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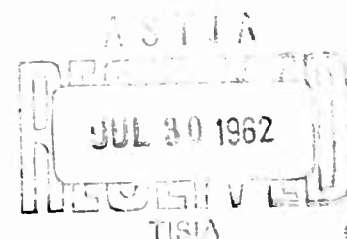
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MATERIAL - ADHESIVES - FMS-0015
(SHELL 422J OR HEXCEL HP-422) AND
FMS-0016 (PLASTILOCK 620-626) -
JP-4 FUEL IN SANDWICH PANELS -
EFFECTS OF

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TITLE

MATERIAL - ADHESIVES - FMS-0015 (SHELL 422J OR
HEXCEL HP-422) AND FMS-0016 (PLASTILOCK 620-626) -
JP-4 FUEL IN SANDWICH PANELS - EFFECTS OF

SUBMITTED UNDER

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FMS-0016 FZM-169

REFERENCE: FMS-0015 FPS-0007

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REVISIONS

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MATERIAL - ADHESIVES - FMS-0015 (SHELL 422J OR
HEXCEL HP-422) AND FMS-0016 (PLASTILOCK 620-626) -
JP-4 FUEL IN SANDWICH PANELS - EFFECTS OF

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MATERIAL - ADHESIVES - FMS-0015 (SHELL 422J OR
HEXCEL HP-422) AND FMS-0016 (PLASTILOCK 620-626) -
JP-4 FUEL IN SANDWICH PANELS - EFFECTS OF

PURPOSE:

Configuration of integral fuel tanks on the B-58 airplane is such that the inner skins of sandwich panels are in direct contact with JP-4 jet engine fuel for the life of the airplane. These panels are bonded with FMS-0015 (skin-to-core) and FMS-0016 (metal-to-metal) adhesives. The panels are designed and sealed to prevent fuel entry into the panels. Nevertheless, there may be occasions when JP-4 fuel inadvertently gets inside some of these panels. Therefore the purpose of this test was to determine if JP-4 fuel immersion, in combination with long time exposure to outdoor weathering, has any significant effects on FMS-0015 and FMS-0016 adhesives.

SUMMARY:

Sandwich panels were fabricated in the laboratory using FMS-0015 (skin-to-core) and FMS-0016 (metal-to-metal) adhesives, glass reinforced plastic honeycomb core, 7075T-6 aluminum slugs and 2024T-86 aluminum skins and evaluated before, after and during a five year exposure period to outdoor weather. The following tests were used to evaluate the effect of exposure: 260°F core shear and shear modulus of rigidity, 260°F edgewise compression, 260°F accelerated column-beam creep, R.T. simple beam, R.T. lap shear strength and 260°F flatwise tension.

In addition, standard half inch overlap shear specimens bonded with FMS-0015 and FMS-0016 adhesives and 2024T-3 skins were evaluated by immersion in JP-4 fuel at 140°F and tested at RT and 260°F at intervals up through a five year immersion period.

Results obtained on the FMS-0015 and FMS-0016 adhesive bonded 4FTW244-3 panels indicate that neither exposure to outdoor weathering nor direct contact with JP-4 fuel results in significant reduction of panel strength up through a five year exposure period. Likewise no deleterious effects were observed when FMS-0015 and FMS-0016 adhesive bonded lap shear specimens were immersed in JP-4 fuel at 140°F up through a five year period.

A detailed summary of the results of this test is shown in Tables II and III and Figures 3, 4, and 5.



MATERIAL - ADHESIVES FMS-0015 (SHELL 422J) AND
FMS-0016 (PLASTILOK 620-626) - JP-4 FUEL IN
SANDWICH PANELS - EFFECTS OF

OBJECT:

To determine if JP-4 fuel inside sandwich panels, bonded with FMS-0015 and FMS-0016 Adhesives affects the panels strength when subjected to weathering up through a five year period; and to determine the resistance of lap shear specimens (bonded with FMS-0015 and FMS-0016 Adhesives) to JP-4 fuel at 140°F up through a five year period.

MATERIALS AND TEST SPECIMENS:

- | | |
|--|--|
| 1. 2024-T3 Alclad Aluminum
(4" x 9" x .064") | GD/FW Stock
Fed. Spec. QQ-A-362a |
| 2. Sandwich Panel, 4FTW244-3
Assemblies | GD/FW made in accordance with
GD/FW Drawing 4FTW244-3 * |
| 3. JP-4 fuel | MIL-F-5624 |
| 4. Curable Rubber Buna - N
Type 570-W-19, 1/16" thick | Kirkhill Rubber Co.
Brea, California |

TEST SPECIMENS:

- | | |
|--|---|
| 1. GD/FW FMS-0015 Adhesive:
Shell 422J, lots 607, 626,
607-950, 607-951, 607-961
Hexcel HP422, lots 80,
289 | Shell Development Co.
Emeryville, California

Hexcel Products, Inc.
Oakland, California |
| 2. GD/FW FMS-0016 Adhesive
Plastilock 620 tape, Roll
No's HW 3609-176, HW 3617-
238

Plastilock 626 Liquid
Primer, Batch AJ-13 | B. F. Goodrich Company
Akron, Ohio

B. F. Goodrich Company
Akron, Ohio |

*See page 45 and page 16.



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EQUIPMENT:

- | | |
|---|-----------------------------------|
| 1. Electrically heated bonding presses
(24" x 24" platens) | GD/FW made |
| 2. Tate Emery Test Machine (PTE 60,000
Lbs., Capacity) | A.E. Emery Co.
Stamford, Conn. |
| 3. Electrically heated test chamber
24" x 36" x 24" | GD/FW made |
| 4. Test Fixtures for beam tests | GD/FW made |
| 5. Column Creep Test Fixture | GD/FW made |
| 6. Electrically heated oil immersion
bath fixture, (3" x 4" x 1" operating
temperature 140°F) | GD/FW made |

PROCEDURE:

Procedures are shown in Table I.

RESULTS:

Results appear in Tables IV - XI with summaries in Tables II and III.

DISCUSSION:

Previous to this test, FMS-0015 and FMS-0016 adhesives had been evaluated and shown to meet or exceed specification requirements. However, additional test data was needed to determine if these adhesives would be affected by the combination of long time outdoor weathering and JP-4 fuel immersion. Tests on lap shear specimens were needed to determine if immersion in JP-4 fuel at 140°F for periods up through 5 years would affect adhesion of the two adhesives.

Twenty five sandwich panels were fabricated in the Laboratory in accordance with GD/FW drawing 4FTW244-3 for this test. Two panels were picked at random and tested for quality control (Condition A). Five panels were stored in the Chemistry Laboratory of the Engineering Test Laboratories as controls for the exposure tests (Condition C), and removed for testing periodically during the five year period. Eighteen



panels were mounted on a test fixture (see Figure 1) and placed at a 45° angle on the roof of the Engineering Test Laboratories facing south. Five of the eighteen panels placed on the roof contained JP-4 fuel internally (Condition D) while the remaining thirteen panels were dry and pressure tested every six months with 100 psi internal air pressure, 260°F temperature for 1 hour (Condition E).

