40	
129				64			
130							
131				593	559	306	
132				365	330	136	
133				728	279	130	
134				2557	938	626	
135				41	170	70	
136				334	226	128	
137							
138							
139							
140							
141							
142							
143							
144							
145				65	187	77	
146				62	82	41	
147				40	58	41	
148				48			
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159					67		
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 11 pbw activator

Cure: 30 min. at 389°K (116°C), 1½ hrs. at 450°K (177°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 623°K (350°C)-723°K (450°C)

$a_0 = 51.8\%$  of initial weight

$$k = 5.5 \times 10^{27} \exp\left(\frac{-83000}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.7 \times 10^{28}$	
373°K (100°C)	$7.4 \times 10^{20}$	
423°K (150°C)	$1.2 \times 10^{15}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

EA901/B3

m/e	298 (25)	473 (200)	623 (350)	648 (375)	673 (400)	773 (500)
14	1174	1095	2253	2956	1385	1303
15	469	458	3763	5449	1767	1269
16	3917	3629	5884	6305	3871	3864
17	10277	8480	14271	14588	8303	7281
18	30521	24298	44371	44048	22919	19204
19	166	153	250	356	169	89
20	226	194	266	284	213	186
21						
22			55	51		
23						
24			238	500	152	51
25			734	1735	502	174
26	224	234	2764	7615	2415	877
27	475	479	2577	7997	2945	1279
28	10857	10118	17699	19088	11889	10424
29	230	222	5256	7241	1476	648
30	1062	1055	1403	1613	1061	1006
31			1085	1187	283	71
32	3276	3016	2983	2904	2543	2552
33			44		50	
34						
35			74			
36			144	424	112	
37			676	3078	800	133
38			1112	5792	1547	236
39	67	104	3303	18150	5182	793
40	1735	1719	2917	7738	2928	1682
41	56	99	1058	2950	966	398
42	48	65	1179	1870	516	216
43	75	156	2588	3312	836	284
44	866	845	8617	5765	1104	814
45			409	598	168	53
46			159	292	92	
47			252	1008	216	
48			70	191	67	
49			295	1096	309	57
50			1335	4993	1579	259
51			700	5484	1966	296
52			437	1792	689	133
53			405	2967	1054	169
54			133	531	176	49
55			676	3650	954	130
56			191	487	104	47
57			524	485	95	
58			327	342	87	
59			50	223	94	
60			86	437	146	
61			241	1247	357	43
62			357	2274	700	91
63			652	4559	1465	196
64			252	1499	478	77
65			1757	9913	2647	275
66			2092	10589	2458	255
67			196	1082	323	59
68			128	469	133	
69			61	117	40	
70			49	59		
71						
72			80	70		
73			213	359	110	
74			95	1239	384	47
75			84	782	279	
76			249	564	187	
77			213	4213	1887	293
78			177	1330	573	119
79			51	1752	774	136
80			47	287	163	48
81			43	187	83	
82				71		
83			48	68	41	
84				62		
85				134	58	
86				144	60	
87				60		
88			87	797	332	56
89			68	479	223	
90			141	3920	1501	220
91			53	562	213	56
92			171	796	303	92
93			3785	14124	3048	243
94			278	1079	242	
95				82		
96						
97						
98				47		
99						
100						
101				109		
102				212	93	
103			43	911	359	48
104				184	81	
105				664	248	65
106				184	85	61
107				1892	1113	210
108			71	617	444	88
109				58		
110						
111						
112						
113						
114						
115				379	170	
116				114	46	
117				185	82	
118			82	240	80	
119			56	2560	780	73
120				478	176	
121			84	2617	1138	133
122				411	232	42
123						
124						
125						
126						
127						



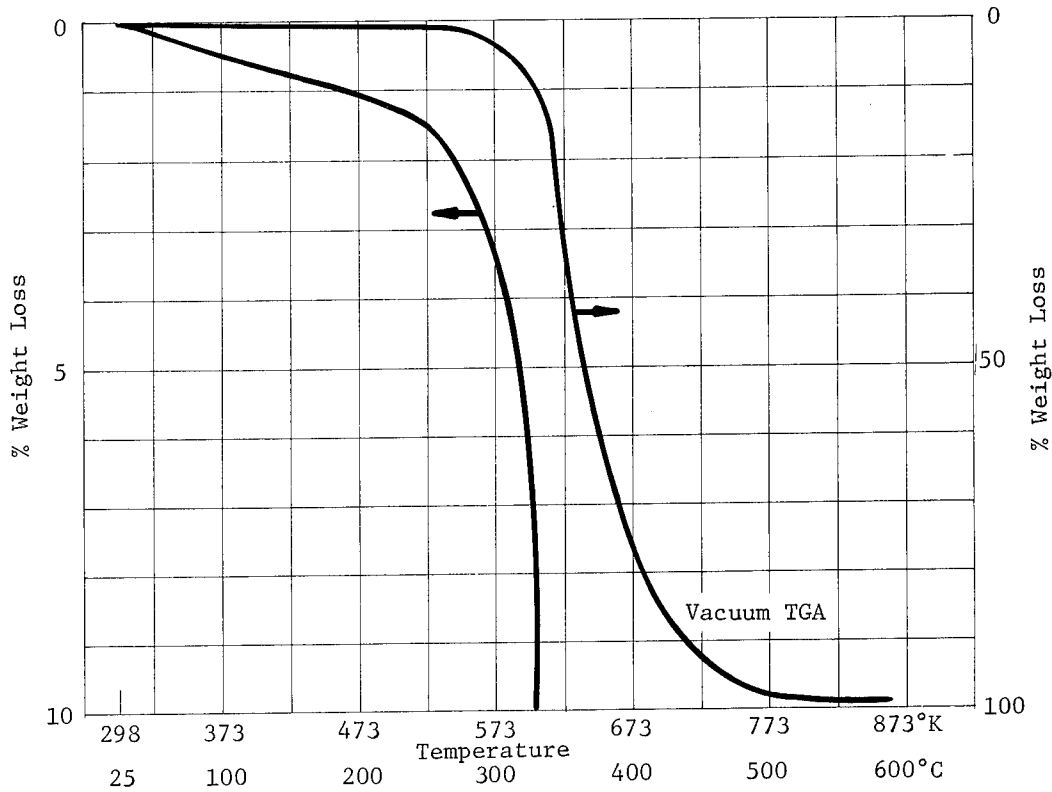
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)						EA901/B3
	298 (25)	473 (200)	623 (350)	648 (375)	673 (400)	773 (500)	
128				41			
129				58			
130		45	45		44		
131			47	193	95	43	
132	40		47	104	64	41	
133				468	167		
134			61	2127	633	55	
135				294	143		
136				494	198		
137				47			
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 58 pbw activator  
 Cure: 1 hr. at 366°K (93°C)

## 1. TGA Preconditioning: None



## 2. Activation Energy of Decomposition:

Over the Range: 298°K (25°C) - 673°K (400°C)

$a_o = 67\%$  of initial weight

$$k = 5.3 \times 10^{20} \exp\left(\frac{-58800}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.0 \times 10^{19}$	
373°K (100°C)	$4.5 \times 10^{13}$	
423°K (150°C)	$3.3 \times 10^9$	

Number and Relative Peak Intensity

Temperature, °K (°C)

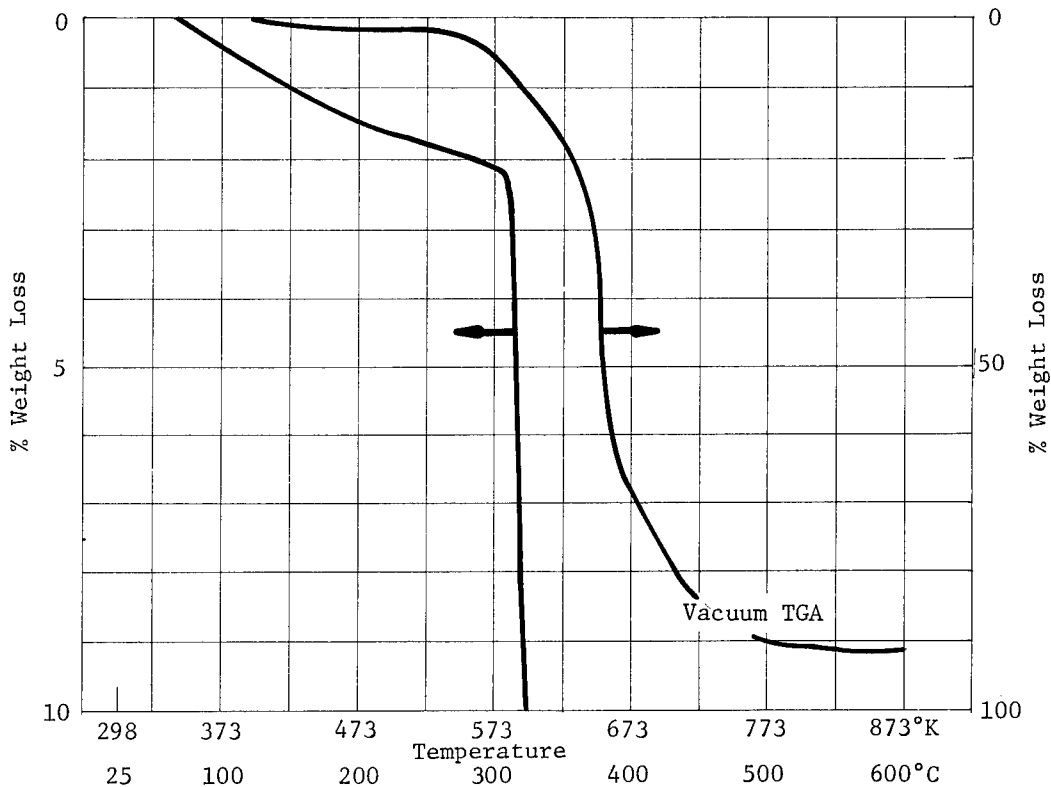
EA956

m/e	298 (25)	473 (200)	573 (300)	623 (350)	723 (450)	823 (550)	
14	672	718	1931	2971	1463	1144	
15	82	152	3388	7045	2950	2131	
16	2100	2218	11171	12738	5192	4732	
17	7232	8245	36457	28359	8083	6570	
18	23794	26619	100972	72848	21980	18838	
19	107	94	180	167	77	49	
20	161	224	455	401	274	210	
21							
22							
23							
24			122	268	93		
25			522	1266	497	100	
26	52	101	5509	10069	4514	867	
27	147	214	6581	13558	7721	1329	
28	16932	17710	30128	38206	25375	18027	
29	66	114	2906	6125	5130	398	
30	386	415	1586	8781	1758	671	
31	3594	3569	185	1733	101	53	
32			3739	3435	2859	2851	
33							
34							
35				40			
36			61	111	67		
37			357	891	262	57	
38			757	1963	736	120	
39			3313	7217	5364	525	
40	1165	1236	4112	5816	3067	1450	
41			2120	5523	7103	437	
42			3407	7148	3042	214	
43			2421	4177	5245	191	
44	194	342	7902	7372	1134	375	
45			174	945	65		
46				51			
47				96			
48				57			
49			111	310	96	87	
50			792	2390	776	94	
51			656	2083	1029	134	
52			1026	2170	431	79	
53			682	1907	1007	107	
54			265	909	334	50	
55			217	991	2525	116	
56			308	1500	1571	87	
57			181	729	1571		
58			270	697	108		
59			60	218			
60				72	48		
61				109	68		
62			44	170	101		
63			76	407	272	62	
64			117	330	77		
65			153	822	489	85	
66			265	1085	231	78	
67			1528	1299	584	46	
68			71	232	150		
69				119	399		
70				179	416		
71				123	219		
72				54	42		
73				80			
74				85	49		
75				57			
76				74			
77			51	352	661	68	
78			105	229	117	40	
79			144	255	454	41	
80			194	799	143		
81			124	180	202		
82				66	72		
83				45	81		
84				42	82		
85				55	56		
86							
87							
88					44		
89							
90				56			
91				78	227	43	
92				66			
93			66	79	63		
94			304	1033	128	49	
95			49	64	41		
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106							
107				49	89		
108				88			
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 19 pbw Activator  
Cure: Room temperature

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C) - 823°K (550°C)

$a_0 = 90.1\%$  of initial weight

$$k = 2.08 \times 10^{27} \exp\left(\frac{-80000}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$6.0 \times 10^{26}$	
373°K (100°C)	$3.2 \times 10^{19}$	
423°K (150°C)	$8.7 \times 10^{13}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

EA9320

m/e	298 (25)	473 (200)	573 (300)	673 (400)	823 (550)		
14	504	910	986	1491	1307		
15	235	413	809	2862	1795		
16	1940	3003	3934	4181	4382		
17	8286	11354	14203	12732	9479		
18	27226	36351	43110	39992	29305		
19	129	160	147	367	153		
20	300	429	421	528	386		
21							
22							
23							
24			60	408	147		
25	42	68	229	1488	401		
26	241	435	1286	9476	2184		
27	732	1138	2024	14317	3894		
28	28283	34504	37013	49259	34848		
29	367	877	1667	9328	2012		
30	2671	2956	3402	5979	3532		
31	114	753	436	3186	417		
32	7947	8569	8469	8005	7303		
33				210			
34	45	68	61	71	58		
35							
36		52	84	464	113		
37		44	196	2939	299		
38	42	67	416	5904	582		
39	94	280	1154	21018	2266		
40	5240	5933	6710	12682	6929		
41	118	295	854	10125	1469		
42	115	125	1128	6920	1112		
43	221	359	1650	6827	1147		
44	1655	2074	4318	7517	2726		
45	97	70	285	4020	443		
46			47	435	68		
47			42	881	58		
48				260	52		
49		95	140	1245	152		
50		131	508	7856	755		
51		109	486	12410	954		
52		61	336	5852	535		
53		231	333	6246	595		
54		56	240	2708	297		
55			250	4937	491		
56			194	2229	383		
57		48	319	1243	193		
58			78	1458	228		
59			49	784	115		
60			45	606	92		
61			60	1321	113		
62			114	2717	222		
63			138	5875	538		
64			197	1890	216		
65		45	262	9286	725		
66		75	449	7660	523		
67		68	103	3187	289		
68			40	1565	186		
69			48	777	100		
70			40	712	110		
71			431	431	73		
72			373	373	83		
73			774	774	83		
74			41	2036	187		
75				1647	138		
76			51	1467	135		
77		59	141	8913	833		
78		70	267	6601	441		
79		69	275	4859	479		
80		64	213	1894	205		
81			128	1372	157		
82				752	79		
83				339	53		
84				354	60		
85				267	50		
86				355	60		
87				393	57		
88				212			
89				1653	173		
90				1114	129		
91			94	9286	978		
92			97	2259	254		
93			146	1658	176		
94			416	10751	601		
95			88	1395	124		
96				334	54		
97				201			
98				209			
99				129			
100				119			
101				227			
102					69		
103				4172	180		
104				6517	123		
105				2126	289		
106			68		198		
107			121	4907	686		
108				2659	363		
109			197		89		
110				483			
111				159			
112							
113				84			
114				89			
115				74			
116				1055	132		
117				407	53		
118				1102	127		
119				1070	81		
120				2988	231		
121				902	131		
122			70	3167	314		
123			55	1136	164		
124				204			
125				67			
126				53			
127				55			

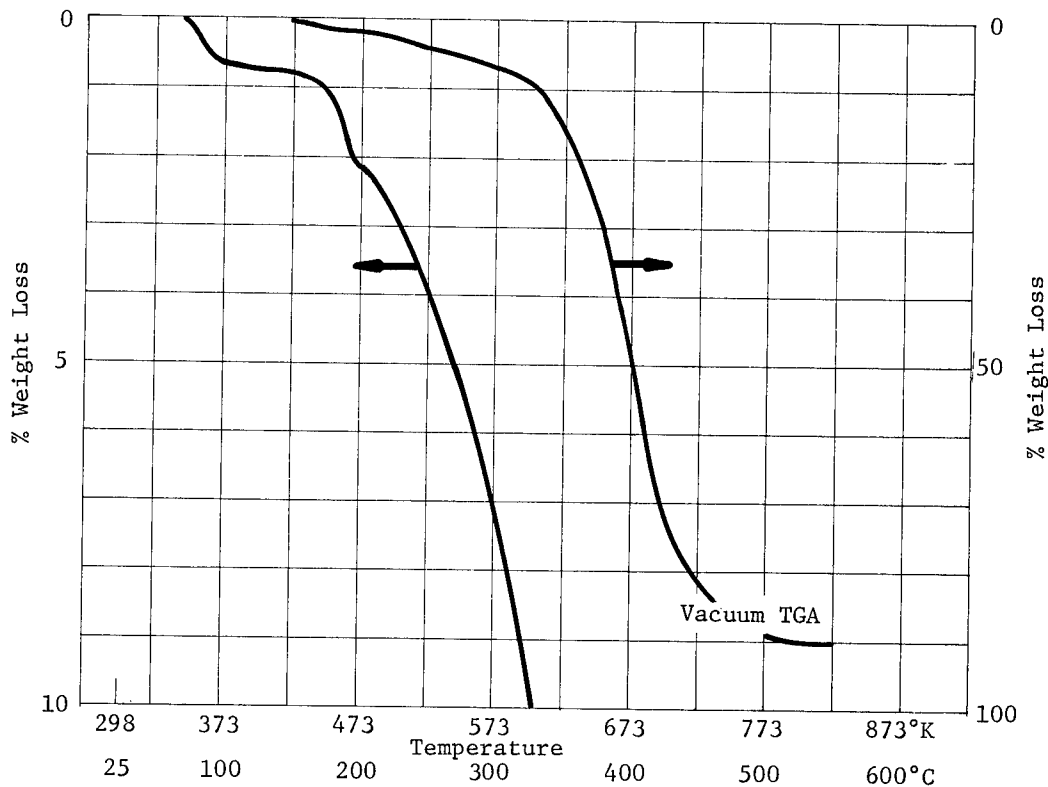
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)			EA9320
	573 (300)	673 (400)	823 (550)	
128		114		
129		272	55	
130		267	62	
131		194	47	
132		635	97	
133		321	75	
134		882	83	
136		2462	203	
136		772	87	
137		697	78	
138		103		
139				
140		43		
141				
142		80		
143		88		
144		118		
145		124		
146		395	41	
147		171		
148		157	40	
149		190		
150		139		
151		118		
152		49		
153				
154				
155				
156		48		
157		40		
158		97		
159		92		
160		118		
161		80		
162		56		
163		63		
164				
165		48		
166				
167				
168				
169				
170				
171				
172		42		
173		51		
174				
175		48		
176				
177				
178				
179				
180				
181				
182				
183				
184				
185				
186				
187				
188				
189				
190				
191				
192				
193				
194				
195				
196				
197				
198				
199				
200				
201				
202				
203				
204				
205				
206				
207				
208				
209				
210				
211				
212				
213				
214				
215				
216				
217				
218				
219				
220				
221				
222				
223				
224				
225				
226				
227				
228				
229				
230				
231				
232				
233				
234				
235				
236				
237				
238				
239				
240				

Chemical Characterization Summary

Mix Ratio: One component  
 Cure: 1 hr. at 394°K (121°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 423°K (150°C)-773°K (500°C)

$a_0 = 86.8\%$  of initial weight

$$k = 2.34 \times 10^6 \exp\left(\frac{-22100}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.4 \times 10^8$	
373°K (100°C)	$3.1 \times 10^6$	
423°K (150°C)	$8.5 \times 10^4$	

## Number and Relative Peak Intensity

Temperature, °K (°C)

EA9414

m/e	298(25)	423 (150)	523 (250)	623(350)	723(450)	823 (550)	
14	3079	3246	3230	6033	6083	4754	
15	1720	2393	2700	10916	10792	7468	
16	12017	13063	15504	29967	16780	16377	
17	39008	37494	38168	55329	36370	32395	
18	100788	100809	100780	100801	100800	95373	
19	476	513	540	597	586	416	
20	1024	1055	1070	1376	1517	1421	
21				382			
22							
23				694	853	237	
24				2497	3147	1048	
25		46	58				
26	430	646	848	12519	15483	4986	
27	1047	1499	1820	14748	19950	6324	
28	34648	36240	35983	71303	57954	45013	
29	633	906	1048	8638	11550	3114	
30	1703	1849	1888	8006	4324	2577	
31	110	258	293	3296	1784	755	
32	9565	9469	8693	8787	8622	8535	
33				105	65		
34				81	135		
35			169	553	462	104	
36			198	2654	2884	520	
37		78	338	4722	5562	906	
38		160	591	14389	22978	3280	
39		545	8071	15277	15259	9935	
40	8008	8277	493	5608	13020	1987	
41	128	439	653	8861	5513	1411	
42	103	213	778	6185	9588	2132	
43	208	3678	6718	57506	7008	3278	
44	2089	60	150	2596	933	303	
45				453	301		
46				775	510		
47				229	161		
48				1188	1168	158	
49			51	5505	6230	986	
50		340	319	4468	8726	1272	
51		178	182	3152	3577	535	
52		193	223	2781	5673	637	
53		49		2534	1991	242	
54		145	62	2988	6376	704	
55		52	45	1992	2129	490	
56				1411	1250	248	
57			70	1246	851	140	
58				473	305		
59				249	373		
60			53	828	1007	142	
61			88	1382	2098	269	
62			256	2553	5013	700	
63		82	195	1158	1646	261	
64	83		610	8637	9262	1137	
65		228	193	8400	7440	956	
66	107	156	55	1690	4608	294	
67		54		992	1404	129	
68				343	1139	73	
69				265	704		
70				230	230		
71				106	159		
72			56	347	308	44	
73				695	1261	147	
74				505	946	100	
75				360	818	82	
76				1559	9014	1034	
77		74		1501	3090	562	
78		140		2034	6223	527	
79		68		1335	1800	136	
80		48		670	2810	116	
81				265	954	50	
82				139	462	47	
83			172	357	501	242	
84	203	190		81	133		
85				82	240	58	
86	40				198		
87					50		
88				203	1219	129	
89				184	747	65	
90				1161	8912	1336	
91			46	870	2063	352	
92		48	180	1529	2695	177	
93				11642	9026	917	
94				1114	1857	74	
95				84	452		
96					174		
97					93		
98				55			
99				74			
100					111		
101				89	359		
102				348	1624	182	
103				607	832	71	
104				242	2081	346	
105				219	651	120	
106				520	4941	627	
107				744	1540	211	
108				175	443		
109					134		
110							
111							
112				47	1159	92	
113					363		
114					814	55	
115					373		
116				117	1980	217	
117				321	98	55	
118				98	653	55	
119				110	4428	387	
120				66	1002	45	
121					110		
122							
123							
124							
125							
126		156	389	673	215		
127							



Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

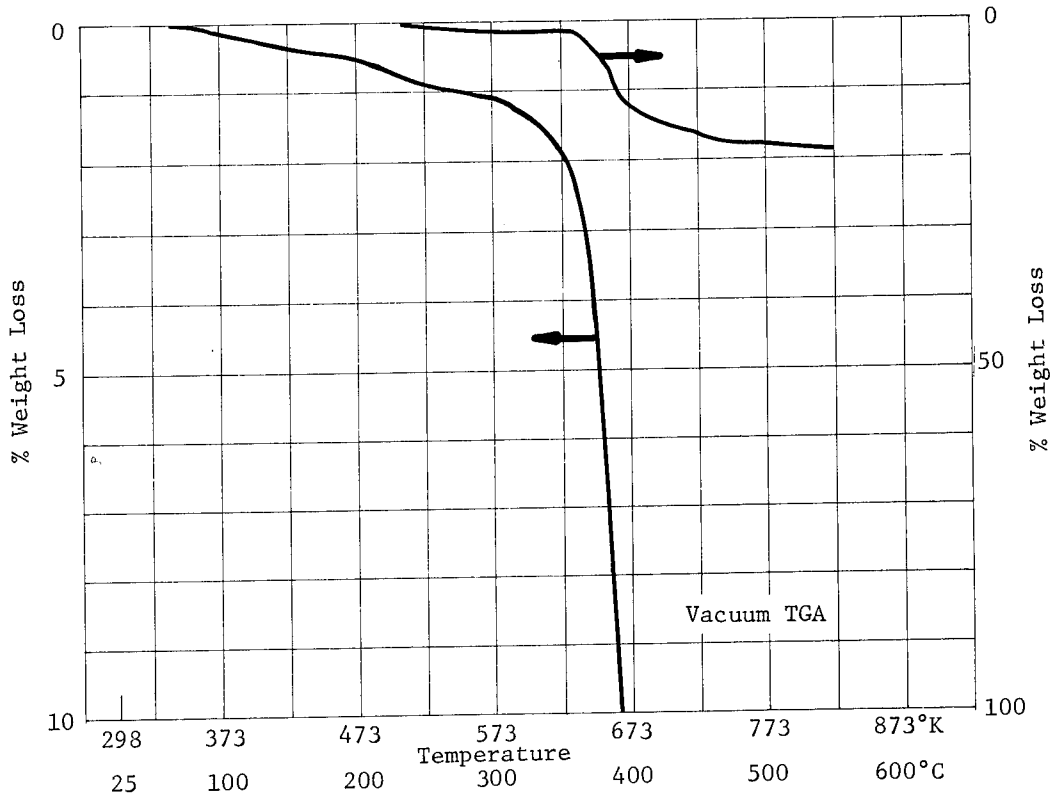
EA9414

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)
128					432	
129					726	
130	259	315	314	497	169	288
131	156	150	125	321	754	259
132	214	235	174	317	484	262
133				41	481	
134				320	1122	160
135	53				516	
136					818	67
137					46	
138						
139						
140						
141						
142					76	
143						
144					87	
145					45	
146					169	
147					48	
148*					69	
149						
150						
151						
152						
153						
154						
155						
156						
157						
158						
159						
160						
161						
162						
163						
164						
165						
166						
167						
168						
169						
170						
171						
172						
173						
174						
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						

Chemical Characterization Summary

Mix Ratio: 1 pbw Resin to 20 pbw Catalyst  
 Cure: 4 hrs. at 339°K (66°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:  
 Over the Range: 603°K (330°C) - 698°K (425°C)

$a_o = 17.2\%$  of initial weight

$$k = 1.7 \times 10^{39} \exp\left(\frac{-114,800}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.0 \times 10^{38}$	
373°K (100°C)	$1.1 \times 10^{28}$	
423°K (150°C)	$1.9 \times 10^{20}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Eccobond 56C/Cat 11

m/e	298 (25)	473 (200)	623(350)	673 (400)	773 (500)		
14	1632	1664	3452	1913	172		
15	225	802	6059	1652	1353		
16	2613	2482	6499	3265	3462		
17	11249	9167	19881	8886	7325		
18	41634	33150	73504	31072	25158		
19	132		45				
20		115	218	114	88		
21							
22							
23							
24			161				
25	193				56		
26	200	733	5925	2689	900		
27							
28	25395	26200	37129	27039	24377		
29	194	438	8957	1531	586		
30	57	151		227	111		
31	59						
32	6334	5559	5704	5114	4892		
33							
34							
35							
36			73				
37							
38		49			54		
39			9110				
40	2130	2186	6308	5175	2046		
41			2032	845	176		
42	43	1742			156		
43				1345	126		
44	411	3021	10744	1466	615		
45			858	84			
46			70	45			
47			614	97			
48			40				
49				77			
50			2462	100			
51			2091	1883	83		
52			865		125		
53			1013	786			
54				71			
55		41	1998	750			
56			367	42			
57			493	40			
58			163				
59							
60			388	54			
61			636	262			
62							
63			1912	1145			
64					50		
65				2951	111		
66			7925	2913	85		
67			414	149			
68			151				
69							
70		44					
71		44					
72							
73			83	78			
74			408	171			
75			106	165			
76			45				
77			999	1868	88		
78			242				
79			415	670			
80			41	64			
81			43				
82							
83							
84							
85							
86							
87							
88							
89							
90			138	162			
91			117				
92			894	1493	71		
93			95	87			
94			100	102			
95			13936	4081	103		
96			605	85			
97							
98		573					
99		746					
100							
101							
102			52				
103			81	194			
104			43				
105			121	132			
106					43		
107					58		
108			504	1492			
109			174	506			
110							
111							
112							
113							
114							
115			49	42			
116			46				
117							
118			155				
119			928	899			
120			70	66			
121			133	1631			
122			54	201			
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Eccobond 56C/Cat 11

m/e	298 (25)	473 (200)	623 (350)	673 (400)	773 (500)		
128							
129		50	89	57	61		
130							
131			114	126	48		
132		44	97	100	57		
133							
134			1240	959			
135			111				
136			109	209			
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

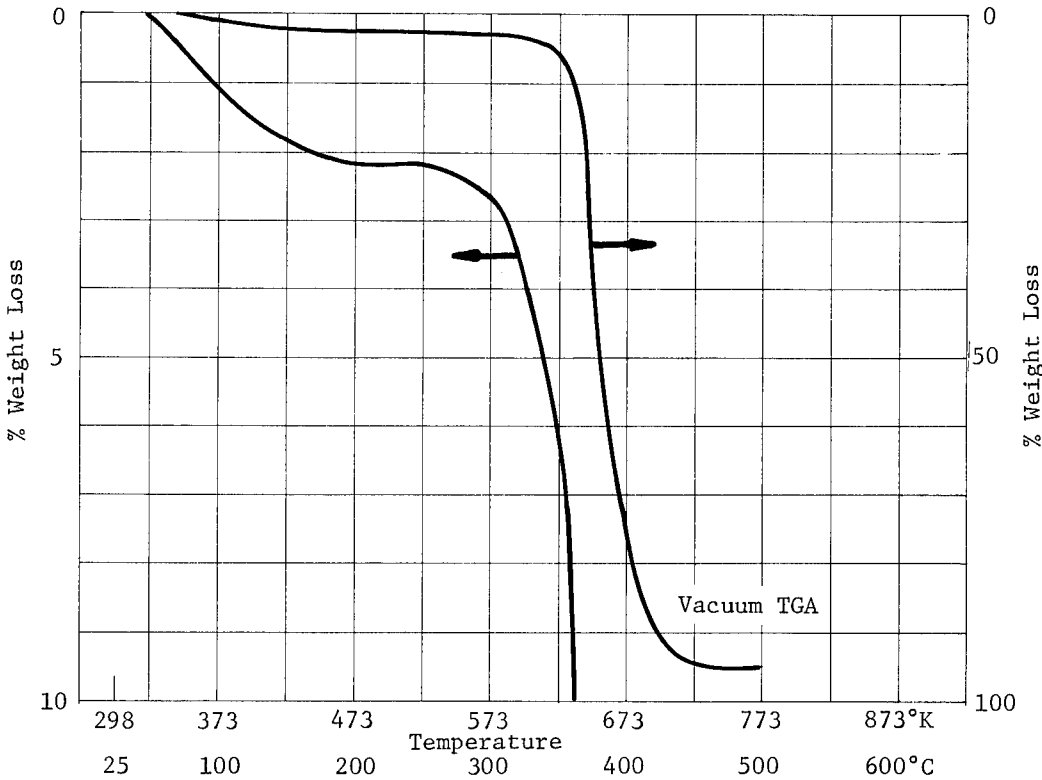
Eccocoat EP-3

Chemical Characterization Summary

Mix Ratio: 2 pbw resin to 1 pbw activator

Cure: 24 hrs. at ambient temperature

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C) - 773°K (500°C)

$a_0 = 92.4\%$  of initial weight

$$k = 9.57 \times 10^{15} \exp \left( \frac{-55,500}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.1 \times 10^{19}$	
373°K (100°C)	$2.8 \times 10^{14}$	
423°K (150°C)	$3.8 \times 10^{10}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Eccocoat EP-3

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)
14	140	60	53	1573	242	178
15	583	365	295	6556	1690	1543
16	11606	7328	7039	8279	6070	5994
17	22379	13805	12809	16923	10087	8817
18	37131	21198	18924	35190	14645	12025
19	3600	3560	4087	3830	1856	1497
20	117	60		91	41	
21						
22						
23						
24						
25				380		
26		78		3320	953	388
27		407		6334	2382	1041
28	3059	3942	2544	10991	5113	3880
29				11813	2306	880
30				1124	157	47
31				2245	480	42
32	264	120	119	195	131	67
33						
34						
35						
36				85	45	
37				485	109	42
38		192			566	59
39		1631		4886	3260	800
40	692	1582	649	2801	1839	939
41		41		6209	2205	710
42						341
43		42		10571	2461	632
44	74	53		5744	518	305
45		121		3385	584	53
46						
47						
48				42		
49						
50		386		2221	412	54
51		684		459	710	70
52		49		826	311	
53				221	351	
54				89		
55				695	326	
56				1048	129	
57					199	
58				2082	298	
59				1053	213	
60				44		
61		46				
62					128	
63		621		47	389	
64						
65		1060		278	1076	62
66				233	805	
67				50		
68				41		
69				90		
70				210		
71				47		
72				83		
73				74		
74						
75						
76						88
77				73	970	102
78				41	216	
79				94	331	
80				55	45	
81						
82						
83						
84						
85						
86				66		
87				185		
88						
89		47				
90						
91		8651			708	97
92		5419				
93		70				
94				1431	2031	111
95				97	49	
96						
97						
98						
99						
100						
101						
102						
103						
104						
105					47	
106						84
107				87	1559	175
108				115	426	
109						
110						
111						
112						
113						
114						
115						
116						
117						
118						
119					386	
120						
121					767	41
122					81	
123						
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

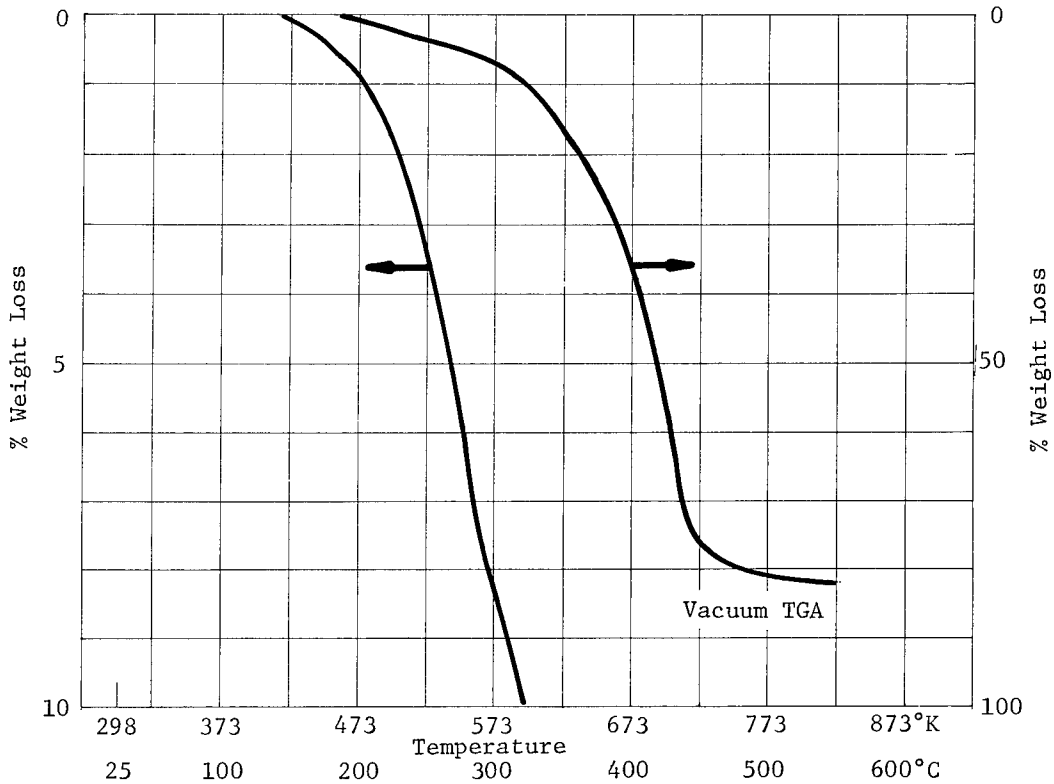
Temperature, °K (°C) Eccocoat EP-3

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)	
128							
129							
130							
131							
132							
133					62		
134				46	873		
135				43	873	46	
136					80		
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148'							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 1.5 pbw catalyst  
 Cure: 4 hrs. at 350°K (77°C), 1 hr. at 450°K (177°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 423°K (150°C)-773°K (500°C)

$a_0 = 24.3\%$  of initial weight

$$k = 5.47 \times 10^3 \exp \left( \frac{-12700}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.7 \times 10^4$	
373°K (100°C)	$3.2 \times 10^3$	
423°K (150°C)	$4.2 \times 10^2$	



Number and Relative Peak Intensity

Temperature, °K (°C)

Eccoseal 1207/20

m/e	298(25)	423 (150)	523 (250)	623(350)	723 (450)	823 (550)
14	19163	19820	2045	2574	2753	2893
15	4985	5880	2209	3718	4803	6343
16	55013	54964	5169	11537	8874	11618
17	100323	100362	15787	19517	15535	13718
18	100282	100327	48195	62138	46172	39802
19	963	426				
20	3843	4283	230	326	264	222
21						
22	51	86		375		
23	63					
24	42	215				
25	151	768	656	651	478	185
26	2226	4999	5680	4431	3920	1807
27	6503	8919	8522	6627	8857	3142
28	100367	100401	33828	45844	41232	33456
29	3656	4539	943	5245	4693	1532
30	17899	18384	1975	2659	2693	2217
31	398	640	191	2345	447	
32	65044	61626	5581	6747	5099	4753
33	60	41				
34	213	206				
35	108					
36	49	246	78	56		
37	153	469	1697	887	1141	
38	169	1121	3354	1490	2631	
39	396	3711	13113	5732	11260	
40	30310	31187	5428	5420	6358	
41	667	1643	1895	1622	4561	
42	505	1228	566	1220	1955	
43	1337	1957	349	2502	4029	
44	12180	16523	4387	66948	12997	
45	172	457	42	960	843	
46	52	176		138	86	
47					204	
48		42				
49		263	805	223	239	
50	65	1726	6074	2415	2651	
51	98	1909	7310	1914	4559	
52	87	1341	5265	1527	1568	
53	60	681	3185	1248	2855	
54	41	426	2351	1099	634	
55	67	193	131	1166	2297	
56		86		1419	950	
57		69		571	305	
58		65	568	579	224	
59		316	157			
60		63			315	
61		167	386	157	397	
62		330	782	470	1022	
63		776	1875		2612	
64		195	222		702	
65		1322	3662	1295	4522	
66		590	1354	1033	4091	
67		182		1501	1204	
68		65		355	269	
69		45			96	
70						
71						
72						
73		48	121		85	
74		163	674	125	532	
75		81	148		334	
76		72			256	
77		1809	11816	2346	5442	
78		818	2728	553	1496	
79	56	3513	29715	5704	3202	
80		2630	18967	3423	1073	
81		194	1095	453	440	
82				214	66	
83						
84		61				
85						
86						
87						
88						
89		117			614	
90					501	
91		2764	1009	188	3520	
92		1727	280		428	
93		88			654	
94		55		1050	4711	
95					375	
96						
97						
98						
99						
100						
101						
102					40	
103					838	
104					79	
105					738	
106		62			90	
107		50				
108					4354	
109					1736	
110						
111						
112						
113						
114						
115					504	
116					45	
117					251	
118					44	
119					758	
120					168	
121					3317	
122					759	
123						
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Eccoseal 1207/20

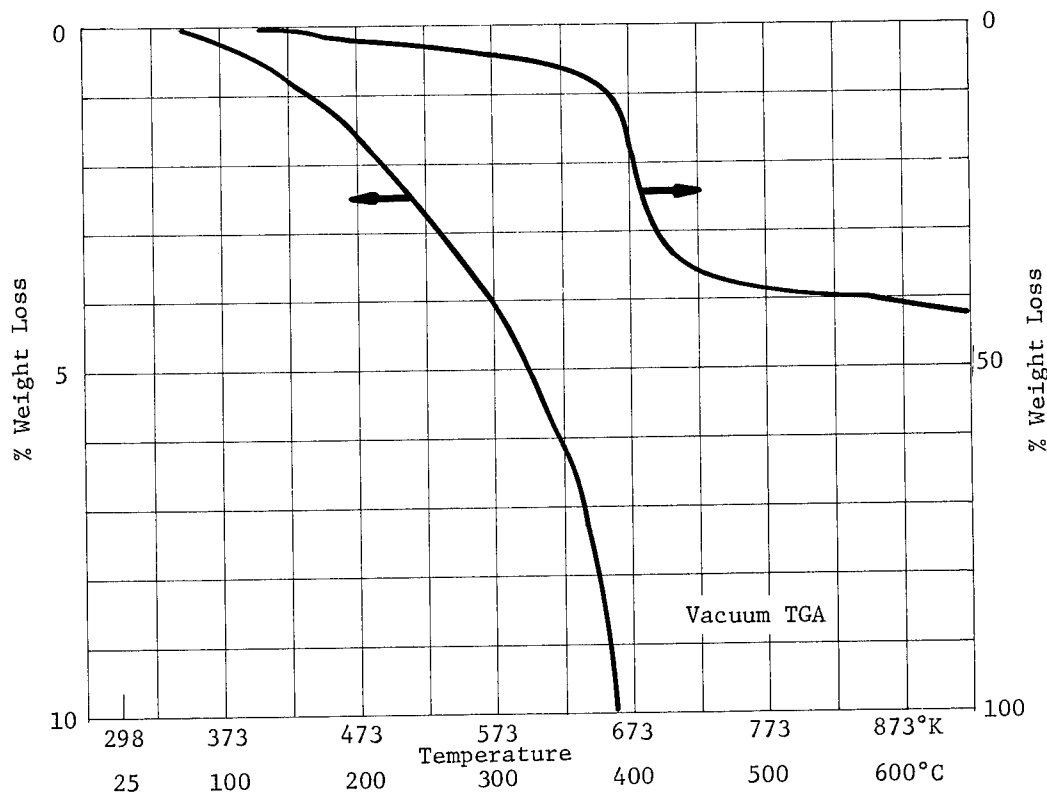
m/e					723 (450)		
128							
129							
130							
131					274		
132					60		
133					220		
134					333		
135					705		
136					667		
137							
138							
139							
140							
141							
142							
143							
144							
145					97		
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159					48		
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: As received

Cure: As received

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 598°K (325°C)-823°K (550°C)

$a_0 = 32.1\%$  of initial weight

$$k = 1.14 \times 10^{25} \exp\left(\frac{-78000}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$5.3 \times 10^{27}$	
373°K (100°C)	$4.1 \times 10^{20}$	
423°K (150°C)	$1.6 \times 10^{15}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Eccostock R-25

m/e	298 (25)	473 (200)	573 (300)	673 (400)	823(550)		
14	760	3122	3296	6530	6306		
15	879	1280	1744	10103	13952		
16	5254	10263	10546	23081	27076		
17	8330	27122	26157	39566	22986		
18	18341	82641	78675	100437	63632		
19	68	134	171	386	121		
20	324	615	653	891	696		
21							
22				504	234		
23							
24				1058	292		
25		49	236	3888	1323		
26	221	544	1506	18838	6478		
27	673	1201	2361	24603	7672		
28	8112	31326	34451	85119	51792		
29	135	534	1415	15104	3100		
30	1472	2202	2355	3953	2854		
31		8815	128	1943	343		
32	2266		8642	8380	7322		
33				71			
34							
35							
36				671	136		
37			57	4259	1136		
38			110	7196	2086		
39	55	177	442	26355	7286		
40	4047	5805	6002	14630	8113		
41		98	215	10906	2858		
42		72	215	3749	1299		
43	42	150	405	9906	2155		
44	1183	2528	5754	66078	35810		
45			48	1487	625		
46			56	469	191		
47				966	51		
48				225	40		
49				1503	513		
50				6814	3307		
51				6214	4159		
52				3222	1779		
53				5322	1118		
54				13707	445		
55			226	6755	743		
56			265	3424	506		
57			91	1541	154		
58				1768	161		
59				112			
60				320	86		
61				1153	411		
62				1895	771		
63				3657	1719		
64	43		43	1169	406		
65	52	42	42	9034	2471		
66	41		50	10993	1894		
67				16657	1838		
68				1710	324		
69				282	93		
70				100	63		
71				52			
72				118			
73				492	251		
74				1372	560		
75				654	335		
76				1325	371		
77				3555	3773		
78				1806	3626		
79				4047	2201		
80				1250	806		
81				2081	267		
82				12339	302		
83				940	44		
84	78	61	71	262	147		
85							
86				77	65		
87				55	42		
88							
89				402	331		
90				360	179		
91		54		1451	4349		
92				352	1669		
93				783	182		
94				15601	913		
95				1106	47		
96				184	48		
97							
98							
99							
100							
101							
102				75	51		
103				333	222		
104				608	144		
105				317	1576		
106				66	602		
107				1297	674		
108				1082	316		
109				96			
110				85			
111							
112							
113							
114							
115				174	211		
116					82		
117				87	99		
118				143	40		
119				249	147		
120				91	293		
121				787	225		
122				164	66		
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

