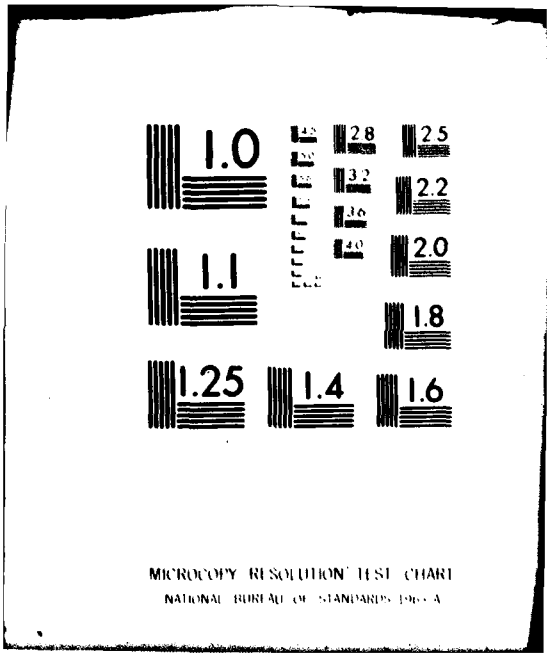
AD-A082 742 AIR FORCE PACKAGING EVALUATION AGENCY WRIGHT-PATTERSO--ETC F/G 11/9
EVALUATION OF POLYIMIDE FLEXIBLE FOAM,(U)
MAR 80 W P ROBBINS
UNCLASSIFIED PTPT-80-6 NL


1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

PTPT [illegible]-80-6
AFPEA Project No. 79-P7-105

(12) B.S.

(10) W. PAUL ROBBINS
Materials Engineer

AUTOVON 787-4519
Commercial (513)257-4519

(6) EVALUATION OF POLYIMIDE FLEXIBLE FOAM

HQ AFALD/PTP
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

(11) MARCH 1980 (12) 10

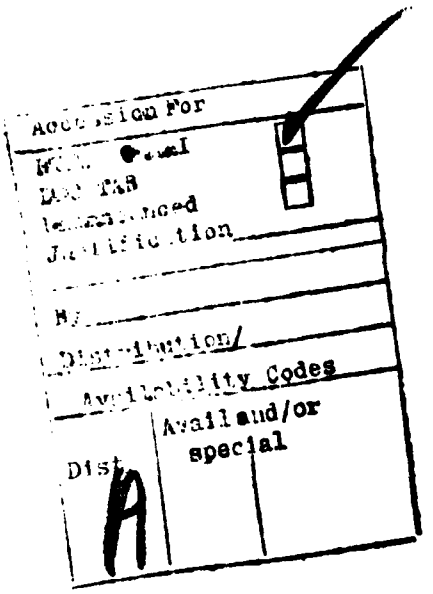
4/B

NOTICE

When government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related government procurement operation, the United States Government thereby incurs no responsibility whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto. This report is not to be used in whole or in part for advertising or sales purposes.

ABSTRACT

A 0.5 pcf polyimide flexible foam developed by Solar Turbines International, Division of International Harvester Corp., was evaluated for cushioning and flammability characteristics. The results showed that the dynamic cushioning characteristics were equivalent to 0.5 polyurethane foam at 72°F, superior at -40°F and the foam has improved reuseability. When exposed to a flame of a bunsen burner the polyimide foam was considered non-burning, with little smoke emmission or odor.



PREPARED BY:
PAUL ROBBINS, Materials Engineer
Materials Engineering Division
AF Packaging Evaluation Agency

PUBLICATION DATE:
20 MAR 1980

REVIEWED BY:
MATTHEW A. VENETOS
Chief, Materials Engineering Division
AF Packaging Evaluation Agency

APPROVED BY:
JACK E. THOMPSON
Director, Air Force Packaging
Evaluation Agency

INTRODUCTION

In a joint effort with the Navy Logistics Engineering Group, an investigation of non-flammable cushioning materials has been conducted by this agency during the past several years. The flame retardancy test, ASTM D-1692, of MIL-P-26514, Polyurethane Foam, Rigid or Flexible, for Packaging has not been considered entirely satisfactory from the standpoint of realism in actual field situations. Recently, Solar Turbines International,Divison of International Harvester Corp., San Diego, CA, submitted samples of newly developed polyimide foams developed under contract with NASA-Johnson Space Center, Houston, TX. The purpose of the contract was to develop thermally stable, fire-resistant, low smoke emitting, low toxicity, cost effective materials for aircraft and spacecraft intended for long duration flights. The polyimide flexible foams were the result of one phase of this development program. At the present time, Solar Turbine International furnishes the material as pre-foamed cushioning material. Investigations are being conducted to explore the possibilities of using foam-in-place packaging techniques.