Test panels were removed periodically as outlined in Table I and tested for 260°F core shear and modulus of rigidity strength, 260°F edgewise compression strength, 260°F accelerated column creep, 260°F flatwise tension, R.T. simple beam and R.T. lap shear strength.

A. SANDWICH PANEL TESTS (Effects of JP-4 and outdoor weather on FMS-0015 Adhesive)

1. Core Shear and Modulus of Rigidity -

The 260°F core shear and modulus of rigidity results (Table IV) indicate that JP-4 fuel inside the bonded sandwich panels exposed to outdoor weathering up through five years had no detrimental effects on the FMS-0015 adhesive. The average 260°F core shear strength ranged from 417 to 527 psi for the sandwich panels containing JP-4 fuel, 379 to 488 for the dry, pressure tested exposure sandwich panels and 376 to 519 psi for the sandwich panels not exposed to weather, pressure or JP-4 fuel. Likewise the 260°F shear modulus of rigidity results indicate that JP-4 fuel inside bonded sandwich panels exposed to weather up through five years had no detrimental effect on the FMS-0015 adhesive. The average 260°F shear modulus of rigidity ranged from 24,247 to 26,688 psi for the sandwich panels containing JP-4 fuel, 22,050 to 31,032 psi for the dry, pressure tested, exposure, sandwich panels, and 23,105 to 30,139 for the sandwich panels not exposed to weather, pressure or JP-4 fuel.

2. Edgewise Compression -

Edgewise compression results of 260°F also show (see Table V) that JP-4 fuel inside



bonded sandwich panels exposed to outdoor weathering up through five years had no detrimental effect on the FMS-0015 adhesive. The average 260°F edgewise compression strength ranged from 74,350 to 76,813 psi for the JP-4 fuel, exposure, sandwich panels, 72,067 to 75,619 psi for the dry, pressure tested exposure sandwich panels and 66,275 to 72,375 psi for sandwich panels not exposed to weather, pressure or JP-4 fuel.

3. Column - Beam Creep -

The 260°F column-beam creep results (see Table VI) indicate that JP-4 fuel inside bonded sandwich panels exposed to outdoor weathering up through four years (the fifth year test was deleted at the request of the test originator) had no detrimental effects on the FMS-0015 adhesive. The creep results show that eight specimens were capable of passing the G load while three failed in the F load for the sandwich panels which contained JP-4 fuel.

Six specimens passed the G load, five failed in the F load and one specimen passed the F load for the sandwich panels not exposed to weather, pressure or JP-4 fuel. Permanent set ranged from .05" to .46" for the JP-4 fuel - containing sandwich panels, .06" to .34" for the no fuel, exposure, pressure test, sandwich panels, and .14" to .28" for the sandwich panels not exposed to weather, pressure or JP-4 fuel.

4. Flatwise Tension -

Results from the 260°F flatwise tension specimens (see Table IX) indicate that JP-4 fuel inside the bonded sandwich panels in combination with exposure to outdoor weathering up through five years had no detrimental effect on FMS-0015 adhesive. The average flatwise tension strength ranged from 757 to 864 psi for the JP-4 fuel containing sandwich panels, 901 to 1032 psi for the no fuel, exposure, pressure test sandwich panels and 826 to 893 psi for the no fuel, no pressure test, no exposure panels. The observed variations in results are within



experimental limits of this test and the average minimum value of 2100 lbs. (668 psi) stipulated by FMS-0015D at room temperature was exceeded even at 260°F.

5. Simple Beam -

Simple Beam (RT) results (See Table VII) indicate that JP-4 fuel inside the bonded sandwich panels exposed to outdoor weather up through five years had no significant effect on the FMS-0015 adhesive. The average simple beam strength ranged from 558 to 655 psi for the JP-4 fuel containing sandwich panels, 542 to 627 psi for the no fuel, exposure, pressure test sandwich panels, and 566 to 661 psi for the sandwich panels not exposed to weather, pressure, or JP-4 fuel.

B. LAPSHEAR PANEL TESTS (EFFECTS OF JP-4 AND OUTDOOR WEATHER ON FMS-0016 ADHESIVE)

Only R.T. lapshears tests were utilized to determine the effects of fuel and environmental conditions on the FMS-0016 adhesive and these results indicate that JP-4 fuel inside the bonded sandwich panels exposed to outdoor weathering up through five years had no significant effect on the shear strength of the FMS-0016 adhesive. The average shear strength ranged from 3946 to 4788 psi for the JP-4 fuel-containing sandwich panels, 3886 to 4815 psi for the no fuel, exposure, pressure test sandwich panels, and 4119 to 4622 psi for the no fuel, no pressure test, no exposure sandwich panels. A summary of the results of the effects of outdoor weathering and JP-4 fuel on 4FTW-244 panel specimens described in items A, and B above, appears in Table II and Figures 3 and 4.

C. LAPSHEAR TESTS (EFFECTS OF IMMERSION IN JP-4 @140°F ON FMS-0015 AND FMS-0016 ADHESIVES)

Standard lap shear immersion pads were prepared in accordance with MIL-A-8431 specification. Quality control specimens for each pad were tested prior to starting the immersion tests. The test results (see Tables X and XI) indicate that JP-4 fuel at 140°F has no detrimental effect on the lap shear strength of the FMS-0015 and FMS-0016 adhesives. A summary



of the results up through five years immersion in JP-4 fuel is shown in Table II and III and Figure 5.

A cursory examination of Summary Tables II and III and Figures 3, 4, and 5 gives the impression that immersion in JP-4 and weather aging up through 5 years, with the exception of modulus of rigidity and lap shear strengths, actually enhances the strength of the bonded panels. However, it is believed that this falls within the experimental variation of the adhesives tested and further indicates that JP-4 immersion and exposure to outdoor weathering for periods of time up to five years had no deleterious effect on FMS-0015 and FMS-0016 bonded aluminum panels.

CONCLUSION:

The structural properties of FMS-0015 and FMS-0016 adhesives in bonded sandwich panel construction were determined before and after exposure to weather and with and without JP-4 fuel inside the sandwich panel and immersion in JP-4 fuel at 140°F as outlined in this report. Results obtained are listed in Tables IV to XI. In accordance with the results and conditions of the tests included in this report, the following conclusions can be drawn:

1. No detrimental effects on laboratory bonded sandwich panels, having glass reinforced honeycomb core, 2024T-86 alclad aluminum skins and 7075T-6 aluminum slugs was observed when the panels were subjected to outdoor weathering with and without JP-4 fuel inside the panels for a period up through 5 years.
2. Likewise, no significant degradation was observed in FMS-0015 and FMS-0016 adhesive bonded 2024T-3 alclad aluminum lapshear specimens when immersed in JP-4 fuel at 140°F for a period up through 5 years.

TABLE I

PROCEDURES FOR FABRICATION AND TESTING OF 4FTW244-3
SANDWICH PANELS AND STANDARD LAP SHEAR PANELS

I. Surface Preparation of Metal Parts:

All metal parts are cleaned in accordance with GD/FW Specification FPS-0007. Paragraph 3.2. General procedures for the metal parts are:

- A. Remove all surface dyes and foreign materials by wiping with cheese cloth moistened with methyl-ethyl-ketone.
- B. Vapor degrease all parts using stabilized trichloroethylene.
- C. Immerse the parts from 9 to 13 minutes in a solution of the following composition maintained at a temperature of $160^{\circ}\text{F} \pm 10^{\circ}\text{F}$.