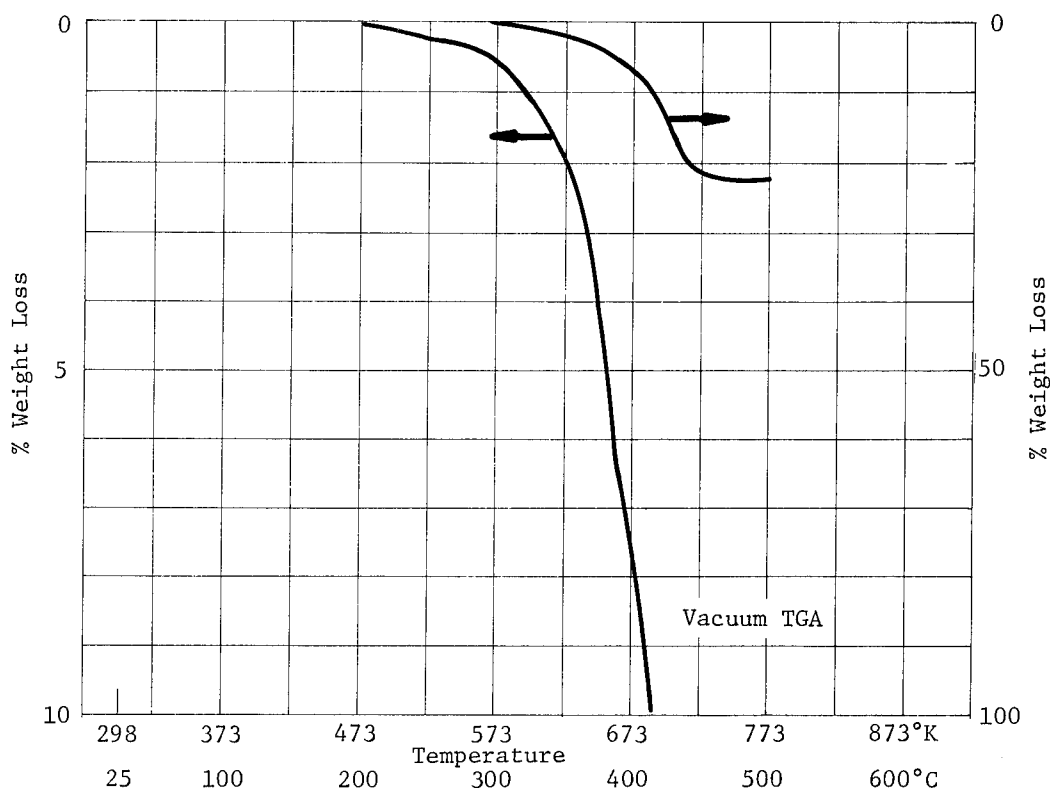
m/e	Temperature, °K (°C)					Eccostock R-25	
	298 (25)	473 (200)	573 (300)	673 (400)	823 (550)		
128				47	43		
129	105	98	90	168	149		
130							
131	59	61	65	413	142		
132	91	87	88	290	140		
133				57			
134				185	52		
135							
136				113			
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: One component

Cure: 2 hrs. at 394°K (121°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C) - 773°K (500°C)

$a_0$  = 22.1% of initial weight

$$k = 2.78 \times 10^6 \exp \left( \frac{-22,600}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.7 \times 10^8$	
373°K (100°C)	$4.1 \times 10^6$	
423°K (150°C)	$1.1 \times 10^5$	

Number and Relative Peak Intensity

Temperature, °K (°C)

BCF-550

m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)
14	613	496	497	1017	585
15	606	481	536	1700	824
16	6572	4665	4556	5292	4090
17	17938	12226	10977	11221	9002
18	47280	30734	27069	28674	22787
19	547	528	504	459	223
20	100	79	67	91	62
21					
22					
23					
24				117	
25				549	84
26	99	121	221	2882	791
27	398	346	543	2727	919
28	8368	6561	7075	14706	8683
29	350	349	426	3000	699
30	159	132	129	696	197
31	380	262	237	590	294
32	1939	1530	1379	1324	1115
33					
34					
35					
36				80	
37				439	82
38				852	247
39	65	78	121	2627	938
40	1073	1005	1036	2289	1365
41	118	119	166	1408	515
42			66	1072	249
43	138	142	198	2336	
44	875	856	1916	7665	5921
45	62			166	92
46					
47				80	
48					
49				176	
50				877	296
51			45	702	325
52				354	96
53				507	146
54				263	
55				800	233
56				460	117
57			60	533	78
58				275	
59					
60					
61				76	
62				203	53
63				447	189
64					59
65				1254	459
66				1692	490
67				325	59
68				116	
69				73	
70					
71					
72					
73					
74				96	
75					
76					
77				322	294
78				251	139
79				379	148
80				256	
81				161	
82					
83					
84					
85					
86					
87					
88					
89					
90					
91				226	338
92					42
93					
94				4487	1211
95				376	47
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106				41	83
107				307	322
108				237	137
109					
110					
111					
112					
113					
114					
115					
116					
117					
118				62	
119				43	42
120					
121					
122					300
123					
124					
125					
126					
127					

Number and Relative Peak Intensity (Continued)

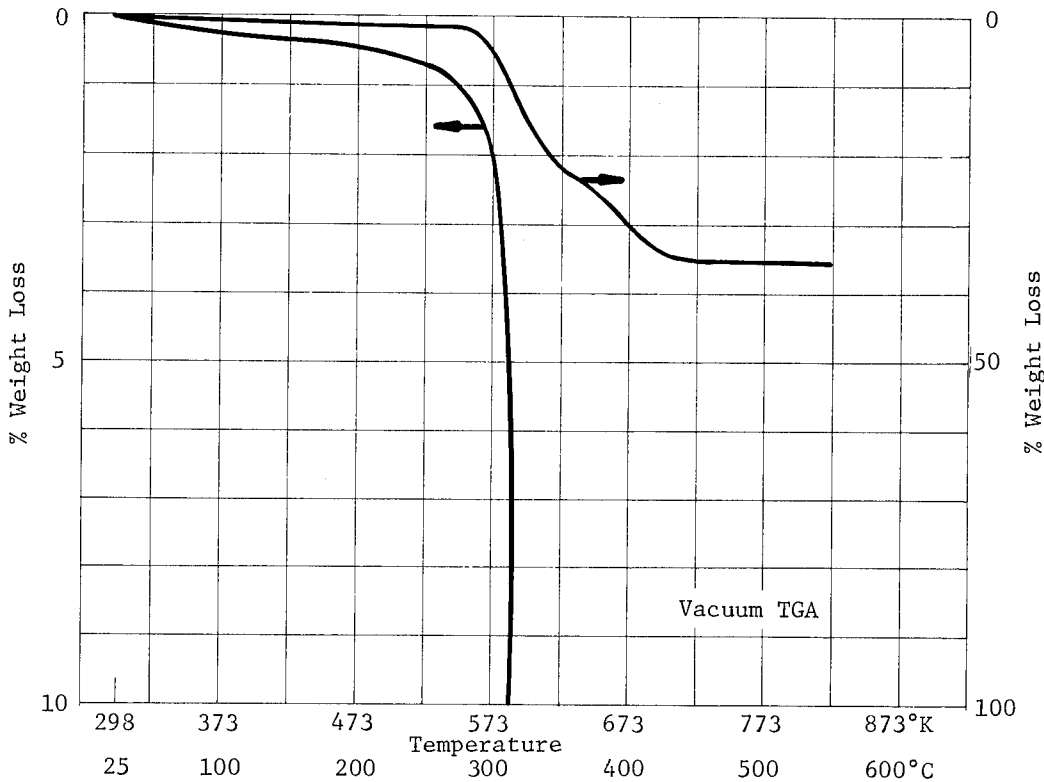
m/e	Temperature, °K (°C)					ECF-550	
	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
128				56	47		
129							
130				283	178		
131				174	119		
132							
133				41	55		
134							
135							
136					48		
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							



Chemical Characterization Summary

Mix Ratio: As received sheet stock  
 Cure: As received

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 533°K (260°C)-583°K (310°C)

$a_0 = 21\%$  of initial weight

$$k = 6.85 \times 10^{10} \exp\left(\frac{-32300}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$8.5 \times 10^{10}$	
373°K (100°C)	$8.9 \times 10^7$	
423°K (150°C)	$4.8 \times 10^5$	

Number and Relative Peak Intensity

Temperature, °K (°C)

EG818T

m/e	298 (25)	423 (150)	548 (275)	623 (350)	698 (425)	773 (500)
14	397	599	574	882	602	501
15	79	228	915	1193	680	706
16	1713	1693	3002	2751	1684	2077
17	7607	6592	8741	8317	5484	5393
18	29062	23955	29337	26626	20386	19845
19	306	413	400	382	157	184
20	115	90	172	264	137	106
21						
22						
23						
24				73		
25			64	452	241	63
26	73	209	851	3347	1912	1142
27	175	481	1617	2942	2142	1177
28	18192	19455	20974	23621	21012	20268
29	107	421	704	2029	1355	576
30	67	227	238	312	306	216
31		93	46	279	139	71
32	4941	4769	4506	4096	3960	3702
33		43				
34						
35						
36				257	100	
37				1086	499	81
38			48	2320	1040	241
39		63	324	7253	4044	1332
40	1472	1466	1764	4619	2798	1843
41		56	152	1036	679	288
42		270	432	1063	507	139
43		143	371	2501	1794	289
44	325	1331	8000	5769	1010	1180
45		224	64	93	51	
46				63		
47				317	59	
48						
49				278	85	
50			150	1784	1081	371
51			86	1851	1419	417
52			111	363	294	108
53				1000	607	152
54				109	69	
55				1556	601	142
56			56	222	58	
57				75		
58				71	70	
59						
60						
61				303	106	
62				726	291	
63				1514	882	171
64				328	130	
65				4847	2252	522
66			68	6189	2426	534
67				259	62	
68				147		
69						
70						
71						
72						
73		262				
74				240	92	
75				120		
76				44	46	
77				831	1253	362
78			40	173	215	60
79			51	337	366	124
80					45	
81				64		
82						
83						
84						
85						
86						
87						
88						
89				53	45	
90						
91						41
92				617	685	199
93				71		
94			280	260	81	
95				9337	3391	774
96			138	386	51	
97				78		
98						
99						
100						
101						
102						
103				46	56	
104						
105					43	
106						
107						
108				51	203	69
109						
110						
111						
112						
113						
114						
115						
116						
117						
118						
119						
120				115	68	
121						
122				153	213	
123						
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

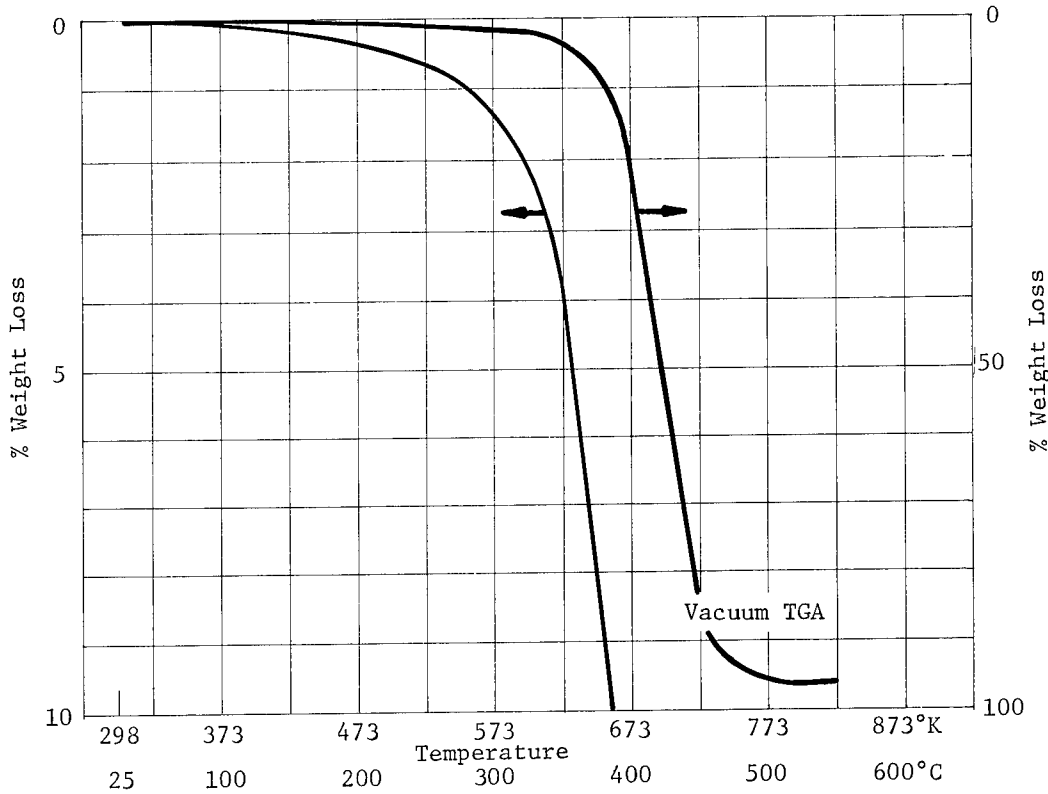
m/e	Temperature, °K (°C)						EG818T
	298 (25)	423 (150)	548 (275)	623 (350)	698 (425)	773 (500)	
128							
129							
130							
131							
132							
133							
134							
136				42			
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Epocast 203

Chemical Characterization Summary

Mix Ratio: 100 pbw of A to 100 pbw of B to 1 pbw of D-2  
 Cure: 4 hrs. at 338°K (65°C), 4 hrs. at 423°K (150°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 408°K (135°C)-623°K (350°C)

$a_0 = 96\%$  of initial weight

$$k = 5.1 \times 10^4 \exp\left(\frac{-19300}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.5 \times 10^{10}$	
373°K (100°C)	$2.7 \times 10^8$	
423°K (150°C)	$1.2 \times 10^7$	

Isothermal weight loss in nitrogen - 0.14%

Number and Relative Peak Intensity

Temperature, °K (°C)

Epocast 203

m/e	298 (25)	473 (200)	598 (325)	698 (425)	798 (525)		
14	2943	2848	3290	12000	4065		
15	1049	1166	2703	37584	4774		
16	9896	9907	10359	24288	13046		
17	33182	28551	26557	38439	26732		
18	103536	84358	77416	112671	74214		
19	180	149	137	1404	110		
20	619	493	514	1392	567		
21							
22				621			
23							
24			84	2471	57		
25			630	9093	614		
26	491	646	4394	58008	3716		
27	1125	1311	7268	138942	6079		
28	29589	29146	38171	149415	38954		
29	429	512	2831	50373	2632		
30	2099	2190	2588	8364	2894		
31	91	60	477	9489	301		
32	8675	8258	8139	10314	7944		
33							
34							
35							
36				1893			
37			412	11370	310		
38			873	26430	805		
39	67	161	6024	156741	4456		
40	5167	5300	6518	41352	7111		
41	91	172	4068	102009	2513		
42	55	90	960	14907	720		
43	112	165	852	26817	1400		
44	1657	1834	5863	43146	3692		
45			135	7218	163		
46				1167			
47				1578			
48				792			
49			102	4068	51		
50			1267	25917	1004		
51			1313	34494	1402		
52			940	19953	562		
53			1625	40113	1012		
54			7109	173262	2659		
55		62	1221	28470	711		
56			597	9651	215		
57			176	4713	44		
58			43	3249			
59				798			
60				1938			
61				3057			
62				5148	109		
63			159	11310	556		
64				3639	60		
65			523	21990	770		
66			564	22320	600		
67			8325	196395	3194		
68			527	14358	126		
69				1608			
70				645			
71				516			
72				804			
73				1932			
74				4011	45		
75				2178			
76				2010			
77			507	18129	972		
78			207	6609	339		
79			1034	22185	753		
80			317	6927	113		
81			763	18171	291		
82			6866	145221	2209		
83			343	10701	65		
84				1098			
85				531			
86				723			
87				702			
88				399			
89				2148			
90				1884			
91				6303	829		
92				1467	56		
93				1806			
94			192	18870	464		
95				1851			
96				567			
97				426			
98				393			
99				453			
100							
101				402			
102				771			
103				1722			
104				837			
105				1551	205		
106				561			
107				6759	390		
108			82	5013	142		
109				1542			
110				1173			
111							
112				432			
113				324			
114							
115							
116				1317			
117				555			
118				759			
119				912			
120				1800			
121				780			
122				3090	50		
123				1221			
124				360			
125							
126							
127							

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C) Epocast 203

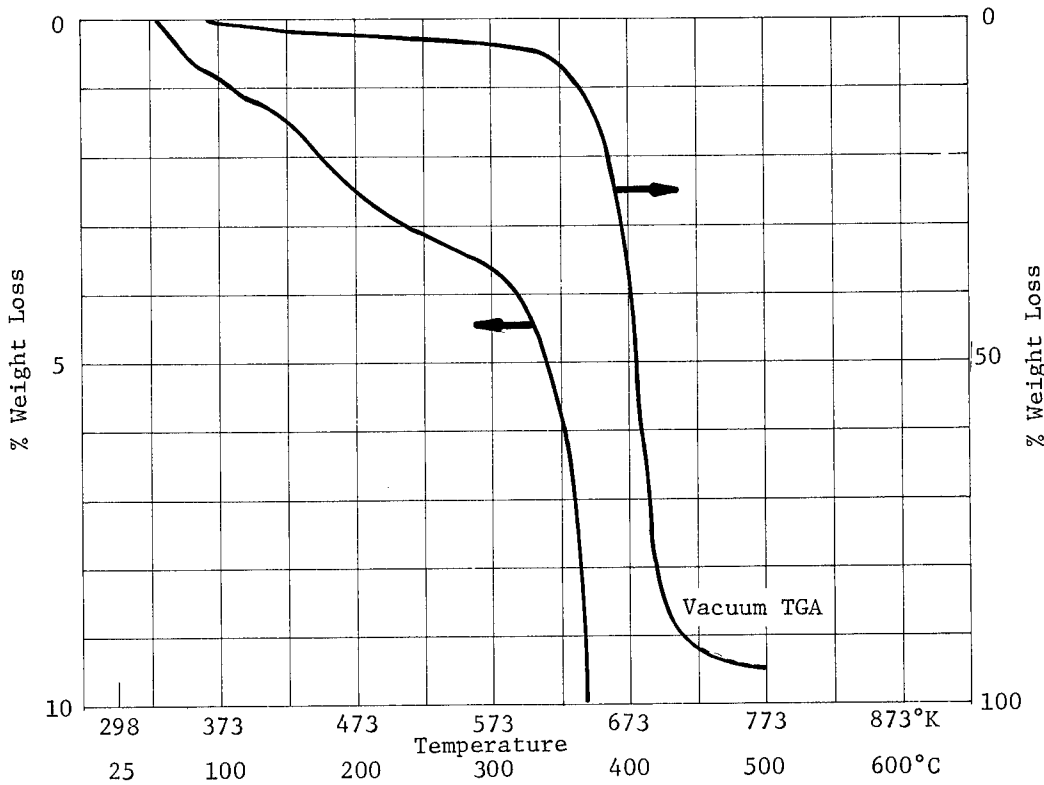
m/e	298 (25)	473 (200)	598 (325)	698 (425)	798 (525)		
128				369			
129				521			
130				528			
131				315			
132				1218			
133				771			
134				785			
135				1260			
136				660			
137				783			
138							
139				303			
140							
141							
142							
143							
144							
145							
146				423			
147				321			
148				309			
149				315			
150							
151				318			
152							
153							
154							
155							
156							
157							
158							
159							
160				309			
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Epon 815/A

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 8 pbw activator  
 Cure: 1½ hrs. at 393°K (120°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 498°K (225°C) - 748°K (475°C)

$a_0 = 95.1\%$  of initial weight

$$k = 8.0 \times 10^5 \exp \left( \frac{-22,500}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.4 \times 10^9$	
373°K (100°C)	$1.2 \times 10^7$	
423°K (150°C)	$3.4 \times 10^5$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Epon 815/A

m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
14	822	1169	824	2847	1062		
15	242	688	417	5793	932		
16	2076	1678	1824	4026	2442		
17	7973	7218	5476	7921	4546		
18	33745	25127	23176	35000	18291		
19	145	188	104	748	71		
20	244	295	196	297	245		
21							
22							
23							
24		47	70	769	71		
25	82	277	306	2653	359		
26	383	1232	1268	12945	1860		
27	612	2710	2210	21660	2913		
28	24513	26441	25243	50533	26214		
29	388	4117	2401	26512	2023		
30	537	917	905	5113	939		
31	111	1697	695	9923	447		
32	4713	4585	4147	4857	3619		
33			60	405			
34				41			
35		54	48				
36		69	55	825	48		
37		94	175	5503	307		
38	49	204	256	10577	551		
39	101	908	855	33448	2184		
40	2622	2831	2799	13843	3059		
41	129	2166	1387	17739	1284		
42	52	468	787	10225	593		
43	275	1074	1059	26233	1434		
44	469	1095	1011	8445	932		
45	42	339	195	3475	205		
46				357			
47		40		1387			
48			40	219			
49		121	106	1330	71		
50		123	129	6151	486		
51	45	80	152	5974	627		
52		75	66	2385	217		
53		67	92	4028	298		
54		72	71	1130	64		
55		621	214	5394	359		
56		509	522	4162	216		
57		1456	453	5660	303		
58		557	299	2686	143		
59		81	57	709			
60				502	41		
61				1548	49		
62				2091	107		
63				3664	348		
64		132	176	1087	83		
65			48	7579	477		
66		46	67	9506	296		
67				1176	44		
68				550			
69				264			
70				202			
71		50		195			
72		50	66	521			
73		97		320			
74				741			
75				340			
76				245			
77				1906		60	
78				604		77	
79				936			
80				466			
81				190			
82				87			
83				43			
84				70			
85				50			
86				117			
87				149			
88							
89				163			
90				192			
91				549		110	
92				126			
93				236			
94				3761		68	
95				295			
96							
97							
98							
99							
100							
101							
102							
103				61			
104							
105				56			
106							
107				244			
108				149			
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

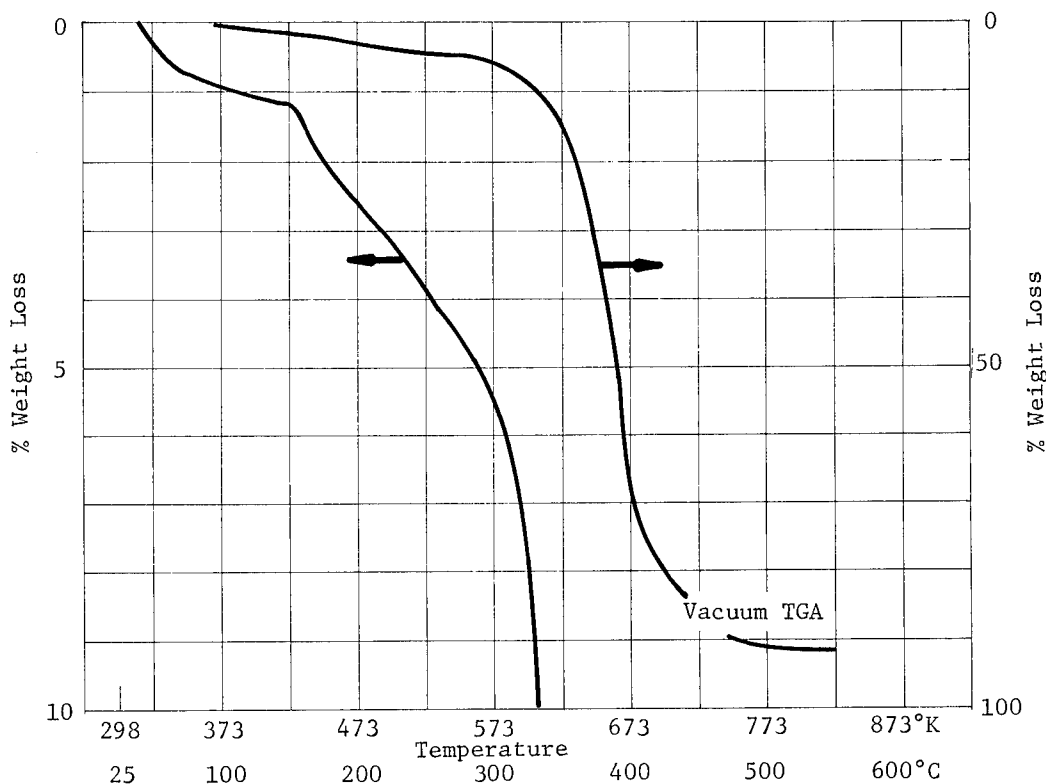


Chemical Characterization Summary

Mix Ratio: 35 pbw resin to 65 pbw catalyst to 15.5 pbw Flexibilizer

Cure: 2 hrs. at 403°K (130°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-773°K (500°C)

$a_0 = 90.6\%$  of initial weight

$$k = 3.9 \times 10^{17} \exp \left( \frac{-53,300}{1.98 T^{\circ}\text{K}} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.4 \times 10^{18}$	
373°K (100°C)	$3.4 \times 10^{13}$	
423°K (150°C)	$6.7 \times 10^9$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Epon 828/Cat. 2/Flex 871

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)
14	2216	2200	2331	10364	3903
15	453	545	1234	22977	6274
16	3224	3012	3280	18827	7961
17	11277	9896	11216	55366	11422
18	37217	32440	36757	101113	35497
19	364	332	327	661	273
20	154	136	164	628	237
21					
22				72	
23					
24		42	76	1301	273
25	47	144	325	4712	1279
26	194	914	1599	19476	6437
27				19622	10636
28	23685	24228	23547	56009	34565
29	283	481	975	33437	7551
30	414	444	475	3788	1714
31		64		5198	
32	5159	4995	4723	6534	4668
33				647	
34				51	
35				43	
36			48	912	108
37		40	87	7231	962
38		59	110	13219	1841
39	54	242	721	39735	9007
40	971	1005	1149	16805	3339
41	60	286	954	7899	8561
42	49	88	172	7545	3562
43	71	315	390	14335	5960
44	453	517	966	16882	2353
45		52	73	3006	264
46				614	55
47				2510	86
48			41	403	
49			86	2134	302
50		124	599	9899	1818
51		65	195	10856	2409
52		45	155	3356	954
53		45	123	5188	1702
54			61		616
55		122	646	8307	322
56		40	116	1826	1880
57		51	59	1280	1663
58		40		863	171
59				298	64
60				1411	123
61				2350	198
62				3928	469
63			73	7733	1154
64		42	54	2511	357
65		54	134	18735	1911
66	46	47	110	23723	1525
67		57	134	2176	1025
68				1028	313
69			42	340	646
70				278	650
71				146	382
72				155	57
73				608	57
74				2051	232
75				1121	139
76				837	139
77		42	111	7008	2123
78			110	2034	639
79			64	3111	1134
80				684	253
81			88	422	383
82			66	191	159
83		41	164	204	187
84	51	43	56	139	203
85				86	162
86				120	48
87				136	
88				55	
89				1161	219
90				793	139
91		70	539	4315	1579
92			94	765	238
93				1358	293
94				26990	1245
95				1818	153
96				102	43
97				48	48
98				43	49
99					
100					
101				74	
102				127	
103				741	197
104				421	88
105		45	150	705	315
106			44	380	166
107				2307	1062
108				929	388
109				67	
110					
111					
112					
113					
114					
115			61	444	179
116				69	
117			121	281	87
118				446	
119				1805	246
120				430	59
121				1662	495
122				233	114
123					
124					
125					
126					
127					

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Epon 828/Cat 2/Flex 871

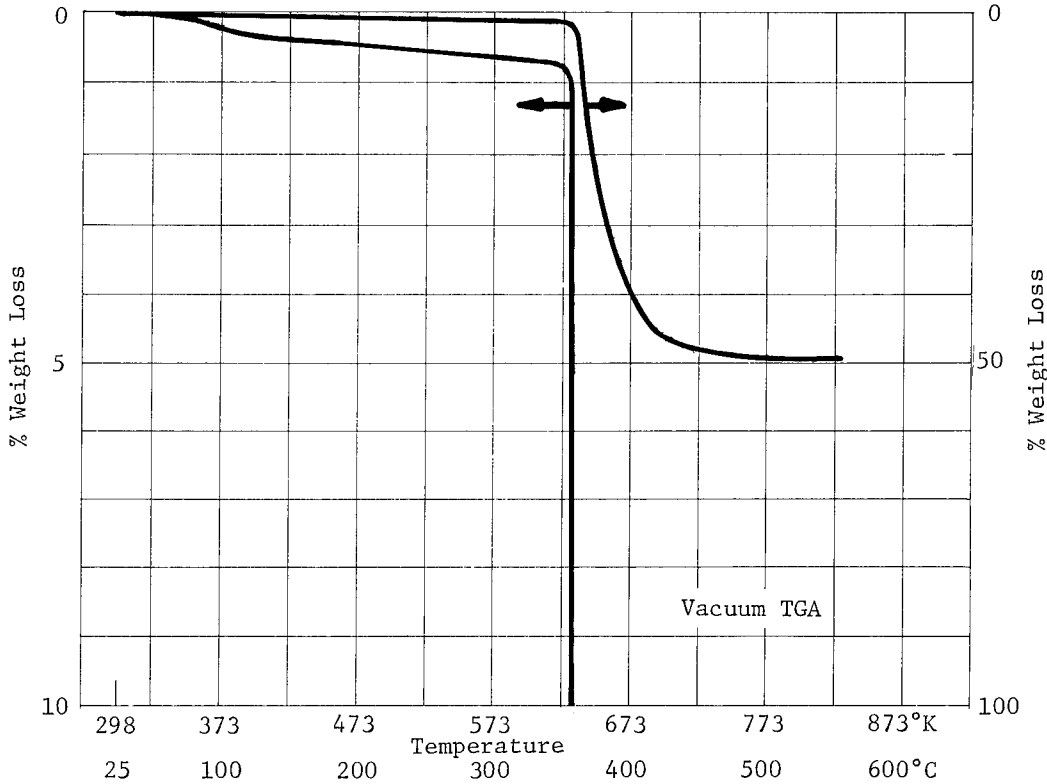
m/e	523 (250)	623 (350)	723 (450)
128			
129	45	75	47
130			
131		126	41
132		69	
133		83	
134		443	
136		920	48
136		90	
137		157	
138			
139			
140			
141			
142			
143			
144			
145			
146			
147			
148			
149			
150			
151			
152			
153			
154			
155			
156			
157			
158			
159			
160			
161			
162			
163			
164			
165			
166			
167			
168			
169			
170			
171			
172			
173			
174			
175			
176			
177			
178			
179			
180			
181			
182			
183			
184			
185			
186			
187			
188			
189			
190			
191			
192			
193			
194			
195			
196			
197			
198			
199			
200			
201			
202			
203			
204			
205			
206			
207			
208			
209			
210			
211			
212			
213			
214			
215			
216			
217			
218			
219			
220			
221			
222			
223			
224			
225			
226			
227			
228			
229			
230			
231			
232			
233			
234			
235			
236			
237			
238			
239			
240			

Epon 828/MPDA/120  
Fiberglass Cloth

Chemical Characterization Summary

Mix Ratio: 100 pbw of Resin to 14 pbw of Hardener  
Cure: 1 hr. at 339°K (66°C), 2 hrs. at 394°K (121°C),  
2 hrs. at 450°K (177°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C)-773°K (500°C)

$a_0 = 50\%$  of initial weight

$$k = 1.8 \times 10^8 \exp\left(\frac{-30200}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.1 \times 10^{12}$	
373°K (100°C)	$2 \times 10^9$	
423°K (150°C)	$1.5 \times 10^7$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Epon 828/MPDA/120 Fiberglass Cloth

m/e	298(25)	623(350)	673(400)	773(500)			
14	7838	12404	10050	8657			
15	326	13787	4010	2760			
16	4977	14401	7494	6981			
17	13706	37368	14816	9951			
18	51566	101180	53023	35913			
19	41	279	188	64			
20	479	842	608	481			
21							
22		92					
23							
24		761	395	92			
25	63	3004	1495	572			
26	385	11509	7677	2959			
27		10802	8855	3791			
28	110340	141330	122680	111790			
29	1124	27450	6605	2694			
30	509	3180	1669	1129			
31		3108	1241				
32	24848	26419	23917	22903			
33		184	104				
34	82	110	60	101			
35		176	55				
36		649	354	93			
37		4254	2469	328			
38		7420	5246	828			
39	163	20795	17928	2852			
40	6261	16410	12129	7586			
41	167	4994	3989	1306			
42	139	7052	2409	698			
43	273	19105	4420	1070			
44	1035	26394	3499	1626			
45	105	2796	885	225			
46		442	240				
47		1915	749				
48		276	123				
49		1795	1067	159			
50	42	8601	5948	926			
51	54	5316	7719	1231			
52		2599	2665	451			
53		3270	4294	652			
54		966	806	170			
55		6281	3932	537			
56		1678	512	131			
57		2034	519	92			
58		1906	438	101			
59		428	284				
60		1150	711	61			
61		1856	1352	165			
62		2988	2609	337			
63		5725	5988	819			
64		1751	1969	231			
65		15102	10747	1233			
66		18896	9428	969			
67		1580	1190	167			
68		1035	496				
69		466	110				
70		332	81				
71		84	56				
72		282	136				
73		592	508	74			
74		1628	1628	194			
75		805	1119	103			
76		570	855	100			
77		2503	8267	1293			
78		1137	2587	446			
79		1735	3672	523			
80		654	831	128			
81		410	406	43			
82		224	87				
83		104					
84		109	42				
85		67	88				
86		145	184				
87		75	240				
88							
89		1088	1633	204			
90		837	1153	170			
91		1603	6389	1199			
92		455	936	170			
93				103			
94		37746	13962	1331			
95		2457	976	68			
96		206	48				
97							
98							
99							
100							
101							
102		111	341	47			
103		351	1706	206			
104		138	390	77			
105		350	1178	372			
106		159	293	109			
107		1462	5793	1049			
108		1090	2806	464			
109		97					
110			201				
111							
112							
113							
114							
115							
116		356	851	185			
117		61	186				
118		121	426	102			
119		1127	461	60			
120		1025	3427	327			
121		376	1008	115			
122		1433	5179	505			
123		266	1208	159			
124			65				
125							
126							
127							

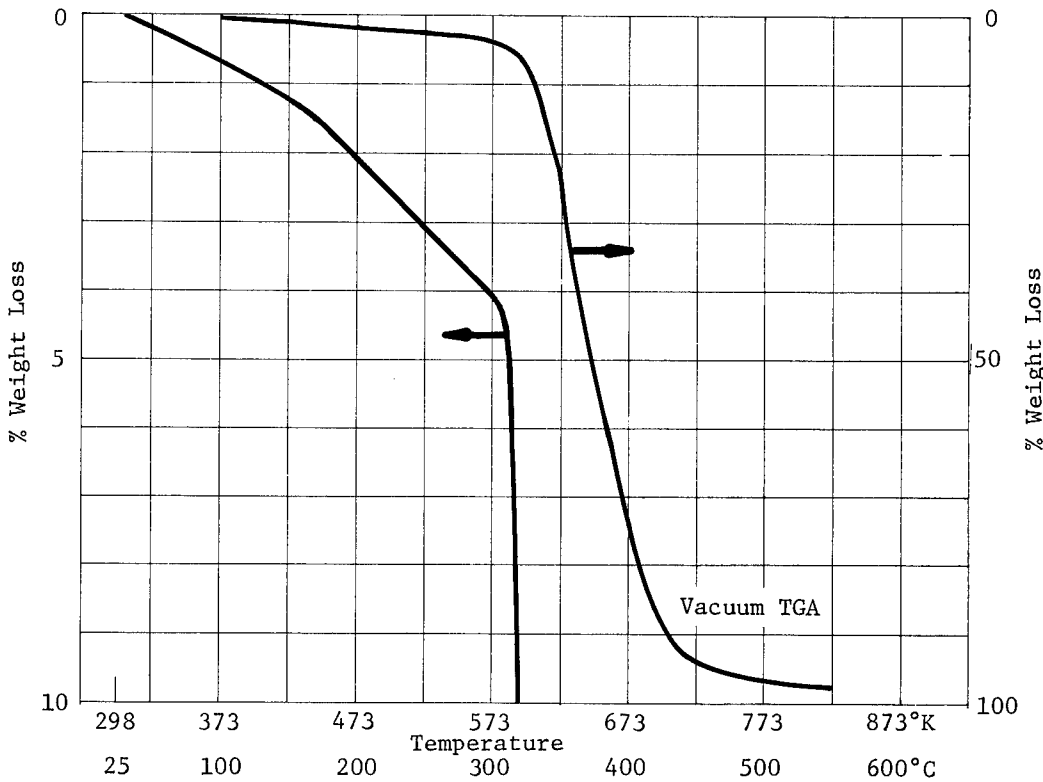
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)				Epon 828/MPDA/120 Fiberglass Cloth		
	298 (25)	623 (350)	673 (400)	773 (500)			
128			127	41			
129			99				
130			49				
131							
132		270	596	113			
133		121	270	60			
134		337	994	65			
135		1121	2847	245			
136		225	920	128			
137		314	984	80			
138			74				
139							
140							
141							
142							
143							
144			42				
145			229	60			
146		95	57				
147			113				
148			182				
149		120	168				
150		52	166				
151		42					
152							
153							
154							
155							
156							
157							
158							
159		65	51				
160			102				
161							
162							
163							
164		75	108				
165		159	68				
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 1 pbw resin to 1 pbw activator  
 Cure: 24 hrs. at room temperature

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 573°K (300°C)-723°K (450°C)

$a_0 = 93.3\%$  of initial weight

$$k = 1.6 \times 10^{31} \exp\left(\frac{-89,900}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.5 \times 10^{29}$	
373°K (100°C)	$2.9 \times 10^{21}$	
423°K (150°C)	$1.6 \times 10^{15}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Epon 828/Versamid 125

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)
14	1489	1349	1528	5360	2151
15	259	287	754	15061	3143
16	2491	2222	2258	14637	4266
17	11081	8524	8445	42888	16587
18	40266	31186	31003	100564	27082
19	44	67	64	154	76
20	124	86	112	373	116
21					
22					
23					
24				567	86
25					
26	133	96	310	17938	
27					
28	22088	20314	20911	60083	27292
29	186	259	1216	17211	5338
30	80	44	92	13008	1094
31	53	61	56	4164	
32	5078	4567	4368	4806	4050
33				52	
34				45	
35					
36					
37					
38					
39			50	26892	7405
40	2087	1900	2023	16531	6832
41	42	44	73		
42	50	49	114	18545	5367
43		156	142		
44	283	348	946	16182	1605
45				3284	160
46					40
47				1406	50
48					70
49					
50				7424	
51				6757	2092
52				5793	
53				5862	1472
54					
55				5404	2947
56				4632	1936
57					1539
58				4358	234
59				945	52
60				847	55
61					175
62					
63				3668	1030
64					2104
65	44				1617
66				14605	
67				6783	875
68				1461	280
69				599	537
70				874	565
71				554	309
72				411	48
73				377	70
74				899	116
75				415	78
76					
77				2262	2191
78					
79				2526	1143
80				2924	197
81				1230	265
82				375	133
83				174	110
84				298	127
85				137	109
86				69	118
87				57	56
88					
89				394	103
90					
91				1713	1874
92					138
93					157
94				23497	1337
95				1941	168
96				129	44
97				81	44
98				60	
99					
100				45	
101					
102					
103				243	268
104				73	328
105				257	52
106				580	98
107				2546	1610
108				3479	433
109				440	
110					
111					
112				99	
113					
114				62	
115				110	177
116					
117				92	60
118				459	53
119				1589	710
120				650	153
121				1935	1398
122				1031	215
123				96	
124					
125					
126					
127					



Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Epon 828/Versamid 125

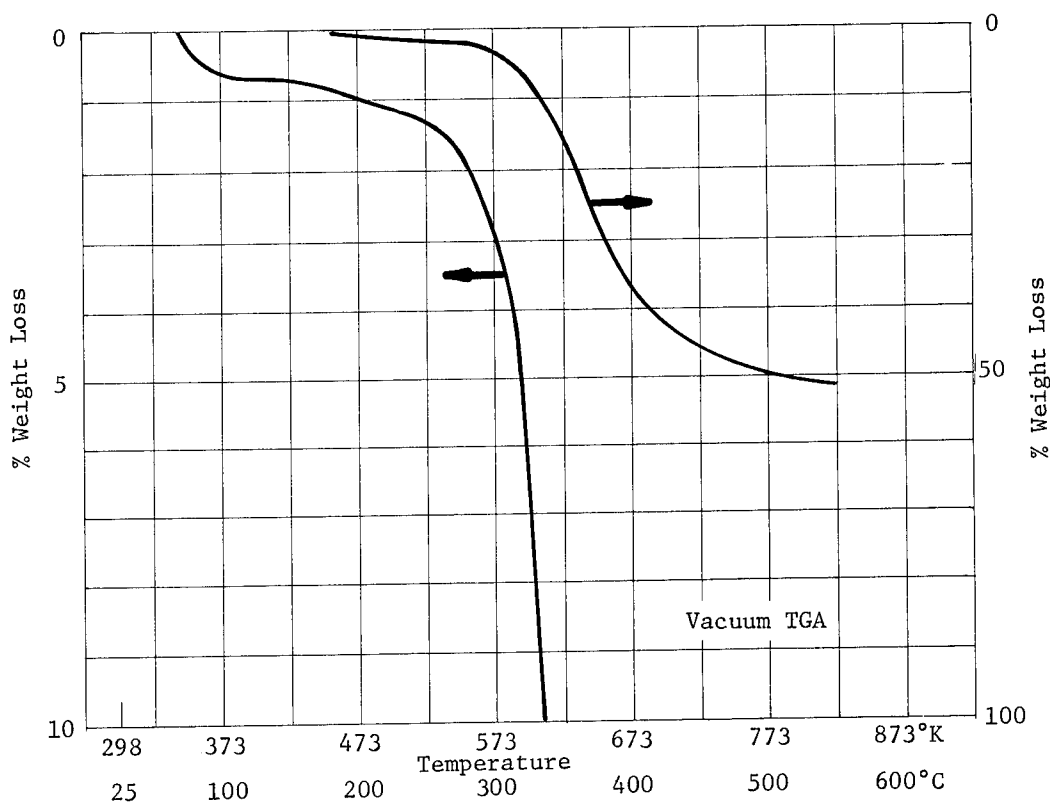
m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
128							
129							
130		46	46	96	44		
131		56		44	132		
132		53		314			
133		52	47	97			
134				8322			
135				346			
136				74			
137				288			
138				56			
139				84			
140				319			
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Epon 929/B

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 33 pbw activator  
 Cure: 1 hr. at 422°K (149°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C) - 823°K (550°C)

$a_o = 51.6\%$  of initial weight

$$k = 1.93 \times 10^{10} \exp\left(\frac{-32,100}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.1 \times 10^{11}$	
373°K (100°C)	$2.5 \times 10^8$	
423°K (150°C)	$1.4 \times 10^6$	

Number and Relative Peak Intensity

Temperature, °K (°C)