This report presents the results of dynamic cushioning, creep, compression set tests, and a selected test for evaluating the flammability properties of the foam.

TEST INSTRUMENTATION AND EQUIPMENT

The following instrumentation and equipment were employed during this evaluation:

1. Oscilloscope, Tektronic, 4 channel storage, Model 565B.
2. Accelerometer, Statham, Model A5-100-350.
3. Amplifier, Sensotec, Model RM-6.
4. Energy Computer, GHI Systems, Model EC700.
5. Hardigg Cushion Tester, Hardigg Industries, Inc., Model 3.

DYNAMIC CUSHIONING TEST (72°F, 50% R.H.)

The dynamic cushioning test was conducted in accordance with ASTM Test Method D-1596, Dynamic Properties of Package Cushioning Materials. The sample sizes were 8 x 8 x 3 inches. The drop tests were conducted at a height of 24 inches. Five drops were made on each of three test specimen at each of the following static stress values: 0.066, 0.08, 0.1, 0.15, 0.2, 0.3, 0.4, 0.5, and 0.6 psi.

Test Results: The test results are presented in the form of peak acceleration - static stress curves in Graph 1. The dynamic cushioning curves from MIL-P-26514, Type II, Class 2 (Flexible), Grade C for 0.5 pcf polyurethane foam is displayed for comparative purposes. The polyimide foam is within the requirements of these curves. In addition, the polyimide foam did not fracture of split throughout the entire 0.066 psi to 0.6 psi range. These results indicate that the foam should have excellent reusability. The 0.5 pcf polyurethane foams currently used begins to fracture at approximately 0.15 psi. Two of the polyimide specimens did display evidence of slight permanent deformation after completion of the 0.5 psi load test.

DYNAMIC CUSHIONING TEST (-40°F)

Due to a lack of sufficient polyimide foam, it was necessary to use the same specimens that were used in generating the data for Graph 1. As a consequence, due to compression set, the average thickness for these specimens was 2.70 inches instead of the normal 3 inches. Five drops were made on each test specimen at each of the following static stress values: 0.1, 0.2, and 0.4 psi. The five drops at each individual static stress value were completed in rapid succession with minimal rest time between drops. The specimens were rested for a minimum of two hours before being tested at the next higher static stress value. Tests were first conducted at a temperature of 72°F and a relative humidity of 50%. Samples were allowed to recover for six hours before being placed in the cold chamber at -40°F and conditioned for 16 hours. Specimens were then brought out of the cold chamber in an insulated box, one at a time, for a series of free fall drops made from a height of 24 inches. Five drops were made on each test specimen at 0.1, 0.3, and 0.4 psi. The five drops at each individual static stress were completed in rapid succession with minimal rest time between drops. Samples were returned to the cold chamber for conditioning at -40°F for a minimum of two hours before being tested at the next higher static stress value.

Test results: The test results are presented in Graph 2. The dynamic cushioning curves for the +72°F data is presented for comparative purposes. The test specimens displayed no fracturing or splitting throughout the 0.1 to 0.4 psi range. The polyimide foam showed the approximately the same dynamic cushioning characteristics at -40°F as at +72°F.

FLAMMABILITY PROPERTIES OF POLYIMIDE FOAM

Specimens of the polyimide, 3 x 8 x 8 inches, foam were exposed to a 4 to 5-inch high flame of a bunsen burner for 60 seconds. The specimens were then removed from the flame. There was no burning, smoking, or odor from the specimens. There was approximately 15 to 20% erosion of the specimen where it was in contact with the flame. The foamed material would be considered non-burning from the results of this test.