Water	30 parts by weight
Sulphuric acid (66° Be)	10 parts by weight
Sodium Dichromate	4 parts by weight

- D. Rinse the parts by immersing them in clean tap water followed by a distilled or demineralized water spray rinse. A continuous water film must be noted over the bond areas.
- E. Dry the parts in an air circulating oven for at least 20 minutes.

II. Cleaning of Glass Reinforced Honeycomb Core:

- A. Vapor degrease thoroughly using stabilized trichloroethylene.
- B. Air dry for at least 20 minutes.

III. Adhesive Application:

Adhesive applications were in accordance with FMS-0015 and FMS-0016 specifications.



A. Sandwich Panel Assemblies

1. Apply one brush coat of FMS-0016, Form II, liquid adhesive to the cleaned surfaces of the metal to metal areas described in drawing 4FTW244-3.
2. Air dry the primed surfaces 2 hours.
3. Heat the metal slugs in an oven to a temperature not exceeding 160°F. Apply one film thickness of FMS-0016, Form I, adhesive to each side of the slug area to be bonded.
4. Assembly slugs in a suitable bonding form and position the clean core materials.
5. Apply one film thickness of FMS-0015 adhesive to each side of the core area.
6. Position the skins on the core and slugs to form a sandwich configuration.
7. Position in bonding press with one layer of curable buna-N-rubber over the panel area.

B. Lap Shear Panel Assemblies

1. FMS-0015 Adhesive
 - a. Clean the metal skins as described in Table I, Part I.
 - b. Apply one thickness of FMS-0015 adhesive to the bond area of one skin.
 - c. Assemble with the second skin to form a 0.500" overlap.
 - *d. Assemble on a bonding fixture as described in FZM-169 and apply a metal bonding strip over the bond area and one thickness of curable buna-N-rubber over the bonding strip.
 - e. Test specimens must comply with Specification MIL-A-8431.

*See Supplemental Sheet S-1.



2. FMS-0016 Adhesive

- a. Clean the metal skins as described in Table I, Part I.
- b. Apply one brush coat of FMS-0016, Form II liquid adhesive to the cleaned surfaces to be bonded.
- c. Air dry the primed surfaces for 2 hours.
- d. Apply one thickness of FMS-0016, Form I adhesive to one skin assembly with the second skin to form a .500" overlap.
- ** e. Assemble on a bonding fixture as described in FZM-169 and apply a metal bonding strip over the bond area and one thickness of buna-N-rubber over the bonding strip.
- f. Test specimens must comply with Specification MIL-A-8431.

IV. Bonding Conditions:

- A. Sandwich Panels - Apply 150 psi bonding pressure, raise the glue line temperature to $235^{\circ} \pm 15^{\circ}\text{F}$ with a maximum heat up rate of 50°F per minute, hold at 235°F for 30 minutes, and heat to $350^{\circ} \pm 10^{\circ}\text{F}$ with a maximum heat up rate of 10°F per minute. Hold at 350°F for two (2) hours. Cool to below 150°F , and remove test panel from the press.
- B. Lapshear Panels -
 1. Apply 100 psi to the FMS-0015 adhesive bond area. Raise the glue line temperature from R.T.* to 350°F , hold at $350^{\circ} \pm 10^{\circ}\text{F}$ for 1 hour. Cool to below 150°F , and remove test panel.
 2. Apply 100 psi to the FMS-0016 adhesive bond area while the glue line temperature is held at a temperature of $350^{\circ}\text{F} \pm 10^{\circ}\text{F}$ for a period of 2 hours.

*R.T. (room temperature) in this report is $77^{\circ} \pm 3^{\circ}\text{F}$.

** See Supplemental Sheet S-1.



V. Exposure and Immersion Conditions:

- A. Each of the two bays in the 4FTW244-3 panels is tapped through the slugs on opposite sides. The holes are threaded and fitted with AN 815, $\frac{1}{4}$ " unions. These fittings are used to introduce pressure or JP-4 fuel. JP-4 is introduced into the bays of the panels by drawing a vacuum on one fitting while introducing JP-4 into the opposite fitting. Fittings are capped off during aging.

Exposure panels are mounted on a suitable fixture at an angle of 45° facing south (Figure 1).

- B. Immersion pads are placed in JP-4 fuel using one gallon containers with an air reflux condensor on the lid of the container. The containers are placed in an oil bath maintained at 140°F .

VI. Testing and Specimen Schedule:

- **A. Sandwich panels - Cut each sandwich panel into specimens in accordance with FZM-169 specification and test 260°F core shear and modulus of rigidity, 260°F column creep, 260°F column compression, R.T. simple beam, and R.T. lap shear specimens. The testing schedule is as follows:

	<u>4FTW 244-3 Panel No.</u>	<u>Test Condition</u>	<u>Period for Testing</u>
** See Supplemental Sheet S-2 and pages 16 and 27.	A, B	A	Prior to starting exposure tests
	1C, 2C	C	One Year
	K, M	D	One Year*
	I, J, AC	E	One Year
	O, P, Q	E	Two Years
	F, G	E	Three Years
	N, Y	C	Three Years
	R, S, T	D	Three Years*
	U, V, W	E	Four Years
	H	C	Five Years*
	Z	D	Five Years*
	X	E	Five Years

*Panels still contained fuel and fuel vapors when opened.



Condition A - Quality control panels to determine if the processing is satisfactory.

Condition C - Controls for the exposure panels to determine if R.T. aging will affect the panels.

Condition D - Exposure panels to determine effects of JP-4 fuel applied internally on the adhesive system.

Condition E - Dry exposure panels to determine the effect of weathering. Panels are to be pressure tested every six months by applying 100 psi internal pressure and raising the temperature from R.T. to 260°F for 1 hour, then cooling to R.T.

B. Lap Shear Panels

- Cut each pad into specimens in accordance with MIL-A-8431 Specification and test in shear at R.T. and 260°F. The testing schedule for FMS-0015 and FMS-0016 adhesives is as follows:

<u>Panel No.</u>	<u>Immersion Period</u>
A, B	1 week
C, D	2 weeks
E, F	3 weeks
G, H	4 weeks
I, J	8 weeks
K, L	4 months
M, N	6 months
O, P	1 year
Q, R.	2 years
S, T	3 years
U, V	4 years
W, X	5 years

Test specimens 1 and 2 from each pad as controls prior to immersion of the test panels. Test specimens 3, 4, 5 and 6 from each panel at R.T. and 260°F.



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- * C. Flatwise tension specimen - Cut sandwich flatwise tension specimens in accordance with FMS-0015 Specification except test at 260°F instead of R.T. Testing schedule is for one, four, and five year exposure periods.

*See Supplemental Sheet S-3.