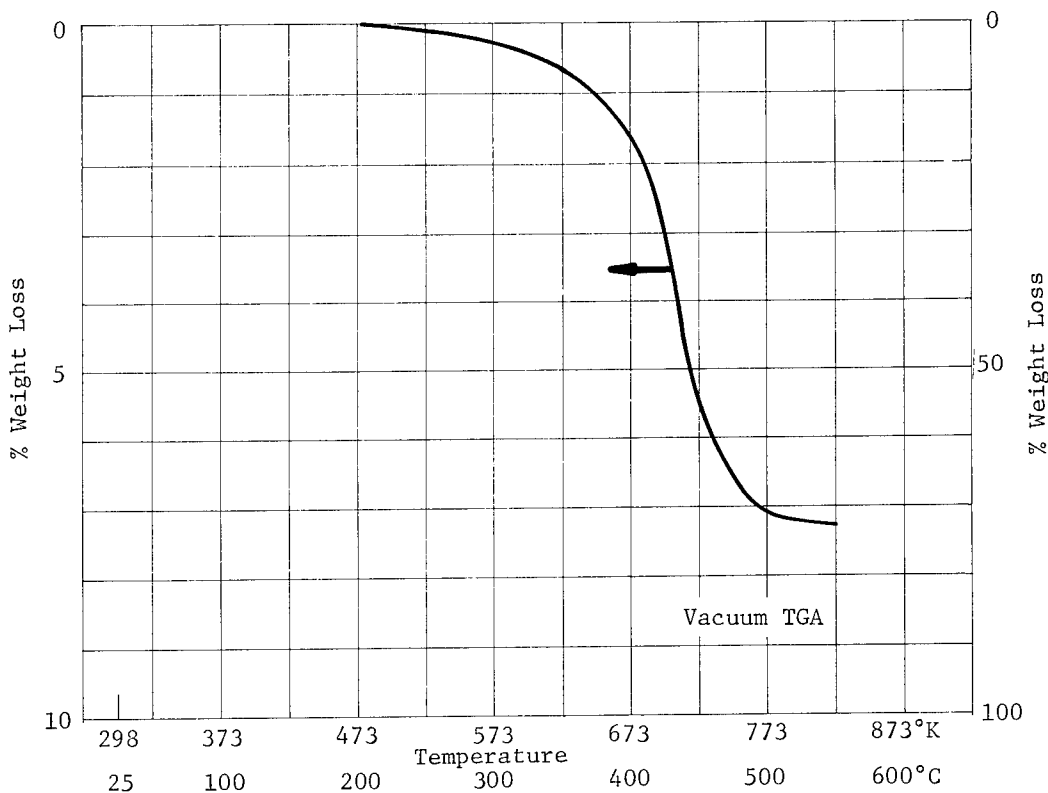
Epon 929

m/e							
14							
15							
16							
17							
18							
19							
20							
21							
22		DATA NOT	AVAILABLE				
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							
65							
66							
67							
68							
69							
70							
71							
72							
73							
74							
75							
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92							
93							
94							
95							
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

Chemical Characterization Summary

Mix Ratio: One component  
 Cure: 15 min. at 423°K (150°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 573°K (300°C) - 773°K (500°C)

$a_0 = 6.6\%$  of initial weight

$$k = 5.08 \times 10^{11} \exp\left(\frac{-39,900}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.4 \times 10^{15}$	
373°K (100°C)	$3.4 \times 10^{11}$	
423°K (150°C)	$5.7 \times 10^8$	

Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Epotek H43
	298 (25)	523 (250)	623 (350)	450 (450)	823 (550)	
14	1505	1344	1666	3083	1842	
15	485	624	1760	5230	1940	
16	5450	4800	5347	6386	6276	
17	25079	20098	20430	23877	19534	
18	79110	67024	61835	72042	58548	
19	178	179	237	366	173	
20	309	397	459	689	510	
21						
22						
23						
24			40	241	50	
25		52	362	1232	170	
26	204	475	2016	5871	1331	
27	560	952	2977	7394	1857	
28	24612	22571	27735	40899	28316	
29	273	735	4083	11306	1622	
30	1115	996	2095	3603	1251	
31	135	177	813	3798	587	
32	6199	5437	5391	5743	5417	
33						
34						
35			73			
36			213	226	56	
37			150	956	83	
38			327	1609	199	
39	67	114	1274	5354	934	
40	5464	5655	5951	8248	6570	
41	48	100	1261	4166	564	
42		54	996	2900	284	
43	58	154	1947	11301	951	
44	785	1018	1832	3807	1902	
45			221	1584	140	
46				50		
47				54		
48						
49			83	141		
50			374	976	258	
51			92	993	282	
52			114	363	87	
53			85	753	132	
54			55	214		
55			243	1221	140	
56			326	862	102	
57			566	1097	49	
58			195	916		
59				138		
60				82		
61				101		
62				142	50	
63				484	99	
64		51	105	112		
65			51	557	131	
66			54	609	97	
67				137		
68			43	79		
69				146		
70			41	157		
71				58		
72				125		
73				53		
74				242		
75				48		
76						
77				580	132	
78				268	86	
79				269	67	
80						
81				61		
82						
83						
84						
85						
86						
87						
88						
89						
90				42		
91				235	184	
92						
93						
94						
95				524	88	
96				41		
97						
98						
99						
100						
101						
102						
103						
104						
105				63		
106						
107				269	65	
108				124	40	
109						
110						
111						
112						
113						
114						
115						
116						
117						
118						
119						
120						
121				74		
122				49		
123						
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)		Epotek H43	
			723 (450)	
128				
129				
130				
131			42	
132				
133				
134			59	
135				
136				
137				
138				
139				
140				
141				
142				
143				
144				
145				
146				
147				
148				
149				
150				
151				
152				
153				
154				
155				
156				
157				
158				
159				
160				
161				
162				
163				
164				
165				
166				
167				
168				
169				
170				
171				
172				
173				
174				
175				
176				
177				
178				
179				
180				
181				
182				
183				
184				
185				
186				
187				
188				
189				
190				
191				
192				
193				
194				
195				
196				
197				
198				
199				
200				
201				
202				
203				
204				
205				
206				
207				
208				
209				
210				
211				
212				
213				
214				
215				
216				
217				
218				
219				
220				
221				
222				
223				
224				
225				
226				
227				
228				
229				
230				
231				
232				
233				
234				
235				
236				
237				
238				
239				
240				

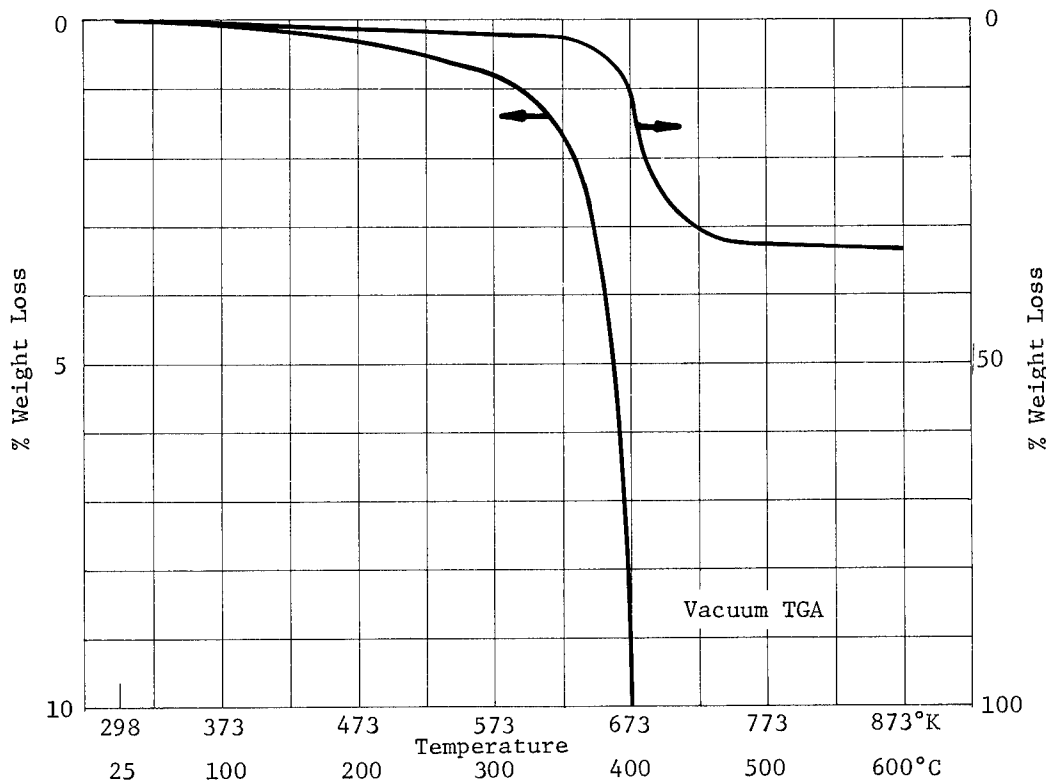
Epotek H72

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 4 pbw activator

Cure: 20 min. at 373°K (100°C), 24 hrs. at 411°K (138°C) and 10<sup>-5</sup> Torr

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 298°K (25°C) - 633°K (360°C)

$a_0 = 32\%$  of initial weight

$$k = 1.35 \times 10^4 \exp \left( \frac{-17500}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	3.5 x 10 <sup>7</sup>	
373°K (100°C)	8.8 x 10 <sup>5</sup>	
423°K (150°C)	5.2 x 10 <sup>4</sup>	

Number and Relative Peak Intensity

Temperature, °K (°C)

Epotek H72

m/e	298 (25)	473 (200)	623 (350)	698 (425)	748 (475)	823 (550)	
14	2215	2092	3017	8013	3507	3938	
15	734	748	2937	18038	5216	7549	
16	5229	4860	6872	13673	9264	12397	
17	20512	17473	23653	32296	17276	16569	
18	69435	58347	79472	101722	56435	53571	
19	592	606	702	1459	551	465	
20	396	380	566	898	556	494	
21							
22				66			
23							
24		43					
25	41	65	186	965	236	138	
26	377	529	812	3571	1022	625	
27	523	633	3858	16012	4822	3140	
28	25900	25471	4511	19543	5588	3572	
29	369	484	35800	72616	38569	37009	
30	379	371	3374	23500	3410	2216	
31	135	371	873	4163	1249	1043	
32	6164	143	882	8946	612	540	
33		5817	5677	6258	5646	5542	
34				170			
35							
36			108	691	152	118	
37			386	3253	870	560	
38			697	5422	1619	1055	
39	104	140	3121	17595	5445	3418	
40	3156	3158	4436	9962	5021	4749	
41	62	108	2563	10462	2196	1117	
42	54	78	1376	8039	1272	650	
43	81	146	3943	32803	2367	1545	
44	1562	2147	8616	14122	3220	2842	
45	57	63	402	5743	480	341	
46			68	404	86	61	
47				416	104	89	
48				176	41		
49			124	1109	359	208	
50			719	5289	2050	1304	
51			664	6012	2551	1632	
52			463	2593	1061	679	
53			669	4077	1659	990	
54			2353	1833	654	361	
55			577	3621	1113	662	
56			378	1591	279	157	
57			402	3866	193	114	
58			401	3530	159	99	
59			47	898	69		
60			208	980	153	69	
61				1096	287	198	
62			54	1529	576	382	
63			134	3093	1296	906	
64			67	1051	435	283	
65			322	4560	1793	1258	
66	40	43	348	4168	1602	1226	
67			2725	2090	627	327	
68			227	656	207	121	
69			46	846	304	138	
70				240	44		
71				313	43		
72				451	53		
73			47	554	102	49	
74			100	1764	435	252	
75				713	220	97	
76				801	274	139	
77			288	4488	2171	1198	
78			220	2111	901	601	
79			566	2912	1401	822	
80			236	992	447	229	
81			330	798	405	214	
82			2138	1029	464	257	
83			137	215	46	41	
84	62	94	124	284	137	121	
85				208			
86				295	53	42	
87				317	51		
88				66			
89				752	317	176	
90				733	348	221	
91		42	123	2599	1344	1321	
92			54	544	264	414	
93			73	376	115	59	
94			206	4957	1798	1472	
95				582	178	113	
96				175			
97				50			
98				65			
99				61			
100				51			
101				92			
102				155			
103				383	172	70	
104				190	83		
105				603	278	225	
106				170	117	202	
107				4296	2042	994	
108			43	2546	1326	783	
109				234	88		
110				297	460	280	
111							
112							
113							
114				46			
115				308	90		
116				60			
117				95			
118				87			
119				160	40		
120				134	46		
121				742	351	57	
122				532	358	81	
123				118	103		
124				99	88		
125							
126							
127							



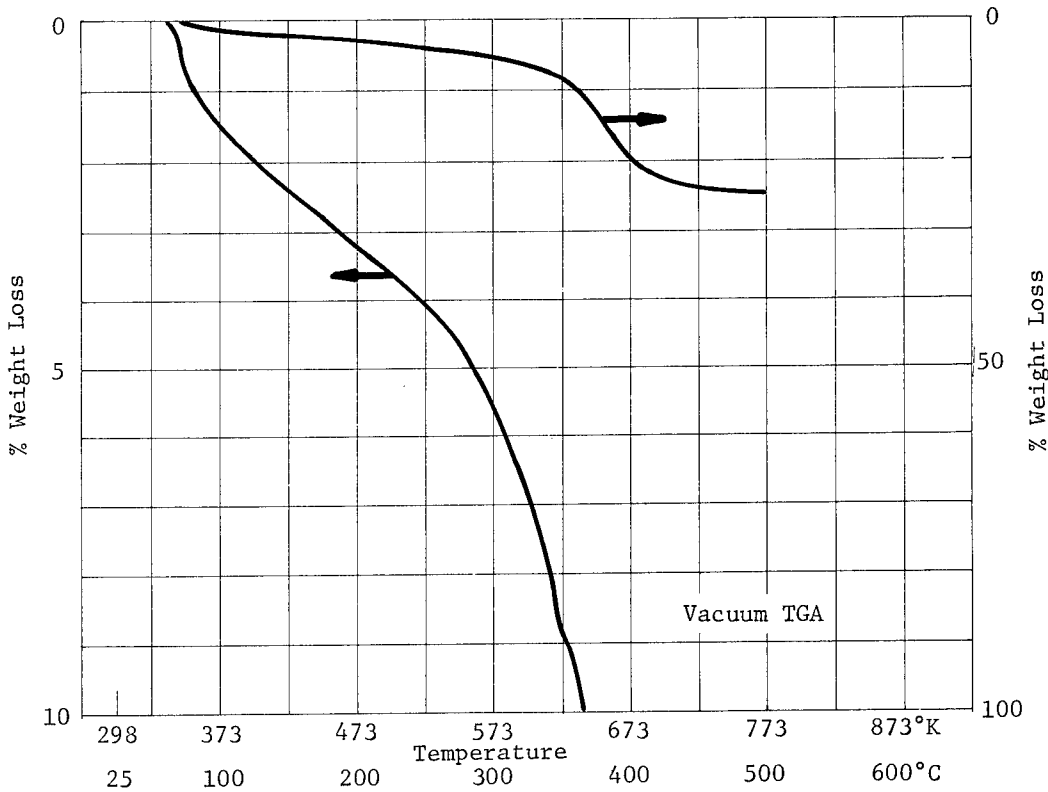
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)						Epotek H72
	298 (25)	473 (200)	623 (350)	698 (425)	748 (475)	823 (550)	
128				53			
129				192			
130	64		95	40	141	95	
131				315	142	90	
132	68	52	58	197	116	79	
133		60	77	66			
134				275	51		
135				85			
136				119	42		
137							
138							
139							
140							
141							
142							
143							
144							
145				101	45		
146							
147							
148				588	109		
149				458	75		
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 15 pbw Resin to 1 pbw Activator  
 Cure: 4 hrs. at 398°K (125°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C) - 698°K (425°C)

$a_0$  = 20.3% of initial weight

$$k = 1.6 \times 10^{16} \exp\left(\frac{-50,700}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$9.5 \times 10^{17}$	
373°K (100°C)	$2.3 \times 10^{13}$	
423°K (150°C)	$6.9 \times 10^9$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Epotek 417

m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
14	5900	6338	6903	6701	6724		
15		651	1260	2056	1319		
16	7650	7596	8035	8799	7625		
17	20150	27496	28711	26124	23246		
18	130270	97016	86315	95465	84246		
19		261	246	243	170		
20		452	472	536	515		
21							
22							
23				222	44		
24				1055	251		
25			106	760	1433		
26		466	2816	5048	2792		
27				5818			
28	111370	100598	100404	100592	100638		
29		2253	3296	4869	2133		
30		1339	1216	1979	1523		
31		500	736	1002	498		
32	21630	21564	20367	20442	20285		
33			42	43	43		
34							
35							
36		71	90	245	78		
37		63	255	1436	159		
38		143	693	2902	415		
39		780	2503	8928	1562		
40	3760	5371	5953	8604	5951		
41		1029	1626	2088	1012		
42		794	718	1416	528		
43		805	2206	2639	927		
44	1110	2970	4221	4979	2633		
45		510	455	734	340		
46				133	42		
47				361			
48				68			
49			73	528	74		
50		108	754	3027	454		
51		182	1091	3494	611		
52		66	423	1261	195		
53		115	624	1922	308		
54		56	136	462	84		
55		286	528	1716	366		
56		232	222	366	161		
57		139	164	377	135		
58			42	157			
59				57			
60			42	210			
61			44	444			
62			112	884	88		
63		40	404	1992	169		
64			112	604	63		
65		66	554	4075	363		
66		72	564	4421	378		
67		42	95	440	95		
68			41	181	47		
69		46	44	73	53		
70				55			
71							
72							
73				132			
74			82	424	53		
75				259			
76				223			
77		172	1158	2698	414		
78		73	313	892	98		
79		85	928	1822	287		
80			327	433	68		
81			45	121			
82							
83							
84							
85							
86							
87							
88							
89			146	441	47		
90			303	563	55		
91		56	226	1641	217		
92				197			
93				347	57		
94		50	471	4634	318		
95				292			
96							
97							
98							
99							
100							
101							
102							
103				128			
104							
105			48	141	43		
106				77	41		
107		85	846	1368	244		
108		85	950	1344	176		
109			41	75			
110							
111							
112							
113							
114							
115				77			
116							
117				42			
118							
119				564			
120				105			
121				610			
122				93			
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

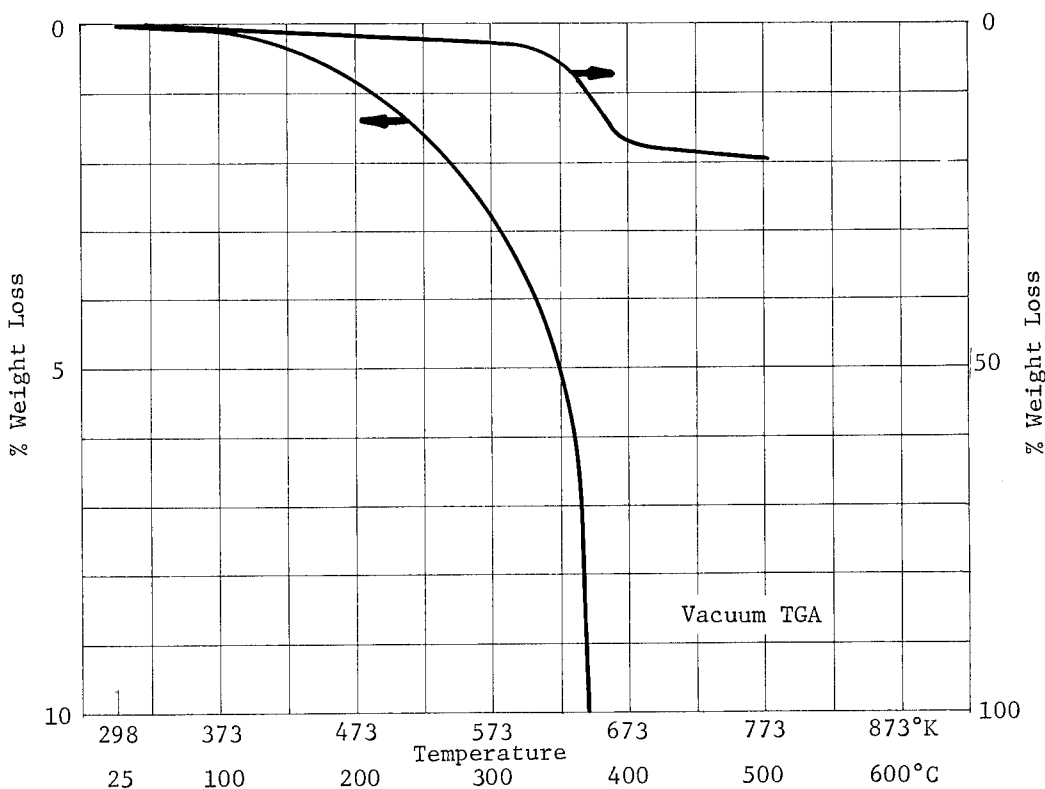
m/e	Temperature, °K (°C)					Epotek 417	
	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
128							
129							
130							
131							
132							
133							
134							
136							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Epotek 417

Chemical Characterization Summary

Mix Ratio: 15 pbw of Resin to 1 pbw of Hardener  
 Cure: 1 hr. at 383°K (105°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 423°K (150°C)-563°K (290°C)

$a_o = 2\%$  of initial weight

$$k = 1.3 \times 10^5 \exp \left( \frac{-13300}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$5.2 \times 10^3$	
373°K (100°C)	$3.2 \times 10^2$	
423°K (150°C)	37	

Number and Relative Peak Intensity

Temperature, °K (°C)

Epotek 417

m/e	298(25)	523 (250)	623 (350)	673 (400)	773 (500)		
14	993	1010	1393	1109	1161		
15	389	502	1761	1127	1048		
16	3443	3173	3635	2977	3190		
17	10160	8113	9371	7637	7172		
18	31594	23709	27951	21620	19856		
19	117	121	181	130	93		
20	201	181	203	182	179		
21							
22							
23							
24			59		72		
25		53	218	101	180		
26	111	238	1031	581	823		
27	303	544	2035	1368	847		
28	8225	8581	10114	8941	9190		
29	263	561	2618	1212	752		
30	830	896	924	848	852		
31	161	289	711	570	477		
32	2823	2635	2540	2419	2446		
33			45				
34							
35			88	61			
36							
37		46	545	349	88		
38		67	1027	704	147		
39		216	2943	2192	442		
40	1236	1281	1696	1724	1307		
41	51	187	765	497	290		
42	45	203	623	304	174		
43	81	173	1333	690	236		
44	612	821	2530	875	743		
45		70	169	107	55		
46			53	52			
47			140	122			
48			42				
49			178	124	45		
50		55	1073	612	141		
51		67	1385	866	167		
52		50	634	321	84		
53		47	879	502	88		
54			254	131	46		
55		60	536	442	101		
56		64	167	116	89		
57		44	234	110	56		
58			141	83			
59				51			
60			64	67			
61			216	167	43		
62			380	302	52		
63			796	619	95		
64			248	200	47		
65		49	1191	1061	132		
66		40	1235	1038	112		
67			150	140			
68			121	86			
69			63	44			
70			44				
71							
72			60				
73			88	55			
74			247	174			
75			124	114			
76			121	88			
77		58	1565	872	130		
78		40	586	286	83		
79			1286	484	85		
80			487	145			
81			121	60			
82			50				
83							
84		47	65	44	41		
85							
86		42	50				
87			40				
88							
89			360	188			
90			597	195			
91		40	568	542	123		
92			114	105	44		
93			132	134	40		
94			1880	1456	110		
95			156	114			
96							
97							
98							
99							
100							
101							
102							
103			59	133			
104				47			
105			87	101			
106			54	51			
107			1498	585	82		
108			1738	437	70		
109			149	50			
110							
111							
112							
113							
114							
115			46	63			
116							
117							
118			41	41			
119			56	201			
120				68			
121			104	388			
122			43	85			
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

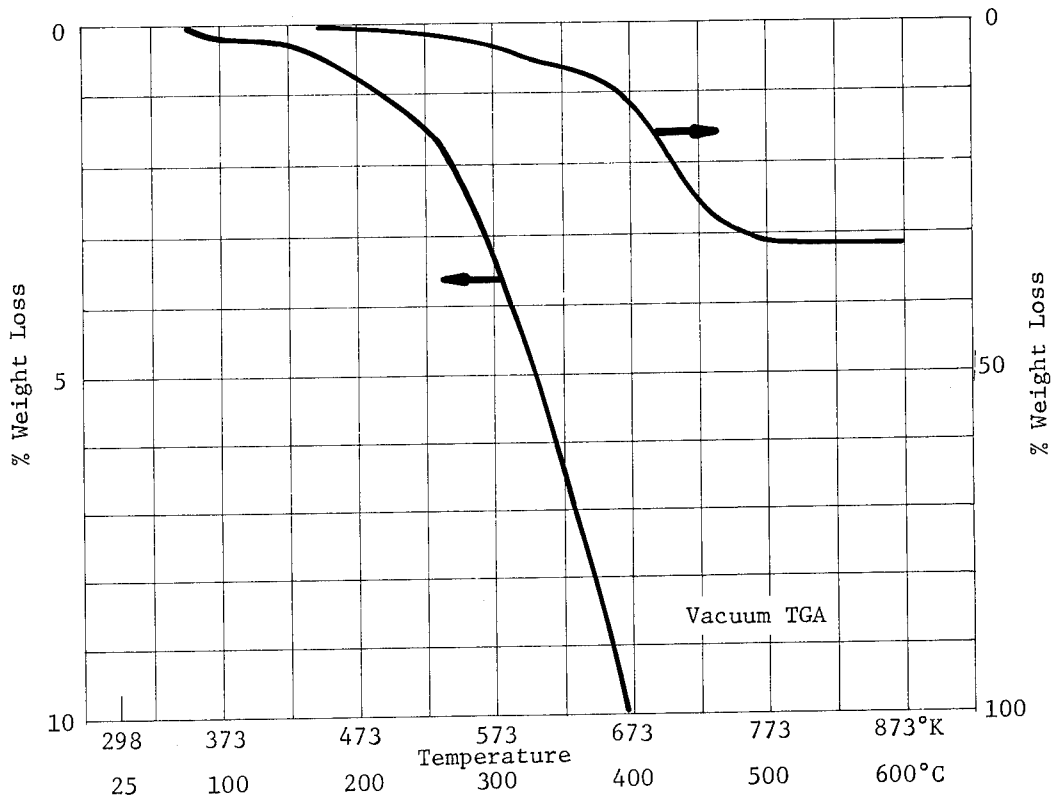
m/e	Temperature, °K (°C)					Epotek 417	
	298 (25)	523 (250)	623 (350)	673 (400)	773 (500)		
128							
129	42	52	40	41			
130							
131							
132			67	62			
133	41		64	49			
134			44	51			
135			59	167			
136				40			
137				76			
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Epoxy 450 Tubing

Chemical Characterization Summary

Mix Ratio: As received  
 Cure: As received

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 423°K (150°C)-773°K (500°C)

$a_0 = 30.6\%$  of initial weight

$$k = 4.0 \times 10^1 \exp\left(\frac{-9000}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.8 \times 10^4$	
373°K (100°C)	$2.8 \times 10^3$	
423°K (150°C)	$6.7 \times 10^2$	



Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Epoxy 450 Tubing	
	298 (25)	423 (150)	573 (300)	673 (400)	823 (550)		
14	1946	1969	2340	3228	2276		
15	653	688	1413	3105	1774		
16	4897	4627	4893	6817	5174		
17	18998	16346	15097	16108	13374		
18	63593	53884	49464	52757	41603		
19	576	630	628	748	461		
20	371	364	408	564	474		
21							
22							
23							
24				196			
25			242	1136	199		
26	305	332	1737	5838	1531		
27	467	501	3229	9722	2373		
28	24011	23223	27134	42265	26822		
29	295	328	3978	11578	2352		
30	263	320	1290	3015	703		
31	150	135	929	1920	446		
32	5853	5409	5282	5038	4933		
33							
34							
35							
36				70			
37			101	784	81		
38			266	1241	229		
39			1815	6756	1849		
40	3248	3103	3693	5506	3795		
41		40	3187	10444	2571		
42			539	2572	686		
43	40	59	3465	8603	1105		
44	574	680	1901	13001	1463		
45			378	1296	190		
46							
47							
48							
49							
50				134			
51			83	760	190		
52			61	590	215		
53			44	263	65		
54			84	1043	426		
55				470	68		
56			956	4572	1141		
57			1148	4836	852		
58			386	2256	521		
59				441	72		
60							
61				144			
62							
63				71			
64							
65				273	74		
66				335	48		
67				723	404		
68				408	207		
69				526	152		
70				271	61		
71			84	346	65		
72			628	1592			
73			191	624			
74				47			
75							
76							
77				121	52		
78				83	45		
79				115	43		
80							
81				80			
82				45			
83				128			
84	42		76	391	89		
85							
86				105			
87							
88							
89							
90							
91				76	75		
92							
93							
94							
95				351			
96							
97							
98							
99				90			
100							
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Epoxy 450 Tubing

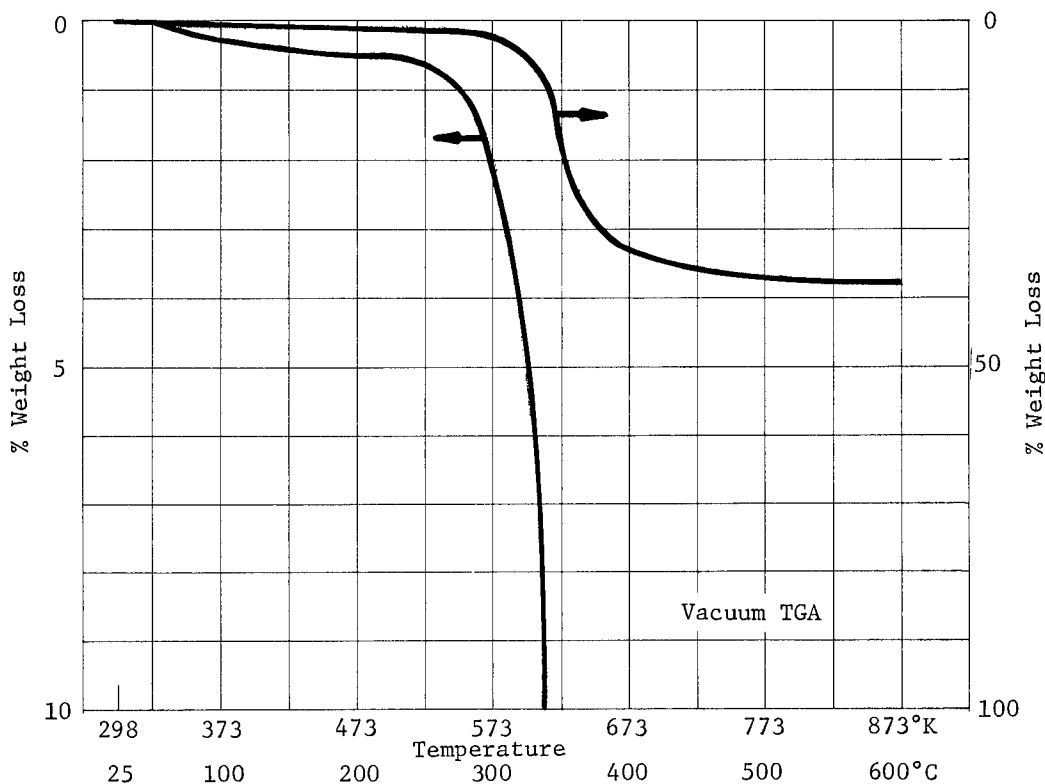
m/e	298 (25)	423 (150)	573 (300)	673 (400)	823 (550)		
128							
129							
130			42	81	45		
131				43			
132				54			
133							
134							
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: Not available

Cure: Not available

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 413<sup>o</sup>K (140<sup>o</sup>C)-753<sup>o</sup>K (480<sup>o</sup>C)

a<sub>o</sub> = 35% of initial weight

$$k = 4.5 \times 10^{11} \exp \left( \frac{-39000}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323 <sup>o</sup> K (50 <sup>o</sup> C)	1.5 x 10 <sup>11</sup>	
373 <sup>o</sup> K (100 <sup>o</sup> C)	1.2 x 10 <sup>8</sup>	
423 <sup>o</sup> K (150 <sup>o</sup> C)	5.0 x 10 <sup>5</sup>	

Number and Relative Peak Intensity

Temperature, °K (°C)

ES-222

m/e	298 (25)	473 (200)	623 (350)	723 (450)	823 (550)
14	2324	2530	6028	2866	3349
15	374	546	10904	2120	3935
16	3734	3984	11432	5106	7519
17	14353	14292	26078	12146	11703
18	47655	46583	75459	37776	36263
19	1349	1305	1298	603	517
20	326	325	591	364	359
21					
22					
23					
24			1067	68	64
25	45	68	3892	377	305
26	271	452	19003	2130	1768
27			20014		
28	26092	26778	51125	27361	27466
29	319	614	9369	1342	945
30	695	728	6738	1155	1083
31	62	67	2684		109
32	6443	6135	5923	5371	5356
33					
34					
35				40	
36				239	84
37			5081	500	195
38			9894	2066	838
39		50	31971	1580	1255
40	984	996	13247		
41	44	61	7137	932	399
42	40	51	7606	550	255
43	65	124	5831	601	284
44	774	991	7340	873	697
45			1570	81	58
46			482		
47			1477		
48			281		
49			1613	73	
50			7732	516	207
51			9384	695	270
52			3771	240	111
53			5685	355	102
54			1400	85	41
55			5464	263	79
56			1647	92	45
57			732	57	
58			1123	49	
59			555		
60			488		
61			1575	54	
62			2944	118	44
63			5937	311	104
64			2054	99	50
65			13448	542	179
66			14418	491	153
67			2546	89	41
68			831	46	
69			187		
70			217		
71			164		
72			134		
73			449		
74			1366	48	
75			891		
76			607		
77			6201	547	172
78			1849	138	67
79			2684	217	69
80			1147	71	
81			422		
82			154		
83			59		
84			115	47	
85			75		
86			118		
87			117		
88					
89			910	51	
90			496	45	
91			5030	350	161
92			711	44	
93			1139	48	
94			15669	437	100
95			1218		
96			76		
97					
98			44		
99					
100					
101			70		
102			131		
103			877	50	
104			102		
105			602	45	
106			123		
107			2761	299	69
108			195	100	49
109			104		
110					
111					
112					
113					
114					
115			49		
116			264		
117			94		
118			638		
119				54	
120			275		
121			2356	97	
122			402	41	
123					
124					
125					
126					
127					

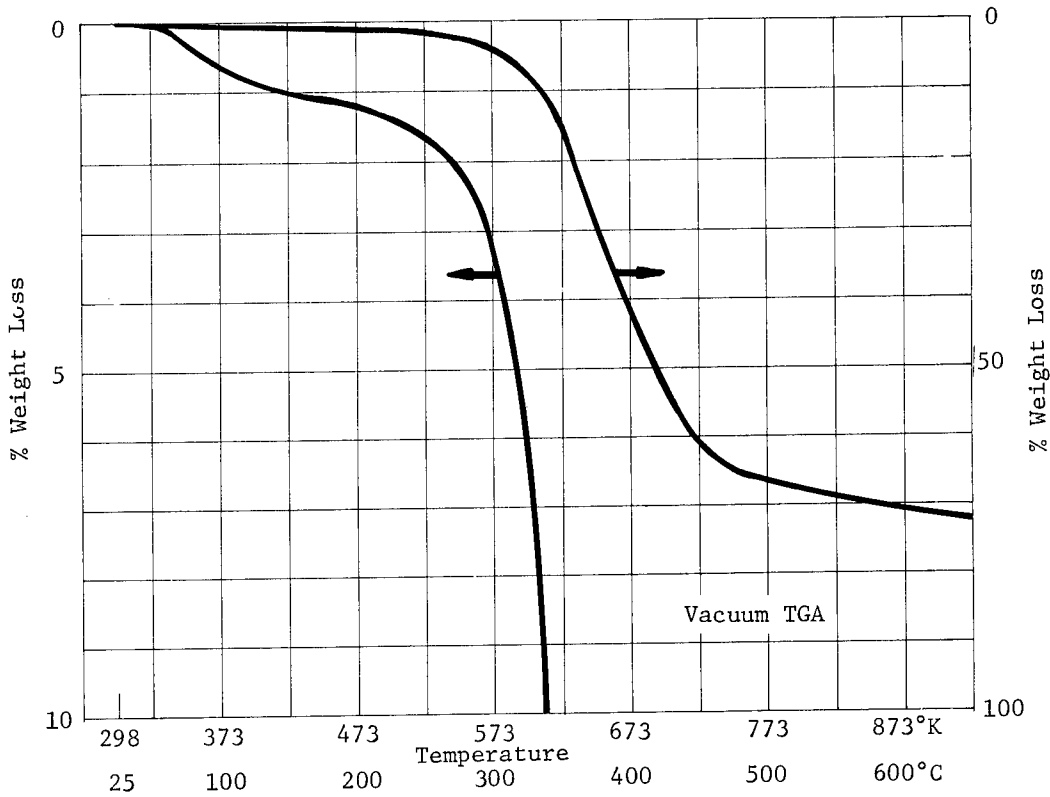
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)						
	298 (25)	473 (200)	623 (350)	723 (450)	823 (550)		
128							
129							
130							
131							
132			63				
133			67				
134			547				
135			834				
136			92				
137			117				
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: As received  
 Cure: 1 hr. at 450°K (177°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 453°K (180°C)-673°K (400°C)

$a_0 = 59\%$  of initial weight

$$k = 8.2 \times 10^8 \exp\left(\frac{-28600}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2 \times 10^{10}$	
373°K (100°C)	$5 \times 10^7$	
423°K (150°C)	$4.8 \times 10^5$	

Isothermal weight loss in nitrogen - 1.23%

Number and Relative Peak Intensity

Temperature, °K (°C)

FM-40

m/e	298(25)	523 (250)	673 (400)	773 (500)	923 (650)		
14	270	3750	853	5814	6230		
15	84	2675	1806	11581	13981		
16	1064	16797	2988	21140	26318		
17	3162	34018	5912	28033	30740		
18	9727	84673	16428	75686	83260		
19		506		344	197		
20		736	52	827	816		
21							
22		50					
23		41	65	472	105		
24		148	413	1822	482		
25		1194	2184	9120	2736		
26		2574	2761	11350	4256		
27	73						
28	4349	43520	9085	54613	56830		
29		1137	2199	5096	2121		
30	143	2510	943	3807	2650		
31		121	405	644	268		
32	945	9088	933	8167	8497		
33				152	46		
34				313	125		
35							
36			45	290	76		
37		43	710	1994	236		
38		113	1407	3876	456		
39		326	4693	12495	1416		
40	630	7136	2321	10723	8154		
41		372	1462	3500	983		
42		356	1011	1979	695		
43		621	1920	2712	1008		
44	175	8669	4896	4879	5056		
45		125	274	561	227		
46				160			
47			164	398			
48		61		251			
49			245	923	99		
50		137	1391	4714	551		
51		101	1725	6468	675		
52		107	682	2653	370		
53			1058	3841	259		
54		41	260	910	126		
55		61	871	2078	429		
56		42	178	396	198		
57			111	226	82		
58			152	204	61		
59				101			
60			93	357			
61			229	837	47		
62			466	1545	91		
63			963	3285	246		
64		105	296	1150	114		
65		52	1979	4911	390		
66		85	2253	4876	399		
67			332	747	127		
68			152	380	64		
69			171	122			
70			119	80			
71				50			
72				129			
73			42	225			
74			227	900	68		
75			100	531	58		
76			77	475	48		
77			1644	6679	414		
78		64	527	2423	585		
79			953	4550	189		
80			347	1439	48		
81			117	394			
82				108			
83				54			
84		114		181	169		
85				60			
86				147			
87				101			
88							
89			156	971			
90			216	1312			
91			730	3545	350		
92			119	761	109		
93			219	580			
94			2964	5718	385		
95			228	396			
96				44			
97							
98							
99							
100							
101							
102				128			
103			93	508			
104				218			
105			125	811			
106				463			
107			1633	7399	200		
108			974	4712	115		
109			49	314			
110							
111							
112							
113							
114							
115				335			
116				82			
117				180			
118				96			
119			61	195			
120				157			
121			510	1630	52		
122			224	1584			
123				90			
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

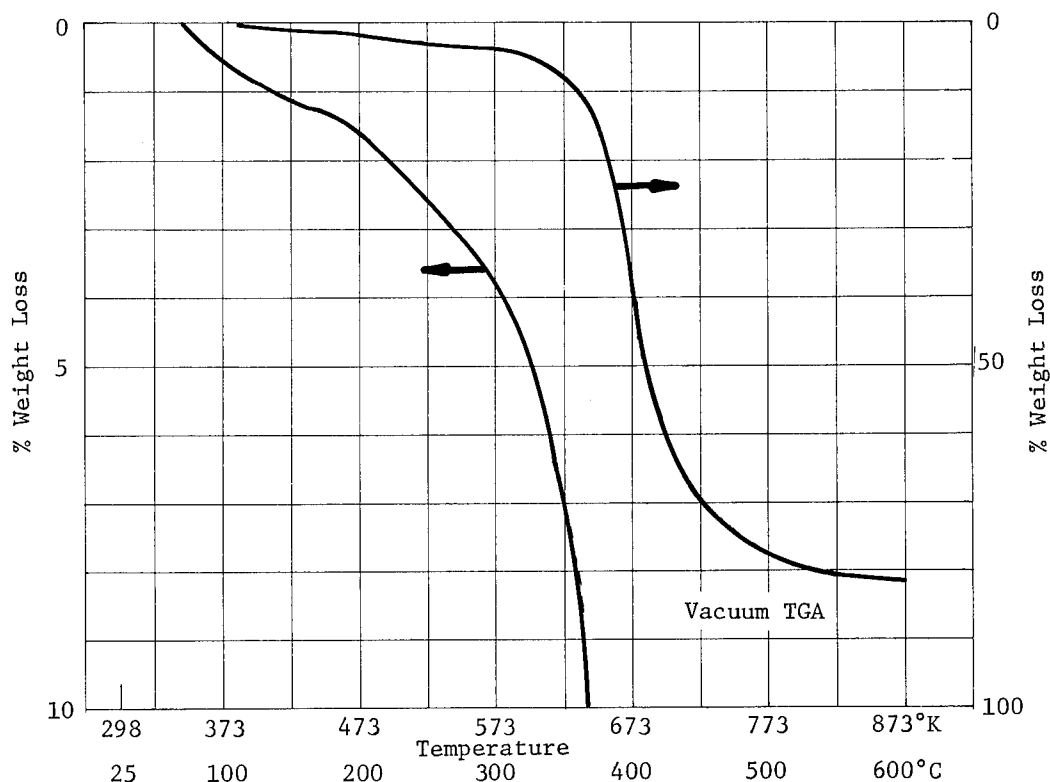
m/e	Temperature, °K (°C)					FN-40	
	298 (25)	523 (250)	673 (400)	773 (500)	923 (650)		
128				51			
129		118		176	135		
130							
131		67		287	105		
132		109		212	147		
133							
134				81			
136				115			
136				182			
137							
138							
139							
140							
141							
142							
143							
144							
145				120			
146							
147				78			
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							



Chemical Characterization Summary

Mix Ratio: One Component  
 Cure: 2 hrs. at 448°K (175°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C) - 773°K (500°C)

$a_0 = 79.6\%$  of initial weight

$$k = 2.2 \times 10^{13} \exp\left(\frac{-42,000}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$9.8 \times 10^{14}$	
373°K (100°C)	$1.5 \times 10^{11}$	
423°K (150°C)	$1.7 \times 10^8$	

Number and Relative Peak Intensity

Temperature, °K (°C)

FM-96 Supported Film

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)
14	3006	2947	3208	7715	6027	4732
15	1786	1628	2318	12743	10884	8852
16	10661	10771	15232	37478	19374	18075
17	31060	29555	32897	64202	33565	26605
18	94091	87418	79808	101005	86051	70783
19	262	260	234	305	384	83
20	536	478	473	794	513	418
21						
22				600		
23						
24				616	530	72
25			76	2036	2348	585
26	388	511	816	10216	13028	3785
27	946	1092	1499	12475	18512	5036
28	27493	27455	28234	65944	51175	35514
29	1742	1625	1754	8404	10526	3262
30	2821	2989	2973	9185	7300	3648
31	1474	1323	1288	3853	2596	1449
32	9026	8732	8351	9517	8481	7744
33				47		
34				83		
35				356	319	
36				1805	2940	595
37				3426	5718	1319
38		136	197	9761	20184	4347
39		4422	4535	10459	10530	5765
40	4404	117	163	4826	9134	1238
41	59	72	150	9921	5368	744
42	52			8104	7360	1038
43	147	182	361	75259	10254	2865
44	1893	2106	5149	4594	828	113
45			47	380	160	
46				386	389	
47				116	74	
48				770	1118	173
49				3618	6179	1626
50				3032	8270	2092
51			41	2722	3551	807
52				1809	5334	1110
53				1055	1784	197
54				1925	5806	814
55				1589	2021	126
56				797	751	
57				1816	566	
58				795	201	
59				1348	452	
60				435	1024	148
61				680	2007	438
62				1350	4480	1105
63				687	1261	200
64				3207	6827	1546
65				4377	6250	1467
66				1180	1902	114
67				524	803	40
68				203	466	
69				154	312	
70				145	78	
71				52	90	
72				173	258	
73				288	1019	156
74				163	605	63
75				152	531	53
76				863	8494	1860
77				920	2737	723
78				1335	5255	1195
79				1023	1644	266
80				657	698	
81				172	321	
82				67	104	
83				230	505	
84					76	
85					90	
86					78	
87						
88				70	1057	186
89				73	1314	259
90		76	41	374	4521	1819
91				428	833	412
92				1098	958	59
93				6816	8360	1967
94				695	676	
95					76	
96						
97				43		
98						
99						
100						
101					114	
102					732	
103					222	
104						
105				57	850	262
106				177	356	191
107				593	9394	1924
108				1342	5095	1286
109				220	328	
110						
111						
112						
113						
114						
115					406	
116					47	
117					195	
118				98	98	
119				67	555	
120				50	210	
121				91	3435	
122				193	1987	150
123					60	
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)						EM-96 Supported Film
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)	
128				68	65		
129							
130							
131				89	268		
132				94	130		
133					79		
134				64	223		
135					305		
136					443		
137							
138							
139							
140							
141							
142							
143							
144							
145					69		
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