DENSITY

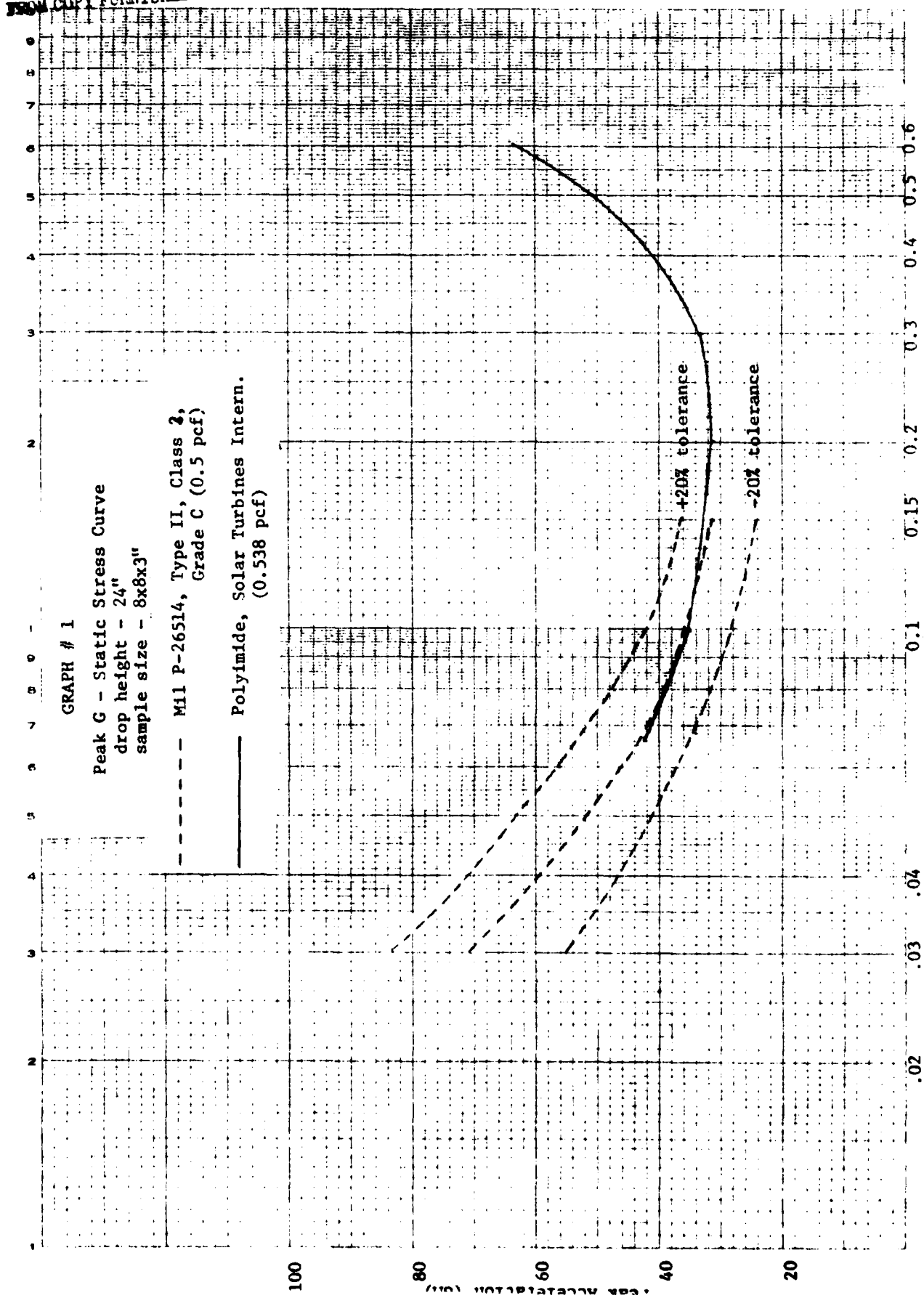
Density of a sample of the polyimide foam measuring 8 x 8 x 3 inches was determined IAW Federal Test Method Standard No. 101B, Method 4008 to be 0.538 pound per cubic foot.