TABLE II
SUMMARY OF RESULTS OF BONDED 4FTW244-3 SANDWICH PANELS AFTER EXPOSURE
TO OUTDOOR WEATHERING CONDITIONS FOR VARIOUS PERIODS OF TIME

TYPE OF TEST	TEST COND.	260°F		260°F		260°F		260°F		260°F		260°F			
		CORE STRENGTH AVE. PSI	SHEAR STRENGTH OF RIGIDITY AVE. PSI	MODULUS OF RIGIDITY AVE. PSI	EDGEWISE COMPRESSION STRENGTH AVE. PSI	R.T. SIMPLE BEAM AVE. PSI	R.T. LAP SHEAR STRENGTH AVE. PSI	FLATWISE TENSION AVE. PSI	CORE STRENGTH AVE. PSI	SHEAR STRENGTH OF RIGIDITY AVE. PSI	MODULUS OF RIGIDITY AVE. PSI	EDGEWISE COMPRESSION STRENGTH AVE. PSI	R.T. SIMPLE BEAM AVE. PSI	R.T. LAP SHEAR STRENGTH AVE. PSI	FLATWISE TENSION AVE. PSI
QUALITY CONTROL PANELS															
ONE YEAR EXPOSURE TESTS:															
R.T. Controls Panels for Exposure Tests	C	376	26,275	66,275	613	826	4328	570	3887	No Test					
Exposure Panels with JP-4 Fuel	D	417	26,688	74,350	559	864	4566	613	4328	826					
Exposure Panels - Dry	E	398	26,417	72,067	594	901	4548	559	4566	864					
TWO YEARS EXPOSURE TEST:															
Exposure Panels - Dry	E	379	31,032	74,312	543	None	3686	543	3686	None					
THREE YEARS EXPOSURE TESTS:															
R.T. Control Panels For Exposure Tests	C	519	30,139	72,092	559	No Test	4622	559	4622	No Test					
Exposure Panels with JP-4 Fuel	D	468	24,247	75,240	585	No Test	4788	585	4788	No Test					
Exposure Panels - Dry	E	468	25,039	73,785	576	No Test	4815	576	4815	No Test					
FOUR YEARS EXPOSURE TEST:															
Exposure Panels Dry	E	439	23,183	72,523	603	915	4474	603	4474	915					
FIVE YEARS EXPOSURE TESTS:															
R.T. Control Panels For Exposure Tests	C	406	23,105	72,375	661	893	4119	661	4119	893					
Exposure Panels with JP-4 Fuel	D	527	25,206	75,619	655	757	3946	655	3946	757					
Exposure Panels - Dry	E	488	22,050	76,813	627	1032	4296	627	4296	1032					



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TABLE III

SUMMARY OF RESULTS OF LAP SHEAR SPECIMENS IMMERSSED IN
JP-4 FUEL AT 140°F AND TESTED AT R.T. AND 260°F

FMS 0016 Adhesive (Plastilock 620-626):

<u>Immersion Period</u>	<u>Average Shear Strength (PSI)</u>	
	<u>R.T.</u>	<u>260°F</u>
1 week	4633	2340
2 weeks	4543	2238
3 weeks	4593	2165
4 weeks	4444	2025
8 weeks	4437	2046
4 months	4514	2007
6 months	4290	2284
1 year	4399	2212
2 years	4327	2384
3 years	4506	2568
4 years	4636	2073
5 years	4324	2145

FMS-0015 Adhesive (Shell 422 J):

	<u>Average Shear Strength (PSI)</u>	
	<u>R.T.</u>	<u>260°F</u>
1 week	2648	2178
2 weeks	2675	2280
3 weeks	2568	2245
4 weeks	2500	2258
8 weeks	2674	2320
4 months	2720	2184
6 months	2684	2234
1 year	2618	2136
2 years	2749	2282
3 years	2745	2178
4 years	2734	2265
5 years	2531	2054



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TABLE IV

CORE SHEAR AND FLEXURAL SHEAR MODULUS OF RIGIDITY RESULTS OF BONDED 4FTW244-3*
 SANDWICH PANELS TESTED AT 260°F AFTER EXPOSURE TO WEATHERING CONDITIONS FOR

VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TOTAL PANEL THICKNESS IN.	WIDTH IN.	SLOPE LBS/IN.	ULTIMATE CORE LOAD PSI	CORE SHEAR PSI	SHEAR MODULUS OF RIGIDITY PSI
3-A-1	A	None	.578	3.02	20,200	1500	461	33,200
3-A-2	A	None	.580	3.02	19,420	1560	479	33,150
3-B-1	A	None	.586	3.00	19,050	1680	516	33,550
3-B-2	A	None	.586	3.00	20,000	1660	510	36,300
Ave.							492	34,050
1-C-2	C	None	.583	3.05	18,500	1115	342	26,600
1-C-5	C	(Controls	.587	3.05	18,500	1275	391	26,750
2-C-2	C	for 1 Yr	.583	3.04	18,500	1200	368	26,750
2-C-5	C	test)	.584	3.05	17,800	1305	401	25,000
Ave.							376	26,275
3-K-2	D	1 Year	.584	3.02	18,850	1305	401	28,200
3-K-5	D	1 Year	.581	3.05	18,500	1480	454	26,300
3-M-2	D	1 Year	.581	3.03	19,250	1245	382	28,550
3-M-5	D	1 Year	.582	3.06	17,450	1400	430	23,700
Ave.							417	26,688
3-I-2	E	1 Year	.586	3.05	18,200	1220	374	26,250
3-I-5	E	1 Year	.587	3.05	18,150	1480	454	26,300
3-J-2	E	1 Year	.583	3.04	17,350	1235	379	23,900
3-J-5	E	1 Year	.584	3.04	17,500	1325	406	24,300
3-AC-2	E	1 Year	.585	3.06	20,075	1255	385	31,350
3-AC-5	E	1 Year	.586	3.06	18,400	1260	387	26,400
Ave.							398	26,417

CONDITIONS: A Quality control panels tested prior to exposure tests. Core thickness .500"
 C R.T. aged panels - controls for exposure tests Load rate .015"/min
 D Exposure panels - JP-4 fuel internal R.D. - Longitudinal
 E Exposure dry panels - pressure tested

*Skins .040 clad 2024-T86 core 3/16" hexagonal cell (9#/cu.ft.) glass fabric reinforced plastic aluminum edge members (7075-T6 bare) were used around periphery of panel. Corners were sealed.



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TABLE IV (Continued)