FM 96 U Film Adhesive

TABLE I  
LAP SHEAR TEST SUMMARY FOR (ASTM D1002)

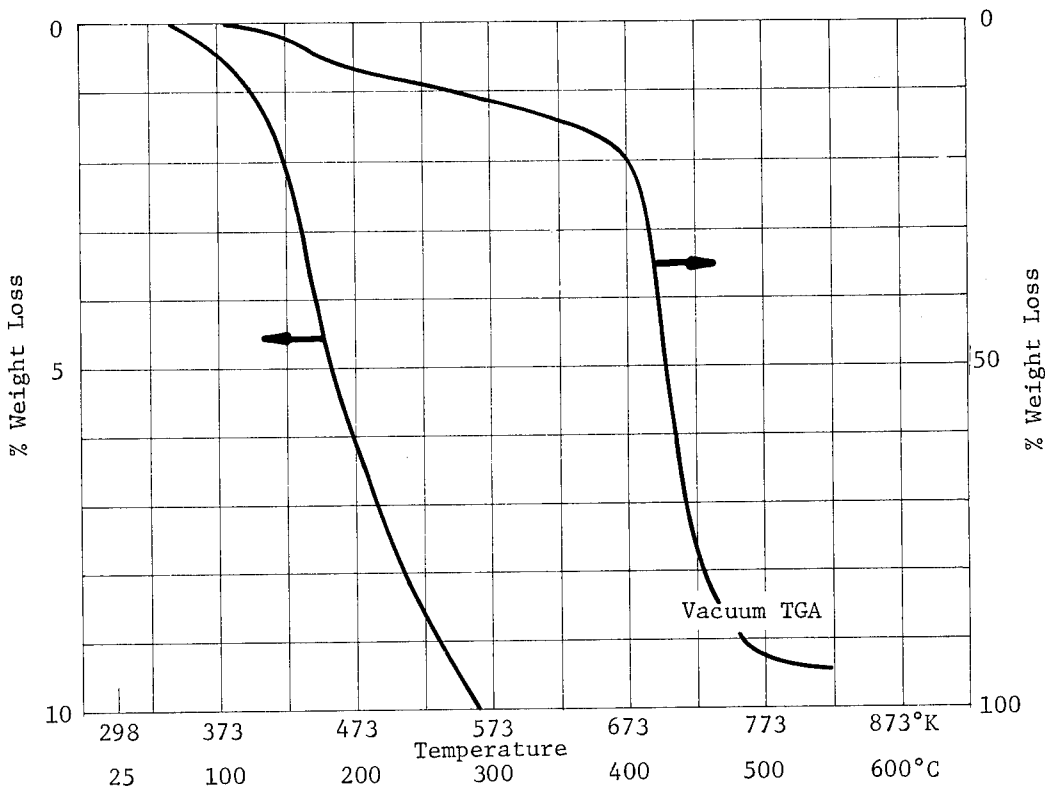
EXPOSURE	TEST CONDITION	LAP SHEAR STRENGTH, Pa x 10 <sup>-7</sup> (PSI)		
		High	Low	Average
Ambient Air	298°K (25°C), air	2.38 (3450)	2.21 (3200)	2.27 (3290)
Heat Compatibility 380 hours at 408°K (135°C)	298°K (25°C), air	2.50 (3630)	2.19 (3170)	2.37 (3430)
Heat Compatibility 1 month thermal va- cuum at 338°K (65°C)	298°K (25°C), in- situ vacuum	2.50 (3620)	2.28 (3300)	2.36 (3420)

Chemical Characterization Summary

Mix Ratio: One component

Cure: 12 hrs. at 398°K (125°C),  
2 hrs. at 423°K (150°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 393°K (120°C) - 573°K (300°C)

$a_0 = 10.8\%$  of initial weight

$$k = 3.3 \times 10^9 \exp\left(\frac{-20,900}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.7 \times 10^4$	
373°K (100°C)	$3.4 \times 10^2$	
423°K (150°C)	12	

Number and Relative Peak Intensity

Temperature, °K (°C)

High Temp. 221

m/e	298 (25)	473 (200)	573 (300)	673 (400)	748 (475)	823 (550)
14	1674	1541	1915	5059	4219	2670
15	527	719	2492	8610	9167	4939
16	5868	4927	5884	14658	11374	10827
17	24222	21084	19309	37896	24005	18126
18	81059	66774	67673	100902	70226	61985
19	93	125	248	435	261	75
20	530	479	517	916	793	644
21						
22				231		
23						
24			148	1150	637	115
25		109	961	4780	2723	692
26	299	823	5760	22117	15071	3887
27	816	1841	9590	30828	28304	5899
28	27716	27198	33647	100917	62726	37723
29	316	1226	6931	24219	20769	3037
30	1078	1219	1735	3984	3688	2050
31		3759	9561	4254	1127	279
32	6456	5896	5680	6168	5936	5901
33				59	49	
34						
35				86	42	
36			158	1205	703	211
37		44	606	4265	3084	239
38		86	816	6166	6060	656
39		349	2604	17651	29054	3127
40	6297	6270	6832	15070	16260	7747
41	76	372	2444	10070	29266	2488
42	53	402	2230	7734	12479	1120
43	106	423	7138	20292	21431	1977
44	1004	1320	4351	45360	6778	2583
45		47	539	7985	2943	611
46				470	312	53
47				742	409	
48				106	117	
49			73	969	1195	91
50			245	4002	5659	755
51			112	4070	7655	968
52			80	1708	2986	305
53			357	2894	5801	516
54			135	1036	2719	276
55			1548	9440	13352	1321
56		46	2021	7961	6320	404
57			660	2910	5564	536
58			801	3022	1807	72
59		167	630	380	501	49
60		129	529	4476	4923	878
61			91	967	1332	119
62				1298	1561	110
63			46	2646	4087	452
64				781	1119	82
65			83	5737	6246	624
66			89	7324	5099	319
67			41	1345	4218	212
68			48	554	1895	140
69				486	2648	230
70				367	2195	104
71				237	1373	47
72				183	405	
73				693	2519	412
74				1039	1136	135
75				391	597	54
76				361	531	42
77				2170	6147	737
78				1115	1919	295
79				1052	3828	304
80				191	907	56
81				189	1352	54
82				139	770	45
83				115	766	45
84				174	777	67
85				127	513	41
86				90	232	
87				87	428	
88					43	
89				438	743	71
90				401	726	51
91				1284	4729	1153
92				186	788	172
93				45	735	43
94			111	9485	4905	261
95				540	643	
96				120	279	
97				40	232	
98				70	428	
99					61	
100					48	
101				41	159	
102				105	222	
103				280	691	87
104				60	222	
105				191	1312	269
106				41	208	64
107				1008	3337	265
108				494	1365	93
109					105	
110					53	
111					48	
112						
113						
114					50	
115				182	926	81
116				41	148	
117				62	438	41
118				195	143	
119				280	1118	78
120				68	281	66
121				362	1881	87
122				109	468	
123					44	
124						
125						
126						
127					59	

Number and Relative Peak Intensity (Continued)

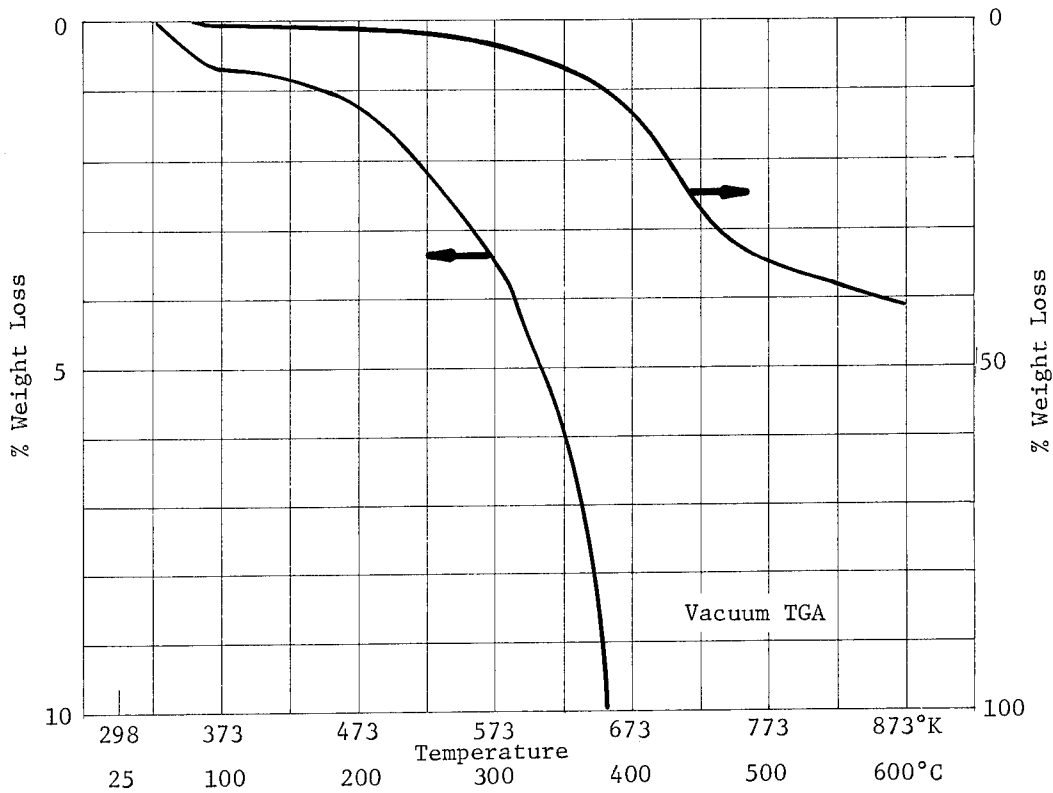
m/e	Temperature, °K (°C)			High Temp. 221		
		673 (400)	748 (475)	823 (550)		
128				209		
129				199		
130		41		56		
131		697		400		
132		323		172		
133		101		482		
134		365		557		
136		43		526		
136		79		385		
137						
138						
139						
140						
141				104		
142				65		
143				47		
144						
145				180		
146		56		54		
147				130		
148				72		
149				93		
150				43		
151						
152						
153						
154						
155						
156						
157						
158				41		
159				99		
160						
161				42		
162						
163						
164						
165						
166						
167						
168						
169						
170						
171						
172						
173						
174						
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						

Chemical Characterization Summary

Mix Ratio: One component

Cure: 1 hr. at 444°K (171°C), vacuum bag

1. TGA Preconditioning: 100 hrs. at 398°K (125°C) in N<sub>2</sub> atmosphere



2. Activation Energy of Decomposition:

Over the Range: 649°K (376°C)-973°K(700°C)

$a_0 = 42\%$  of initial weight

$$k = 1.7 \times 10^{12} \exp \left( \frac{-41600}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$6.3 \times 10^{15}$	
373°K (100°C)	$1.0 \times 10^{12}$	
423°K (150°C)	$1.3 \times 10^9$	



Number and Relative Peak Intensity

Temperature, °K (°C)

HT 435 Film Adhesive

m/e	298 (25)	523 (250)	623 (350)	723 (450)	823 (550)		
14	688	1093	1476	1812	2063		
15	187	633	1609	3376	6191		
16	4118	8660	11092	6911	11354		
17	15583	17885	20859	14876	14074		
18	52672	42526	50595	44380	42985		
19	47	69	66	119	62		
20	116	107	162	164	158		
21							
22			61				
23							
24				150	69		
25			70	727	292		
26	68	204	812	5367	2869		
27	228	734	2078	7561	3915		
28	16133	17794	25694	25847	25382		
29	176	541	1840	2856	1339		
30	763	1055	1530	1360	1260		
31		194	159	361	191		
32	4295	4034	4093	3928	3850		
33				63			
34							
35					40		
36				88			
37			42	1483	472		
38			88	3184	1197		
39			245	11960	4905		
40	1394	1679	2208	5688	3410		
41			428	1920	463		
42			491	710	213		
43	40	489	2379	2375	473		
44	511	3909	16748	2281	1825		
45		81	112	156			
46			44	91	65		
47				341	131		
48				57	179		
49				458			
50			51	3618	1393		
51			68	4950	2117		
52			45	1730	574		
53				2887	1019		
54				424	142		
55			45	1738	439		
56			80	91	48		
57		50	133	75			
58				103	47		
59				70			
60				118	61		
61				397	164		
62				847	251		
63				2211	837		
64				454	155		
65			48	4248	1667		
66			46	4524	1678		
67				235	75		
68				123	69		
69				47			
70							
71							
72							
73				86	58		
74				315	99		
75				122	68		
76				128	70		
77				4091	1468		
78				1006	384		
79				2294	796		
80				489	188		
81				74			
82							
83							
84							
85							
86							
87							
88							
89							
90				169	113		
91				363	140		
92				901	800		
93				114	156		
94				81			
95			48	3364	1375		
96				94			
97							
98							
99							
100							
101							
102							
103				43			
104							
105					43		
106					47		
107					174		
108				669	179		
109				352			
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

TABLE 1 LAP SHEAR STRENGTH (ASTM D1002)

Exposure	Ultimate Strength Pa x 10 <sup>-7</sup> (PSI)			No. Specs.
	High	Low	Average	
Baseline	1.66 (2400)	1.54 (2230)	1.63 (2360)	5
Heat Compatibility (1)	1.63 (2360)	1.50 (2170)	1.61 (2330)	5
Heat Compatibility, One Month Thermal Vacuum (1) (2)	1.52 (2200)	1.31 (1900)	1.45 (2100)	5
Heat Compatibility, Three Months Thermal Vacuum (1) (3)	1.57 (2275)	1.32 (1920)	1.50 (2180)	5
Heat Compatibility, Seven Months Thermal Vacuum (1) (4)	1.04 (1500)	.90 (1300)	1.13 (1640)	5

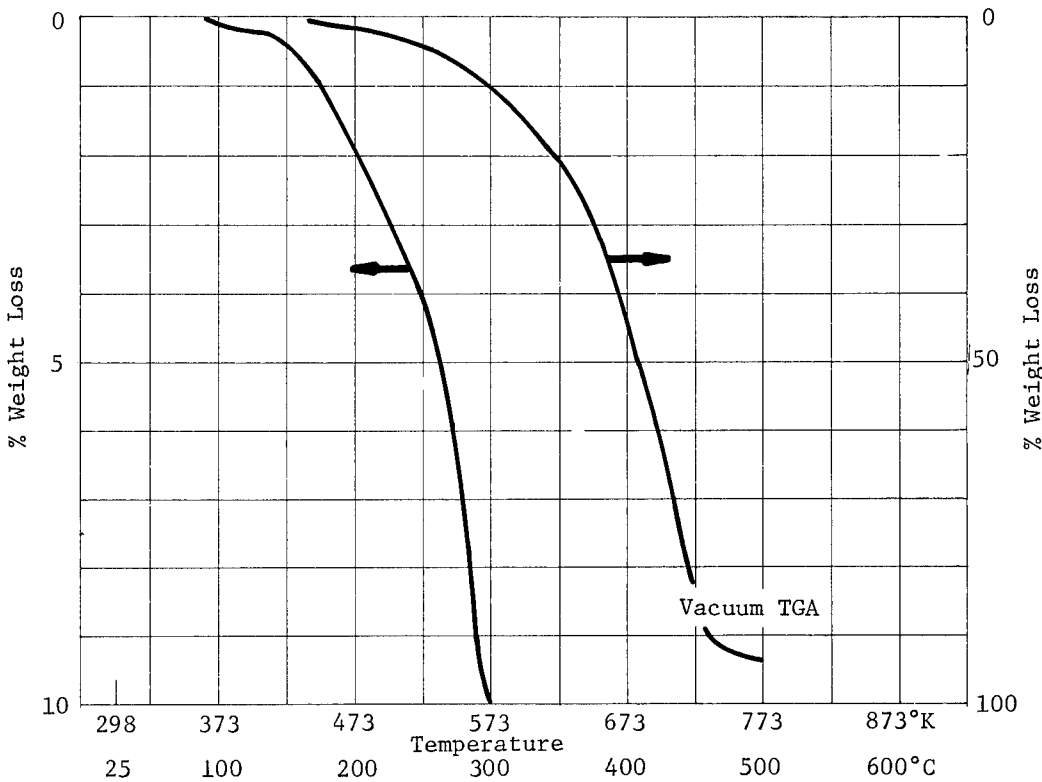
- (1) Heat compatibility - 379 hours at 408°K (135°C) in N<sub>2</sub> atmosphere.
- (2) Thermal vacuum - tested at 1 x 10<sup>-5</sup> torr after 30 days at 338°K (65°C) and 1 x 10<sup>-6</sup> torr.
- (3) Same as Note (2), except exposure is 90 days.
- (4) Same as Note (2), except exposure is 210 days.

Chemical Characterization Summary

Mix Ratio: One component

Cure: 4 hrs. at 311°K (38°C), 4 hrs. at 477°K (204°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 448°K (175°C)-748°K (475°C)

$a_0 = 91.7\%$  of initial weight

$$k = 5.39 \times 10^3 \exp\left(\frac{-14600}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$8.8 \times 10^5$	
373°K (100°C)	$4.1 \times 10^4$	
423°K (150°C)	$4.0 \times 10^3$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Hysol AS-7-4315

m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)
14	1001	992	1523	2610	1455
15	403	417	1660	4246	1695
16	3399	3194	3769	5802	4153
17	10767	8772	8664	11015	8004
18	32691	25961	25498	32351	22171
19	115	90	342	240	106
20	250	215	241	298	246
21					
22				105	
23					
24			135	325	86
25	47	44	438	1261	281
26	203	214	2039	6076	1290
27	397	437	2696	8105	1707
28	9536	9499	14834	27593	12145
29	186	202	3867	6923	1162
30	779	758	1470	1886	993
31	71		1170	1397	213
32	2826	2657	2646	2707	2481
33			62	69	
34					
35					
36			105	381	68
37			501	2685	302
38			626	3594	491
39		71	1107	6820	1371
40	1753	1758	2093	4055	2235
41	62	59	765	4866	593
42	57	54	757	3042	360
43	80	90	1736	5966	691
44	705	768	2949	10634	1304
45			2235	1067	171
46			82	135	
47				252	53
48			46	177	
49			199	1119	136
50			1069	6500	693
51			167	1629	565
52			161	924	254
53			177	1193	291
54			90	388	82
55			606	7313	340
56			326	2790	134
57			819	1126	110
58			631	1030	111
59			54	102	
60			41	291	58
61			173	570	100
62			50	587	175
63			67	889	340
64	44		45	297	126
65			54	1793	515
66	45		64	2220	443
67			45	428	86
68				208	49
69				128	
70				78	
71				59	
72			52	140	
73			114	563	64
74			343	1891	172
75			195	1028	126
76			1153	5819	339
77			156	1233	526
78			63	417	230
79				328	235
80				100	57
81				88	
82				88	
83				145	
84	62		136	1725	71
85				161	
86				62	42
87				53	
88					
89				151	
90				133	95
91				388	490
92				87	105
93				132	57
94				3266	511
95				300	63
96				81	
97					
98					
99					
100					
101					
102				53	
103				147	106
104			763	3571	211
105			77	393	250
106				63	85
107				405	388
108				196	173
109					
110					
111					
112					
113					
114					
115				86	63
116					
117				51	56
118				72	40
119				99	114
120					68
121				105	171
122				47	66
123					
124					
125					
126					
127					

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

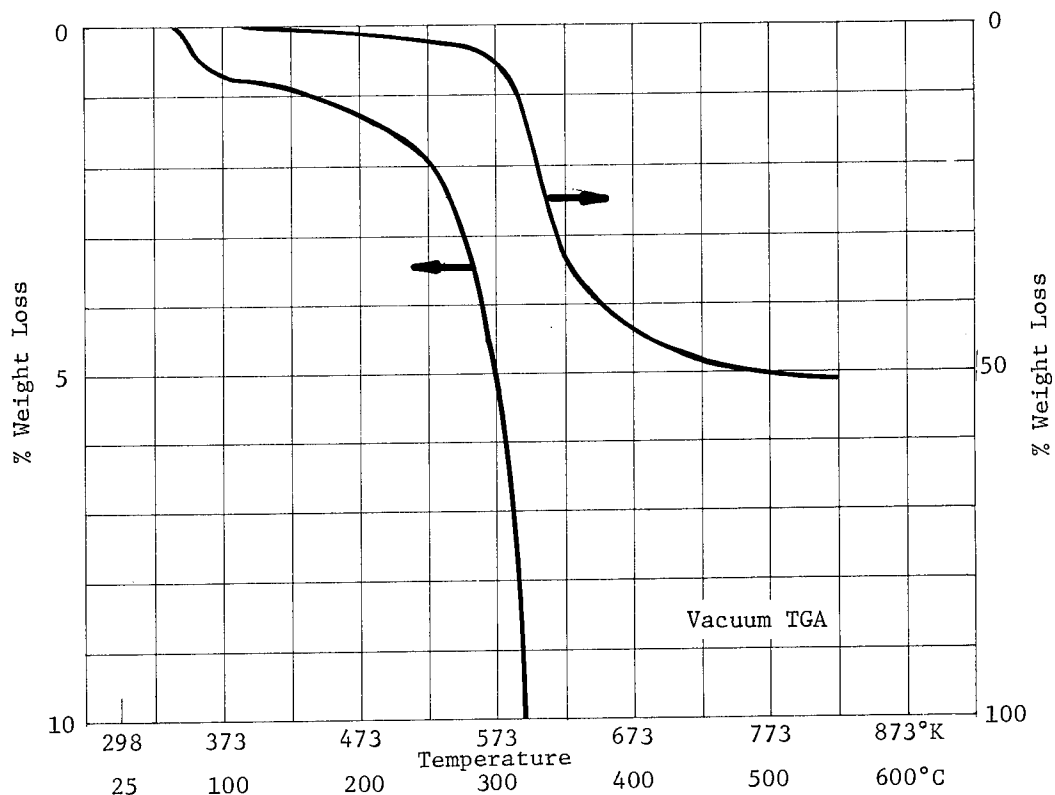
Hysol AS-7-4315

m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
128							
129	63	40	53	68	57		
130							
131	49		44	135	79		
132	58		51	97	66		
133				47			
134				94	67		
135				185	57		
136				51	44		
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148			64	197			
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw C9 to 30 pbw H2  
 Cure: 24 hrs. at room temperature

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 423°K (150°C) - 723°K (450°C)

$a_o = 50.5\%$  of initial weight

$$k = 1.32 \times 10^{12} \exp \left( \frac{-35,700}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$7.4 \times 10^{11}$	
373°K (100°C)	$4.2 \times 10^8$	
423°K (150°C)	$1.4 \times 10^6$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Hyso1 C9-4183/H<sub>2</sub>-3561

m/e	298 (25)	473 (200)	573 (300)	623 (350)	723 (450)	823 (550)	
14	130	107	464	568	314	322	
15			869	1202	500	665	
16	601	460	877	1279	778	1130	
17	3737	2759	4795	5197	2870	2703	
18	14740	11333	18318	19088	11143	10164	
19	60	44	61	158	50	41	
20	48		63	94	48		
21							
22							
23							
24			62	127			
25			226	580	200	117	
26	59	73	982	2677	1016	675	
27	79	85	1085	3183	1394	809	
28	2243	2102	4462	8175	4261	3645	
29	75	94	2423	3390	1120	656	
30			320	1262	282	160	
31			220	1187	255	121	
32	701	556	688	701	638	614	
33				55			
34							
35							
36			53	96			
37			155	624	223	72	
38			222	1127	426	160	
39			795	3898	1634	610	
40	64	72	630	1853	783	540	
41	257	254	846	2648	874	460	
42	69	81	971	2805	471	276	
43	70	81	1392	1979	670	365	
44	201	215	1908	2321	660	496	
45			345	1586	225	103	
46				88			
47				130			
48							
49			63	208	83		
50			421	898	512	201	
51			156	964	677	230	
52			193	566	278	105	
53			120	599	453	145	
54			100	460	134	57	
55			254	842	371	154	
56			269	926	173	113	
57			214	440	144	113	
58			219	540	76	48	
59			46	308	49		
60			93	114	40		
61				172	74		
62				300	185	59	
63			41	592	416	130	
64				233	132		
65			95	1415	643	178	
66			93	1681	507	103	
67			82	364	149	57	
68			144	469	92		
69			65	178			
70			52	309			
71			52	166			
72				109			
73				186	50		
74				176	109		
75				221	64		
76				139	64		
77			54	482	706	168	
78				265	251	92	
79			67	397	375	104	
80			41	260	137		
81				114	60		
82				125			
83				61			
84				101			
85				63			
86							
87							
88							
89				84	125		
90				49			
91				418	492	287	
92				130	93	55	
93							
94			128	2340	677	117	
95				241	77		
96				49			
97							
98							
99							
100							
101							
102							
103				55	81		
104							
105				86	104	54	
106				79			
107				228	538	111	
108				254	260	48	
109				73			
110							
111							
112							
113							
114							
115				49			
116				49	82		
117					40		
118							
119							
120				283	149		
121				80			
122				95	253	40	
123					89		
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

HysoI C9-4183/H<sub>2</sub>-3561

m/e				623 (350)	723 (450)	823 (550)	
128							
129							
130							
131					56		
132							
133				71			
134				274	43		
135					95		
136					64		
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

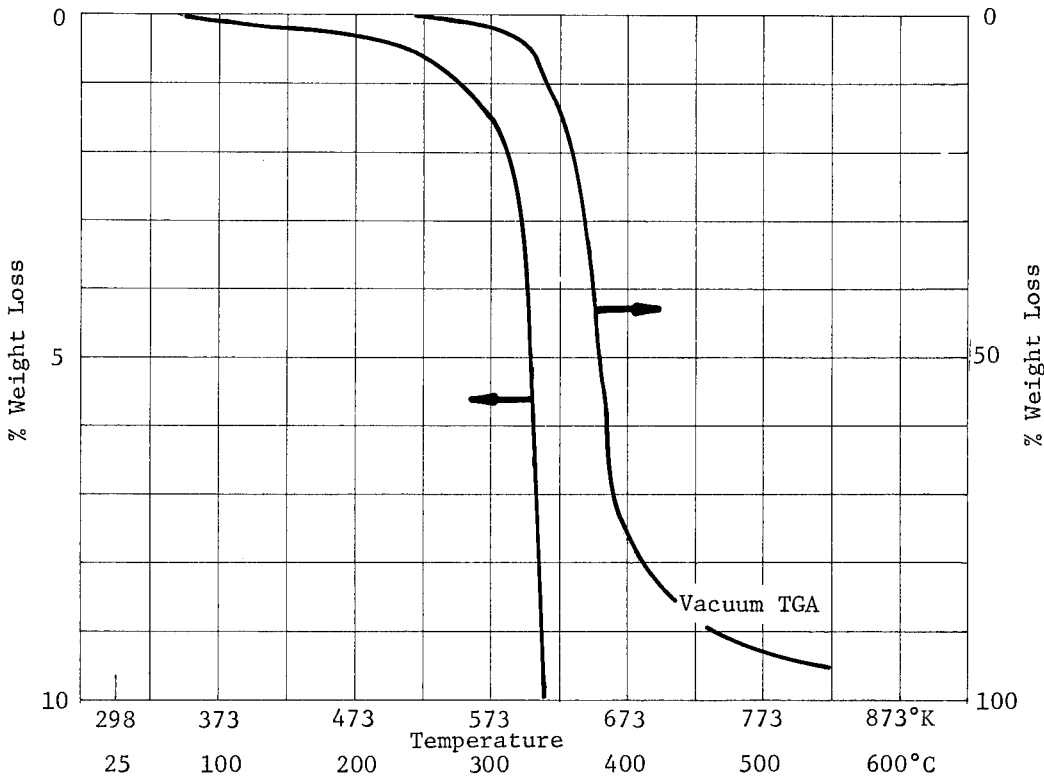


Hysol R9-H2

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 30 pbw Catalyst  
 Cure: 2 hrs. at 333°K (60°C), 8 hrs. at 394°K (121°C),  
 4 hrs. at 453°K (180°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C) - 773°K (500°C)

$a_0 = 92.5\%$  of initial weight

$$k = 5.0 \times 10^7 \exp \left( \frac{-26,000}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$5.6 \times 10^9$	
373°K (100°C)	$2.4 \times 10^7$	
423°K (150°C)	$3.7 \times 10^5$	

Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Hycol R9/H <sub>2</sub>
	298 (25)	573 (300)	623 (350)	673 (400)	823 (550)	
14	1737	2003	13584	2044	4262	
15	941	2656	44637	5580	8185	
16	5527	7316	22356	4196	14588	
17	25426	26348	80472	10562	21047	
18	86917	92165	100964	35889	66717	
19	121	199	5818	1309	243	
20	477	456	1464	203	636	
21			42			
22			79			
23						
24		104	2398	333	230	
25	71	546	9802	1700	957	
26	784	3047	46029	8795	5590	
27	1286	4437	68432	14217	7898	
28	27690	33887	100966	26650	44768	
29	1467	4373	84241	11757	5649	
30	1286	2674	32586	4020	3581	
31	478	1471	32945	7413	1822	
32	6056	5735	8205	2525	5880	
33			1493	416		
34			53			
35		47	347		52	
36		87	1595	197	77	
37		418	10931	2106	511	
38	85	831	21017	4500	1094	
39	345	2917	65526	16296	4081	
40	5994	7561	34956	7752	9197	
41	462	2146	42746	6213	2920	
42	421	2674	66167	5142	2923	
43	966	2827	50653	7606	2931	
44	1290	8575	64125	6326	3400	
45	390	2106	73748	13199	2463	
46		47	2818	493	93	
47		62	3959	653	62	
48			764	49		
49		246	4403	784	160	
50		1613	18949	4641	1080	
51		950	18101	6339	1513	
52		1091	12963	2561	597	
53		367	11815	3591	674	
54		257	7988	1009	305	
55		42	14747	3081	956	
56	53	354	17965	1177	687	
57	84	462	10533	1012	669	
58	214	687	21730	1798	1038	
59	289	498	8992	1316	606	
60		69	3018	394	66	
61		59	3465	809	141	
62		63	5701	1721	272	
63		236	10880	3750	689	
64		103	4156	1225	179	
65		559	23851	6551	1178	
66		720	28605	6039	930	
67		190	6232	999	146	
68		214	7383	534	112	
69		115	3317	153	82	
70		50	3811	220	87	
71		40	2976	125	49	
72		41	2445	207	58	
73			3160	520	90	
74		41	2851	858	128	
75		83	8102	1564	177	
76		108	4980	955	116	
77		127	7289	5345	913	
78		297	4164	1609	404	
79		533	7501	3000	542	
80		66	4750	1115	151	
81		42	2138	329	77	
82		48	2565	109	68	
83			1326	59		
84			1973	40		
85			1029	83		
86			910	126		
87			796	58		
88			435	964	137	
89			1846	795	101	
90		56	1211	795	1198	
91		78	5335	3549	190	
92		274	2965	503	103	
93		354	5059	740	953	
94		447	36803	7033	78	
95		56	4021	608		
96			796			
97			495			
98			346			
99			208			
100			135			
101			265			
102			266	90	92	
103			1082	633		
104			541	131		
105			1299	493	205	
106		99	2029	185	104	
107		130	3688	3319	647	
108		43	3724	1813	236	
109			1150	147		
110			217			
111			145			
112			68			
113			74			
114			49			
115			457	282	45	
116			121			
117			456	130		
118			830	147		
119			3513	1370	135	
120			1127	288	52	
121			2492	1900	173	
122			1045	660	64	
123			361			
124			53			
125			58			
126						
127			41			

Number and Relative Peak Intensity (Continued)

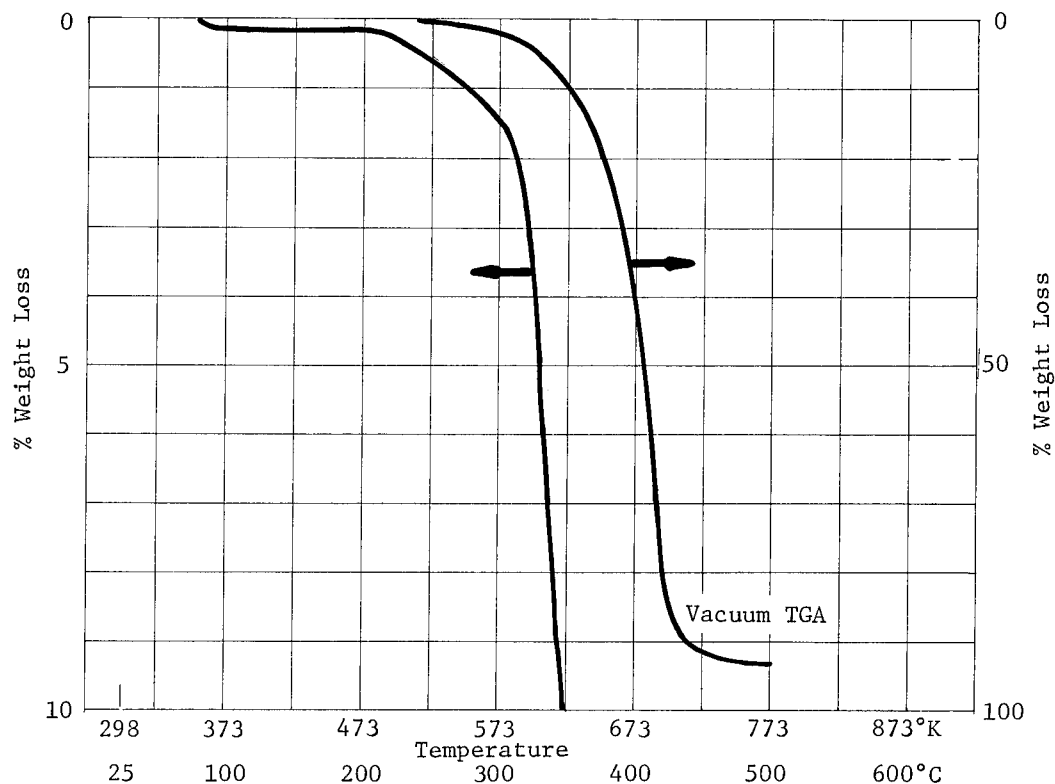
m/e	Temperature, °K (°C)					Hysol R9/H2	
	298 (25)	573 (300)	623 (350)	673 (400)	823 (550)		
128			51				
129			71				
130			152				
131			389	163			
132			412	59			
133			1203	412			
134			4043	1476	132		
135			672	607	41		
136			615	387			
137			98				
138							
139							
140							
141							
142							
143							
144			108				
145			94	55			
146			91				
147			65				
148			173	69			
149			69	40			
150			60				
151			42				
152							
153							
154							
155							
156							
157							
158			56				
159			48				
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Impregnant 3-BA-4

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 5 pbw Activator  
 Cure: 2 hrs. at 369°K (96°C), 6 hrs. at 408°K (135°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C)-773°K (500°C)

$a_0 = 96.5\%$  of initial weight

$$k = 5.78 \times 10^7 \exp\left(\frac{-26300}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$7.9 \times 10^9$	
373°K (100°C)	$3.2 \times 10^7$	
423°K (150°C)	$4.7 \times 10^5$	

Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Impregnant 3-BA-4
	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)	
14	2008	2343	2822	10561	3746	
15	593	3943	5058	28969	6007	
16	4372	4120	4664	12721	8298	
17	16578	13594	14784	25730	14228	
18	56712	45302	47695	84495	45245	
19	249	305	304	1133	323	
20	341	316	360	764	420	
21						
22						
23						
24			56	1240	210	
25		67	346	4951	957	
26	329	632	1810	21189	4667	
27	501	740	2257	26120	5021	
28	23315	23434	26913	72946	32761	
29	312	552	3324	41853	3884	
30	295	888	2617	9023	1259	
31	50	81	550	14193	965	
32	5606	5097	5006	6463	5125	
33				348		
34						
35		109				
36				1268	104	
37			125	7916	672	
38			272	13365	1234	
39			923	41734	4557	
40	66	137	3655	19803	4741	
41	2828	3132	1157	15945	1898	
42	58	235	3984	16799	1393	
43	41	1061	2177	52263	3524	
44	66	354	2488	16035	2095	
45	920	1157	374	5394	520	
46		41		559	41	
47		117		2009	68	
48				311		
49		169	83	1970	218	
50		2012	1027	8448	1410	
51		72	204	8763	1860	
52		589	358	3367	668	
53			156	7075	914	
54			64	1931	184	
55			211	9499	912	
56			416	4163	429	
57		88	714	10685	369	
58		1733	4835	6798	311	
59		663	1674	1249	91	
60				1058	74	
61				2192	196	
62				3295	479	
63				6323	1019	
64				2133	306	
65			61	15824	1674	
66			85	20367	1381	
67			58	2588	218	
68			82	1330	89	
69				1095	46	
70			42	562		
71			62	647		
72				1264	100	
73				703	47	
74				2742	291	
75				970	158	
76				763	142	
77			42	5198	1634	
78			41	2115	612	
79				3149	723	
80				1981	148	
81			41	1741	75	
82			40	845	45	
83				300		
84		47	145	675	108	
85				451		
86				509	57	
87				432	54	
88				63		
89				945	231	
90				855	164	
91				3357	1665	
92				677	304	
93				1204	94	
94			80	29075	1600	
95				2436	98	
96				445		
97				196		
98				106		
99				185		
100				92		
101				100		
102				190	40	
103				795	247	
104				161	63	
105				587	551	
106				254	161	
107				3484	1148	
108				2270	502	
109				267		
110				107		
111						
112				109		
113						
114				43		
115				424	165	
116				87		
117				181	76	
118				165	44	
119				1172	279	
120				312	92	
121				1960	563	
122				572	171	
123				62		
124						
125						
126						
127				48		

Number and Relative Peak Intensity (Continued)

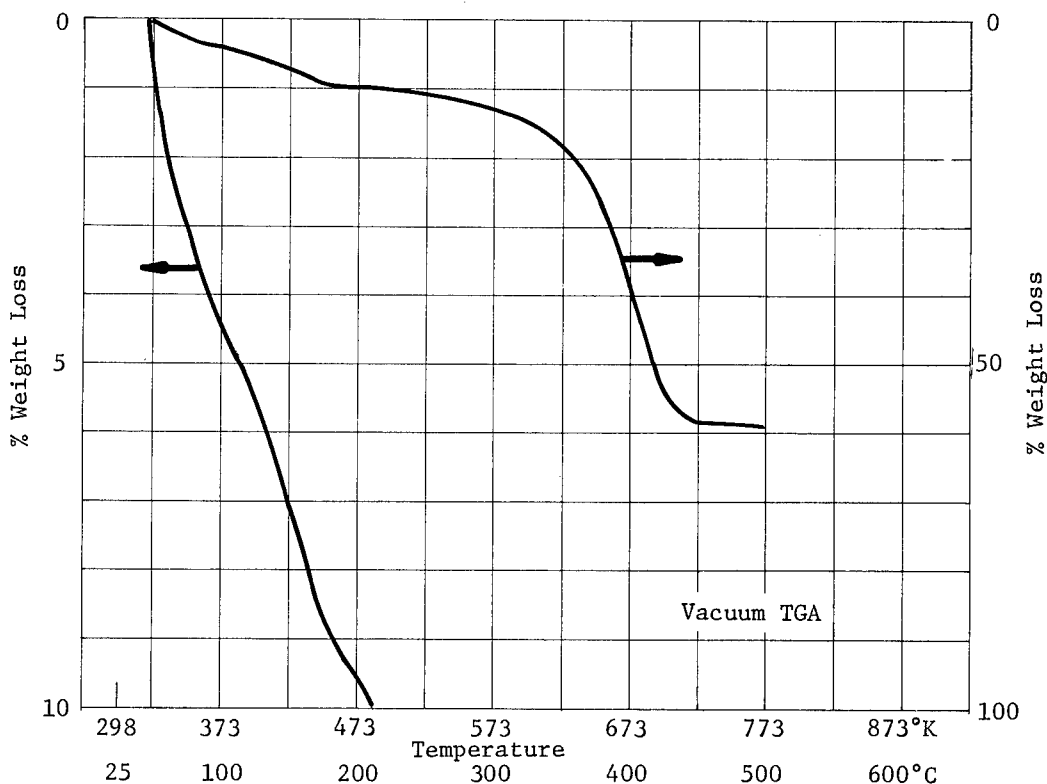
m/e	Temperature, °K (°C)				Impregnant 3-BA-4
	473 (200)	573 (300)	673 (400)	773 (500)	
128			125		
129			210		
130	60	53		72	
131			459	168	
132			362	121	
133			320		
134			306	149	
135			147		
136			262		
137					
138					
139					
140					
141					
142					
143					
144					
145					
146					
147					
148					
149					
150					
151					
152					
153					
154					
155					
156					
157					
158					
159					
160					
161					
162					
163					
164					
165					
166					
167					
168					
169					
170					
171					
172					
173					
174					
175					
176					
177					
178					
179					
180					
181					
182					
183					
184					
185					
186					
187					
188					
189					
190					
191					
192					
193					
194					
195					
196					
197					
198					
199					
200					
201					
202					
203					
204					
205					
206					
207					
208					
209					
210					
211					
212					
213					
214					
215					
216					
217					
218					
219					
220					
221					
222					
223					
224					
225					
226					
227					
228					
229					
230					
231					
232					
233					
234					
235					
236					
237					
238					
239					
240					

Ink, Cat-L-Ink 50-100/  
Cat. 20

Chemical Characterization Summary

Mix Ratio: 100 pbw 50-100 to 6 pbw of Catalyst 20  
Cure: 1 hr. at 366°K (93°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-723°K (450°C)

$a_0 = 47.8\%$  of initial weight

$$k = 5.4 \times 10^8 \exp\left(\frac{-28800}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.0 \times 10^{10}$	
373°K (100°C)	$9.5 \times 10^7$	
423°K (150°C)	$9.5 \times 10^5$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ink, Cat-L-Ink 50-100, White

m/e	298 (25)	473 (200)	623 (350)	673 (400)	673 (500)		
14	1450	1815	3423	4215	1887		
15	418	2291	9777	8750	2436		
16	2410	2383	4811	6114	3821		
17	10333	8045	13606	13312	6445		
18	37367	28105	47135	46529	22187		
19	85	356	124	292	43		
20	229	274	339	403	238		
21							
22							
23							
24		45	194		240		
25		210			2064		
26	231		8237	13953			
27							
28	22357	24217	37598	43590	21943		
29	421	6985	8612	16509	1672		
30	65		6456	5348	402		
31		4392					
32	5429	4731	4859	5263	4136		
33							
34							
35							
36			72				
37					148		
38		75					
39			8458	27785	1966		
40	1211				1680		
41		2675		10514	810		
42			12682				
43		3242		12835	828		
44	244		11006		868		
45		10138	4288		157		
46		103	175				
47			315	2035			
48							
49							
50		215	2418	7331			
51		85	1988	7470	722		
52		49	1376		152		
53		43	1616	4677	200		
54		101					
55		209	3815	11484	229		
56					84		
57		3751		5807	119		
58			8220		68		
59		3929	2099	417			
60		70	80				
61			189		45		
62							
63		46	1058	5856	282		
64							
65		42			674		
66			4449	20057			
67			894				
68			447	786			
69		63					
70		42	1818	3416			
71			604	292			
72		2699	429				
73		2320	227				
74		47	191	1515	44		
75		43	64	754			
76							
77			739	5691	638		
78					142		
79			581	2681	175		
80			580	491	40		
81			253	162			
82			194	109			
83			342	734			
84			371	283			
85		923	158	61			
86				69			
87		65	43	61			
88							
89		51		838	51		
90			76		60		
91		114	460	4675	721		
92			73	661	57		
93					44		
94			8193	31317	736		
95			668	2063			
96				46			
97							
98			54	83			
99							
100							
101							
102				174			
103		62		1336	64		
104				153			
105				745	104		
106				65	59		
107			680	4803	499		
108			732	1859	143		
109				48			
110			45	64			
111							
112			57	194			
113							
114							
115				40	40		
116				544			
117				78			
118				179			
119			148	2211			
120			43		106		
121							
122			155	5419	228		
123			101	1055	50		
124							
125							
126							
127							