CREEP CHARACTERISTICS

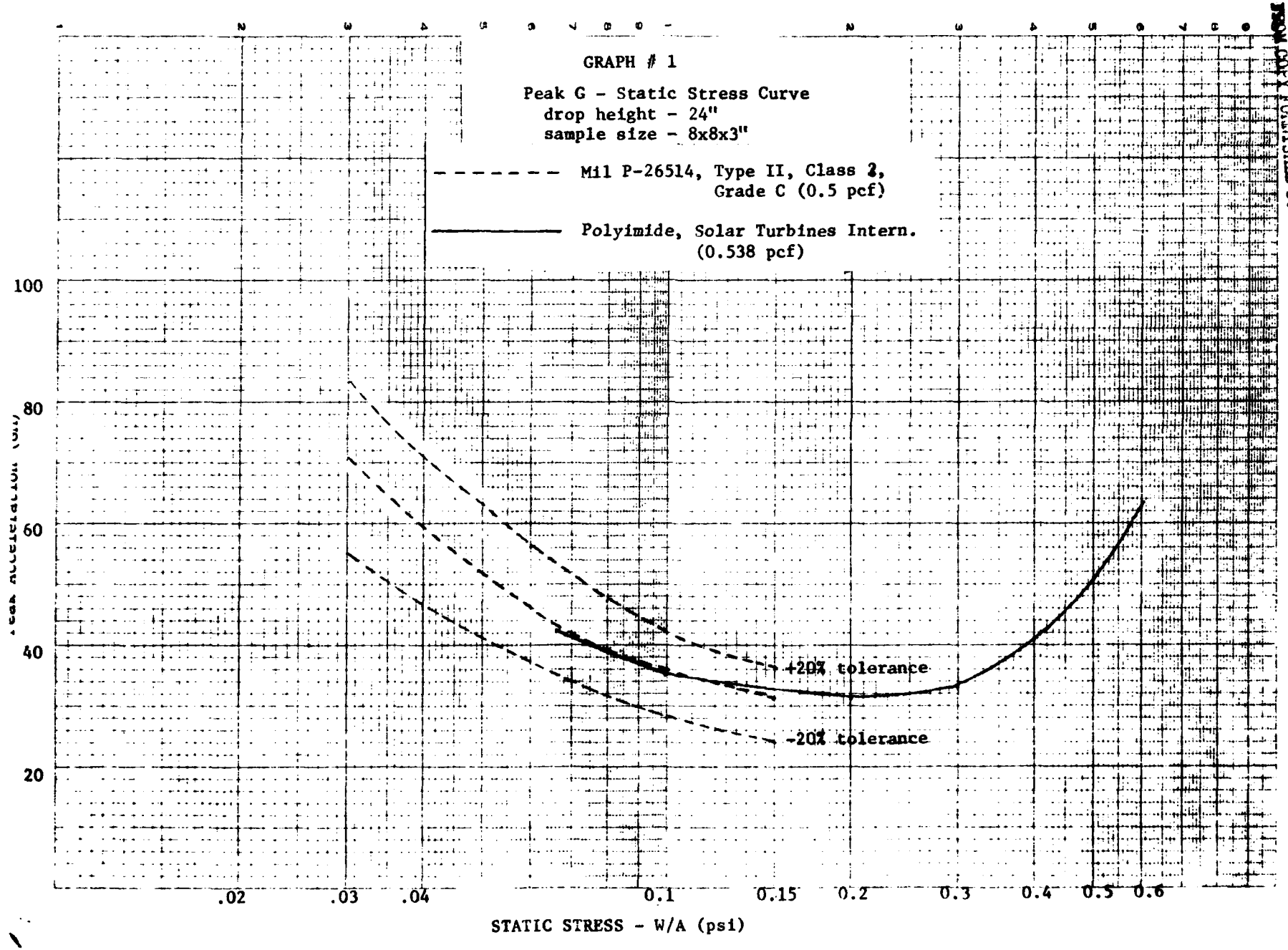
The creep of three samples measuring 6 x 6 x 3 inches was evaluated IAW Federal Test Method Standard No. 101B, Method 2013. The average creep of the samples tested was 10.5% after 96 hours. This value was within the acceptable requirement (15% max.) of MIL-P-26514 for polyurethane foams, flexible, Type II, Class 2.