CORE SHEAR AND FLEXURAL SHEAR MODULUS OF RIGIDITY RESULTS OF BONDED 4FTW244-3
 SANDWICH PANELS TESTED AT 260°F AFTER EXPOSURE TO WEATHERING CONDITIONS FOR
 VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TOTAL PANEL THICKNESS IN.	WIDTH IN.	SLOPE LBS/IN.	ULTIMATE LOAD PSI	CORE SHEAR PSI	SHEAR MODULUS OF RIGIDITY PSI
3-O-1	E	2 Years	.586	3.00	18,350	1305	401	27,470
3-O-2	E	2 Years	.588	3.00	19,800	1320	405	32,440
3-P-1	E	2 Years	.585	3.01	20,500	1220	374	33,800
3-P-2	E	2 Years	.582	3.03	19,700	1130	345	30,090
3-Q-1	E	2 Year	.584	3.02	20,550	1255	384	32,636
3-Q-2	E	2 Years	.584	3.07	19,700	1205	362	29,758
Ave.								
3-F-1	C	None	.583	3.01	21,550	1925	379	31,032
3-F-2	C	(Controls	.583	3.02	20,833	2000	590	36,963
3-G-1	C	for 3 Yrs	.580	3.02	17,361	1330	611	34,133
3-G-2	C	Test)	.530	3.01	18,115	1520	408	23,728
Ave.							467	25,731
3-N-1	D	3 Years	.583	3.03	17,123	1605	519	30,139
3-N-2	D	3 Years	.584	3.03	17,201	1490	489	23,340
3-Y-1	D	3 Years	.583	3.01	17,123	1460	453	23,680
3-Y-2	D	3 Years	.585	3.05	18,292	1600	448	23,662
Ave.							483	26,306
3-R-1	E	3 Years	.583	3.01	17,605	1440	468	24,247
3-R-2	E	3 Years	.584	3.03	18,656	1470	442	24,808
3-S-1	E	3 Years	.583	3.03	16,666	1520	449	27,475
3-S-2	E	3 Years	.584	3.02	17,669	1620	463	22,330
3-T-1	E	3 Years	.585	3.00	18,337	1575	495	25,069
3-T-2	E	3 Years	.585	3.00	16,816	1550	484	27,260
Ave.							476	23,290
							468	25,039

Core Thickness: .500"; Load Rate-0.015"/min.
 CONDITIONS: C R.T Age Panels - Control for exposure tests
 D Exposure Panels - JP-4 Fuel Internal
 E Exposure Dry Panels - Pressure Tested



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TABLE IV (Continued)
 CORE SHEAR AND FLEXURAL SHEAR MODULUS OF RIGIDITY RESULTS OF BONDED 4FTW244-3
 SANDWICH PANELS TESTED AT 260°F AFTER EXPOSURE TO WEATHERING CONDITIONS FOR
 VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TOTAL PANEL THICKNESS IN.	WIDTH IN.	SLOPE LBS/IN.	ULTIMATE LOAD PSI	CORE SHEAR PSI	SHEAR MODULUS OF RIGIDITY PSI
3-U-1	E	4 Years	.587	3.00	16,892	1395	427	23,725
3-U-2	E	4 Years	.584	3.01	15,432	1430	438	19,912
3-V-1	E	4 Years	.585	3.00	18,656	1285	395	28,153
3-V-2	E	4 Years	.584	2.97	17,421	1310	406	25,090
3-W-1	E	4 Years	.584	2.99	16,025	1560	480	21,635
3-W-2	E	4 Years	.586	3.00	15,576	1600	490	20,585
Ave.							439	23,183
3-H-1	C	None	.583	2.99	17,400	1315	406	24,704
3-H-2	C	(Controls For 5 Yrs. Test)	.584	3.00	16,000	1320	406	21,505
Ave.							406	23,105
3-Z1	D	5 Years	.583	3.02	18,200	1725	528	26,199
3-Z2	D	5 Years	.583	3.01	17,400	1710	525	24,212
Ave.							527	25,206
3-X-1	E	5 Years	.586	2.99	15,385	1470	453	20,217
3-X-2	E	5 Years	.586	2.99	16,950	1695	522	23,884
Ave.							488	22,050

CORE THICKNESS: .500"; Load rate 0.015"/min.
 CONDITIONS: C R.T. Age Panels - Controls for exposure
 D Exposure panels - JP-4 Fuel Internal
 E Exposure Dry Panels - Pressure Tested



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TABLE V

EDGEWISE COMPRESSION RESULTS OF BONDED 4FTW244-3 SANDWICH PANELS *
TESTED AT 260°F AFTER EXPOSURE TO OUTDOOR WEATHERING CONDITIONS
FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244 AND SPEC.	TEST COND.	EXPOSURE PERIOD	WIDTH IN.	AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI
3-A-6	A	None	1.98	.1580	10,880	68,860
3-A-7	A	None	2.01	.1610	10,380	64,470
3-A-8	A	None	2.04	.1630	11,250	69,020
3-A-9	A	None	2.02	.1620	11,040	68,150
3-B-6	A	None	2.01	.1610	11,140	69,190
3-B-7	A	None	2.01	.1610	11,300	70,180
3-B-8	A	None	1.98	.1580	10,600	67,090
3-3-9	A	None	1.98	.1580	10,920	69,110
Ave						68,259
1-C-7	C	None	2.01	.1608	7,600	47,300
1-C-8	C	(Controls	2.01	.1608	10,220	63,600
2-C-7	C	For 1 Yr	2.00	.1600	12,280	76,800
2-C-8	C	Test)	1.99	.1592	12,230	77,400
Ave.						66,275
3-K-7	D	1 Year	2.03	.1624	11,940	73,600
3-K-8	D	1 Year	1.99	.1592	11,500	72,300
3-M-7	D	1 Year	2.04	.1632	12,340	75,800
3-M-8	D	1 Year	2.06	.1646	12,440	75,700
Ave.						74,350
3-L-7	E	1 Year	2.02	.1615	11,080	68,600
3-L-8	E	1 Year	2.03	.1624	12,020	73,000
3-J-7	E	1 Year	2.00	.1600	11,670	72,900
3-J-8	E	1 Year	2.02	.1615	11,260	69,700
3-AC-7	E	1 Year	2.00	.1600	11,640	72,800
3-AC-8	E	1 Year	2.03	.1624	12,260	75,400
Ave.						72,067

Skin Thickness .040"

Load Rate - 8000 lbs/min., R.D. Longitudinal

CONDITIONS: A Quality Control Panels Tested Prior to Exposure Tests
 C R.T. Aged Panels - Controls For Exposure Tests
 D Exposure Panels - JP-4 Fuel Internal
 E Exposure Dry Panels - Pressure Tested

*See note page 16.



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EDGEWISE COMPRESSION RESULTS OF BONDED 4FTW244-3 SANDWICH PANELS
TESTED AT 260°F AFTER EXPOSURE TO OUTDOOR WEATHERING CONDITIONS
FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244 AND SPEC.	TEST COND.	EXPOSURE PERIOD	WIDTH IN.	AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI
3-O-6	E	2 Years	2.02	.1616	12,640	78,210
3-O-7	E	2 Years	2.04	.1632	12,300	75,367
3-O-8	E	2 Years	2.06	.1648	12,120	73,544
3-O-9	E	2 Years	2.04	.1632	12,500	76,593
3-P-6	E	2 Years	2.02	.1616	12,160	75,248
3-P-7	E	2 Years	2.03	.1624	11,640	71,675
3-P-8	E	2 Years	2.04	.1632	11,300	69,240
3-P-9	E	2 Years	2.04	.1632	11,740	71,936
3-Q-6	E	2 Years	2.03	.1624	12,900	79,433
3-Q-7	E	2 Years	2.02	.1616	12,480	77,227
3-Q-8	E	2 Years	2.01	.1608	11,440	71,144
3-Q-9	E	2 Years	2.02	.1616	11,600	71,822
Ave.						74,312
3-F-6	C	None	1.99	.1592	12,000	75,376
3-F-7	C	(Controls	2.00	.1600	12,040	75,250
3-F-8	C	for 3 Yrs	2.00	.1600	12,200	76,250
3-F-9	C	test)	2.01	.1608	10,520	65,422
3-G-6	C	"	1.97	.1576	11,600	73,604
3-G-7	C	"	1.95	.1560	10,860	69,615
3-G-8	C	"	1.99	.1592	11,760	73,869
3-G-9	C	"	1.96	.1568	10,560	67,346
Ave.						72,092
3-N-6	D	3 Years	1.98	.1584	11,740	74,116
3-N-7	D	3 Years	1.99	.1592	11,600	72,864
3-N-8	D	3 Years	1.99	.1592	12,000	75,376
3-N-9	D	3 Years	1.99	.1592	12,180	76,507
3-Y-6	D	3 Years	2.00	.1600	12,200	76,250
3-Y-7	D	3 Years	2.00	.1600	11,500	71,875
3-Y-8	D	3 Years	2.03	.1624	12,640	77,832
3-Y-9	D	3 Years	2.02	.1616	12,460	77,103
Ave.						75,240