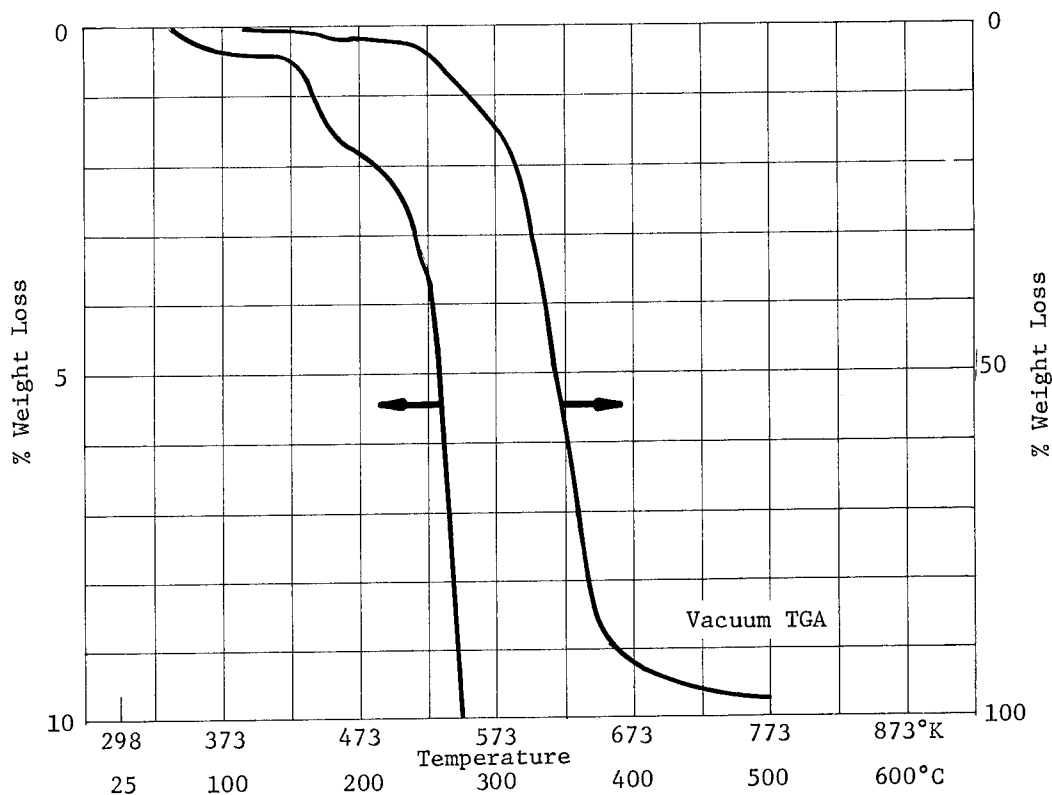
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Ink, Cat-L-Ink 50-100, White	
	298 (25)	473 (200)	623 (350)	673 (400)	673 (500)		
128							
129				84	43		
130				132			
131			58	50	82		
132			57	830	68		
133				466			
134				696			
136			223	2153	78		
136				314			
137			47	1090			
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 6.4 pbw activator  
 Cure: 1 hr. at 422°K (149°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C) - 673°K (400°C)

$a_0 = 92.3\%$  of initial weight

$$k = 1.69 \times 10^{22} \exp\left(\frac{-62,000}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.2 \times 10^{19}$	
373°K (100°C)	$9.6 \times 10^{13}$	
423°K (150°C)	$4.7 \times 10^9$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ink, Cat-I-Ink 50-300-9

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
14	1680	1609	1959	4418	2100		
15	646	528	1854	8899	2303		
16	2722	2487	4246	5716	3665		
17	12280	9299	13450	14019	8056		
18	44047	34068	43499	48693	27844		
19	49	59	158	335	58		
20	249	197	316	361	259		
21							
22							
23							
24							
25							
26	144	197	2291	12370	2605		
27							
28	24382	22810	27071	43471	25121		
29	974	832	2142	12809	2204		
30	124	115	1370	2705	492		
31							
32	6685	6416	5863	6028	5856		
33					408		
34					1280		
35					69		
36					566		
37			68				
38			229				
39				23869	2720		
40	1713	1596	2400	11835	2436		
41		49		4449	822		
42			1106				
43		65		11990	1185		
44	309	671	2111	4868	910		
45			189	1212	87		
46				294			
47				2022			
48							
49					54		
50			217	6646			
51			182	6252	1059		
52			176		240		
53			160	3349	336		
54			106		53		
55			80	5951	424		
56			115	1757	118		
57			50	1146	150		
58				1226	58		
59			42				
60			46				
61					45		
62					178		
63				5016	554		
64			46				
65			63		1312		
66			101	18308	1144		
67			351	1514	62		
68				617			
69				129			
70				59			
71							
72				80			
73							
74				1295	71		
75				644			
76					85		
77				3835	881		
78					164		
79				1687	246		
80			43	276			
81				80			
82				48			
83							
84				45			
85							
86				49			
87				44			
88							
89				518	58		
90			469				
91				3602	930		
92				421	75		
93					96		
94				28064	1748		
95				1797			
96				44			
97							
98							
99							
100							
101							
102				59			
103				614	80		
104				71			
105				590	171		
106							
107				2688	570		
108			55	819	159		
109							
110							
111							
112					47		
113							
114					48		
115				275	49		
116					41		
117				76			
118							
119				2504			
120					260		
121				548	81		
122				2804	322		
123					52		
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

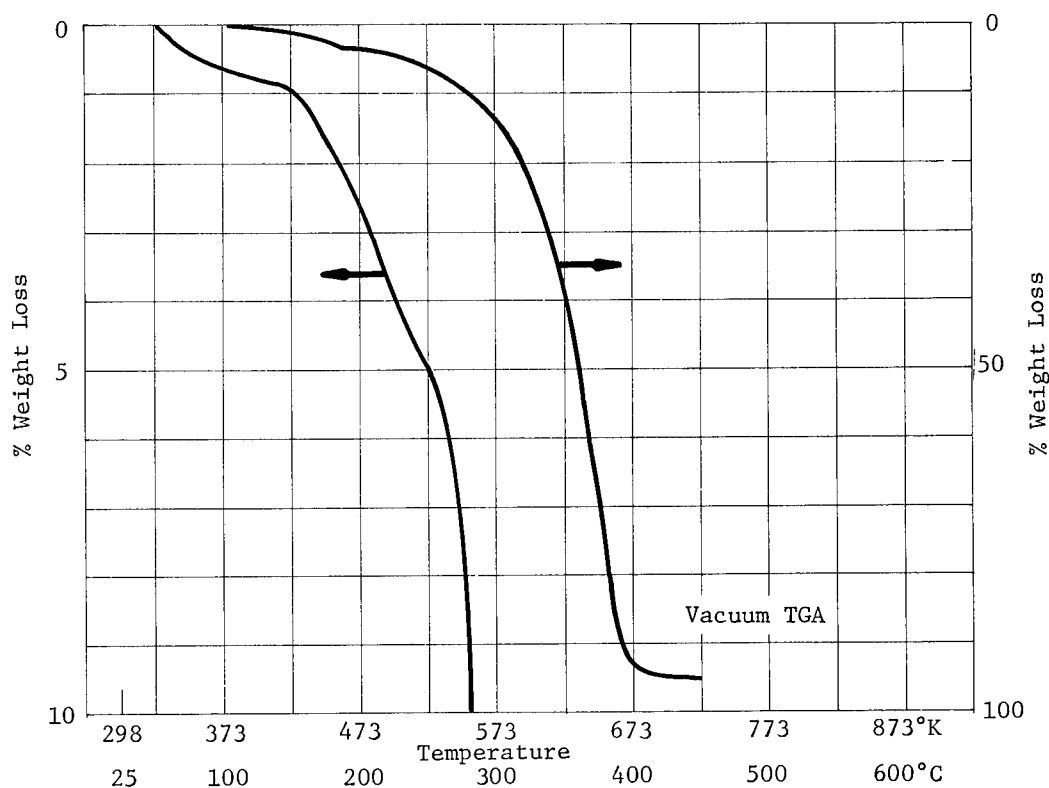
m/e	Temperature, °K (°C)					Ink, Cat-L-Ink 50-300-9	
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
128				42			
129	45		43	93	54		
130				40	43		
131		40					
132	43	60		452			
133							
134							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: As Received

Cure: 1 hr. at 422°K (149°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-833°K (560°C)

$a_0 = 92.1\%$  of initial weight

$$k = 2.7 \times 10^{12} \exp\left(\frac{-37400}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$5.5 \times 10^{12}$	
373°K (100°C)	$2.1 \times 10^9$	
423°K (150°C)	$5.5 \times 10^6$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ink, Cat-L-Ink 50-407-9

m/e	298 (25)	473 (200)	523 (250)	623 (350)	673 (400)		
14	1585	1623	1978	4840	2663		
15	194	654	1599	9168	3396		
16	2719	3132	4538	6962	3709		
17	12024	10951	14119	16059	9272		
18	44336	37913	45772	55084	32370		
19	118	125	153	333	112		
20	278	292	376	14510	292		
21							
22							
23							
24					129		
25		51	224				
26	128	591	2002	14100	5257		
27							
28	24098	25686	29036	45728	29128		
29	166	590	1505	13893	3924		
30	64	157	920	3511	795		
31	47	79					
32	5947	5258	5306	5473	4582		
33				68	47		
34							
35							
36			43		102		
37			65				
38							
39				28260	9660		
40	1762	1766	2323	13903	5066		
41		101		6156	2356		
42		120	996				
43		150		12872	4491		
44	325	2092	5161	8254	1943		
45		82	290	1909	303		
46					68		
47				2237	367		
48				215			
49							
50		40	236	7364			
51			187	7465	3340		
52			185				
53			146	4424	1587		
54			90		215		
55			83	6779	1941		
56			272	1995	323		
57			67	2185	312		
58			41	1497	398		
59			43		70		
60			49		145		
61							
62							
63				5861	2276		
64			43	21387			
65			195		5222		
66			186		5280		
67			248		416		
68				916			
69				284	127		
70				152	41		
71				80			
72				138			
73					77		
74				1694	419		
75				836	226		
76					200		
77			47	4878	3093		
78					783		
79			46	2805	1112		
80			63	714	93		
81				285	43		
82				129			
83				66			
84				173			
85				200			
86				75			
87							
88							
89				794	306		
90							
91				4402	2804		
92				566	251		
93			41				
94			482	33684	7452		
95				2147	350		
96				92			
97							
98							
99							
100							
101							
102				79	67		
103				752	560		
104				96	63		
105				798	502		
106					160		
107				4152	2058		
108				1656	555		
109				89			
110				50			
111							
112							
113							
114							
115							
116				494	265		
117				69	105		
118				143			
119				285	120		
120				2813	1383		
121				609	332		
122				2631	2578		
123				620	280		
124							
125							
126							
127	57						

Number and Relative Peak Intensity (Continued)

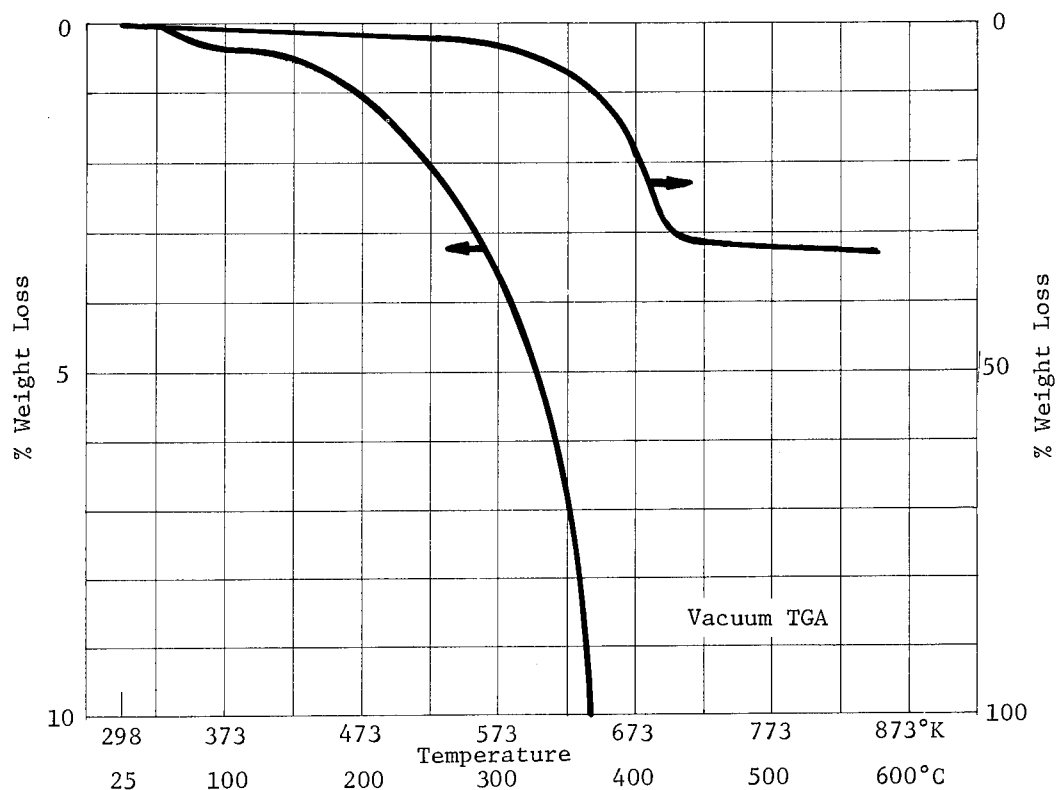
m/e	Temperature, °K (°C)					Ink, Cat-I-Ink 50-407-9	
	298 (25)	473 (200)	523 (250)	623 (350)	673 (400)		
128				48			
129				109			
130		57	64		41		
131	41	45	61		100		
132	61	68	110		574		
133					279		
134						397	
136				736		218	
136				2973		1189	
137				251		109	
138				521		341	
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw of Resin to 5 pbw of Catalyst

Cure: 1½ hrs. at 422°K (149°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 298°K (25°C)-583°K (315°C)

$a_o = 33\%$  of initial weight

$$k = 4.6 \exp\left(\frac{-6510}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.5 \times 10^3$	
373°K (100°C)	$8.8 \times 10^2$	
423°K (150°C)	$3.1 \times 10^2$	



Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Ink, M-9-N/Cat. A
	298 (25)	423 (150)	623 (350)	673 (400)	773 (500)	
14	2303	2459	4675	5155	2941	
15	838	1360	9896	7634	2994	
16	4883	4873	7000	7702	5891	
17	18080	15920	18980	19682	12519	
18	60310	51563	62992	64094	39915	
19	1385	1622	1547	1261	820	
20	458	397	539	594	432	
21						
22						
23	97	97				
24			365	677	62	
25	44	94	1538	2505	451	
26	539	825	7992	11252	2457	
27	836	1138	10334	10749	2836	
28	28303	28666	45202	45853	29451	
29	695	860	6728	9376	1843	
30	436	716	5614	2155	790	
31	947	1087	2443	2657	1435	
32	6915	6352	5794	6086	5382	
33				176		
34						
35						
36			158	440		
37			953	3501	293	
38			1996	6438	594	
39	103	160	5261	19093	2325	
40	3113	3262	6662	11153	3828	
41	66	175	3916	3238	934	
42	60	592	11305	3613	961	
43	130	469	6577	10264	1120	
44	1131	1918	10829	4104	1301	
45	323	598	4143	1451	695	
46	73	88	265	457	141	
47			176	1355		
48				155		
49			315	1237	90	
50		73	1553	5249	740	
51			1395	5349	920	
52			919	1687	317	
53			991	3088	333	
54			660	604	53	
55			1740	4900	305	
56			2770	1385	142	
57			1454	587	85	
58		598	7640	1956	193	
59		185	1879	174		
60			193	461		
61			169	1333	55	
62			301	2249	178	
63			645	4340	450	
64			275	1419	123	
65			1916	11082	811	
66			2540	13876	746	
67			572	1313	83	
68			411	494		
69			157	97		
70			443	73		
71			491			
72			198	71		
73			271	322		
74			133	1131	81	
75			55	571		
76			41	452	41	
77			452	3914	720	
78			232	1270	450	
79			366	1848	286	
80			452	170	53	
81			237	102		
82			222	64		
83			92			
84	51	69	329	136	72	
85			182			
86			55	62		
87			65	49		
88						
89				575	57	
90				499	42	
91			223	2870	868	
92			74	450	187	
93			191	859		
94			4507	20513	991	
95			418	1340		
96				52		
97						
98						
99						
100						
101						
102				76		
103				655	58	
104				68		
105				428	156	
106				47	41	
107			359	2674	379	
108			362	1194	167	
109						
110						
111						
112						
113						
114						
115				266	43	
116						
117				82		
118				77		
119				1150	80	
120				232		
121			77	2599	142	
122			54	535		
123						
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

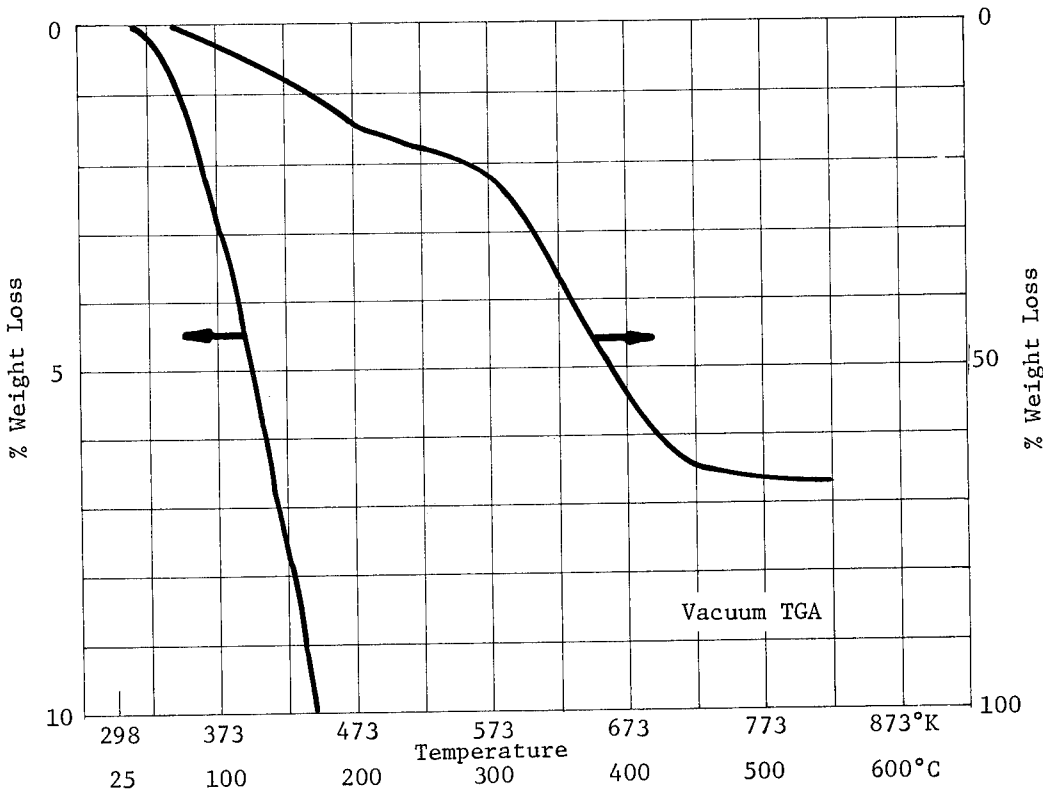
m/e	Temperature, °K (°C)					Ink, M-9-N/Cat. A	
	298 (25)	423 (150)	623 (350)	673 (400)	773 (500)		
128							
129	80	89	82	134	82		
130							
131		43	85	319	93		
132	68	69	111	217	98		
133				233			
134			50	976	47		
135				111			
136				440			
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: Not Applicable

Cure: 15 min. at 422°K (149°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C) - 723°K (450°C)

$a_o = 49.2\%$  of initial weight

$$k = 1.23 \times 10^{28} \exp\left(\frac{-80,100}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.2 \times 10^{26}$	
373°K (100°C)	$6.0 \times 10^{18}$	
423°K (150°C)	$1.6 \times 10^{13}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ink, Markem 7224

m/e	298 (25)	473 (200)	573 (300)	673 (400)	823 (550)		
14	898	2221	1704	2647	2024		
15	47	3116	2110	4862	3948		
16	1355	2877	2951	6389	6550		
17	5531	5969	6658	12068	6598		
18	20015	21128	22524	35872	20070		
19		406	43	65			
20		46	55	82	40		
21							
22							
23							
24		272	54				
25							
26		9715		11643	3405		
27	45						
28	16156	36107	31047	34916	24558		
29		13062	8694	8881	2886		
30					369		
31		15690	3653	4028			
32	3837	4347		77	3387		
33		931					
34							
35							
36							
37							
38							
39		8826	5347	23537	3638		
40	407						
41		20047	11315	9071	3394		
42							
43		10670		8086			
44	83		7891		2766		
45		1264	323	535	43		
46				297			
47				1267			
48			52				
49			84				
50		1265	1293	8597	1231		
51		845	770		1313		
52					488		
53				4355	450		
54							
55				5615	682		
56		15366	4280	2038	610		
57			2946	2055	467		
58		59	108				
59							
60							
61							
62							
63				5368	433		
64		42					
65		72	56	14579	788		
66		50			557		
67		3076	1973		146		
68		54					
69		47		84			
70				43			
71				46			
72				45			
73		109		185			
74				1495	60		
75					56		
76			468				
77		79	112	7706	1091		
78					286		
79			48	3358	327		
80				682			
81				383			
82		2651	1939	829	70		
83		76	77	67			
84		41		47			
85							
86							
87							
88							
89				1023	41		
90							
91		62		5282	1185		
92					114		
93							
94				21448	755		
95							
96							
97							
98		184	429	191			
99		6440	10997	5650	2188		
100							
101				46			
102							
103		51	1252	4948	771		
104							
105				947	290		
106					67		
107				6624	912		
108				2877	307		
109				60			
110							
111							
112							
113							
114							
115				623	43		
116				44			
117				220			
118				348			
119				1945	56		
120				854			
121				7400	261		
122				1487	50		
123							
124							
125		105	249	89			
126				74			
127							

Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Ink, Markem 7224	
	298 (25)	473 (200)	573 (300)	673 (400)	823 (550)		
128				54			
129				48			
130							
131					66		
132					42		
133							
134							
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155				1984			
156				626			
157				1962			
158				238	58		
159	415		805	401			
160				151			
161							
162							
163			430				
164	144						
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

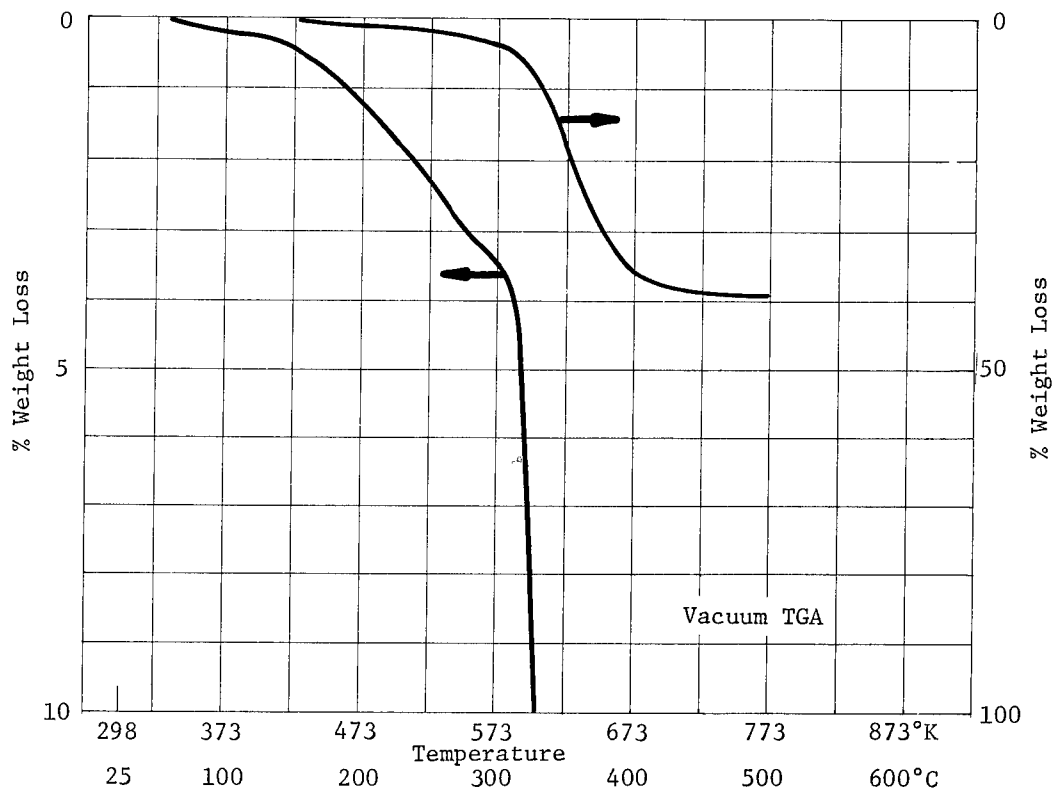
Ink, M-O-N, Black

Chemical Characterization Summary

Mix Ratio: 1 pbw resin to 1 pbw activator

Cure: 6 hrs. at 333°K (60°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 573°K (300°C)- 773°K (500°C)

$a_0 = 37.7\%$  of initial weight

$$k = 1.3 \times 10^{11} \exp \left( \frac{-34,100}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$7.1 \times 10^{11}$	
373°K (100°C)	$5.5 \times 10^8$	
423°K (150°C)	$2.3 \times 10^6$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ink, M-O-N, Black

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
14	1079	1186	1418	5060	1674		
15	144	694	1126	10458	1521		
16	1976	1898	2335	5081	2980		
17	8622	7429	8440	13754	6723		
18	30965	26393	30104	48343	22975		
19				118			
20	41			84	41		
21							
22							
23							
24							
25			59				
26	79	287	730	12215	1649		
27							
28	17790	17904	19408	37284	19782		
29	226	447	1055	9947	1244		
30		107	239		201		
31							
32	4411	4060	3869	4869	3761		
33				261			
34							
35							
36							
37							
38							
39							
40	658	620	815	27606	2427		
41		56			1460		
42					688		
43							
44	232	734	2520	24772	1606		
45		52	452		119		
46							
47							
48				2184			
49		49					
50		137	48	7021	830		
51							
52					223		
53				3790	249		
54							
55				6081	248		
56					51		
57		54	75	4033	47		
58			105				
59			68				
60			61	2110			
61					40		
62					134		
63					426		
64				5686	75		
65							
66				22026	1143		
67					42		
68				754			
69				107			
70				61			
71							
72							
73							
74				1567	53		
75				653	40		
76							
77				3898	749		
78					355		
79				1895	222		
80				231			
81				100			
82				42			
83				53			
84							
85				45			
86				47			
87				62			
88				41			
89				547	45		
90					51		
91				3921	677		
92					59		
93							
94							
95				37070	1510		
96				2373			
97				100			
98				40			
99							
100							
101							
102							
103				793	64		
104				43			
105				708	107		
106				164			
107				2099	515		
108				721	141		
109							
110							
111							
112							
113							
114							
115					57		
116				457	50		
117				49			
118				111			
119							
120				3201	192		
121				621			
122				3532	260		
123				320			
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

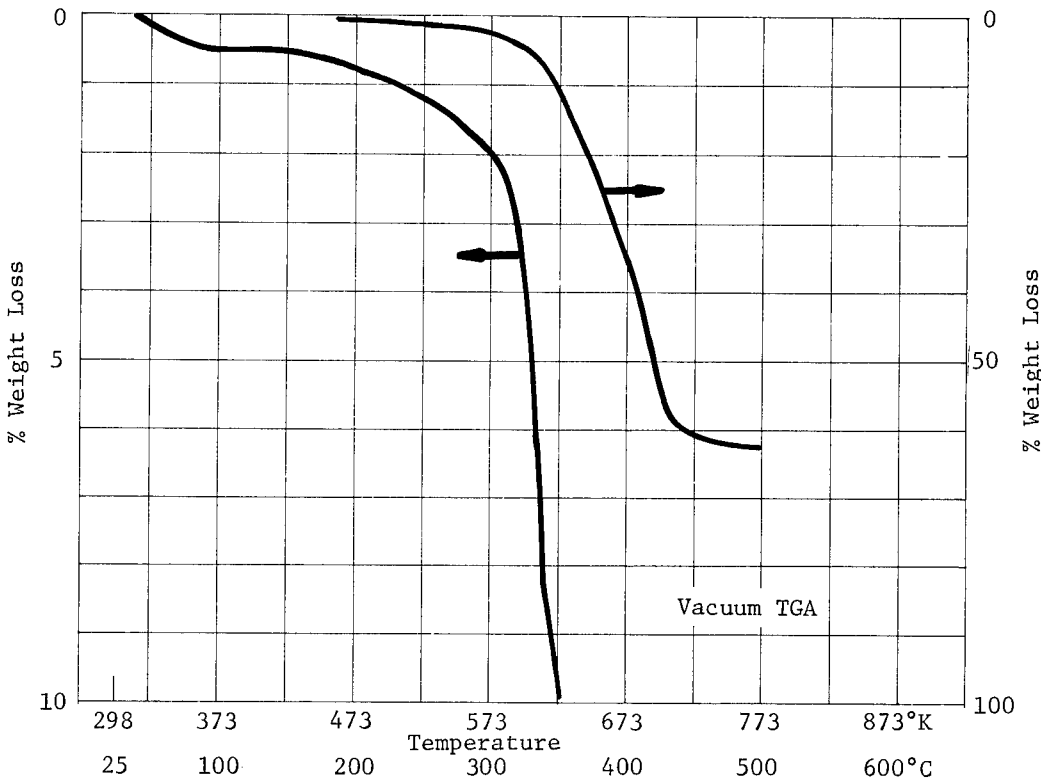
m/e	Temperature, °K (°C)				Ink, M-O-N, Black	
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	
128				62		
129						
130						
131						
132						
133						
134						
135						
136						
137						
138						
139						
140						
141						
142						
143						
144						
145						
146						
147						
148						
149						
150						
151						
152						
153						
154						
155						
156						
157						
158				1013	46	
159				267		
160				1064	40	
161				1082		
162				262		
163						
164						
165						
166						
167						
168						
169						
170						
171						
172						
173						
174						
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						



Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 6 pbw Catalyst  
 Cure: 1 hr. at 422°K (149°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C)-723°K (450°C)

$a_0 = 61.1\%$  of initial weight

$$k = 2.48 \times 10^{10} \exp\left(\frac{-33200}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$8.7 \times 10^{11}$	
373°K (100°C)	$8.2 \times 10^8$	
423°K (150°C)	$4.0 \times 10^6$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ink, Red, 50-507-9

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	773 (500)
14	2252	2353	2258	5603	3022	3177
15	848	1301	1191	11994	3251	3529
16	4991	4961	4916	10104	6124	7055
17	18220	16080	15713	27849	15676	15142
18	60517	52218	50545	90383	49301	48284
19	1163	1246	1195	1416	951	910
20	852	890	905	1416	1137	1316
21						
22						
23				777	179	155
24				2689	775	697
25	56	213	143	14095	3772	3296
26	457	1235	916	18008	4213	3625
27	595	1659	1032	53525	33822	32107
28	26602	27691	26646	13096	3268	2530
29	361	2041	959	7534	1145	1045
30	464	612	518	4809	908	596
31		879	277	5962	5828	5968
32	6338	5962	5750	84	176	247
33				41	454	677
34						
35						
36		53	63	421	199	169
37				2038	829	493
38		81	71	3735	1704	953
39		625	216	11381	5775	3420
40	3446	3489	3441	9621	5450	4722
41		1112	262	8971	2007	1456
42		407	307	14206	1437	1158
43		1287	473	10060	2893	1805
44	732	1200	1466	10965	2037	1616
45		1795	229	3076	479	367
46		40		544	90	66
47				541	230	87
48				202	40	
49				716	297	171
50		120	114	3086	1653	1049
51		124	53	2995	2061	1311
52		43	45	2240	675	450
53		49		2843	1068	604
54				2311	286	171
55		168	85	5958	1448	934
56		108	94	5646	519	378
57		1348	77	4528	873	671
58		404		2974	373	286
59		609		688	76	53
60			40	506	168	89
61				461	309	162
62				781	613	354
63				1478	1365	826
64	44			802	448	293
65				3864	2756	1531
66		83	44	5181	2959	1477
67	64	61	71	2352	354	199
68		57	41	1194	172	100
69				1066	97	58
70		106		3331	195	120
71				1022	42	
72		491		556	51	
73		440		308	88	54
74				440	317	172
75				217	204	115
76				189	175	86
77		65		955	1878	1059
78		58		636	650	476
79			40	877	791	419
80				1586	180	104
81				757	74	67
82				698	75	65
83		43		951	96	61
84		169	105	697	182	164
85	113	727		307		
86		40		191	53	52
87				48		
88						
89				174	246	177
90				130	173	89
91		129		793	1622	1226
92				258	232	214
93				526	241	130
94				9571	3803	2035
95				1069	256	123
96				202		
97				369		
98				187		
99				76		
100				57		
101					56	
102					359	218
103				60	71	62
104				40	339	327
105				154	58	95
106				801	1166	639
107				788	393	243
108						
109				188		
110				51		
111				138		
112				476	140	48
113				55		
114				57		44
115				65	168	100
116						
117					95	88
118				91	50	47
119		60		373	574	321
120				161	188	115
121				222	977	592
122				153	123	88
123						
124						
125						
126				43		
127						

Number and Relative Peak Intensity (Continued)

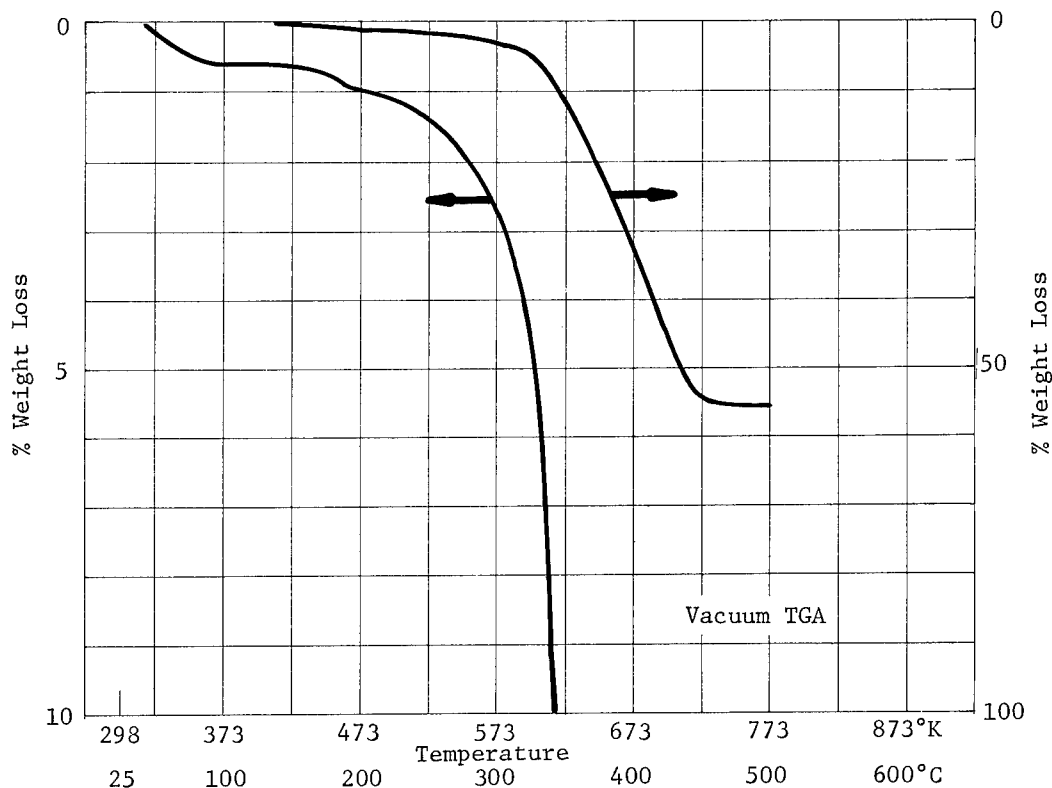
m/e	Temperature, °K (°C)					773 (500)	
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
128							
129	113	131	123	187	132	142	
130							
131	83	75	82	170	223	173	
132	118	112	108	191	180	184	
133				95	130	40	
134				394	360	236	
135				55	63		
136				49	133	78	
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 6 pbw Catalyst

Cure: 1 hr. at 422°K (149°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C)-723°K (450°C)

$a_o = 54.2\%$  of initial weight

$$k = 2.76 \times 10^{11} \exp\left(\frac{-35500}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.7 \times 10^{12}$	
373°K (100°C)	$1.6 \times 10^9$	
423°K (150°C)	$5.5 \times 10^6$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Ink, Yellow, 50-202-9

m/e	298 (25)	423 (150)	573 (300)	673 (400)	773 (500)
14	2401	2541	3191	4983	3092
15	799	1803	3664	8029	2928
16	5516	5290	6741	9049	6458
17	21282	17590	21917	19918	15325
18	72153	57991	71347	64638	48573
19	1336	1558	1431	1433	1010
20	1007	932	1319	1408	1314
21					
22					
23					
24		67	156	727	137
25	57	384	699	2739	597
26	448	1965	3731	12348	2950
27	557	3008	4257	14341	2971
28	28368	30789	34107	51460	32158
29	367	4459	3847	15575	2066
30	420	889	2123	3878	955
31	94	2444	723	4517	479
32	6953	6321	6289	6174	6456
33					527
34				49	1306
35					
36	40	62	155	568	166
37		41	359	3524	392
38		135	633	6254	925
39		1000	1780	20669	2853
40	3450	3696	4546	11768	4544
41	69	1978	1520	9578	1099
42	48	706	2546	5737	1003
43	77	2792	2485	10717	1459
44	762	1932	4593	9634	1505
45		5736	913	1721	289
46		123	72	578	40
47			120	1375	91
48			78	243	44
49			147	1745	126
50		216	744	5351	878
51		186	532	5551	1038
52		62	541	1973	359
53		86	468	3742	520
54			426	1240	120
55		244	644	10198	734
56		203	795	3166	309
57		2712	481	5798	483
58		890	577	1321	222
59		2295	286	237	
60		66	210	540	61
61			42	1269	117
62			56	2166	294
63			113	4210	673
64		40	177	1445	297
65		73	394	10601	1243
66	40	60	552	13274	1267
67		75	512	1613	149
68			158	766	73
69		218	109	1115	
70			249	4569	65
71		78	85	542	
72		1805	74	297	
73		1591	52	427	
74		60		1125	144
75				631	79
76				490	62
77		62	90	3797	876
78		77	151	1373	370
79			146	2124	355
80			325	637	43
81			137	278	
82			75	288	
83		74	56	1038	
84	113	232	194	603	152
85		1430	186	145	
86		62	53	142	
87				80	
88					
89		56		671	103
90				618	53
91		321	62	2762	1062
92				473	166
93			83	788	83
94			1092	19934	1693
95			97	1405	86
96				109	
97				55	
98				170	
99					
100					
101					
102				125	
103		64		629	158
104				120	46
105		44		524	258
106		65		114	61
107			63	2932	513
108			134	1405	175
109				83	
110					47
111					
112				407	119
113					
114					103
115				345	70
116				62	
117				140	57
118				188	44
119				1066	243
120				340	86
121				1717	487
122				431	50
123					
124					
125					
126					
127					

Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Ink, Yellow, 50-202-9	
	298 (25)	423 (150)	573 (300)	673 (400)	773 (500)		
128							
129	126	122	161	208	144		
130							
131	76	77	101	484	153		
132	124	107	144	309	146		
133				342	40		
134			53	951	207		
135				116			
136				359	61		
137							
138							
139							
140							
141							
142							
143							
144							
145				52			
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

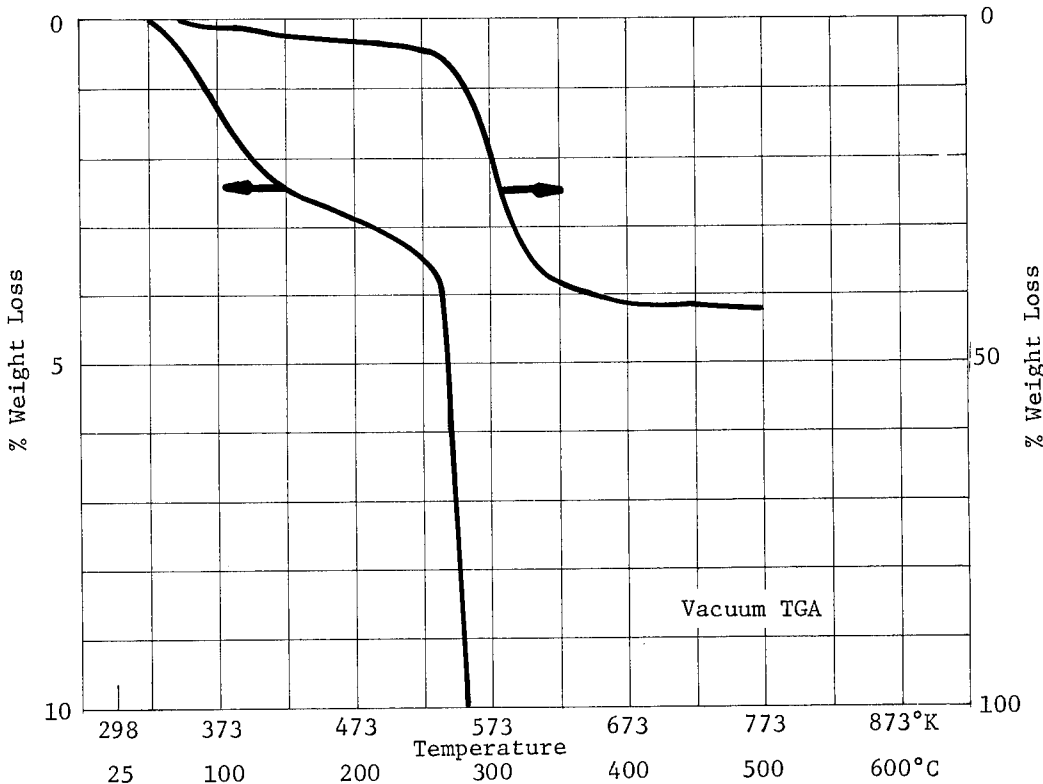
Laminate, Epoxy / Glass  
102-21

Chemical Characterization Summary

Mix Ratio: Pre-Preg

Cure: 30 min. at 447°K (174°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C)-773°K (500°C)

$a_o = 39.8\%$  of initial weight

$$k = 3.04 \times 10^{21} \exp\left(\frac{-57000}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$9.4 \times 10^{16}$	
373°K (100°C)	$6.1 \times 10^{11}$	
423°K (150°C)	$6.7 \times 10^7$	

Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Laminate, Epoxy / glass 102-21	
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)		
14	1017	661	852	1036	1236		
15	218	214	657	1148	956		
16	2521	2408	3176	3521	2982		
17	12250	9925	11411	11081	8973		
18	46924	36272	36490	36930	31913		
19	128				40		
20	84	41	71	107	97		
21							
22							
23							
24				46			
25				427	170		
26	137	219	457	2993	1625		
27	261	346	777	2944	1964		
28	23966	24032	24276	28751	28199		
29	330	422	641	2165	1423		
30	112	113	235	406	389		
31	368	327	435	1073	999		
32	7157	6805	6329	5978	5725		
33							
34							
35				73			
36				660	148		
37				919	243		
38				2103	575		
39	40	46	131	6066	2383		
40	916	1023	1240	3310	1668		
41	48	61	119	1149	709		
42		59	225	1123	440		
43	112	100	246	1798	731		
44	763	847	2536	4218	1276		
45	102	84	172	514	407		
46				138	103		
47				181			
48				51			
49				190			
50			130	1793	529		
51				2033	697		
52			46	482	137		
53				1044	291		
54				87	45		
55				1274	370		
56			58	100	123		
57				87	41		
58		41	71				
59				42			
60				56			
61				255	70		
62				706	102		
63				1567	414		
64				495	68		
65				3705	957		
66				4342	1054		
67				226	55		
68				62			
69							
70							
71							
72							
73							
74				220	50		
75				84	43		
76				86			
77				1441	745		
78				345	167		
79				453	233		
80				77			
81				40	43		
82							
83							
84							
85							
86							
87							
88							
89							
90				65			
91				56			
92				1409	450		
93				284	87		
94				372	54		
95				6504	1532		
96				201			
97							
98							
99							
100							
101							
102							
103							
104				107	51		
105							
106					40		
107							
108				590	308		
109				142	141		
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120				128			
121							
122				401	81		
123				40			
124							
125							
126							
127							