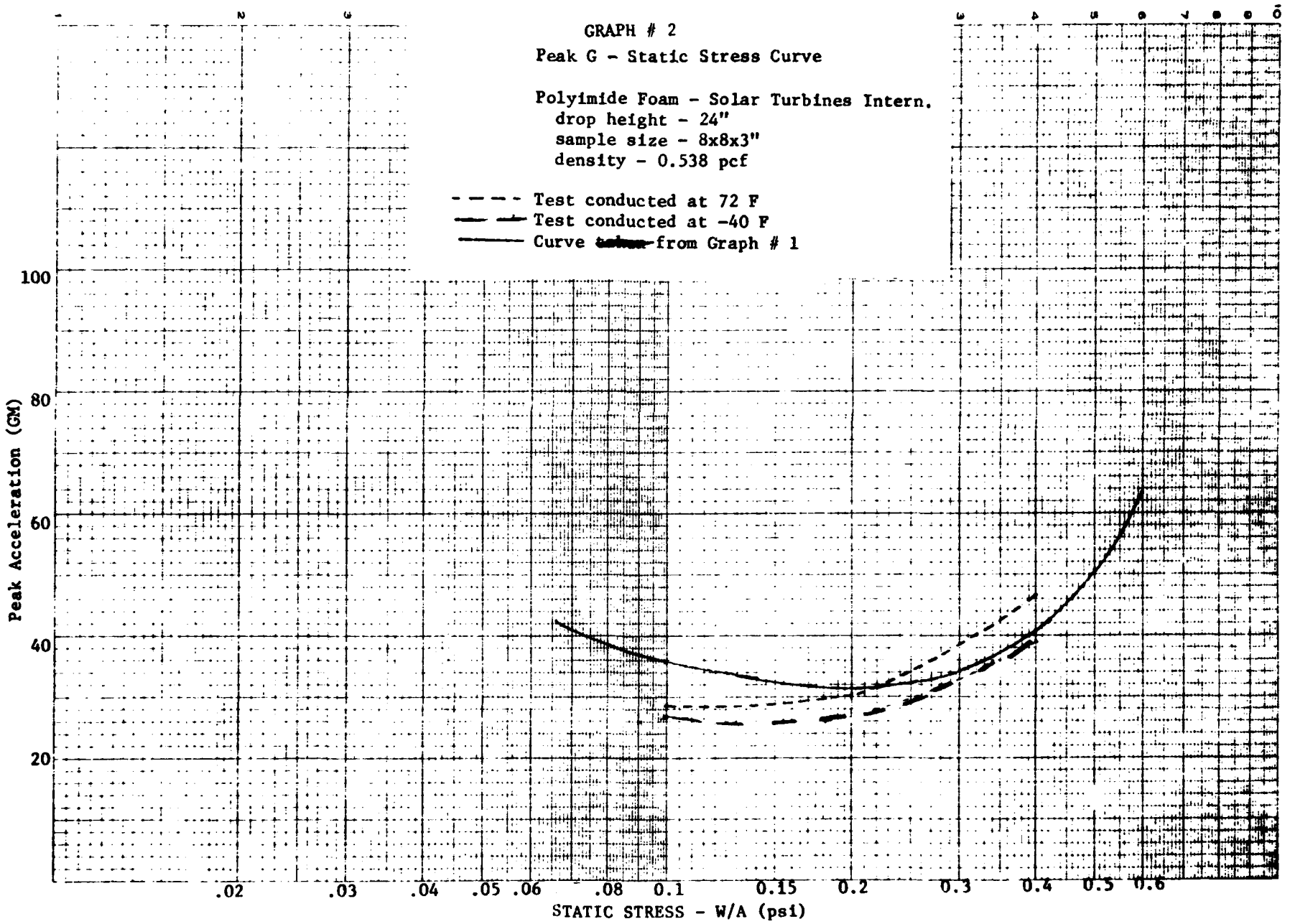
COMPRESSION SET

Compression set of three samples measuring 6 x 6 x 3 inches was evaluated IAW MIL-P-26514E, paragraph 4.5.3.7. The average compression set of the samples tested was 5%. This value was well within the requirement of 15% or less compression set for polyurethane foam, flexible, Type II, Class 2 as established by MIL-P-26514E, paragraph 3.7.2.



GRAPH # 1




GRAPH # 2
Peak G - Static Stress Curve
Polyimide Foam - Solar Turbines Intern.
drop height - 24"
sample size - 8x8x3"
density - 0.538 pcf
Test conducted at 72 F
Test conducted at -40 F
Curve from Graph # 1
Peak Acceleration (GM)
100
80
60
40
20
.02
.03
.04
.05
.06
.08
0.1
0.15
0.2
0.3
0.4
0.5
0.6
STATIC STRESS - W/A (psi)