CONDITIONS: C R.T. Aged Panels - Controls For Exposure Tests
 D Exposure Panels - JP-4 Fuel Internal
 E Exposure Dry Panels - Pressure Tested



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TABLE V (Continued)

EDGEWISE COMPRESSION RESULTS OF BONDED 4FTW244-3 SANDWICH PANELS
TESTED AT 260°F AFTER EXPOSURE TO OUTDOOR WEATHERING CONDITIONS
FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244 AND SPEC.	TEST COND.	EXPOSURE PERIOD	WIDTH IN.	AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI
3-R-6	E	3 Years	1.99	.1592	11,840	74,371
3-R-7	E	3 Years	2.00	.1600	11,900	74,375
3-R-8	E	3 Years	2.00	.1600	11,360	71,000
3-R-9	E	3 Years	1.98	.1584	12,280	77,525
3-S-6	E	3 Years	2.00	.1600	12,000	75,000
3-S-7	E	3 Years	1.98	.1584	11,800	74,494
3-S-8	E	3 Years	2.00	.1600	11,800	73,750
3-S-9	E	3 Years	1.97	.1576	9,960	63,197
3-T-6	E	3 Years	2.01	.1608	12,140	75,497
3-T-7	E	3 Years	2.00	.1600	11,880	74,425
3-T-8	E	3 Years	1.99	.1592	11,820	74,246
3-T-9	E	3 Years	1.97	.1576	12,220	77,538
Ave.						73,785
3-U-6	E	4 Years	2.03	.1624	11,640	71,675
3-U-7	E	4 Years	2.00	.1600	10,900	68,125
3-U-8	E	4 Years	2.01	.1608	11,980	74,502
3-U-9	E	4 Years	2.01	.1608	12,050	74,937
3-V-6	E	4 Years	1.98	.1584	11,780	74,368
3-V-7	E	4 Years	2.00	.1600	11,400	71,250
3-V-8	E	4 Years	2.03	.1624	12,170	74,938
3-V-9	E	4 Years	2.03	.1624	10,670	65,701
3-W-6	E	4 Years	1.98	.1584	12,130	76,578
3-W-7	E	4 Years	1.96	.1568	11,820	75,382
3-W-8	E	4 Years	2.01	.1608	10,850	67,475
3-W-9	E	4 Years	2.01	.1608	12,120	75,373
Ave						72,523
3-H-8	C	5 Years	2.00	.1600	11,600	72,500
3-H-9	C	5 Years	2.00	.1600	11,560	72,250
Ave.						72,375
3-2-1	D	5 Year	2.02	.1616	12,360	76,488
3-2-4	D	5 Years	2.01	.1608	12,020	74,750
Ave.						75,619
3-X-6	E	5 Years	2.00	.1600	12,400	77,500
3-X-7	E	5 Year	2.01	.1608	12,180	76,125
Ave.						76,813

CONDITIONS: C - R.T. Age panels - Controls For Exposure Tests
 D - Exposure panel - JP-4 Fuel Internal
 E - Exposure Dry Panels - Pressure Tested



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TABLE VI

ACCELERATED COLUMN CREEP RESULTS OF BONDED 4FTW244-3 SANDWICH*

PANELS TESTED AT 260°F AFTER EXPOSURE TO OUTDOOR WEATHERING

CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TIME AT LOAD HRS**	FAILING OR PASSING LOADS*	TOTAL 260°F DEFORMATION IN.	PERM. SET IN.	TYPE FAILURE
3-A-3	A	None	0:08	G	.283	.18	Bending
3-A-4	A	None	0:03	F	.285	.17	"
3-A-5	A	None	4:15	G	.409	.23	"
3-B-3	A	None	0:10	G	.347	.19	"
3-B-4	A	None	0:12	F	.353	.21	"
3-B-5	A	None	0:10	G	.337	.23	"
1-C-1	C	None	1:21	F	.403	.27	"
1-C-4	C	(Controls	0:13	F	.300	.27	"
1-C-6	C	for 1 Yr.	0:05	G	.311	.20	"
2-C-1	C	Test	0:22	F	.400	.23	"
2-C-4	C	"	0:04	F	.279	.27	"
2-C-6	C	"	0:50	F	.402	.25	"
3-K-1	D	1 Year	0:35	F	.380	.23	"
3-K-4	D	1 Year	0:23	F	.373	.46	"
3-K-6	D	1 Year	0:05	F	.348	.22	"
3-M-1	D	1 Year	1:22	G	.379	.26	"
3-M-4	D	1 Year	3:00	G	.284	.05	None
3-M-6	D	1 Year	3:00	G	.290	.20	"
3-I-1	E	1 Year	0:07	E	.396	.34	Adh.To Skin
3-I-4	E	1 Year	0:07	E	.223	.24	"
3-I-6	E	1 Year	1:02	E	.288	.31	"
3-J-1	E	1 Year	0:18	F	.407	.19	Bending
3-J-4	E	1 Year	0:03	G	.339	.26	"
3-J-6	E	1 Year	0:05	G	.418	.15	"
3-AC-1	E	1 Year	0:07	G	.350	.21	"
3-AC-4	E	1 Year	0:38	F	.385	.24	"
3-AC-6	E	1 Year	0:05	G	.316	.12	"

*LOADS: E Beam Load - 353 Lbs.; Column Load - 4700 Lbs
 F Beam Load - 403 Lbs.; Column Load - 5200 Lbs
 G Beam Load - 440 Lbs.; Column Load - 5500 Lbs.

** Time Required To Pass Each Load Level - 3.0 Hours.

Conditions:

- A Quality Control Panels Tested Prior to Exposure Tests
- C R.T. Aged Panels - Controls For Exposure Tests
- D Exposure Panels - JP-4 Fuel Internal

*See note page 16.