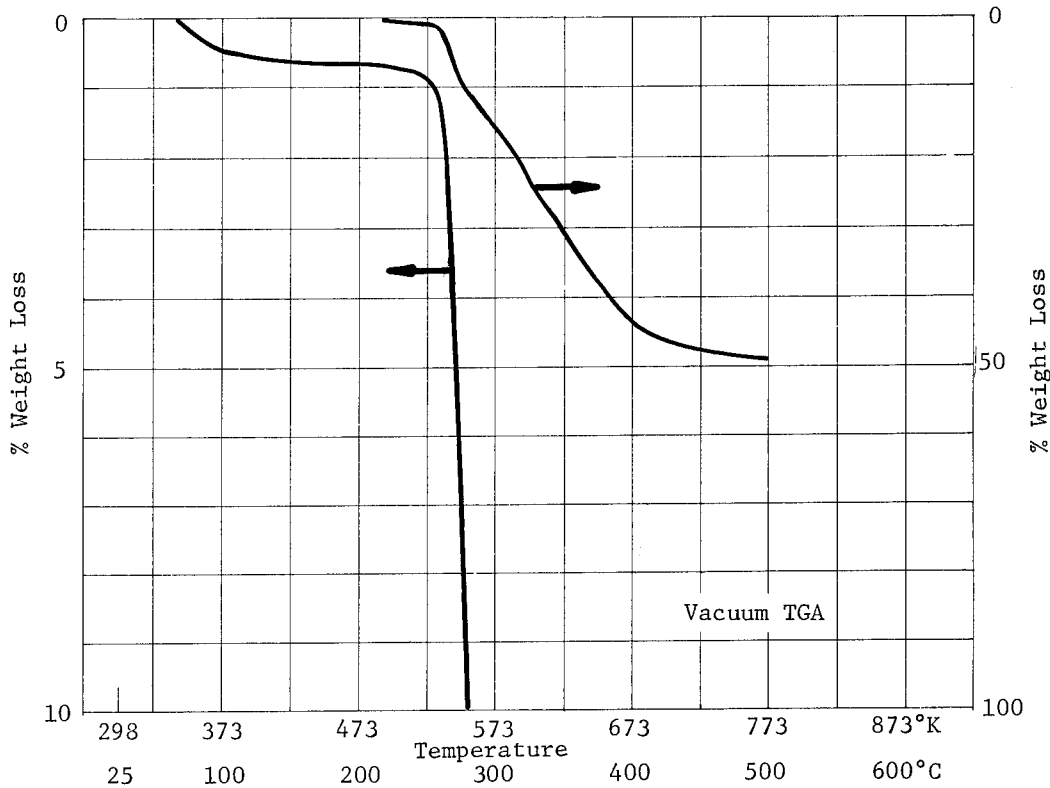
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)			Laminate, Epoxy / glass 102-21		
			623 (350)			
128						
129						
130						
131						
132						
133						
134						
135				51		
136						
137						
138						
139						
140						
141						
142						
143						
144						
145						
146						
147						
148						
149						
150						
151						
152						
153						
154						
155						
156						
157						
158						
159						
160						
161						
162						
163						
164						
165						
166						
167						
168						
169						
170						
171						
172						
173						
174						
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						

Chemical Characterization Summary

Mix Ratio: As received  
 Cure: As received

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C) - 698°K (425°C)

$a_0$  = 26.7% of initial weight

$$k = 2.4 \times 10^{56} \exp \left( \frac{-147,400}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$10^{99}$	
373°K (100°C)	$1.1 \times 10^{30}$	
423°K (150°C)	$6.5 \times 10^{19}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

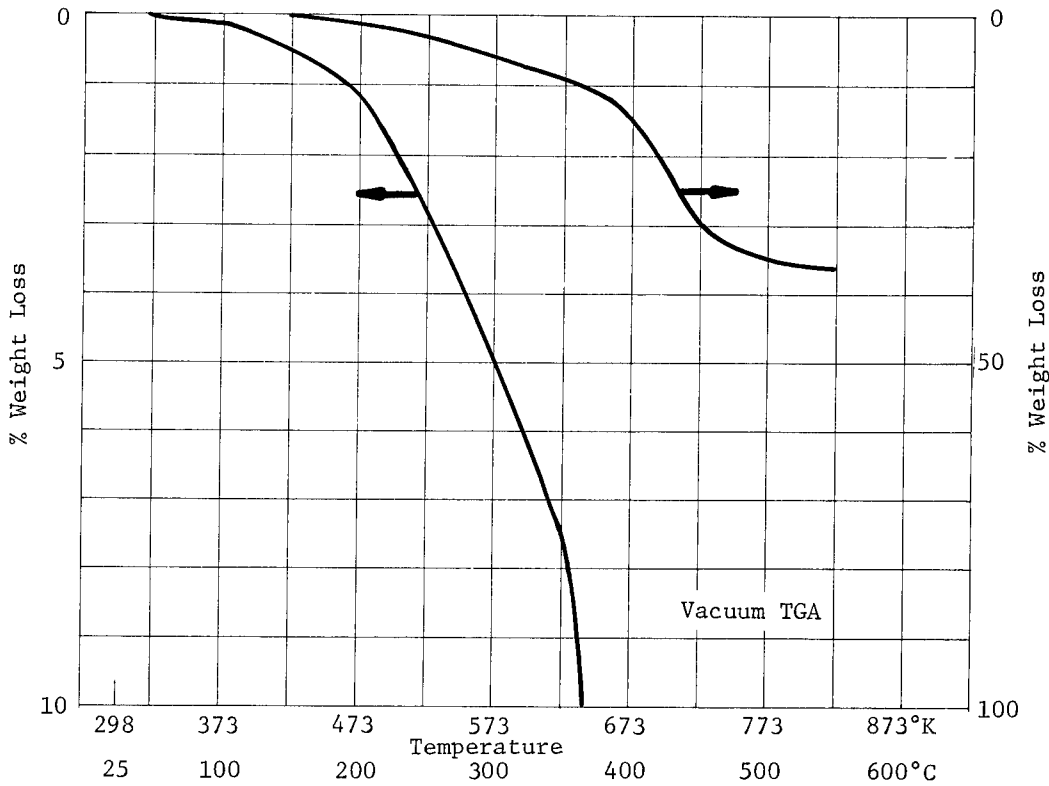
Laminate, Mil P-13949 FL-GFN

m/e	298 (25)	523 (250)	573 (300)	673 (400)	773 (500)		
14	1314	1236	1498	1479	1123		
15	316	486	1976	1316	830		
16	2069	2533	4177	2571	2375		
17	10587	8111	8313	7279	6724		
18	39082	23593	31679	23069	24505		
19	123	172	228	130	75		
20	299	224	334	298	275		
21							
22			119				
23							
24			257	152			
25	63	86	905	639	195		
26	320	483	4454	2907	1170		
27	641	759	4270	2954	1457		
28	30594	28219	35791	31412	26811		
29	491	600	3206	2988	991		
30	763	758	1242	1257	863		
31	95	142	635	551	178		
32	5445	5368	5072	4784	4809		
33			129	57			
34							
35			206	50			
36			949	341	141		
37		44	2282	1054	217		
38	48	62	4406	1880	347		
39	102	164	10794	5315	1053		
40	3582	2913	6988	4986	3374		
41	161	147	1294	1161	345		
42	80	192	1851	1003	286		
43	264	369	2252	2533	566		
44	873	2159	12814	2118	982		
45	50	63	349	233	125		
46			249	108			
47			683	323			
48			118	61			
49			604	289	67		
50		101	2083	1393	354		
51		46	2012	1403	366		
52		47	762	456	133		
53			1239	818	195		
54			242	226			
55			1760	924	129		
56		43	219	185	52		
57			106	166			
58		41	135	207			
59			127	51			
60			119	92	42		
61			505	307	59		
62			848	397	56		
63			1510	808	153		
64			641	296	50		
65			3560	1742	216		
66			4168	2025	218		
67			420	169			
68			140	96			
69							
70							
71							
72							
73			107	61			
74			224	164			
75			98	83			
76			74	58			
77			309	503	149		
78			170	191	49		
79			236	209	51		
80			63	44			
81			117				
82			46				
83							
84							
85							
86							
87							
88							
89			41				
90				45			
91			234	226	67		
92			83				
93			222	58			
94			1967	793	66		
95			106	64			
96							
97			142				
98							
99							
100							
101							
102							
103							
104							
105							
106							
107				62			
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

Chemical Characterization Summary

Mix Ratio: As Received  
 Cure: 2 hrs. at 422°K (149°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 633°K (360°C)-903°K (630°C)

$a_0 = 30.6\%$  of initial weight

$$k = 2.15 \times 10^{13} \exp \left( \frac{-44400}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.9 \times 10^{16}$	
373°K (100°C)	$3.6 \times 10^{12}$	
423°K (150°C)	$2.9 \times 10^9$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Laminate, E-787

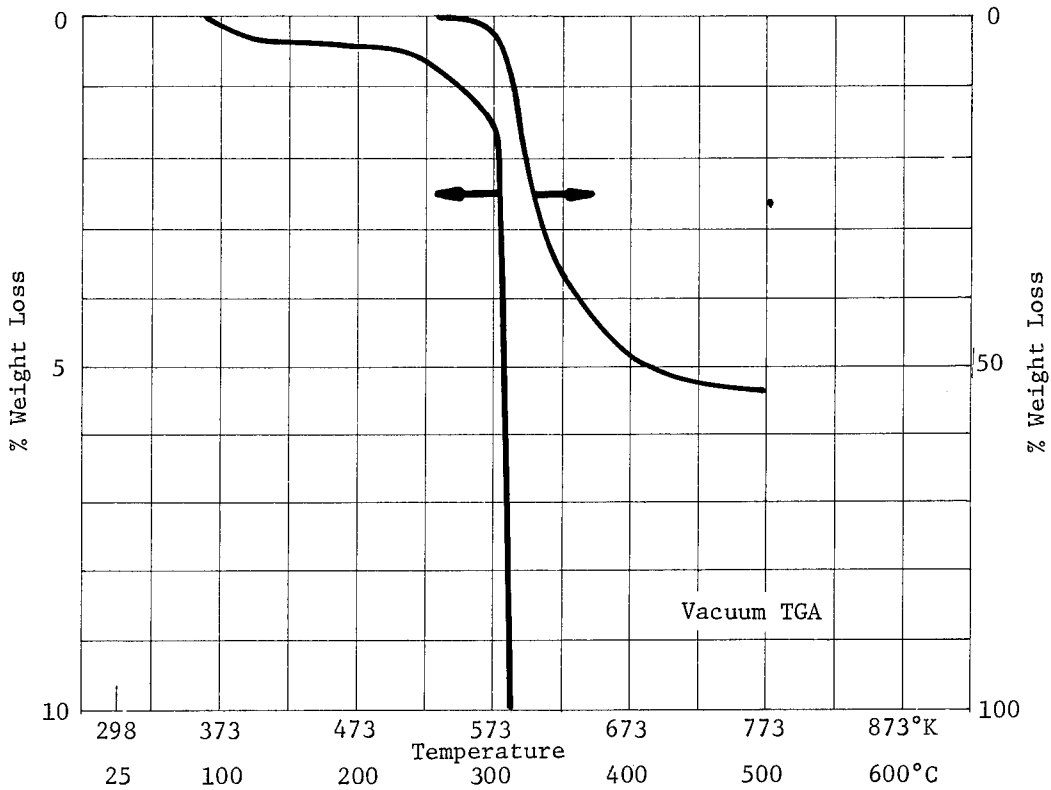
m/e	298 (25)	473 (200)	573 (300)	673 (400)	798 (525)		
14	1265	730	750	1860	1110		
15	449	600	1010	2920	2090		
16	5823	3250	3500	9870	5500		
17	26763	20120	19360	29240	16970		
18	90667	76250	70200	100000	61220		
19	59						
20	280						
21							
22							
23							
24							
25	40		460	990			
26	145	450	2550	7990	1290		
27	295	1030	3450	8260	1270		
28	20601	18590	24150	56690	22790		
29	145			5610	800		
30	588	490	580	1030	640		
31				710			
32	4884	2770	2530	2600	2400		
33							
34							
35							
36							
37			630	720			
38	54	1280	1010	1070			
39			6590	3590	1210		
40	4684	3100	4220	4960	2960		
41	66		700	1480	470		
42	43			1600			
43	74			4940	400		
44	592	510	4340	47960	1490		
45				1130			
46							
47							
48							
49							
50		540	2150	810	420		
51		700	2840	570	580		
52		500	1890	580			
53			830	510			
54			540	420			
55				1350			
56				3310			
57				670			
58				510			
59				440			
60							
61							
62							
63			490	440	410		
64	52						
65	40		1020	780	430		
66	55		420	1220	530		
67				470			
68							
69							
70							
71							
72							
73							
74							
75							
76							
77		980	3890	590	490		
78			790				
79		2820	14310	630			
80		1380	6450				
81							
82							
83							
84	66						
85							
86							
87							
88							
89							
90							
91					450		
92							
93							
94				840			
95							
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

Laminate, G-10 FR Clad

Chemical Characterization Summary

Mix Ratio: As received  
Cure: As received

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C)-673°K (400°C)

$a_o = 50.0\%$  of initial weight

$$k = 3.30 \times 10^{45} \exp \left( \frac{-124800}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$9.5 \times 10^{38}$	
373°K (100°C)	$4.2 \times 10^{27}$	
423°K (150°C)	$8.9 \times 10^{18}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Laminate, G-10 FR Clad

m/e	298 (25)	573 (300)	623 (350)	673 (400)	773 (500)		
14	599	773	952	690	840		
15	94	732	1018	336	303		
16	1368	1684	1851	1420	1475		
17	3504	3135	3267	2855	2920		
18	10530	8906	8778	7504	8010		
19	86	101	178	84	75		
20	55	50	60	56	56		
21							
22							
23							
24			102				
25		73	377	69	48		
26	53	329	1859	318	202		
27			2034	486	324		
28	2552	3221	4602	3395	3610		
29	59	317	1807	353	191		
30	322	366	511	428	451		
31			261				
32	854	825	900	917	1027		
33							
34							
35							
36				76	62		
37		104	1066	157	60		
38					108		
39		428	4833	761			
40	311	456	1880	537	458		
41		119	582	198	111		
42		201					
43				246			
44	180	1320	1411	318	278		
45		49	98	45			
46							
47			303	47			
48							
49				57			
50		190	1396	253	94		
51		160	1325	284	129		
52		124			55		
53		80	812	167	66		
54							
55		93	1148	176	65		
56		51	243	44			
57			79				
58		50	84				
59							
60							
61							
62					72		
63		125	1567	273	93		
64							
65		320	3920	521	146		
66		323	3820	465	125		
67		58	380	84			
68			159				
69							
70							
71							
72							
73							
74		46	460	103	42		
75			296	67			
76							
77		64	967	295	118		
78			484	147	72		
79		268		137	64		
80			141	58			
81		193					
82			40				
83							
84							
85							
86			60				
87			58				
88							
89			216	76			
90							
91		111	920	278	112		
92				103	51		
93							
94		1082	7160	860	197		
95			555	82			
96		381	121				
97							
98							
99							
100			43				
101							
102							
103			331	107	41		
104				66			
105				78	52		
106		71					
107			506	253	120		
108		96	138				
109							
110							
111							
112							
113							
114							
115			154	66			
116			77				
117				50			
118							
119			644	179	57		
120							
121			1368	412	93		
122							
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)				Laminate, G-10 FR Clad	
	298 (25)	573 (300)	623 (350)	673 (400)	773 (500)	
128			84	51		
129			60	44		
130						
131			333	106	60	
132			231	72	47	
133						
134			661	171	54	
135					41	
136			365	113		
137			52			
138						
139						
140						
141						
142						
143						
144						
145			83	53		
146			47			
147			45			
148						
149						
150			110			
151						
152						
153						
154						
155						
156						
157			45			
158						
159			101	50		
160			44			
161						
162						
163						
164						
165						
166						
167						
168						
169						
170						
171						
172			140			
173						
174			114			
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						



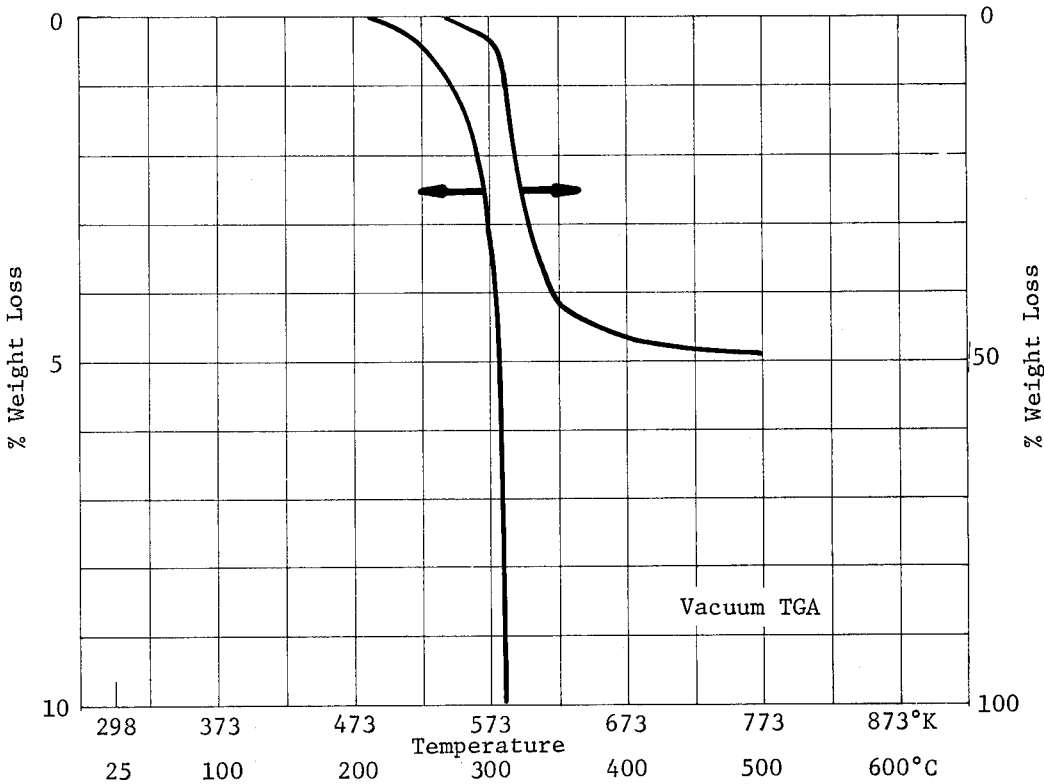
Laminate, G-10 FR Unclad

Chemical Characterization Summary

Mix Ratio: As received

Cure: As received

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C) - 723°K (450°C)

$a_0 = 50.0\%$  of initial weight

$$k = 9.78 \times 10^{36} \exp \left( \frac{-100,500}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.0 \times 10^{31}$	
373°K (100°C)	$7.3 \times 10^{21}$	
423°K (150°C)	$7.6 \times 10^{14}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Laminate, G-10 FR Unclad

m/e	298(25)	573(300)	623 (350)	673 (400)	773 (500)		
14	597	954	675	662	686		
15	77	1452	520	313	311		
16	1116	1829	1356	1229	1370		
17	2590	2949	2356	2306	2417		
18	7547	7956	6156	6092	6554		
19	96	106	120	88	72		
20		45	49		50		
21							
22							
23							
24		50					
25		140	123	66	43		
26	41	632	573	338	206		
27		647	739	437	354		
28	1930	3339	2797	2788	3098		
29	55	602	580	330	227		
30	254	335	348	353	400		
31				64			
32	649	634	673	704	825		
33							
34							
35							
36		57		56			
37		245	286	147	58		
38		417			118		
39		920	1429	686	293		
40	238	577	658	463	399		
41		200	251	145	111		
42		247	198	124	81		
43			337	207			
44	141	2245	480	275	235		
45		76	52				
46		49					
47		64	66	44			
48							
49							
50		318	426	229	109		
51		272	458	254	139		
52		164		118	67		
53		154	265	142			
54							
55		233	300	168	66		
56		99	52				
57		43	40				
58		48					
59							
60							
61		127	200	106			
62		230					
63		281	478	256	110		
64							
65		784	1039	481	173		
66		856	976	452	140		
67		98	119	71			
68		47	53				
69							
70							
71							
72							
73		75					
74		92	148	90	42		
75		62	108	67			
76		56					
77		83	412	255	138		
78			191	125	83		
79		389	172	106	72		
80			63	48			
81		288					
82		55					
83							
84							
85							
86							
87							
88							
89			89	64	40		
90							
91		142	411	209	131		
92			168	82	50		
93							
94		2350	1649	790	218		
95			150	81			
96		462	48				
97							
98							
99							
100							
101							
102							
103			149	86	45		
104							
105			89	53	62		
106		51					
107			256	221	160		
108		81	69	84			
109							
110							
111							
112							
113							
114							
115			61	50			
116							
117			48				
118							
119		40	280	131	66		
120							
121			627	300	108		
122			96	71			
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

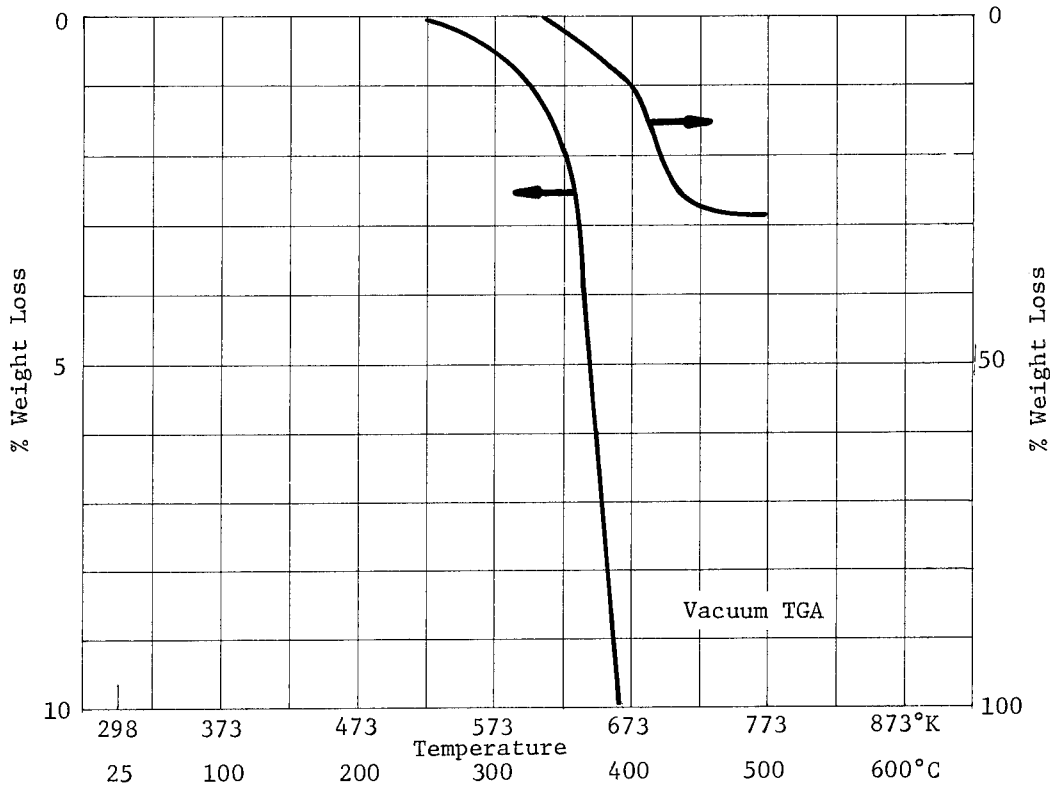
m/e	Temperature, °K (°C)					Laminate, G-10 FR Unclad	
	298 (25)	573 (300)	623 (350)	673 (400)	773 (500)		
128				61			
129			54	67			
130							
131			87	71	52		
132			79	53			
133							
134			292	136	52		
135					44		
136			173	92			
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: As received

Cure: As received

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 523<sup>o</sup>K (250<sup>o</sup>C)-723<sup>o</sup>K (450<sup>o</sup>C)

$a_o = 27.8\%$  of initial weight

$$k = 8.78 \times 10^{11} \exp \left( \frac{-38900}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323 <sup>o</sup> K (50 <sup>o</sup> C)	1.8 x 10 <sup>14</sup>	
373 <sup>o</sup> K (100 <sup>o</sup> C)	5.1 x 10 <sup>10</sup>	
423 <sup>o</sup> K (150 <sup>o</sup> C)	1.0 x 10 <sup>8</sup>	

Number and Relative Peak Intensity

Temperature, °K (°C)

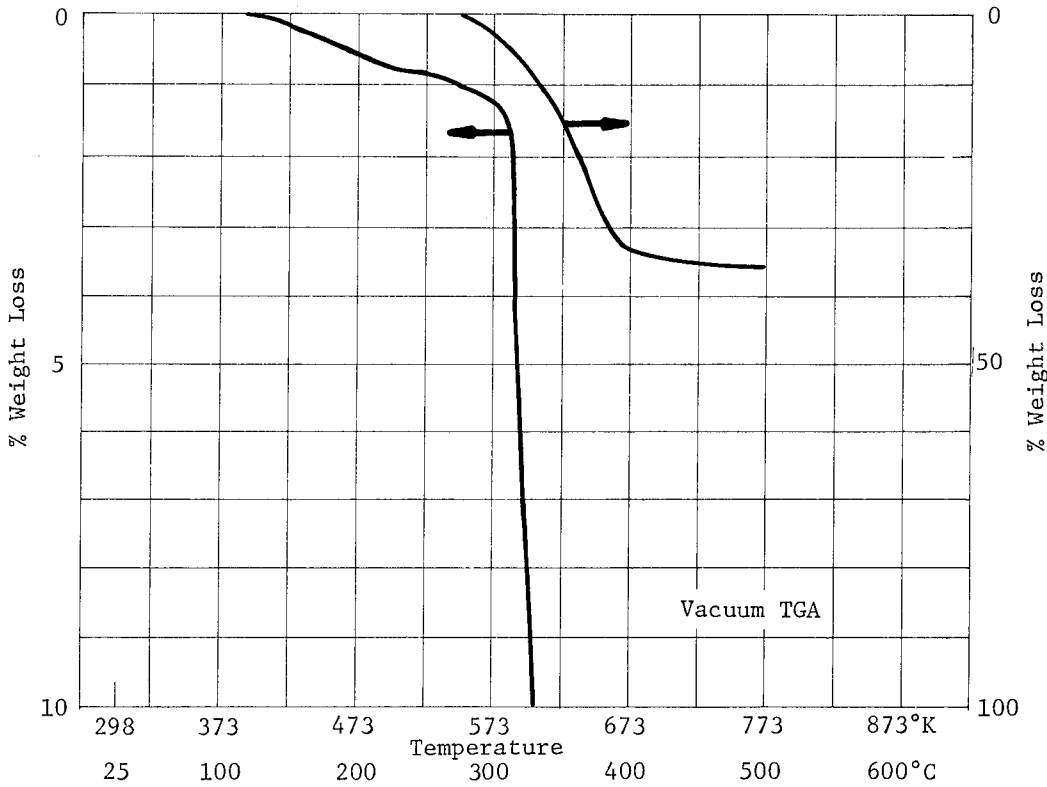
Laminate, L-P-509 GR G-11

m/e	298 (25)	473 (200)	623 (350)	723 (450)	823 (550)		
14	784	727	1186	1006	945		
15	338	475	1755	900	817		
16	1812	1488	2945	1952	2060		
17	13134	8978	10335	9384	8224		
18	48868	35522	541	32791	30201		
19	422	507	418	372	299		
20	99	123	69	75	73		
21							
22							
23							
24							
25	43	54	329	263	71		
26	625	611	2442	2089	1380		
27	1592	1571	3854	3334	1858		
28	23476	22372	28886	23879	22531		
29	1709	2189	4093	3169	1897		
30	456	430	1415	619	420		
31	5818	6474	5407	4192	3724		
32	6041	5800	5517	5337	5307		
33							
34							
35							
36			41				
37			453	446	73		
38			917	949	184		
39	63	57	3384	4251	1151		
40	537	489	2048	1877	881		
41	93	138	1467	1055	429		
42	171	174	2385	883	346		
43	601	722	3050	2766	1277		
44	717	857	10252	1805	1091		
45	2333	2569	2810	2232	1580		
46	755	926	867	485	481		
47			75	115			
48							
49			77	92			
50			1006	1046	268		
51			732	1328	286		
52			441	285	50		
53			439	634	100		
54			278				
55			798	810	180		
56			594	130	48		
57			335	88			
58			378	106			
59			56				
60							
61			75	83			
62			146	207	46		
63			424	875	106		
64			70	118			
65			1545	2056	421		
66			1963	2303	419		
67			149	79	41		
68			169	44			
69			40				
70			49				
71							
72							
73			45	45			
74				107			
75				61			
76							
77			105	1329	215		
78			73	320	68		
79			146	388	83		
80			95	45			
81			59				
82			61				
83							
84							
85							
86							
87							
88							
89				74			
90							
91			135	902	326		
92				91	51		
93			126				
94				62			
95			3281	2527	443		
96			120	57			
97							
98							
99							
100							
101							
102							
103							
104				80			
105							
106				69			
107							
108				405	52		
109				103			
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120				108			
121							
122				215			
123							
124							
125							
126							
127							

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 4.5 pbw Activator  
 Cure: 1 hr. at 322°K (49°C), 2 hrs. at 366°K (93°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C) - 673°K (400°C)

$a_0 = 35.5\%$  of initial weight

$$k = 1.74 \times 10^{20} \exp\left(\frac{-58,800}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.1 \times 10^{19}$	
373°K (100°C)	$1.4 \times 10^{14}$	
423°K (150°C)	$1.1 \times 10^{10}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

LCA-4V/BA-5

m/e	298 (25)	523 (250)	623 (350)	723 (450)			
14	469	354	1912	503			
15	83	232	4914	539			
16	1737	1431	3988	2007			
17	8910	6043	11527	4884			
18	32718	21546	41468	16903			
19			40				
20	63	42	152	50			
21							
22							
23							
24			641				
25			3003	102			
26	115	195	15617	1254			
27	221	275	16039	1685			
28	18853	16811	43101	18064			
29	105	479	10000	812			
30	85	120	4971	305			
31		45	3230				
32	4967	4102	4095	3658			
33			191				
34							
35							
36			538				
37			6269	103			
38			11853	288			
39			40369	2026			
40	1465	1480	17252	2114			
41	40	47	8478	837			
42		64	9165	378			
43		173	11428	528			
44	314	1316	14238	1298			
45			2440				
46			388				
47			2176				
48			186				
49			2137				
50			11060	352			
51			12337	741			
52			7447	128			
53			4692	333			
54			1842	59			
55			8836	163			
56			2673	61			
57			1217				
58			1869				
59			637				
60			569				
61			2599				
62			5009	89			
63			9274	297			
64			3089	772			
65			23541	518			
66			26206	872			
67			3643	66			
68			1462				
69			390				
70			357				
71			172				
72			203				
73			686				
74			2461				
75							
76							
77			8374	673			
78			2588	76			
79			3767	205			
80			1706	58			
81			607				
82			190				
83			43				
84			129				
85			102				
86			92				
87			161				
88							
89			1325				
90			634				
91			7392	386			
92			890				
93			1714				
94			32722	620			
95			138				
96			2166				
97			131				
98							
99			45				
100							
101			74				
102			130				
103			1016				
104			98				
105			899				
106			156				
107			3023	256			
108			1167	49			
109			68				
110							
111							
112							
113							
114							
115							
116			181				
117							
118			76				
119			101				
120			3332				
121			289				
122			2094	49			
123			231				
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

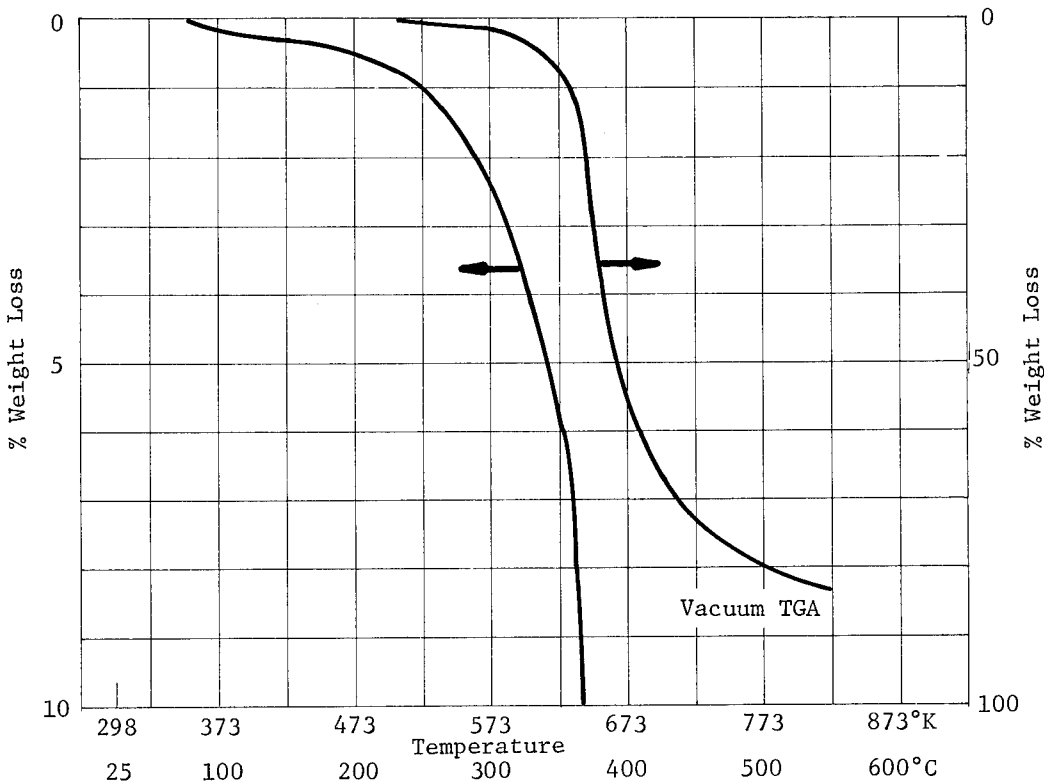
m/e	Temperature, °K (°C)				LCA-6V/BA-5
	298 (25)	523 (250)	623 (350)	723 (450)	
128					
129					
130					
131					
132			45		
133					
134			178		
135			1599		
136			55		
137					
138			77		
139					
140					
141					
142					
143					
144					
145					
146					
147					
148					
149					
150					
151					
152					
153					
154					
155					
156					
157					
158					
159					
160					
161					
162					
163					
164					
165					
166					
167					
168					
169					
170					
171					
172					
173					
174					
175					
176					
177					
178					
179					
180					
181					
182					
183					
184					
185					
186					
187					
188					
189					
190					
191					
192					
193					
194					
195					
196					
197					
198					
199					
200					
201					
202					
203					
204					
205					
206					
207					
208					
209					
210					
211					
212					
213					
214					
215					
216					
217					
218					
219					
220					
221					
222					
223					
224					
225					
226					
227					
228					
229					
230					
231					
232					
233					
234					
235					
236					
237					
238					
239					
240					



Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 74 pbw activator  
 Cure: 24 hrs. at room temperature

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-823°K (550°C)

$a_0 = 83.9\%$  of initial weight

$$k = 1.33 \times 10^4 \exp \left( \frac{-16,800}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.1 \times 10^7$	
373°K (100°C)	$3.2 \times 10^5$	
423°K (150°C)	$2.2 \times 10^4$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Lefkowitz 461M 52

m/e	298 (25)	523 (250)	623 (350)	723 (450)	823 (550)		
14	1629	1332	5581	2893	2493		
15	379	518	11965	4909	3432		
16	4450	4329	17768	7909	7466		
17	18678	16439	51324	18429	17526		
18	58378	53955	100696	61654	59162		
19	127	130	595	220	106		
20	363	290	744	489	402		
21							
22			57				
23							
24		42	1222	530	205		
25		111	4598	2216	839		
26	244	845	27198	12382	4550		
27	564	1286	33136	23203	6395		
28	23212	22993	63377	45447	33103		
29	309	1074	21113	15583	2790		
30	835	1042	16678	4248	1995		
31	47	358	8901	745	331		
32	5199	4374	4913	5420	4949		
33			81				
34			45				
35			51				
36			1006	264	70		
37		83	7155	1743	473		
38		127	11703	3613	989		
39		621	37276	18834	4225		
40	4217	4416	23933	11333	6814		
41	51	407	23536	25050	4229		
42	52	307	23197	11892	2436		
43	78	597	12331	19143	1951		
44	678	1182	13502	3787	1524		
45			2435	353	194		
46			292	90			
47			939	194	47		
48			273	124			
49			1350	725	142		
50			5820	3352	792		
51		44	6739	4512	1074		
52		50	6062	2365	606		
53		51	7026	4057	743		
54		65	3364	2748	583		
55		67	5713	9361	1442		
56		59	4475	7404	960		
57		416	7407	7158	509		
58		109	4381	1036	157		
59			843	181			
60			342	149	43		
61			978	351	90		
62			1757	944	149		
63			3141	2182	492		
64			1588	756	112		
65			7506	3557	790		
66			10588	2346	525		
67		61	8598	2807	515		
68			1382	1262	217		
69			1048	2512	291		
70			917	2796	238		
71			738	2160	108		
72			388	344	57		
73			322	55	41		
74			721	465	84		
75			433	397	102		
76			379	352	56		
77			1781	3551	678		
78			1060	1054	299		
79			1612	2396	354		
80			2530	745	162		
81			1134	1305	212		
82			260	820	102		
83			327	870	78		
84			337	810	78		
85			225	963			
86			153	246			
87			82	89			
88							
89			414	417	52		
90			327	246	43		
91			1160	2926	629		
92			448	531	73		
93			1419	874	77		
94			18253	2354	529		
95			1522	684	150		
96			239	325			
97			119	303	47		
98			59	289			
99			62	110			
100			67	97			
101			72	76			
102			46	115			
103			157	499	73		
104			61	135			
105			211	678	97		
106			286	245	51		
107			2034	1533	243		
108			2271	639	110		
109			322	198	40		
110			61	95			
111			44	74			
112			116	70			
113			43	41			
114				49			
115			118	327	60		
116				78			
117			69	181			
118			287	118	44		
119			787	1101	176		
120			414	274	50		
121			1524	1236	136		
122			829	343			
123			113	49			
124				59			
125							
126				53			
127				47			

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Lefkowitz 46LM 52

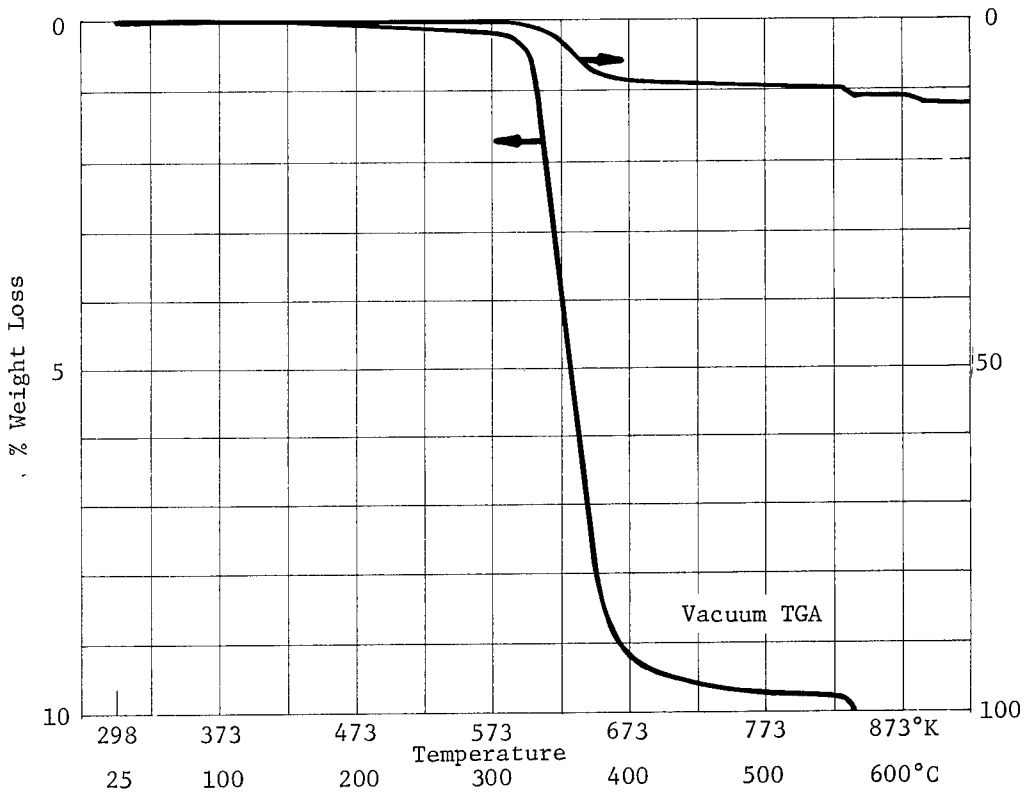
m/e	298 (25)	523 (250)	623 (350)	723 (450)	823 (550)		
128				97			
129				66			
130				48			
131			123	209			
132			92	105			
133			367	371	69		
134			815	1019	147		
135			260	362			
136			339	278			
137				45			
138							
139							
140							
141							
142							
143				49			
144				45			
145				105			
146				60			
147				90			
148				75			
149				98			
150				48			
151							
152							
153							
154							
155							
156							
157							
158							
159				46			
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

MF500F-124 Microwave Absorber

Chemical Characterization Summary

Mix Ratio: As received  
Cure: As received

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 573°K (300°C)-673°K (400°C)

$a_0 = 10\%$  of initial weight

$$k = 1.6 \times 10^{34} \exp\left(\frac{-98000}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.5 \times 10^{32}$	
373°K (100°C)	$1.8 \times 10^{23}$	
423°K (150°C)	$2.3 \times 10^{16}$	

Isothermal weight loss in nitrogen - 0.15%

Number and Relative Peak Intensity

Temperature, °K (°C)

MF500F-124 Microwave Absorber

m/e	298 (25)	473 (200)	598 (325)	623 (350)	698 (425)	873 (600)
14	3665	3609	5188	6977	3645	14412
15	1758	1914	6625	11999	2691	2051
16	12791	11836	13976	16109	11762	11340
17	41235	34062	36223	47133	29646	27750
18	100799	100254	100843	100855	83628	75849
19	294	293	469	562	186	141
20	853	846	881	935	706	829
21						
22						
23						
24			533	1011	44	
25	89	99	2099	4038	389	159
26	898	1209	10028	18363	2563	1916
27	1923	2201	10618	20259	3347	3842
28	43992	42441	62238	63998	32814	100918
29	635	720	7369	12470	1525	1691
30	2219	2267	3431	3992	2228	2566
31		51	3379	2702	164	45
32	10135	9372	8743	8964	8224	8569
33			118	70		
34						
35						
36			388	818		
37			3155	6521	423	
38		56	5670	12729	1018	61
39	148	326	17201	43732	3556	385
40	7732	7954	14968	22343	8490	8868
41	124	512	7369	9931	1226	362
42	75	637	7757	918	718	185
43	148	383	6981	9628	877	314
44	2365	2908	13648	7115	2392	2531
45			1884	1229	63	
46			496	596		
47			1309	1935	59	
48			184	280		
49			1203	2120	91	
50			4907	10679	912	
51			4034	12580	1010	60
52			1351	3809	316	
53			2453	6914	546	
54			639	1017	54	
55			4628	8168	592	
56			925	970	73	
57			2076	1392		
58			1538	1344		
59			169	551		
60			348	858		
61			1409	2334	71	
62			2166	4703	241	
63			3981	3931	652	
64			1365	3003	185	
65			12489	21886	1648	
66	46		17004	21863	1707	84
67			1520	2370	142	
68			927	917		
69			317	156		
70			398	136		
71			376	65		
72			144			
73			356	526		
74			1098	2356		
75			499	1483	92	
76			378	924		
77			1660	11636	923	
78			731	2752	296	
79			889	3393	386	
80			209	313		
81			116	248		
82			71	47		
83			41			
84	88	88	180	122	55	86
85						
86			92	157		
87				136		
88						
89			146	1557	40	
90			81	624		
91			1348	11075	672	
92			235	1341		
93			944	2177	49	
94			26761	23694	2163	
95			1692	1761	52	
96			80	53		
97						
98			1417	222		
99		63	1799	245		
100		85	46			
101				124		
102				283		
103			410	2817	64	
104				274		
105			179	1445	41	
106				129		
107			614	3018	473	
108			231	476	167	
109						
110						
111						
112						
113						
114						
115			81	635		
116				55		
117				176		
118			41	212		
119			436	5269	186	
120			60	831		
121			2172	9899	401	
122			238	829		
123						
124						
125						
126						
127						