DISTRIBUTION LIST

	COPIES
HQ USAF/LETT Wash DC 20330	1
Tobyhanna Army Depot Attn: AMSTO-T Tobyhanna PA 18466	1
Tobyhanna Army Depot Attn: SDSTO-TP-P Tobyhanna PA 18466	2
AFSC/SUP Andrews AFB DC 20334	1
OO-ALC/DSTC Hill AFB UT 84406	2
OC-ALC/DSP Tinker AFB OK 73145	2
SA-ALC/DSP Kelly AFB TX 78241	2
SM-ALC/DSP McClellan AFB CA 95652	2
WR-ALC/DSP Robins AFB GA 31098	2
JMPTC Aberdeen Proving Grounds MD 21005	2
AFALD/PT	1
AFALD/PTP	10
AFALD/PTP Library	20
Naval Supply Systems Code 0321B Wash DC 02376	1
Naval Log Engrg Grp Cheatham Annex Williamsburg, VA 24991	1
Naval Ship R&D Ctr Code 2841 Annapolis, MD 21402	1
HQ US Army Aviation Systems Command DRSAV-EKS P.O. Box 209 St. Louis, MO 63166	2
Naval Air Engineering Center (ESSD) Code 93 Lakehurst, NJ 08733	2
HQ AFLC/LOZPP	1
ASD/AWL	1
DLSIE USA Logistics Mgmt Cen Ft. Lee VA 23801	2
USA Natick Labs Attn: DRDNA-EPS Natick MA 01760	1
DESC-T 1507 Wilmington Pike Dayton, OH 45444	1
DTIC/TSR Cameron Sta Alexandria VA 22314	12
NAVSUPSYSCMD Attn: SUP-0321A Wash DC 20376	5
ADTC Attn: SD3P Eglin AFB FL 32542	1
USA, Armament Research & Devel Comd Attn: DRDAR-TST-S Dover NJ 07801	1
Thomas C. Corbe Naval Electronics Systems Command Code 460T Wash DC 20362	1
J.A. Enslow Naval Electronics Systems Command (Code 460T) Wash DC 20362	1

DISTRIBUTION LIST (Cont'd)

	COPIES
L.W. Bell Aviation Supply Office (TEP-A) 700 Robbins Avenue Philadelphia, PA 19111	1
Ships Parts Control Center J.C. Thomas Navy Ships Parts Control Center Code 561 Mechanicsburg, PA 17055	1
M. Bebel Naval Air Engineering Center ESSD, Code 93 Lakehurst, NJ 08733	1
John Neubauer Naval Supply Systems Command (SUP0321A) Wash DC 20376	1
Elizabeth Foster Naval Supply Systems Command (SUP 0321C) Wash DC 20376	1
E.A. Panigot Naval Air Systems Command (AIR 4121B1) Wash DC 20361	1
Thomas Fleming Naval Facilities Engineering Command (FAC 0454), Rm 9S27, Hoffman Bldg #2 Alexandria, VA 22332	1
G.S. Mustin Naval Sea Systems Command (SEA62T2) Wash DC 20362	1
A.V. Anceravage Naval Sea Systems Command (SEA 05D23) Wash DC 20362	1
Mr. Joseph Brugh Director, Naval Logistics Engineering Group Cheatham Annex Williamsburg, VA 23185	1
Joseph Diliberti/DTNSRDC Naval Ship Research & Dev. Center Code 2833 Annapolis MD 21402	1
Fred Pearlstein Naval Aviation Supply Office Code TEP2-A Philadelphia, PA 19111	1
Phil Smith Naval Weapons Support Center Code 505 Crane, Indiana 46522	1

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER PTPT Report No. 80-6	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Evaluation of Polyimide Flexible Foam		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER AFPEA Project No. 79-P7-105
7. AUTHOR(s) W. Paul Robbins		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS AFALD/PTPT Wright-Patterson AFB OH 45433		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS AFALD/PTP Wright-Patterson AFB OH 45433		12. REPORT DATE March 1980
		13. NUMBER OF PAGES 8
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Foam, cellular	Polyurethane foam	Flammability
Cushioning foam	0.5 pcf foam	Non-burning
Flexible foam	Dynamic Cushioning	
Polyimide foam	Compression set	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A 0.5 pcf polyimide flexible foam developed by Solar Turbines International, Division of International Harvester Corp., was evaluated for cushioning and flammability characteristics. The results showed that the dynamic cushioning characteristics were equivalent to 0.5 polyurethane foam at 72°F, superior at -40°F and the foam has improved reuseability. When exposed to a flame of a bunsen burner the polyimide foam was considered non-burning, with little smoke emmission or odor.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)