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TABLE VI (Continued)

ACCELERATED COLUMN CREEP RESULTS OF BONDED 4FWT244-3 SANDWICH

PANELS TESTED AT 260°F AFTER EXPOSURE TO OUTDOOR WEATHERING

CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FWT244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TIME AT LOAD HRS**	FAILING OR PASSING LOADS*	TOTAL 260°F DEFORMATION IN.	PERM. SET IN.	TYPE FAILURE
3-O-3	E	2 Years	3:00	G	.324	.10	None
3-O-4	E	2 Years	--	C	-	Adh. to	Skin
3-O-5	E	2 Years	--	C	-	" "	" "
3-P-3	E	2 Years	3:00	G	.356	.15	None
3-P-4	E	2 Years	3:00	G	.351	.18	"
3-P-5	E	2 Years	3:00	G	.352	.11	"
3-Q-3	E	2 Years	3:00	G	.347	.12	"
3-Q-4	E	2 Years	3:00	G	.398	.17	"
3-Q-5	E	2 Years	3:00	G	.347	.16	"
3-F-3	C	None	3:00	G	.354	.15	None
3-F-4	C	(Controls	3:00	G	.288	.16	"
3-F-5	C	For 3 Yrs.	3:00	G	.372	.21	"
3-G-3	C	test)	3:00	G	.332	.20	"
3-G-4	C	"	3:00	G	.279	.14	"
3-G-5	C	"	3:00	G	.460	.28	"

*LOADS C Beam Load - 248 Lbs.; Column Load - 3300 Lbs
 F Beam Load - 403 Lbs.; Column Load - 5200 Lbs
 G Beam Load - 440 Lbs.; Column Load - 5500 Lbs.

**Time Required To Pass Each Load level - 3 hours

CONDITIONS: C R.T. Aged Panels - Controls For Exposure Tests
 E Exposure Dry Panels - Pressure Tested.



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TABLE VI (Continued)

ACCELERATED COLUMN CREEP RESULTS OF BONDED 4FWT244-3 SANDWICH

PANELS TESTED AT 260°F AFTER EXPOSURE TO OUTDOOR WEATHERING

CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FWT244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TIME AT LOAD HRS**	FAILING OR PASSING LOADS*	TOTAL 260°F DEFORMATION IN.	PERM. SET IN.	TYPE FAILURE
3-N-3	D	3 Years	3:00	G	.367	.17	None
3-N-4	D	3 Years	3:00	G	.356	.19	"
3-N-5	D	3 Years	3:00	G	.378	.21	"
3-Y-3	D	3 Years	3:00	G	.308	.16	"
3-Y-4	D	3 Years	3:00	G	.316	.13	"
3-Y-5	D	3 Years	3:00	G	.292	.10	"
3-R-3	E	3 Years	3:00	G	.361	.17	"
3-R-4	E	3 Years	3:00	G	.372	.15	"
3-R-5	E	3 Years	3:00	G	.330	.19	"
3-S-3	E	3 Years	3:00	G	.333	.18	"
3-S-4	E	3 Years	3:00	G	.320	.16	"
3-S-5	E	3 Years	3:00	G	.367	.20	"
3-T-3	E	3 Years	3:00	G	.344	.14	"
3-T-4	E	3 Years	.01	E	.321	-	Adh. to Skin
3-T-5	E	3 Years	1:03	G	.430	-	Bending
3-U-3	E	4 Years	3:00	G	.309	.10	None
3-U-4	E	4 Years	3:00	G	.327	.07	"
3-U-5	E	4 Years	3:00	G	.321	.08	"
3-V-3	E	4 Years	3:00	G	.274	.08	"
3-V-4	E	4 Years	3:00	G	.314	.08	"
3-V-5	E	4 Years	3:00	G	.403	.07	"
3-W-3	E	4 Years	3:00	G	.374	.09	"
3-W-4	E	4 Years	3:00	G	.452	.08	"
3-W-5	E	4 Years	3:00	G	.270	.06	"

* LOADS E Beam Load - 353 Lbs.; Column Load - 4700 Lbs.
 G Beam Load 440 Lbs.; Column Load 5500 Lbs.

** Time Required To Pass Each Load Level - 3.0 Hours

CONDITIONS:D Exposure Panels - JP-4 Fuel Internal
 E Exposure Dry Panels - Pressure Tested



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TABLE VII

SIMPLE BEAM RESULTS OF BONDED 4FTW244-3 SANDWICH PANELS *TESTED AT R.T. AFTER EXPOSURE TO OUTDOOR WEATHERING CONDITIONSFOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TOTAL PANEL THICKNESS IN.	WIDTH IN.	ULT. LOAD LBS.	ULT. STRESS IN.
3-A-10	A	None	.579	2.99	1865	578
3-A-11	A	None	.579	3.02	1830	563
3-B-10	A	None	.584	2.99	1820	565
3-B-11	A	None	.584	3.00	1850	573
Ave.						570
1-C-10	C	None	.583	3.08	2000	604
1-C-11	C	(Controls	.583	3.05	1985	605
2-C-10	C	for 1 Yr.	.583	3.03	2000	613
2-C-11	C	Test)	.584	3.06	2065	628
Ave.						613
3-K-10	D	1 Year	.581	3.02	1890	582
3-K-11	D	1 Year	.580	3.03	1790	549
3-M-10	D	1 Year	.580	3.03	1850	568
3-M-11	D	1 Year	.580	3.04	1750	535
Ave.						559
3-I-10	E	1 Year	.586	3.04	1940	583
3-I-11	E	1 Year	.586	3.03	1985	608
3-J-10	E	1 Year	.583	3.04	1940	583
3-J-11	E	1 Year	.583	3.05	2040	622
3-AC-10	E	1 Year	.584	3.06	1905	593
3-AC-11	E	1 Year	.584	3.00	1850	573
Ave.						594
3-O-10	E	2 Years	.584	2.97	1825	573
3-O-11	E	2 Years	.581	3.02	1875	578
3-P-10	E	2 Years	.580	2.98	1560	489
3-P-11	E	2 Years	.580	3.01	1655	519
3-Q-10	E	2 Years	.584	3.03	1870	573
3-Q-11	E	2 Years	.584	3.03	1705	523
Ave.						543

R.D. - Longitudinal Rate of Loading - 500 lbs/min. Core Thickness-.500"

CONDITIONS: A Quality Control Panels Tested Prior To Exposure Test
 C R.T. Aged Panels - Controls For Exposure Tests
 D Exposure Panels - JP-4 Fuel Internal
 E Exposure Dry Panels - Pressure Tested

*See note page 16.



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TABLE VII (Continued)

SIMPLE BEAM RESULTS OF BONDED 4FTW244-3 SANDWICH PANELS
TESTED AT R.T. AFTER EXPOSURE TO OUTDOOR WEATHERING CONDITIONS
FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	TOTAL PANEL THICKNESS IN.	WIDTH IN.	ULT. LOAD LBS.	ULT. STRESS IN.
3-G-10	C	None	.582	2.98	1610	503
3-G-11	C	(Controls	.583	3.05	1400	428
3-F-10	C	For 3 Yrs.	.587	3.00	2240	694
3-F-11	C	Test)	.588	3.02	2100	610
Ave.						559
3-N-10	D	3 Years	.586	3.02	1890	582
3-N-11	D	3 Years	.585	3.02	1970	606
3-Y-10	D	3 Years	.582	3.04	1890	580
3-Y-11	D	3 Years	.583	3.05	1870	572
Ave.						585
3-R-10	E	3 Years	.586	3.03	1730	532
3-R-11	E	3 Years	.585	3.02	1790	551
3-S-10	E	3 Years	.585	3.05	1870	570
3-S-11	E	3 Years	.586	3.03	2000	614
3-T-10	E	3 Years	.585	3.02	1940	597
3-T-11	E	3 Years	.586	3.00	1920	592
Ave.						576
3-U-10	E	4 Years	.587	3.00	2150	660
3-U-11	E	4 Years	.584	2.97	2220	689
3-V-10	E	4 Years	.585	3.03	1760	535
3-V-11	E	4 Years	.584	3.00	1855	570
3-W-10	E	4 Years	.584	2.97	1735	539
3-W-11	E	4 Years	.586	3.00	2000	624
Ave.						603
3-H-10	C	None	.584	3.01	1905	633
3-H-11	C	(Controls	.584	2.98	2055	689
Ave.		For 5 Yrs test)				661
3-Z-10	D	5 Years	.582	3.00	2145	715
3-Z-11	D	5 Years	.585	2.99	1775	594
Ave.						655
3-X-10	E	5 Years	.586	2.98	1825	612
3-X-11	E	5 Years	.584	2.99	1920	642
Ave.						627