Number and Relative Peak Intensity (Continued)

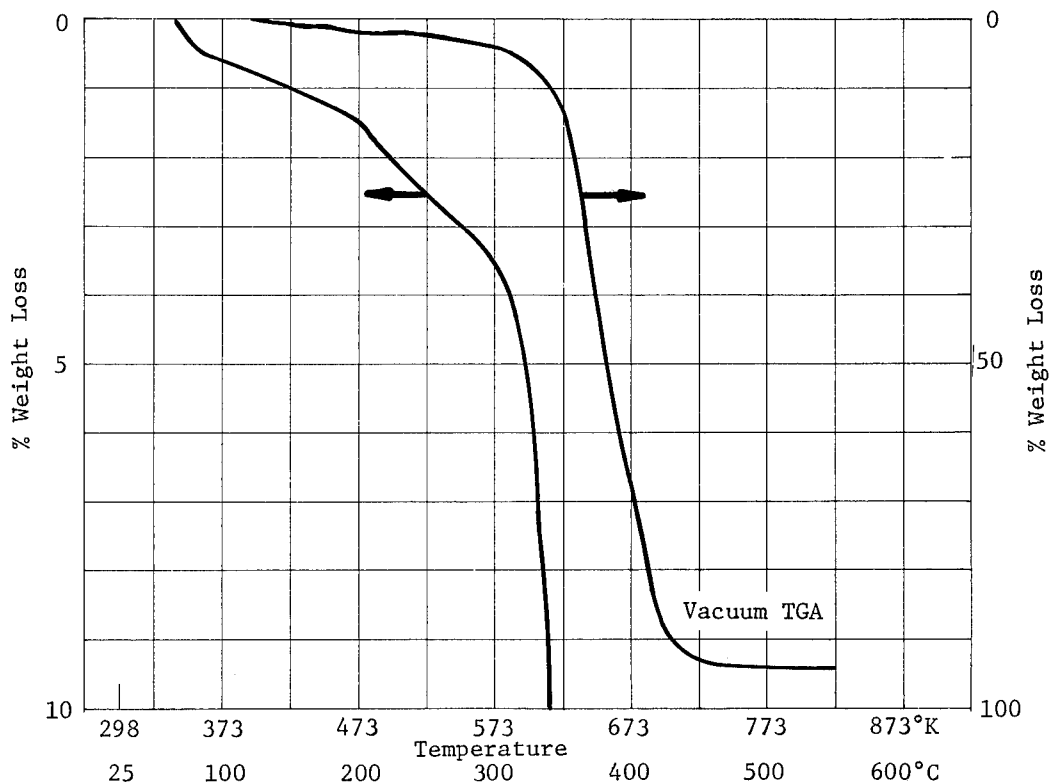
m/e	Temperature, °K (°C)					MF500F-124 Microwave Absorber	
	298 (25)	473 (200)	598 (325)	623 (350)	698 (425)	873 (600)	
128							
129	119	126	93	84	88	112	
130							
131	68	50	96	193	74	47	
132	96	104	105	114	82	77	
133			51	724			
134			456	3962	128		
135				426			
136			278	1501			
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Paint, Cat-A-Lac  
473-3-1/x304

Chemical Characterization Summary

Mix Ratio: 3 pbv resin to 1 pbv activator  
Cure: 24 hrs. at 338°K (65°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C) - 723°K (450°C)

$a_0 = 92.2\%$  of initial weight

$$k = 6.93 \times 10^{13} \exp \left( \frac{-43,100}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.7 \times 10^{15}$	
373°K (100°C)	$2.0 \times 10^{11}$	
423°K (150°C)	$2.0 \times 10^8$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Paint, Cat-A-Lac 473-3-1/x304

m/e	298 (25)	423 (150)	523 (250)	623 (350)	673 (400)	773 (500)	
14	1025	1053	1174	2538	2381	1508	
15	431	568	1026	5509	3942	1941	
16	3390	3396	4712	5985	5057	4300	
17	10514	9727	10500	14572	10393	8459	
18	31821	28783	154	42692	29961	23033	
19	121	120	251	194	217	103	
20	242	256		318	300	270	
21							
22				46			
23							
24	42		49	278	278	104	
25		72	138	939	1016	310	
26	219	375	763	4559	4527	1468	
27	425	706	1636	5797	5136	1832	
28	10371	10648	11881	20798	18320	13134	
29	195	469	1174	4479	4908	1244	
30	778	858	950	3830	1915	1123	
31	51	209	1184	1206		208	
32	2851	2809	2728	2795	2772	2641	
33			102	88			
34				67			
35			85	252	323	112	
36	69	71	83	1059	1912	268	
37			150	1939	3462	477	
38	41	70	634	5585	10124	1522	
39	66	211	2062	4576	5789	2386	
40	1853	1934	1350	2666	1871	621	
41	63	340	755	5577	1782	497	
42	60	174	1511	4258	4870	913	
43	84	676	2696	6554	3113	1043	
44	645	837	268	1490	678	153	
45		78		123	194	41	
46				357	683	70	
47				98	125		
48			41	379	601	115	
49		51	128	1697	2676	488	
50		47	85	1569	2927	642	
51			70	1093	1005	262	
52			96	1218	1773	338	
53		41	72	776	456	118	
54		96	378	1444	2308	309	
55		185	1002	1631	448	139	
56		155	434	1070	951	133	
57		49	98	1348	727	127	
58			45	445	164	43	
59				494	405	80	
60				317	737	106	
61				532	1243	198	
62			88	963	2321	413	
63				407	767	145	
64			49	2288	5438	669	
65			55	2881	6544	573	
66		44	71	971	710	118	
67			454	454	365	73	
68			99	235	129	43	
69			53	306	101		
70				279	68		
71		55		226	106	44	
72			40	191	218	45	
73				307	654	128	
74				166	371	90	
75				149	295	78	
76				631	2131	563	
77			43	381	702	224	
78				536	1076	254	
79			40	708	333	84	
80				341	172	57	
81			45	222	104	41	
82			53	133	57		
83		51	65	168	97	62	
84	49		114	128	61		
85		54		81	86	40	
86				80	78		
87							
88				146	400	108	
89				116	337	85	
90				477	1457	533	
91				169	268	103	
92				342	458	79	
93				4813	9534	759	
94				523	716	79	
95				97	86		
96				95			
97				52			
98				41			
99							
100					50		
101					94	48	
102					388	126	
103				88	99	56	
104				57	281	196	
105				118	80	72	
106				120			
107				370	1400	367	
108				441	686	186	
109				147	91		
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							



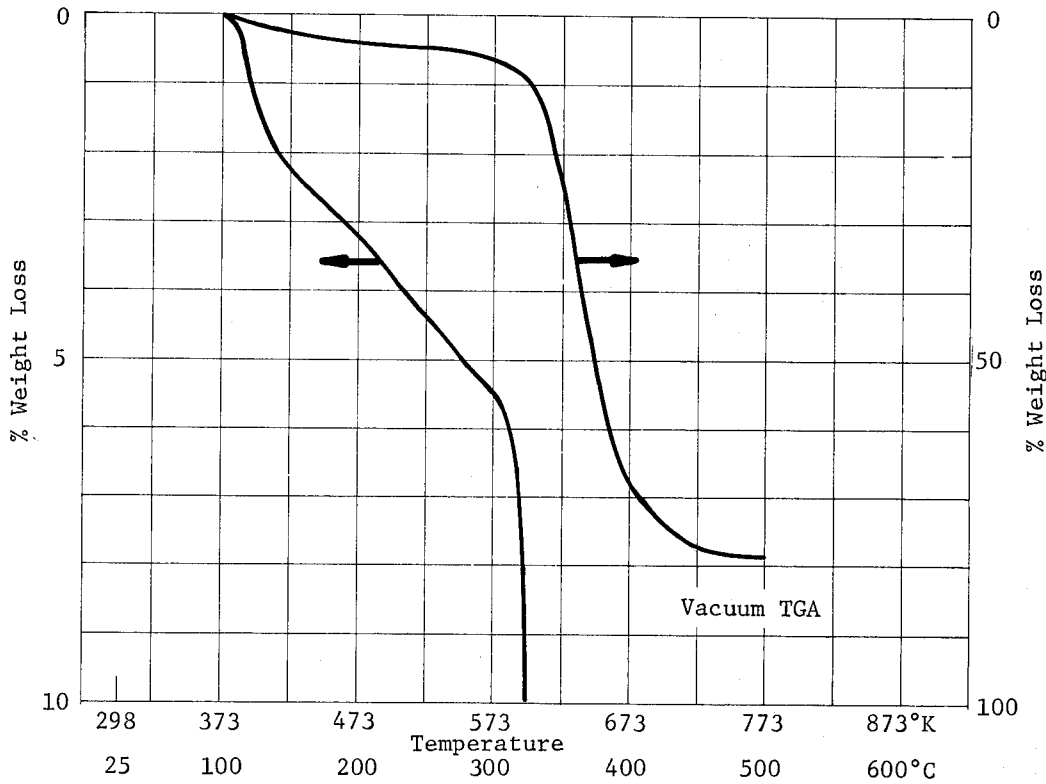
Paint, Brolite Gloss  
Black Enamel

Chemical Characterization Summary

Mix Ratio: 1 pbv resin to 1 pbv activator

Cure: Room temperature

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 573°K (300°C)-703°K (430°C)

$a_0 = 29\%$  of initial weight

$$k = 4.8 \times 10^{21} \exp\left(\frac{-61,600}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$8.6 \times 10^{19}$	
373°K (100°C)	$2.1 \times 10^{14}$	
423°K (150°C)	$1.1 \times 10^{10}$	

Number and Relative Peak Intensity

Temperature, K (°C)

Paint, Brolite Gloss Black Enamel

m/e	298 (25)	473 (200)	623 (350)	673 (400)	773 (500)		
14	2185	4324	22320	19400	5876		
15	389	7634	58760	51390	13835		
16	3475	12232	25970	22620	18199		
17	11727	21211	51110	30500	11722		
18	37335	41235	155230	97250	33252		
19	110	1576	1370	730	102		
20	169	201			288		
21							
22							
23							
24		258	2110	1730	279		
25	45	1124	11310	9320	1237		
26	272	7010	57000	44660	6446		
27		17403	76350	60940	7631		
28	21844	35166	117030	102890	38372		
29	275	19150	62890	49480	3181		
30	540	3380	18670	8750	2181		
31	49	31261	20830	7700			
32	4711	5321	7890	6280	4517		
33		1765					
34		57					
35							
36		42	2320		70		
37		398	24440	14800	553		
38		798	46650	28770	1153		
39	65	4592	143590	100180	4443		
40	1027	2417	57970	33870	2593		
41	51	12612	30270	25020	2034		
42	56	6910	32970		1246		
43	83	14955	58010	56470	2142		
44	422	3914	30040	12970	3302		
45		5101	16020	3770	367		
46		191	1960	1100	55		
47			8710	4010	42		
48			730	420	48		
49		101	6020	3760	175		
50		505	32000	22900	1350		
51		374	36460	30150	1956		
52		143	12450	9220	762		
53		314	21780	15580	768		
54		164	5930	2200	176		
55		2543	30000	18060	609		
56		9017	8980	2460	239		
57		1559	5900	3460	250		
58		251	5640	4890	178		
59		4793	4240	950	72		
60		169	4140	1410	76		
61		162	7490	8520	119		
62		139	13630	19060	368		
63			26670	5680	956		
64		41	8430	3800	285		
65		85	66740	41710	1314		
66	45	68	82720	40800	830		
67		161	8450	3740	177		
68		58	3520	1070	74		
69		170	800		49		
70		67	710		42		
71		106	610				
72		1198	1060				
73		156	2210	700	45		
74		111	6560	3910	185		
75			2990	2140	109		
76			2220	1780	129		
77		78	20520	24240	1284		
78			6140	6450	750		
79		53	10740	8660	548		
80			3810	970	89		
81		56	1350	440	72		
82			430		44		
83		64					
84		128			85		
85		120	550				
86					59		
87					42		
88							
89			2790	2280	159		
90			2220	1410	104		
91		85	15190	18090	1909		
92			1780	1790	443		
93			3570	3000	98		
94			97500	43010	695		
95			7300	2990	70		
96							
97							
98							
99							
100							
101				450	44		
102				3870	103		
103			1960	500	58		
104				2130	290		
105			1480		149		
106					506		
107			11350	11490	173		
108			4540	2780			
109							
110							
111							
112							
113							
114							
115			690	990	71		
116							
117			450	500	43		
118			5500	3590	84		
119			740				
120			4840	760	40		
121			680	11720	112		
122				950			
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

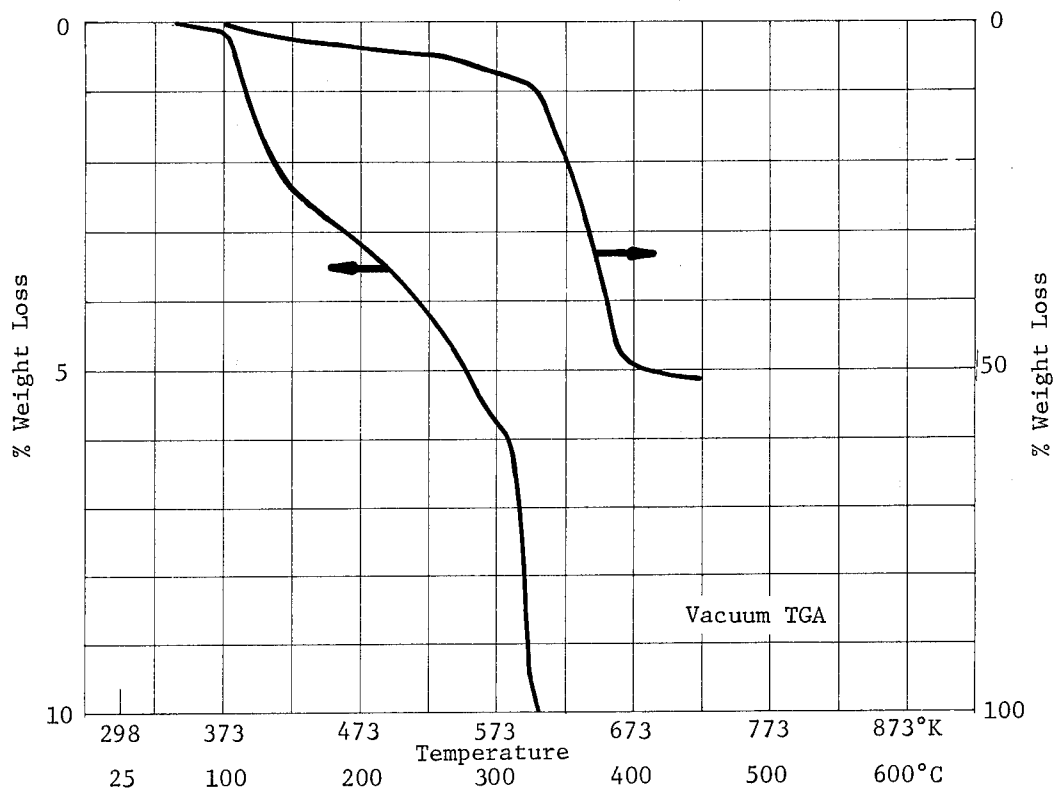
m/e	Temperature, °K (°C)					Paint, Brolite Gloss Black Enamel	
	298 (25)	473 (200)	623 (350)	673 (400)	773 (500)		
128							
129							
130							
131							
132							
133							
134			850				
135			2210	990			
136			420				
137				510			
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Paint, Brolite Gloss  
White Enamel

Chemical Characterization Summary

Mix Ratio: 1 pbv resin to 1 pbv activator  
Cure: Room temperature

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 578°K (305°C)-773°K (500°C)

$a_0 = 20\%$  of initial weight

$$k = 2.6 \times 10^{25} \exp\left(\frac{-72,600}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.6 \times 10^{23}$	
373°K (100°C)	$1.1 \times 10^{17}$	
423°K (150°C)	$1.0 \times 10^{12}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Paint, Brolite Gloss White Enamel

m/e	298 (25)	523 (250)	623 (350)	673 (400)			
14	2248	8842	36210	10300			
15	269	20962	98340	23070			
16	3822	23162	45180	17270			
17	15964	34943	109800	27130			
18	53773	74881	351380	87170			
19	391	1632	2330				
20	188	413	670				
21							
22		354					
23							
24		637	4080	730			
25		2363	19380	4610			
26	185	13959	97800	25270			
27		32032	141910	33190			
28	22115	71716	184360	66600			
29	242	39356	110850	18730			
30	522	7609	28830	3950			
31		27445	27050	2460			
32	5479	6027	12460	5370			
33		2990					
34		141	740				
35		56					
36		46					
37		1119	46770	6150			
38		2124	88550	12360			
39		9387	272180	48090			
40	883	4725	108360	15490			
41		23441	55590	14160			
42		19032	56790	6650			
43	45	40550	85270	17470			
44	494	39944	48090	5740			
45		3302	15600	960			
46		361	3680				
47		101	17650	990			
48		81	1610				
49		339	11260	1390			
50		1778	58810	11080			
51		911	67710	15610			
52		735	22870	4760			
53		792	40540	7700			
54		738	11110	960			
55		5033	60610	7760			
56		16894	18720	1100			
57		3815	10370	1070			
58		1379	8670	750			
59		472	3150	820			
60		242	6130				
61		66	14590	1170			
62		407	25890	3610			
63		77	50050	8850			
64		82	16080	2400			
65		160	127630	17570			
66		147	156550	16340			
67		222	1577	1280			
68		219	7550	420			
69		368	2070				
70		218	1320				
71		149	910				
72		346	1000				
73		206	3630				
74		315	12120	1360			
75			6268	840			
76			4670	670			
77		93	36020	11680			
78		57	10990	2930			
79		85	18590	4000			
80		52	6800	480			
81		61	2620				
82		74	830				
83		87	440				
84		234	510				
85		360	1020				
86		139	580				
87		104	590				
88							
89			5450	910			
90			3990	590			
91		158	28270	8600			
92			4000	660			
93			7190	690			
94		112	186600	15890			
95		63	14210	750			
96							
97							
98							
99							
100		87					
101							
102			630				
103			4010	970			
104			590				
105			3440	570			
106			760				
107			18990	4990			
108			7320	990			
109			440				
110							
111							
112							
113							
114							
115			1760	470			
116							
117			460				
118			750				
119			10230	1440			
120			1630				
121			8430	3270			
122			1260				
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

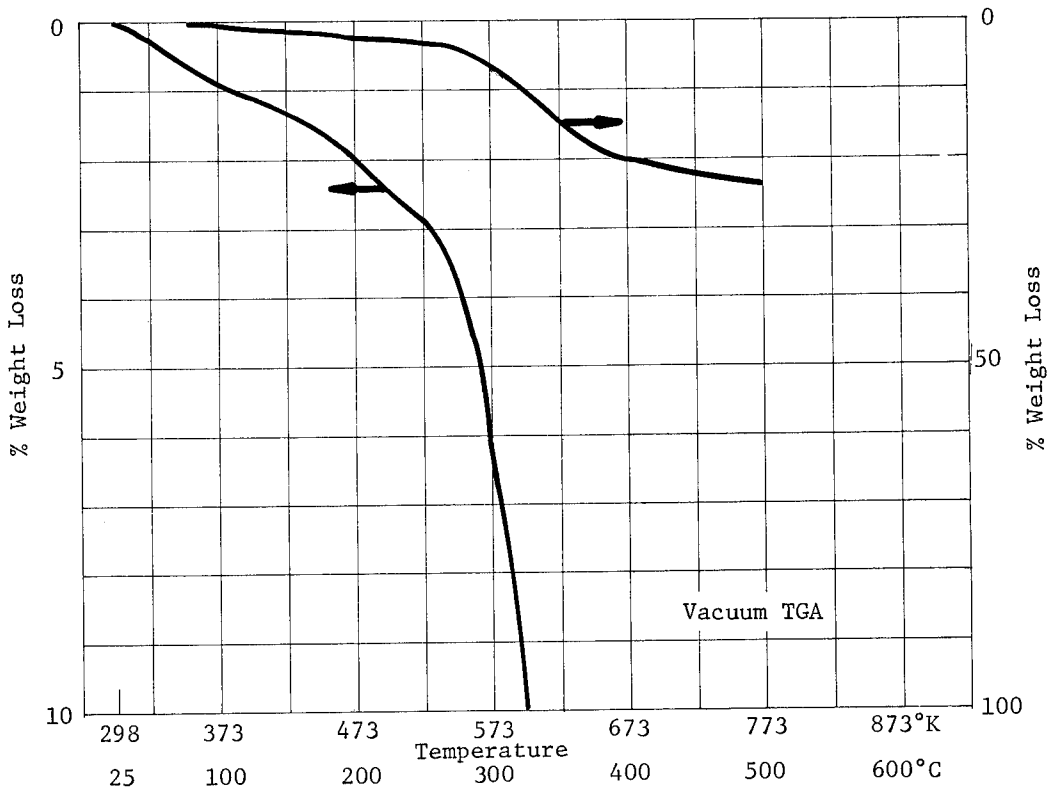
m/e	Temperature, °K (°C)				Paint, Brolite Gloss White Enamel		
	298 (25)	523 (250)	623 (350)	673 (400)			
128							
129							
130							
131							
132							
133			440				
134			550				
135			4640	470			
136			930				
137			420				
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Paint, Nextel 401-C10

Chemical Characterization Summary

Mix Ratio: 3 pbv resin A to 1 pbv activator B  
 Cure: 2 hrs. at 298°K (25°C), 16 hrs. at 383°K (111°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C)-773°K (500°C)

$a_0 = 22.8\%$  of initial weight

$$k = 5.47 \times 10^6 \exp\left(\frac{-20800}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.6 \times 10^7$	
373°K (100°C)	$2.0 \times 10^5$	
423°K (150°C)	$7.1 \times 10^3$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Paint, Nextel 401-C10

m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)
14	2340	2142	2543	2778	2287
15	523	1047	1711	1791	1332
16	4382	4089	5150	5156	4872
17	18103	14153	15614	15631	13295
18	62058	47168	52326	51346	43915
19	233	287	292	247	253
20	285	275	425	397	330
21					
22					
23					
24			108	93	
25		91	550	598	213
26	315	796	2668	3125	1418
27	376	1000	3218	4563	1791
28	24385	24456	32815	32704	26312
29	260	1049	3811	4237	1221
30	242	351	826	1204	475
31	50	827	1424	876	195
32	6037	5386	5418	5240	5181
33					
34					
35			622	67	42
36			2438	664	313
37		45	1247	462	97
38		87	1842	788	307
39		383	1511	2580	1001
40	2587	2694	3317	3513	2929
41		211	1863	3308	1124
42		154	987	1773	583
43		1738	2902	3195	763
44	798	1480	7019	6335	3033
45		240	1006	660	128
46			51	51	
47			93		
48			135		
49			634	83	
50		321	3281	817	203
51		214	482	339	123
52		71	314	151	
53		46	341	372	96
54			141	233	54
55		49	796	1649	373
56		45	565	1128	241
57			705	625	57
58			207	200	
59		347	356		
60			680	385	54
61			616	41	41
62			214		
63		78	127	59	
64					
65		107	213	132	43
66			131	80	45
67			153	309	89
68			78	155	
69			192	223	
70			158	374	43
71			226	148	
72		229	210	46	
73			393	82	
74			930	117	
75			459		
76		146	3617	533	65
77		117	511	209	60
78		65	107	74	41
79		49	52	141	46
80					
81			112	88	
82		41	51	58	
83			197	48	
84	52	41	209	118	49
85			98	43	
86			49		
87					
88					
89					
90					
91		1012	471	213	61
92		76		47	
93					
94					
95			64		
96			150		
97			48		
98					
99					
100					
101					
102					
103					
104		75	2376	268	
105		64	243	42	
106		251	123		
107			69		
108					
109					
110					
111					
112					
113					
114					
115					
116					
117					
118					
119					
120					
121					
122					
123					
124					
125					
126					
127					



Number and Relative Peak Intensity (Continued)

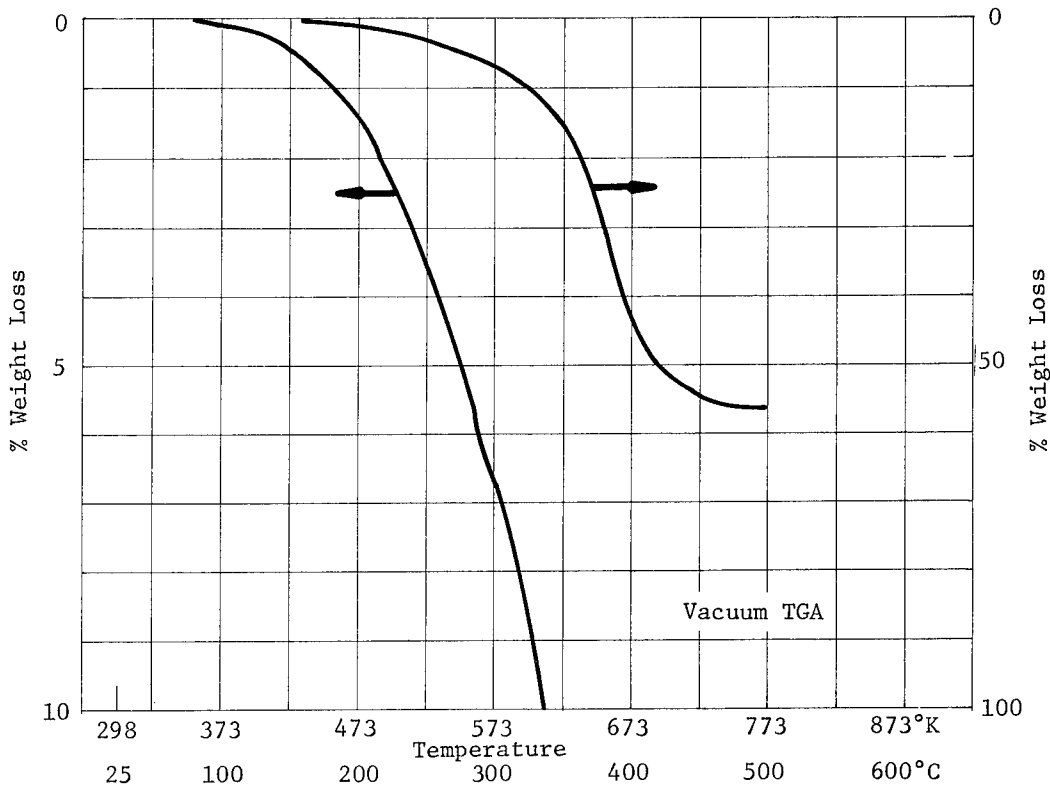
m/e	Temperature, °K (°C)					Paint, Nextel 401-C10
	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)	
128						
129			47	46		
130						
131			42			
132		52	44			
133						
134						
135						
136						
137						
138						
139						
140						
141						
142						
143						
144						
145						
146						
147						
148			43			
149						
150						
151						
152						
153						
154						
155						
156						
157						
158						
159						
160						
161						
162						
163						
164						
165						
166						
167						
168						
169						
170						
171						
172						
173						
174						
175						
176						
177						
178						
179						
180						
181						
182						
183						
184						
185						
186						
187						
188						
189						
190						
191						
192						
193						
194						
195						
196						
197						
198						
199						
200						
201						
202						
203						
204						
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
219						
220						
221						
222						
223						
224						
225						
226						
227						
228						
229						
230						
231						
232						
233						
234						
235						
236						
237						
238						
239						
240						

Scotchcast 241

Chemical Characterization Summary

Mix Ratio: 50 pbw resin to 100 pbw activator  
 Cure: 1 hr. at 433°K (160°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 548°K (275°C)-723°K (450°C)

$a_o = 50.9\%$  of initial weight

$$k = 1.24 \times 10^{26} \exp\left(\frac{-74100}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.0 \times 10^{24}$	
373°K (100°C)	$1.8 \times 10^{17}$	
423°K (150°C)	$1.3 \times 10^{12}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Scotchcast 241

m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
14	3609	3752	4253	3277	1163		
15	395	718	3686	5155	813		
16	8325	7244	7868	4482	1876		
17	22507	17742	16244	6283	2456		
18	74243	51607	44384	20390	7382		
19	1329	1556	1630	356	138		
20	194	99	111	66			
21							
22							
23							
24		76	407	478			
25		310	2225	2634	116		
26	426	2145	12268	13959	1402		
27	679	2238	11612	19269	2551		
28	31235	36889	47155	35085	8628		
29	508	1450	15387	17134	2591		
30	1540	1789	2780	1708	357		
31		53	979	2762	147		
32	7354	7925	6088	1413	1069		
33							
34							
35							
36			166	420			
37		83	1030	2880	128		
38		213	1391	4879	328		
39	158	1368	8468	17981	1977		
40	3142	3728	5361	6089	1019		
41	71	924	12420	14280	2579		
42	75	499	4513	7365	834		
43	131	636	10429	15315	2066		
44	1442	2600	9763	14741	1165		
45	51	80	1408	2679	250		
46				94			
47			40	165			
48							
49			220	647			
50		308	1394	3128	203		
51	4	315	1470	3242	338		
52		131	956	1358	84		
53		120	3131	3704	429		
54		97	4328	1334	83		
55		382	7605	8698	999		
56		98	2111	7277	186		
57		79	3538	4777	480		
58		47	2816	3085	259		
59			542	1323	57		
60			44	281			
61			74	575			
62		47	101	1211			
63		92	434	2281	116		
64			85	674			
65		127	1329	5649	345		
66		48	415	6880	140		
67		62	3433	3304	322		
68			607	1166			
69			5144	3245	371		
70			1400	1391			
71			580	728	50		
72			233	230			
73			54	292			
74			73	636			
75				260			
76		153	67	234			
77		205	2371	2624	81		
78		72	676	885	96		
79		86	2098	2325	402		
80			236	359			
81			2963	1933	279		
82			897	635	116		
83			2101	1248			
84			904	605			
85			200	334			
86			41				
87			260	430			
88							
89			73	263			
90				101			
91		118	2059	2481	491		
92			347	318			
93			989	1268	87		
94		54	288	11093	297		
95			2045	2191	213		
96			687	596			
97			862	436	65		
98			592	222			
99							
100							
101			72	61			
102			48	56			
103			97	274			
104							
105			412	510	97		
106			55	75			
107			515	1279	226		
108			106	464			
109			1075	746	109		
110			206	179			
111			149	70			
112			100	61			
113							
114							
115			136	304			
116			94	71			
117			66	95			
118				44			
119			66	577			
120				76			
121			129	837	92		
122			40	120			
123			456	296			
124			42				
125			56				
126							
127							

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Scotchcast 241

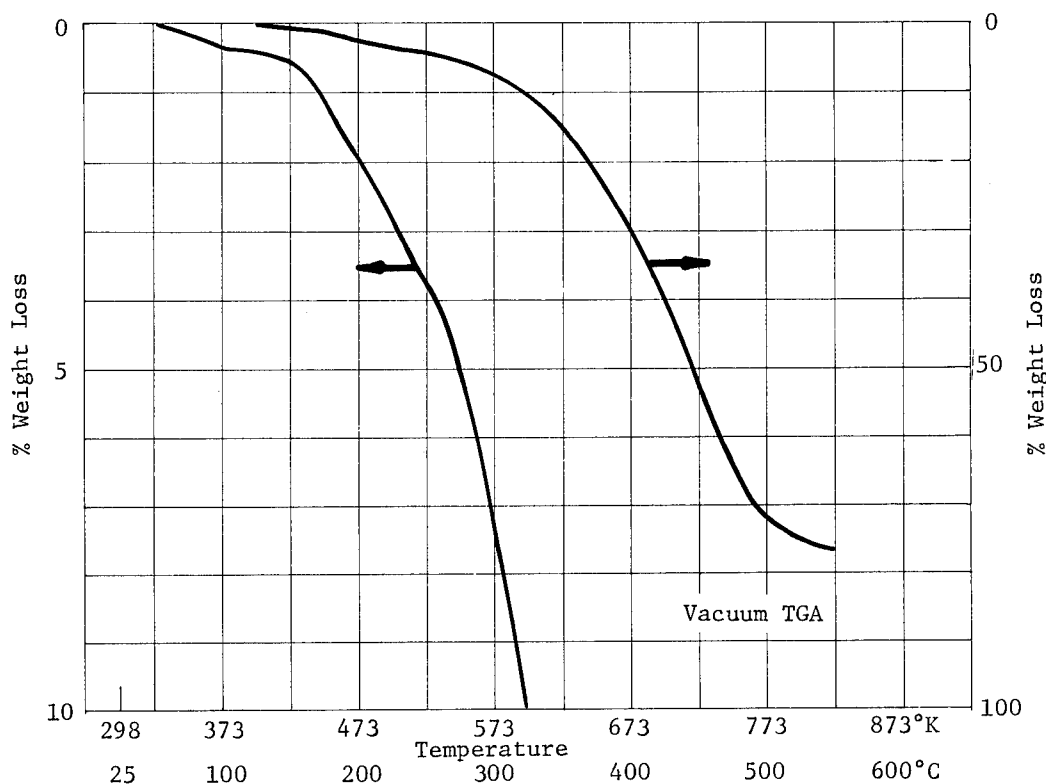
m/e	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
128			51	46			
129							
130							
131							
132				246			
133				64			
134				145			
135				523			
136				73			
137			265	126			
138				104			
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151			40				
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166			110				
167							
168			116				
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Scotchcast 583 Tape

Chemical Characterization Summary

Mix Ratio: Not applicable  
 Cure: 3 hrs. at 414°K (141°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 580°K (307°C)-853°K (580°C)

$a_o = 77\%$  of initial weight

$$k = 7.1 \times 10^2 \exp\left(\frac{-12200}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.6 \times 10^5$	
373°K (100°C)	$1.3 \times 10^4$	
423°K (150°C)	$1.8 \times 10^3$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Scotchcast 583 Tape

m/e							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							
65							
66							
67							
68							
69							
70							
71							
72							
73							
74							
75							
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92							
93							
94							
95							
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

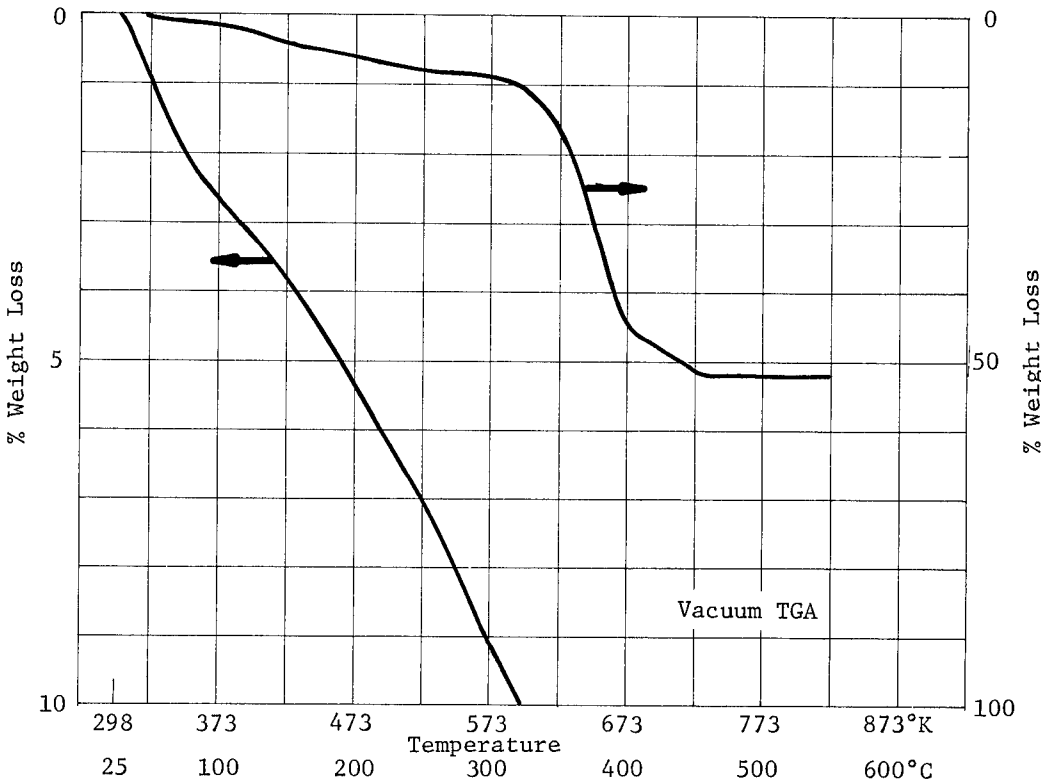
DATA NOT AVAILABLE

Skyspar A423/66

Chemical Characterization Summary

Mix Ratio: 1 pbv resin to 1 pbv activator  
 Cure: Room temperature

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 523°K (250°C)-693°K(420°C)

$a_0 = 44.0\%$  of initial weight

$$k = 8.5 \times 10^{15} \exp\left(\frac{-48200}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$3.8 \times 10^{16}$	
373°K (100°C)	$1.6 \times 10^{12}$	
423°K (150°C)	$7.0 \times 10^8$	

Number and Relative Peak Intensity

Temperature, °K (°C) Skyspar A423/66

m/e	298 (25)	473 (200)	573 (300)	623 (350)	673 (400)	823 (550)
14	1467	1626	2427	4875	4114	2004
15	207	1035	2935	9736	5737	2107
16	2498	2844	3478	5929	4364	3769
17		9341	10869	17109	12400	7819
18	39218	32243	36845	59322	43888	27063
19				42	73	
20	87	78	121	163	149	77
21						
22						
23						
24				261	299	
25	130		224			188
26	133		2081	9062	9092	2153
27	23861	26307				
28	172	3516	27475	41247	35836	25146
29	48		3628	11706	8105	1771
30	40		592	3923	1668	242
31	5618	4932				223
32			4829	4905	4926	4497
33		170			72	
34						
35					147	
36						
37			43			223
38						
39	1751		2232	7205	16228	2488
40				5956	8288	2560
41		3721			4261	886
42				12612		
43	349	3762	5035	13511	8068	1287
44		1857	5082	9021	2796	1053
45		167	1419	4868	944	48
46				53		
47				154	943	
48					42	
49				129		
50		44	118	1615	4526	457
51			78	1579	4418	491
52			69	1186		110
53			57	1433	2327	125
54			58			167
55			506	3288	3808	292
56		3663	547	3333	1122	160
57		303	137	1415	1178	72
58			81	1201	1005	
59					226	
60			424	1910		
61				177		40
62						111
63				648	3306	195
64						
65			69		10840	901
66			65	3555	10873	920
67				1007	817	
68				629	230	
69				193	60	
70				284		
71				262		
72				135	44	
73				87	88	
74				129	709	
75					343	
76						
77				453	3457	314
78				207		84
79				581	1266	65
80				180	118	
81				149	40	
82				73		
83				101		
84					40	
85				189	63	
86				43		
87						
88						
89					316	
90					116	
91				273	3335	433
92				53	294	41
93					340	
94			91	6890	16169	1288
95					964	
96				461		
97						
98						
99						
100						
101					54	
102					659	
103						
104				44		
105				52	417	48
106				43	139	
107				325	2428	161
108				277	464	
109						
110						
111						
112						
113						
114					184	
115						
116					45	
117					128	46
118				48	2014	176
119				141	463	
120					3475	59
121				42	322	
122						
123						
124						
125						
126						
127						



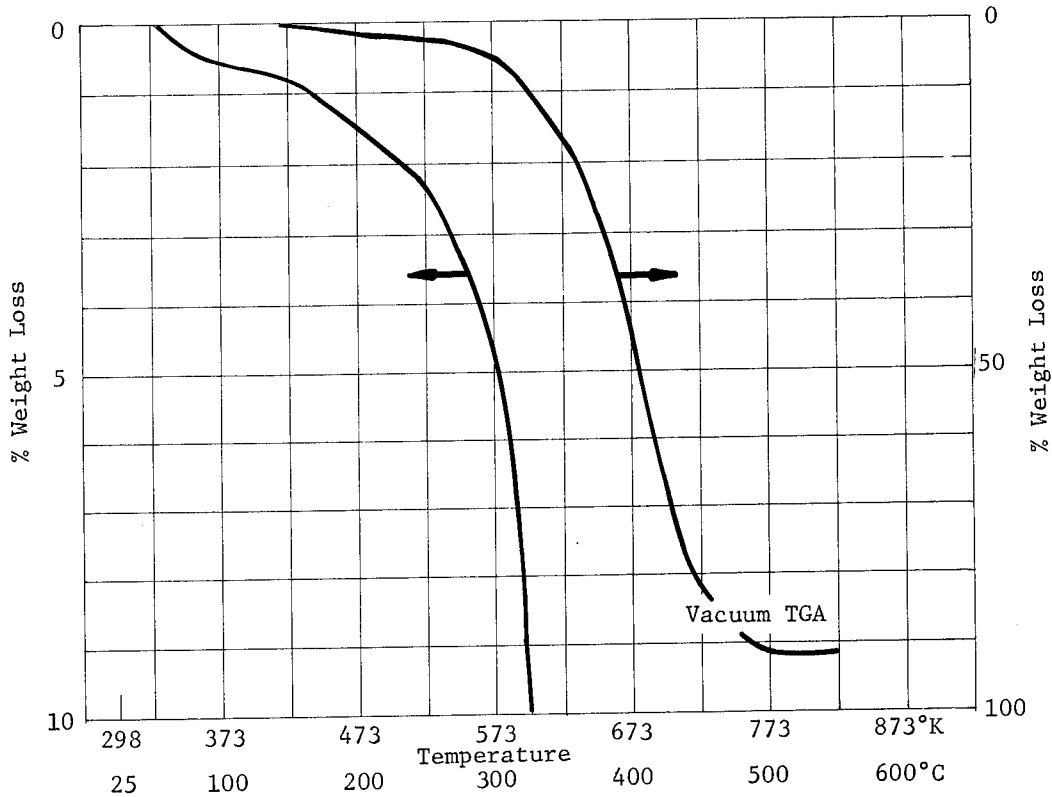
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Skyspar A423/66	
	298(25)	473 (200)	573(300)	623 (350)	673 (400)	823 (550)	
128							
129							
130			42	57	87		
131							
132		45	48	69	279	72	
133				61	160	52	
134					360		
135				262	2001	191	
136				73		46	
137				48	722		
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 57 pbw Resin to 44 pbw Activator  
 Cure: 16 hrs. at 394°K (121°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C) - 773°K (500°C)

$a_0 = 89.6\%$  of initial weight

$$k = 8.13 \times 10^6 \exp\left(\frac{-23,300}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$5.2 \times 10^8$	
373°K (100°C)	$3.9 \times 10^6$	
423°K (150°C)	$9.4 \times 10^4$	

Number and Relative Peak Intensity

Temperature, °K (°C) SMRD 100P-90

m/e	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)
14	873	880	872	2338	1269	1064
15	302	348	352	3038	1547	748
16	2660	2432	2546	5448	3055	2662
17	7330	6353	6468	7818	6315	6265
18	22844	19574	19451	24000	17863	17855
19	83	98	91	145	80	76
20	122	112	114	150	137	121
21						
22				155		
23						
24				200	105	51
25		44	50	817	335	169
26	155	209	249	7087	1887	767
27	318	395	440	15364	4886	1390
28	7743	7662	7797	33766	11962	10073
29	151	209	243	6427	3775	768
30	437	439	460	1018	732	577
31		50	47	1125	200	133
32	1977	1912	1837	1695	1752	1955
33						
34						
35				129	60	
36				1081	305	121
37			43	2127	565	206
38			191	12246	3968	1101
39	68	141		3421	1797	1259
40	809	848				
41	55	128	159	14340	5589	978
42		82	83	6565	2278	419
43	59	125	117	3313	3964	447
44	555	585	696	20016	1343	948
45				528	140	74
46				121		
47				68		
48				410	91	47
49			46	1902	489	223
50			53	2296	669	295
51				1088	326	159
52			44	2640	863	256
53				1380	561	161
54		42	73	21253	2452	512
55				6921	1630	251
56				1484	1643	144
57				189	179	
58						
59				116	80	41
60				189	63	
61				331	108	57
62				652	246	124
63				151	86	42
64				1120	439	205
65			44	623	209	110
66				2210	987	276
67			40	1855	475	139
68				3867	940	202
69				864	716	112
70				547	564	58
71				85	92	
72				54	46	
73				115	63	
74				75	47	
75				83	50	
76				2122	656	310
77			49	711	248	151
78				2774	787	366
79				620	201	85
80				1108	519	135
81				453	266	65
82				623	266	53
83				5004	241	66
84				378	258	
85				76	68	
86				40		
87						
88				101	54	
89				54		
90			42	2173	807	498
91				439	153	96
92				1712	412	197
93				541	130	66
94				651	269	78
95				363	120	44
96				297	132	
97				156	102	
98						
99					44	
100						
101						
102						
103				71	62	
104				49	44	
105				181	207	71
106				310	133	96
107				203	172	46
108				406	101	60
109				133	82	
110				76	43	
111				55	41	
112				48		
113						
114						
115					64	
116						
117					55	
118						
119					70	
120						
121				41	57	
122				86	42	
123						
124				201		
125						
126				50		
127						

Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

SMRD 100F-90

m/e				623 (350)	723 (450)		
128							
129							
130							
131							
132							
133							
134							
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

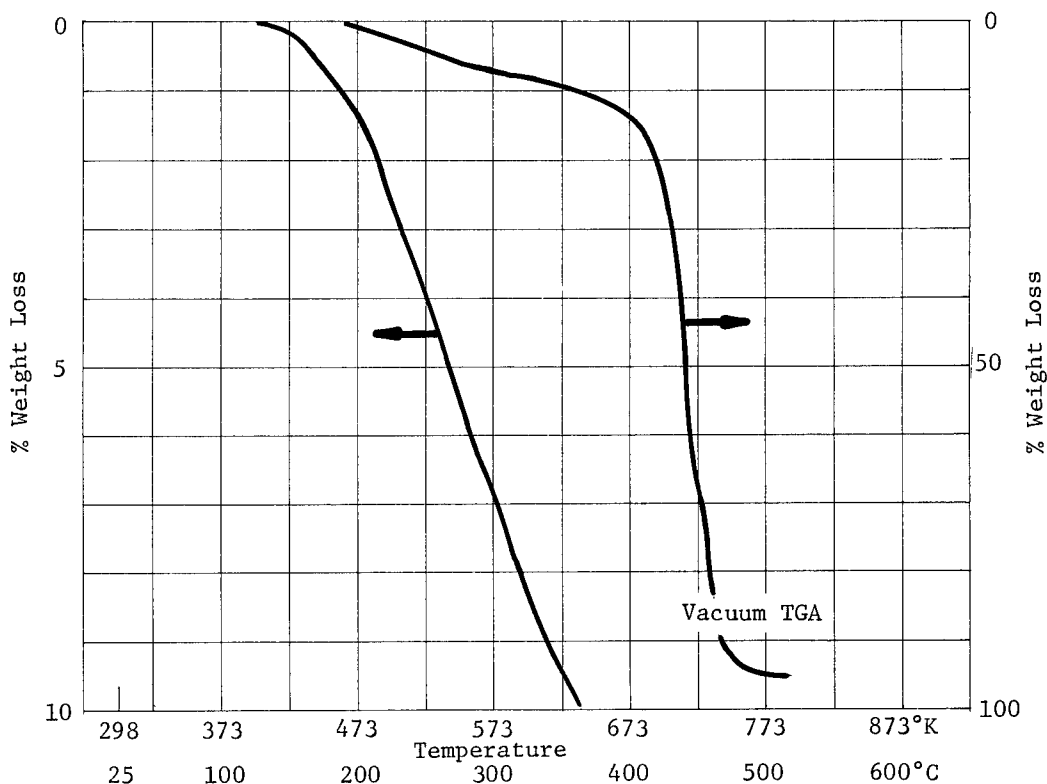
Stycast 36D

Chemical Characterization Summary

Mix Ratio: One component

Cure: 16 hrs. at 496°K (223°C), 16 hrs. at 516°K (243°C)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 623°K (350°C)- 773°K (500°C)

$a_0 = 89.3\%$  of initial weight

$$k = 1.07 \times 10^{14} \exp \left( \frac{-48100}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.7 \times 10^{18}$	
373°K (100°C)	$1.1 \times 10^{14}$	
423°K (150°C)	$5.0 \times 10^{10}$	

Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Stycast 36D
	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)	
14	345	346	385	631	497	
15		191	174	3485	195	
16	553	508	510	776	856	
17	928	956	956	1032	1371	
18	3069	2567	2734	2985	3728	
19	153	132	139	95	106	
20					41	
21						
22						
23						
24				101		
25				334	61	
26		95	119	2480	285	
27		291	294	6764	366	
28	961	1399	1550	5227	2855	
29		147	158	1631	127	
30	66	78	108	156	205	
31						
32	257	265	322	385	527	
33						
34						
35				45		
36				404	42	
37				981	58	
38			41			
39		208	240	6242	354	
40	102	150	186	984	411	
41		192	223	4817	264	
42				455	43	
43				167	41	
44		49	59	135	133	
45						
46						
47						
48						
49				320		
50		58	66	2991	153	
51		106	135	4904	238	
52				1572	78	
53			43	779	43	
54				84	49	
55				317	57	
56				92		
57				573	51	
58				108		
59						
60				233		
61						
62						
63		68	69	786	121	
64		50	58	708	41	
65		57	58	1450	47	
66				203	42	
67				216		
68						
69				48		
70				213		
71				172		
72				241		
73				153		
74				1097	55	
75				1007	44	
76				1134	55	
77		119	127	4680	239	
78		40	64	4097	177	
79		57	51	950	51	
80				62		
81						
82						
83						
84						
85						
86				119		
87				283		
88				97		
89				865	61	
90				182		
91			202	4181	762	
92				467	105	
93				174		
94						
95						
96						
97				138		
98				58		
99						
100						
101		51	51	329		
102		41	69	1826	77	
103		121	51	4279	134	
104		106	118	6565	232	
105		118	100	4085		
106				329		
107						
108						
109						
110						
111						
112						
113				64		
114				87		
115		106	108	3596	230	
116		45	42	1149	82	
117		196	190	8418	235	
118				986	56	
119		64	62	140	43	
120						
121						
122						
123						
124						
125						
126				161		
127			57	933		

Number and Relative Peak Intensity (Continued)

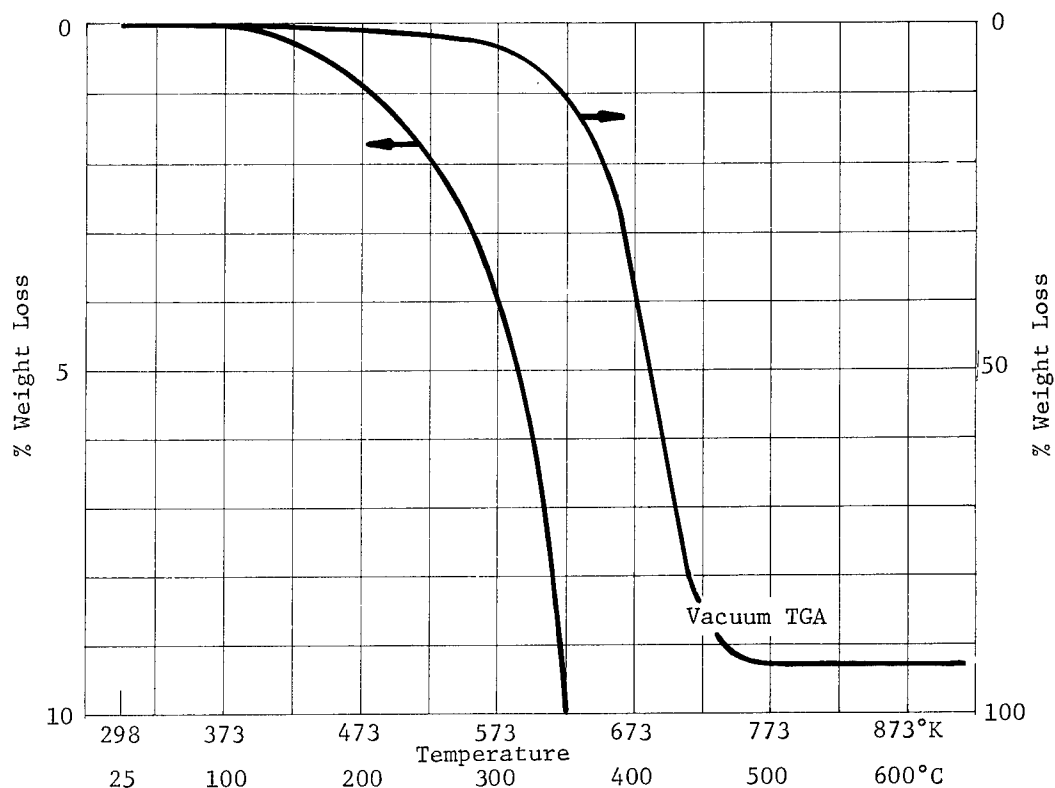
m/e	Temperature, °K (°C)					Stycast 36D	
	298 (25)	473 (200)	573 (300)	673 (400)	773 (500)		
128		80	60	2321	73		
129				1534	54		
130				1268	72		
131				414	41		
132				373			
133				721			
134				72			
135							
136							
137							
138				68			
139							
140							
141				176			
142				69			
143				251			
144				244			
145		328	312	16616	281		
146			43	1956			
147		94	102	196			
148				115			
149							
150							
151							
152							
153							
154							
155							
156							
157							
158				189			
159				3477	58		
160		61	56	411			
161				44			
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: Not Available

Cure: Not Available

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 403°K (130°C)-588°K (315°C)

$a_o = 92\%$  of initial weight

$$k = 1.02 \times 10^3 \exp\left(\frac{-13700}{1.98 T^{\circ}\text{K}}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$1.2 \times 10^6$	
373°K (100°C)	$6.8 \times 10^4$	
423°K (150°C)	$7.4 \times 10^3$	



Number and Relative Peak Intensity

Temperature, °K (°C)

Stycast 1263/Cat 31

m/e	298 (25)	423 (150)	573 (300)	673 (400)	823 (550)		
14	1503	1447	2160	832	2838		
15	447	749	3318	4082	5987		
16	4831	4370	5115	2122	10827		
17	21815	19588	17753	6175	17366		
18	72785	66025	56330	20797	53319		
19	259	251	182		120		
20	548	500	559		662		
21							
22							
23							
24			545	189	157		
25		187	2276	1455	783		
26	253	1473	13898	11175	4737		
27	662	2404	25442	28598	6963		
28	23601	24746	48973	28614	39069		
29	346	760	8456	9364	2826		
30	1024	1159	1493	556	2254		
31		82	521	497	196		
32	4892	4822	4161	463	4713		
33							
34							
35		50	370	92	191		
36		88	2139	1824	458		
37		221	4358	4704	1071		
38		2265	28706	35638	5519		
39	5329	5967	11684	7988	8298		
40		1547	20493	26010	3309		
41	57	181	2546	3093	716		
42	44	218	2644	4959	1145		
43	97	2251	7772	8876	2947		
44	1283	52	628	997	192		
45			78				
46			239	47	49		
47			78				
48		41	796	632	196		
49		379	4631	5406	1565		
50		488	535	7467	1937		
51		222	3426	4734	932		
52		542	7315	10482	1328		
53		2651	33346	51355	3640		
54		269	7711	7262	906		
55		42	3770	2265	194		
56			1523	799	140		
57			80	502	55		
58							
59			47				
60			277	195	111		
61			637	588	263		
62		53	1299	1796	672		
63			333	385	161		
64		114	3869	4140	1179		
65		136	4828	4541	816		
66		3047	36062	57650	3668		
67		109	2609	3690	224		
68			846	324	67		
69			593	68			
70			174				
71			94	456	127		
72			338	429	167		
73			131	67	67		
74			131	102	125		
75		146	1903	3267	1517		
76		73	785	1057	575		
77		256	3429	4750	960		
78		92	1244	1472	262		
79		215	3322	4826	324		
80		2429	28572	43128	2843		
81		106	2143	2774	133		
82			239				
83			53				
84							
85							
86							
87					40		
88				147	45		
89					123		
90					118		
91			91	515	1402		
92			44		235		
93					60		
94			3612	2123	594		
95			231				
96							
97			48				
98							
99							
100							
101							
102							
103					87		
104					40		
105			51		345		
106					112		
107			53	298	732		
108			141	324	338		
109							
110			102				
111							
112							
113							
114							
115					48		
116							
117							
118							
119					40		
120					42		
121				148	148		
122					80		
123							
124							
125							
126							
127							

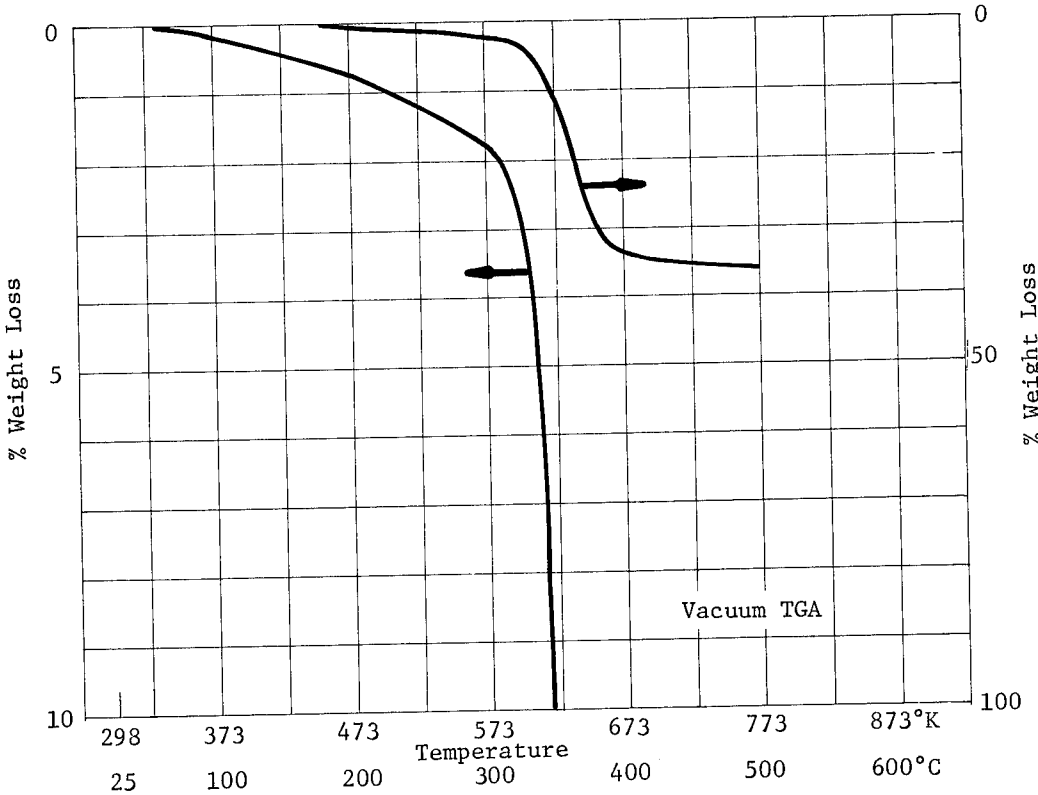
Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Stycast 1263/Cat 31	
	298 (25)	423 (150)	573 (300)	673 (400)	823 (550)		
128							
129							
130							
131			41		41		
132							
133							
134							
135					41		
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 3 pbw catalyst  
 Cure: 4 hrs. at room temperature, 4 hrs. at 405°K (132°C)

1. TGA Preconditioning: 24 hrs. at 23°K (296°K) and 45% of RH



2. Activation Energy of Decomposition:

Over the Range: 483°K (210°C)-853°K (580°C)

$a_0 = 36.0\%$  of initial weight

$$k = 6.2 \times 10^{19} \exp\left(\frac{-58100}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.7 \times 10^{19}$	
373°K (100°C)	$1.4 \times 10^{14}$	
423°K (150°C)	$1.3 \times 10^{10}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Stycast 2651/Cat 9

m/e	298 (25)	473 (200)	623 (350)	673 (400)	723 (450)		
14	1085	1335	6274	1606	1473		
15	127	476	16052	1623	1447		
16	1886	1978	11416	2632	2801		
17	8272	7066	25835	6910	6076		
18	29751	24624	82060	23228	20271		
19			453				
20			188	40			
21							
22							
23							
24							
25							
26	64	445	25886	3051	1894		
27							
28	19820	20236	62625	22142	21094		
29	100	1893	20746	1738	1262		
30	51		11831	689	421		
31			9333		105		
32	4775	4579	5370	3977	3806		
33							
34							
35							
36							
37					99		
38							
39			45848	5252	2262		
40	801	863	20523	2370	1486		
41		777		1655	1062		
42					720		
43							
44	166	728	24142	2274	1589		
45		46	4918	112			
46							
47			2913	41			
48							
49							
50							
51			13233	2068	783		
52					201		
53			8787	1122	351		
54				179	74		
55		205	10721	862	303		
56			8693	235	96		
57		696		193	47		
58		131	4863	40	53		
59			1415	43	56		
60							
61							
62					70		
63			9697	1216	307		
64					49		
65					698		
66				2553	529		
67			29700	1996	59		
68				216	46		
69				41			
70			999	40			
71			649				
72							
73							
74			2782	138			
75			1519	57	44		
76							
77			9137	2200	748		
78					109		
79			4730	892	250		
80			2873	134	45		
81			1139	43			
82			498				
83			243				
84			251				
85			184				
86			199				
87			276				
88							
89			1757	178			
90					50		
91			10043	2036	601		
92				115			
93				254	41		
94			49375	2594	782		
95			3891	83			
96			307				
97			236				
98			117				
99			48				
100			52				
101			121				
102			373				
103			1857	238			
104			350				
105			1884	186	48		
106				63			
107			7757	1809	663		
108			3493	561	181		
109			512				
110			73				
111			99				
112			119				
113			45				
114			61				
115			998	103	41		
116			99				
117			151				
118			1469	80			
119			10505	1495	272		
120			1961	161			
121			6588	1586	408		
122			1802	223	49		
123			82				
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

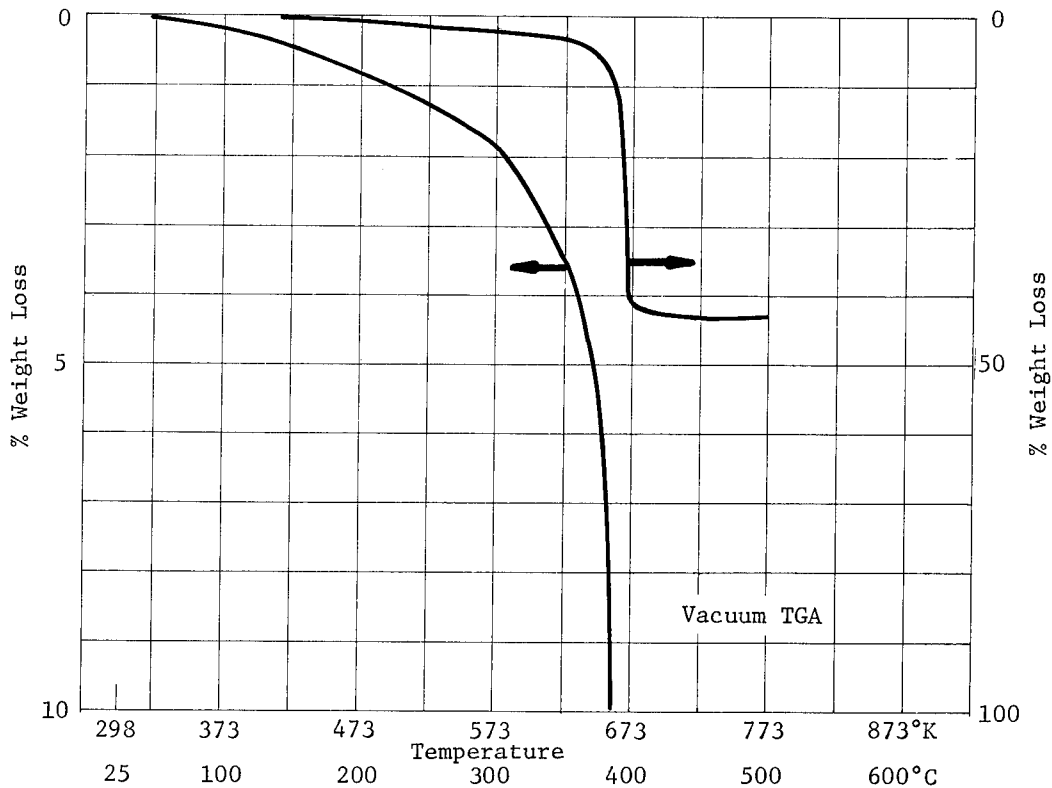
m/e	Temperature, °K (°C)					Stycast 2651/Cat 9	
	298 (25)	473 (200)	623 (350)	673 (400)	723 (450)		
128							
129							
130							
131			94	43			
132			620	44	59		
133			349	50	44		
134			2987	325	224		
135			11075	1425	55		
136			1364	229			
137			1442	77			
138			41	185			
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167			59				
168			1234				
169			78	212			
170			3110				
171				209			
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Chemical Characterization Summary

Mix Ratio: 100 pbw resin to 4.5 pbw catalyst

Cure: 4 hrs. at 345°K (74°C), 4 hrs. at 405°K (132°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 593°K (320°C)-853°K (580°C)

$a_0 = 45.3\%$  of initial weight

$$k = 1.7 \times 10^{34} \exp\left(\frac{-102920}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$2.5 \times 10^{34}$	
373°K (100°C)	$3.0 \times 10^{25}$	
423°K (150°C)	$2.4 \times 10^{18}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Stycast 2651/Cat 11

m/e	298 (25)	473 (200)	623 (350)	648 (375)	673 (400)		
14	1354	1621	4183	5426	1996		
15	73	567	8012	10845	2076		
16	1429	1536	6653	7712	2741		
17	5142	4955	17794	17636	5995		
18	18358	17237	64895	62810	21135		
19			116	305	40		
20			79	96	40		
21							
22							
23							
24			309	955	63		
25							
26	67	781	8512	18646	3912		
27							
28	21554	23549	40747	46925	25609		
29	104	409	16384	16988	2079		
30		116			304		
31		67	5391	5355			
32	5074	4943	5343	5758	4584		
33			193				
34							
35							
36							
37							
38		40					
39			12629	44581	8349		
40	343	598		16751	2891		
41			8323	11133	1924		
42		1758					
43							
44	264	2354	20325	15660	2574		
45			1549	2357	189		
46							
47			766	2933	174		
48				341			
49							
50			3384				
51			2598	13560	3241		
52							
53			1543	7344	1678		
54							
55		50	3362	9407	1382		
56		73	3514	2764	119		
57		85	2808	2126	116		
58		46			76		
59			135		119		
60			149				
61							
62							
63			2491	10637	2164		
64							
65							
66			10406	29063	4512		
67			658		4082		
68			308	994	70		
69			146	131			
70		50	69	82			
71		47	175	171			
72			40				
73							
74			638	2851	384		
75			186	1674	215		
76			73		114		
77			1209	11269	3495		
78			388	4776	904		
79			659		1376		
80			64	639	171		
81			40	401	68		
82				146			
83							
84							
85				49			
86				210			
87			119	214	40		
88			255	40			
89				2050	409		
90			212		445		
91			1136	12014	3035		
92			70		264		
93			93				
94			18512	41060	5425		
95			1119	2729	196		
96				77			
97							
98		589	346	134	43		
99		774	504	108			
100							
101				145			
102			47		67		
103			141	2703	598		
104				467	48		
105			129	2226	400		
106							
107			704	6461	2627		
108			239	2121	942		
109				57			
110							
111							
112							
113							
114							
115			46	1062	237		
116			97	147			
117				412	85		
118			238	1233	62		
119			1061	10766	1962		
120			66	2348	381		
121			1460	10679	3026		
122			85	1539	446		
123							
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

m/e	Temperature, °K (°C)					Stycast 2651/Cat 11	
	298 (25)	473 (200)	623 (350)	648 (375)	673 (400)		
128			41	42			
129				65			
130				60			
131			74	576		137	
132			51			67	
133				248		391	
134			1448	2749		1860	
135			61	10279		392	
136				1441		503	
137				2174			
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162			400	965		57	
163			46	532		155	
164			558	903		274	
165			376	75		527	
166				2063		390	
167							
168							
169							
170				50			
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							



Torr Seal A/B

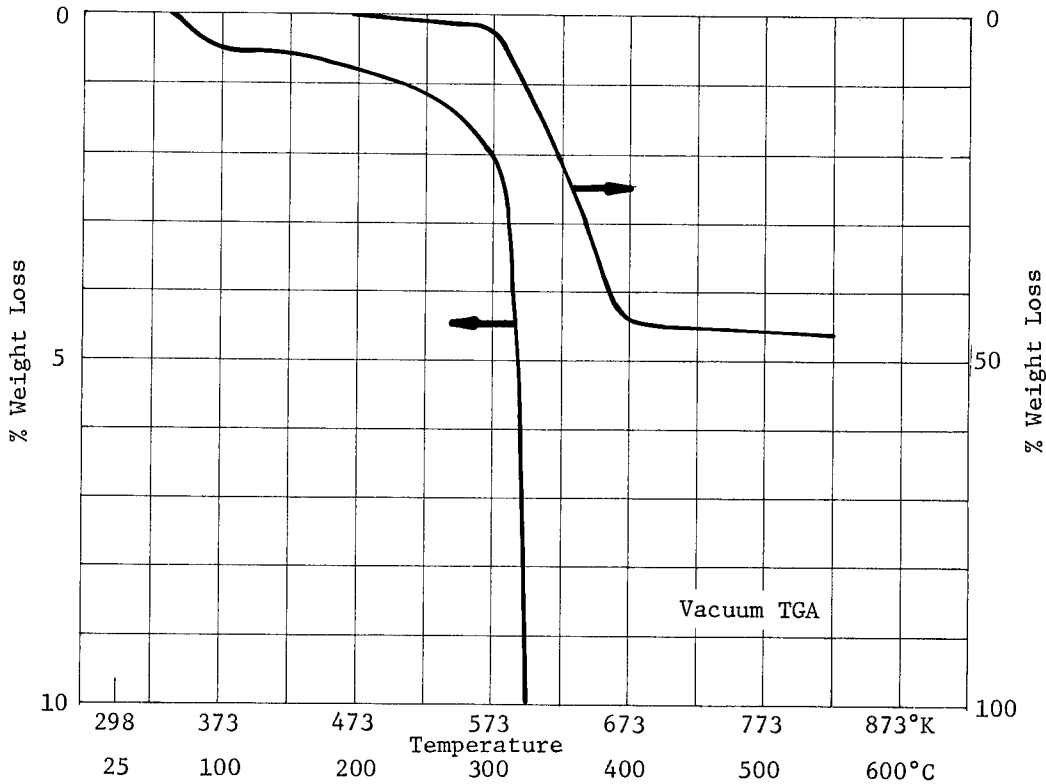
Chemical Characterization Summary

Mix Ratio: 100 pbw Resin (A) to 50 pbw Catalyst (B)

Cure: 30 minutes at 344°K (71°C),

24 hrs. at 415°K (142°C) in Vacuum ( $10^{-3}$  Torr)

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 473°K (200°C) - 673°K (400°C)

$a_0 = 48.0\%$  of initial weight

$$k = 1.10 \times 10^{17} \exp \left( \frac{-49,900}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$4.4 \times 10^{16}$	
373°K (100°C)	$1.3 \times 10^{12}$	
423°K (150°C)	$4.2 \times 10^8$	

Number and Relative Peak Intensity

m/e	Temperature, °K (°C)					Torr Seal A/B	
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)	
14	1284	1184	1244	4549	1473	1556	
15	495	519	571	11815	1221	1752	
16	2747	2549	3130	11054	2891	3917	
17	9912	8603	8541	25475	7397	9071	
18	33392	28612	25294	74518	22941	29041	
19	223	218	211	462	158	155	
20	234	226	201	395	201	229	
21							
22				48			
23				890	82	75	
24				3040	270	260	
25	77	83	88	15977	1415	1299	
26	369	452	457	18394	1726		
27				44494	16308	16446	
28	14946	14316	14246	9614	896	706	
29	259	281	289	14254	634	519	
30	246	255	293	3420			
31			3092	3323	2972	2968	
32	3532	3199					
33							
34							
35				494	46		
36				3227	177	112	
37			41	6563	347	236	
38				20189	1194	685	
39				11067	1963	1863	
40	1530	1501	1483	7881	709	443	
41	71	122	110	13928	689	404	
42	57	85	82	7394	547	363	
43		130	113	11756	656	614	
44	425	564	555	2299	128	109	
45	62	62	62	364			
46				887			
47				255			
48				1184	75	42	
49				5369	382	246	
50	49	66	63	6470	510	301	
51	57	67	66	9580	263	166	
52			48	4339	301	158	
53				2396	163	86	
54				4529	287	151	
55				3928	211	121	
56		64		1733	109	80	
57				3248	118	72	
58				923			
59				367			
60				1027	46		
61				2061	111	50	
62				4174	271	132	
63				1682	119		
64				8848	447	227	
65	48			9513	363	205	
66	44	52	56	3183	148	70	
67				1351	82	51	
68				857	55		
69				1004	63		
70				640			
71				561			
72				578			
73				1170	71		
74				807	50		
75				652	56		
76				3885	442	218	
77				1645	257	192	
78	97	109	98	2087	220	112	
79				1420	97	53	
80				853	66		
81				586	51		
82				515			
83				441	89	82	
84	80	62	66	350			
85				347			
86				201			
87				78			
88				981	86		
89				569	47	200	
90				4666	356		
91				795	80	50	
92				971	66		
93				15031	446	244	
94				1511	67		
95				338			
96				380			
97				255			
98				145			
99				144			
100				158			
101				255			
102				799	79		
103				254			
104				994	97	77	
105				314			
106				2551	291	176	
107				1553	142	78	
108				392			
109				210			
110				271			
111				211			
112				87			
113				117			
114				508	58		
115				145			
116				288			
117				423			
118				3958	158	57	
119				755	53		
120				1454	179	57	
121				577	64		
122				150			
123				76			
124				55			
125				102			
126				48			
127							

Number and Relative Peak Intensity (Continued)

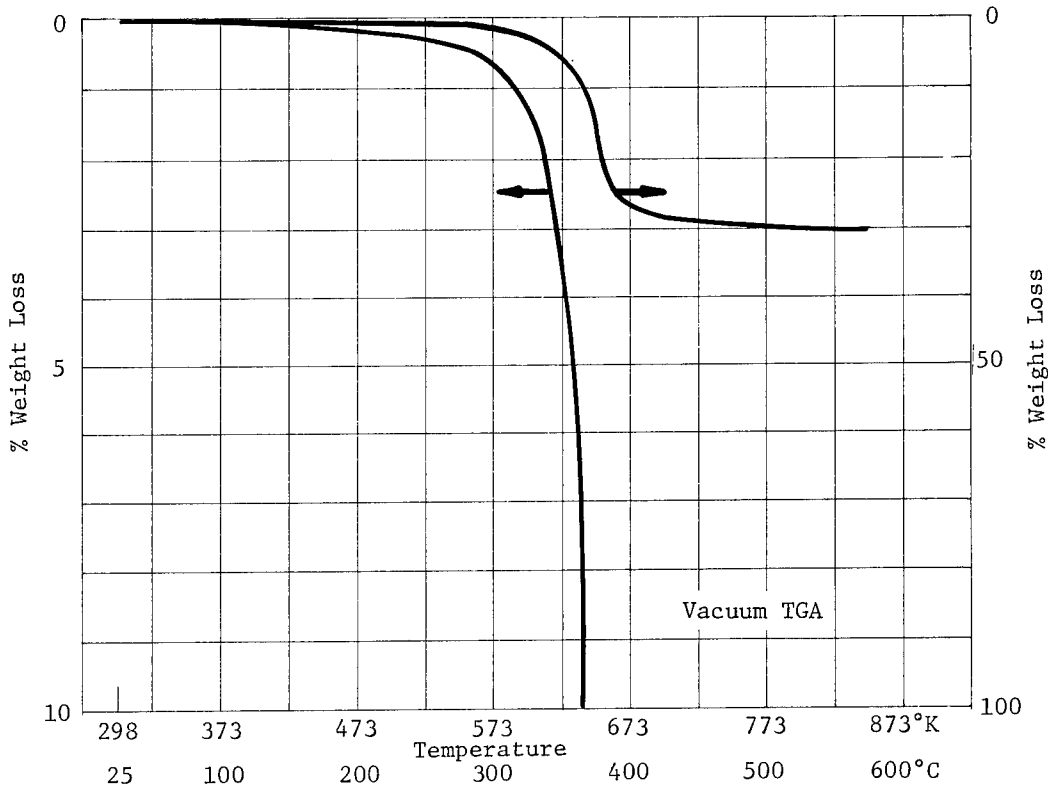
m/e	Temperature, °K (°C)					Torr Seal A/B	
	298 (25)	423 (150)	523 (250)	623 (350)	723 (450)	823 (550)	
128				66			
129	80	62	75	149	70	78	
130				46			
131	57	52	52	291	75	65	
132	68	67	60	223	76	67	
133				809	47		
134				3139	126	52	
135				466	42		
136				298			
137				55			
138							
139							
140							
141							
142							
143							
144							
145				52			
146							
147				75			
148				55			
149				49			
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Trucast 111M/901

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 3.4 pbw Catalyst  
 Cure: 3 hrs. at 338°K (65°C), 24 hrs. at 414°K (141°C) and 1x10<sup>-5</sup> Torr

1. TGA Preconditioning: None



2. Activation Energy of Decomposition:

Over the Range: 463°K (190°C)-743°K (470°C)

a<sub>0</sub> = 30% of initial weight

$$k = 1.6 \times 10^{15} \exp \left( \frac{-45600}{1.98 T^{\circ}K} \right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	3.7 x 10 <sup>15</sup>	
373°K (100°C)	2.6 x 10 <sup>11</sup>	
423°K (150°C)	1.6 x 10 <sup>8</sup>	

Number and Relative Peak Intensity

Temperature, °K (°C)

Trucast 111M/901

m/e	298 (25)	473 (200)	573 (300)	648 (375)	723 (450)		
14	742	679	943	2417	961		
15			323	4655	287		
16	1184	1082	1318	3498	1315		
17	5249	5959	6443	10490	5569		
18	24777	22968	24518	37721	20755		
19				43			
20							
21							
22							
23							
24				176			
25							
26	80	77	838	7814	616		
27		49					
28	12591	14970	17115	28805	15848		
29		46	1152	7412	548		
30			47	2906	66		
31				3067			
32	3636	3504	3313	3472	3240		
33				58			
34							
35							
36				40			
37							
38					43		
39			253	8721	704		
40	116	80	181		330		
41			814	5880	299		
42			199	5981	124		
43				5576	242		
44	250	278	1041	4236	378		
45				929			
46							
47				182			
48							
49							
50				1985	45		
51				2156	83		
52							
53				1425			
54							
55			41		44		
56			321	3148			
57			101	1857			
58				808			
59				70			
60				40			
61				141			
62							
63				1191			
64							
65					99		
66				4163	103		
67				636			
68				241			
69				56			
70				105			
71				112			
72				49			
73				61			
74				182			
75				56			
76				41			
77				1281	74		
78				318			
79				680			
80				428			
81				86			
82							
83							
84							
85							
86							
87							
88							
89			76				
90			92				
91			1182	45			
92			62				
93							
94			6947	190			
95			349	43			
96							
97							
98							
99							
100							
101							
102							
103			81				
104							
105			73				
106							
107			934	45			
108			471				
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119			822				
120			63				
121			669				
122			69				
123			47				
124							
125							
126							
127							

Number and Relative Peak Intensity (Continued)

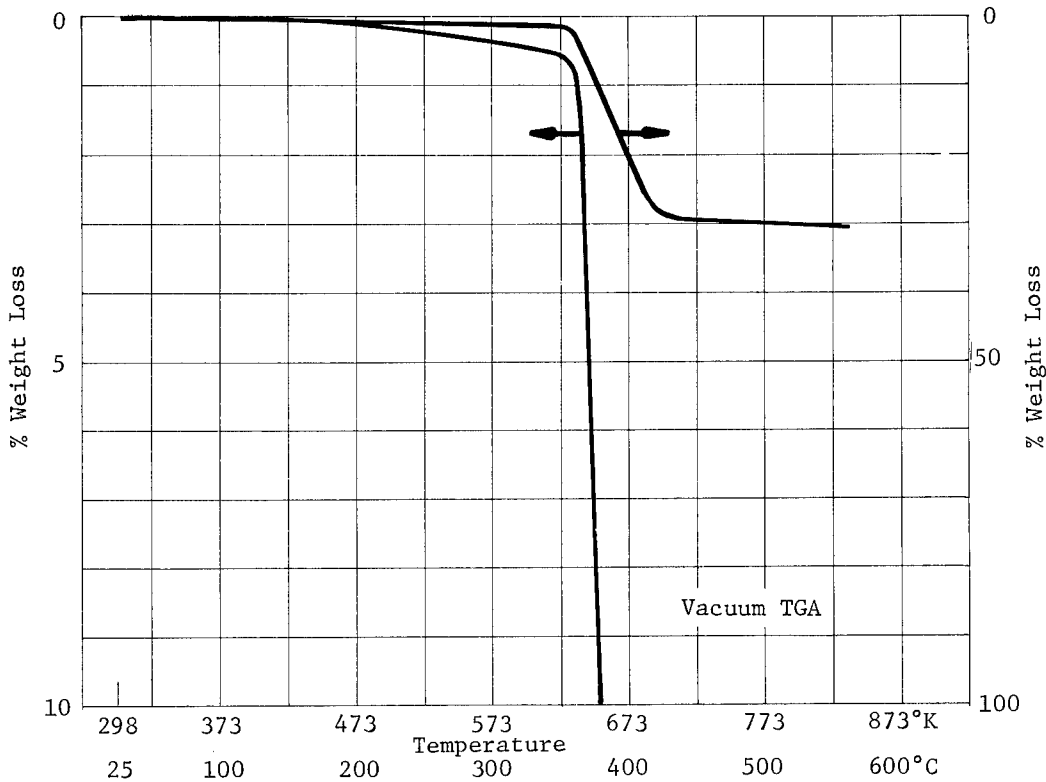
m/e	Temperature, °K (°C)					Truacast 111M/901	
	298 (25)	473 (200)	573 (300)	648 (375)	723 (450)		
128							
129							
130							
131							
132							
133			57				
134			802				
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167			70				
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

Trucast 111M/902

Chemical Characterization Summary

Mix Ratio: 100 pbw Resin to 5 pbw Hardener  
 Cure: 3 hrs. at 338°K (65°C), 24 hrs. at 413°K (140°C)

1. TGA Preconditioning: 24 hrs. at 296°K (23°C) and 45% RH



2. Activation Energy of Decomposition:

Over the Range: 633°K (360°C)-673°K (400°C)

$a_0 = 30\%$  of initial weight

$$k = 3.4 \times 10^{28} \exp\left(\frac{-87,600}{1.98 T^{\circ}K}\right) \text{ min}^{-1}$$

Time to 1% Weight Loss at Temperature T

Temp	Time, sec	
	In Vac	In Nitrogen
323°K (50°C)	$6 \times 10^{30}$	
373°K (100°C)	$6.3 \times 10^{22}$	
423°K (150°C)	$4.4 \times 10^{16}$	

Number and Relative Peak Intensity

Temperature, °K (°C)

Trucast 111M/902

m/e	298 (25)	473 (200)	648 (375)	673 (400)	723 (450)	823 (550)	
14	3246	3097	8232	4977	3494	3961	
15	1223	1238	18159	7159	2809	3868	
16	11603	10497	17338	12322	10258	12494	
17	34960	28309	43721	29166	23149	25603	
18	100986	82105	101070	84443	64704	71156	
19	178	167	1086	464	160	140	
20	580	471	600	519	443	520	
21							
22							
23							
24			683	280	77	74	
25	53		2712	1229	385	305	
26	667	564	13572	6414	2192	2020	
27	1534	1504	23516	11581	3705	3498	
28	39390	35034	60032	42424	35700	38553	
29	618	602	43601	12376	2295	1707	
30	3172	2861	5599	4005	2796	3166	
31		77	18711	3959	386	328	
32	11293	9877	8684	8100	8191	9358	
33			1209	188			
34			40				
35							
36			554	248	48		
37			4766	2244	541	148	
38			8826	4476	1038	360	
39	153	179	31772	14587	3759	1413	
40	5957	5340	14810	9105	5737	5838	
41	146	213	33678	8187	1511	1034	
42	97	89	11899	3391	747	447	
43	136	242	24902	5714	1274	738	
44	2944	2767	16627	5240	2796	2953	
45			5193	1313	144	100	
46			433	136			
47			1498	535	86		
48			169	69			
49			1460	726	135	54	
50			6697	3806	992	389	
51			6101	4610	1355	467	
52			1957	1464	483	172	
53			3592	2392	715	188	
54			1021	498	92	59	
55			9115	3198	684	265	
56			15591	2886	304	308	
57			19770	4041	217	119	
58			4048	734	87	46	
59			692	160			
60			565	255			
61			1859	876	173		
62			2935	1596	384	82	
63			5440	3280	933	253	
64			1795	1017	283	70	
65			13818	6844	1622	408	
66			18084	7204	1632	358	
67			1494	710	171	48	
68			746	320	57		
69			395	102			
70			251	40			
71			665	95			
72			829	178			
73			2027	470			
74			1818	872	177	41	
75			775	515	120		
76			606	381	92		
77			3565	3946	1304	373	
78			1315	1320	448	170	
79			1883	1768	628	140	
80			420	358	101		
81			204	162			
82			88	45			
83			43	63			
84	41		124	63	42		
85			103	83			
86			142	83			
87			2708	447			
88			142				
89			657	603	170		
90			570	498	119		
91			1204	2378	827	380	
92			342	360	98	65	
93			1046	586	158	81	
94			24147	8608	1715	298	
95			1624	592	100		
96			83				
97							
98							
99							
100							
101							
102			47	110			
103			263	455	146		
104			137	150			
105			224	400	99	68	
106			263	241	42	78	
107			1385	2070	754	195	
108			695	974	328	57	
109			51	48			
110							
111							
112							
113							
114							
115			130	206	87		
116			46	93			
117			412	178			
118			359	925	189		
119			317	401	55		
120			989	1509	508	63	
121			129	262	90		
122							
123							
124							
125							
126							
127							



Number and Relative Peak Intensity (Continued)

Temperature, °K (°C)

Trucast 111M/902

m/e	298 (25)	473 (200)	648 (375)	673 (400)	723 (450)	823 (550)	
128							
129	45	45	77	49	54	56	
130							
131			108	140	63		
132	42		64	72	45	46	
133			57	147			
134			273	673	85		
135			44	135	48		
136			212	202	42		
137							
138							
139							
140							
141							
142							
143							
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164							
165							
166							
167							
168							
169							
170							
171							
172							
173							
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							
201							
202							
203							
204							
205							
206							
207							
208							
209							
210							
211							
212							
213							
214							
215							
216							
217							
218							
219							
220							
221							
222							
223							
224							
225							
226							
227							
228							
229							
230							
231							
232							
233							
234							
235							
236							
237							
238							
239							
240							

1. Report No. NASA CR- 3133	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Nonmetallic Materials Handbook Volume 1 - Epoxy Materials		5. Report Date May 1979	6. Performing Organization Code
		8. Performing Organization Report No.	
7. Author(s) Stanley E. Podlaseck		10. Work Unit No.	
9. Performing Organization Name and Address Stanley E. Podlaseck 12768 Grizzly Drive Littleton, Colorado 80123		11. Contract or Grant No. NAS1-15133	
		13. Type of Report and Period Covered Contractor Report	
12. Sponsoring Agency Name and Address National Aeronautics & Space Administration Washington, DC 20546		14. Sponsoring Agency Code	
		15. Supplementary Notes Langley Technical Monitor: Robert T. Magee Topical Report	
16. Abstract  This document contains thermochemical and other properties data on the following types of epoxy materials: adhesives, coatings finishes, inks, electrical insulation, encapsulants, sealants, composite laminates, tapes, and thermal insulators. This document is one of two volumes covering epoxy materials.			
17. Key Words (Suggested by Author(s)) Thermogravimetric analysis; insitu tests; thermal-stability/degradation/vacuum tests; mass spectra; degassing; contamination; degradation predictions		18. Distribution Statement  Unclassified - Unlimited  Subject Category 27	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 249	22. Price* \$9.50

National Aeronautics and  
Space Administration

Washington, D.C.  
20546

Official Business  
Penalty for Private Use, \$300

SPECIAL FOURTH CLASS MAIL  
BOOK

Postage and Fees Paid  
National Aeronautics and  
Space Administration  
NASA-451



11 1 10, A, 042079 S00942DS  
DEPT OF THE ARMY  
ARPAACOM  
PLASTECC BDDAR-LCA-T BLDG 3401  
ATTN: A M ANZALONE  
DOVER NJ 07801

**NASA**

POSTMASTER: If Undeliverable (Section 158  
Postal Manual) Do Not Return

---