CONDITIONS: C - R.T. Aged Panels - Controls
 For Exposure Tests

D - Exposure Panels - JP-4 Fuel Internal

E - Exposure Dry Panels - Pressure Tested



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TABLE VIII

*LAPSHEAR STRENGTH RESULTS OF SPECIMENS CUT FROM BONDED 4FTW244-3
 SANDWICH PANELS TESTED AT R.T. AFTER EXPOSURE TO OUTDOOR WEATHERING

CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	BOND AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI	% COH. FAILURE
3-A-12	A	None	.460	1380	3000	15
3-A-13	A	None	.450	1835	4075	25
3-A-14	A	None	.420	1820	4333	10
3-A-15	A	None	.450	1825	4055	15
3-A-16	A	None	.430	1905	4302	10
3-A-17	A	None	.430	1835	4256	10
3-B-12	A	None	.460	1815	3946	5
3-B-13	A	None	.460	1870	4065	15
3-B-14	A	None	.460	1500	3261	10
3-B-15	A	None	.490	1775	3625	15
3-B-16	A	None	.460	2030	4413	15
3-B-17	A	None	.470	1555	3309	15
Ave.					3887	
1-C-12	C	None	.503	2390	4751	20
1-C-13	C	(Controls	.503	1850	3678	40
1-C-14	C	For 1 Yr	.490	1340	2735	0
1-C-15	C	Test)	.482	2020	4191	70
1-C-16	C	"	.445	1970	4427	60
1-C-17	C	"	.465	1830	3935	80
2-C-12	C	"	.443	2225	5023	20
2-C-13	C	"	.480	2330	4854	40
2-C-14	C	"	.484	2245	4638	10
2-C-15	C	"	.487	2160	4435	60
2-C-16	C	"	.477	2050	4297	70
2-C-17	C	"	.485	2415	4979	5
Ave.					4328	

Skin Thickness: .040" - .040" Load Rate: 1300 psi/min.

CONDITIONS: A - Quality Control Panels Tested Prior To Exposure Tests

C - R T Aged Panels - Controls For Exposure Tests

*Specimens are 7.5" x 1.0" cut from edge member area of panel.
 Edge member is milled to the same thickness as panel skin.
 Specimen is then notched to provide 1/2" x 1" test area in
 center of specimen.



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LAPSHEAR STRENGTH RESULTS OF SPECIMENS CUT FROM BONDED 4FTW244-3
SANDWICH PANELS TESTED AT R.T. AFTER EXPOSURE TO OUTDOOR WEATHERING
CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	BOND AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI	% COH. FAILURE
3-K-12	D	1 Year	.486	2455	5051	5
3-K-13	D	1 Year	-	-	-	-
3-K-14	D	1 Year	.474	2005	4230	0
3-K-15	D	1 Year	.485	1565	3227	5
3-K-16	D	1 Year	.501	2060	4112	0
3-K-17	D	1 Year	.496	1875	3780	10
3-M-12	D	1 Year	.504	2455	4871	20
3-M-13	D	1 Year	.496	2475	4990	20
3-M-14	D	1 Year	.472	2395	5074	20
3-M-15	D	1 Year	.478	2510	5251	20
3-M-16	D	1 Year	.499	2270	4549	20
3-M-17	D	1 Year	.480	2445	5094	20
Ave.					4566	
3-I-12	E	1 Year	.476	2250	4727	20
3-I-13	E	1 Year	.520	1870	3596	10
3-I-14	E	1 Year	.479	2265	4729	15
3-I-15	E	1 Year	.489	2530	5174	15
3-I-16	E	1 Year	.466	2095	4496	10
3-I-17	E	1 Year	.483	2400	4969	10
3-J-12	E	1 Year	.506	2410	4763	10
3-J-13	E	1 Year	.496	1945	3921	15
3-J-14	E	1 Year	.493	2285	4635	10
3-J-15	E	1 Year	.513	2570	5010	10
3-J-16	E	1 Year	.516	2070	4012	40
3-J-16	E	1 Year	.489	2030	4151	90
3-AC-12	E	1 Year	.510	2515	4931	0
3-AC-13	E	1 Year	.484	2300	4752	20
3-AC-14	E	1 Year	.483	2475	5124	0
3-AC-15	E	1 Year	.487	1905	3985	5
3-AC-16	E	1 Year	.464	2125	4580	0
3-AC-17	E	1 Year	.495	2135	4313	0
Ave.					4548	

CONDITIONS: D. Exposure Panels - JP-4 Fuel Internal
E. Exposure Dry Panels - Pressure Tested



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LAPSHEAR STRENGTH RESULTS OF SPECIMENS CUT FROM BONDED 4FTW244-3
SANDWICH PANELS TESTED AT R.T. AFTER EXPOSURE TO OUTDOOR WEATHERING

CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	BOND AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI	% COH. FAILURE
3-O-12	E	2 Years	.453	1860	4106	10
3-O-13	E	2 Years	.468	950	2030	0
3-O-14	E	2 Years	.469	1655	3529	10
3-O-15	E	2 Years	.468	1400	2991	10
3-O-16	E	2 Years	.458	2230	4870	5
3-O-17	E	2 Years	.484	2135	4411	10
3-P-12	E	2 Years	.462	1945	4210	0
3-P-13	E	2 Years	.474	1640	3460	40
3-P-14	E	2 Years	.460	1440	3130	40
3-P-15	E	2 Years	.465	1595	3430	10
3-P-16	E	2 Years	.462	1540	3330	20
3-P-17	E	2 Years	.457	1565	3425	30
3-Q-12	E	2 Years	.457	2035	4453	0
3-Q-13	E	2 Years	.470	2180	4638	5
3-Q-14	E	2 Years	.448	2065	4609	30
3-Q-15	E	2 Years	.417	1870	4484	30
3-Q-16	E	2 Years	.462	1995	4318	5
3-Q-17	E	2 Years	.449	2035	4532	5
Ave.					3886	
3-F-12	C	None	.492	2375	4818	5
3-F-13	C	(Controls	.477	2430	5094	5
3-F-14	C	For 3 Yrs	.476	2275	4776	0
3-F-15	C	Test)	.480	2295	4777	0
3-F-16	C	"	.469	2260	4816	20
3-F-17	C	"	.479	2110	4400	5
3-G-12	C	"	.458	2280	4975	10
3-G-13	C	"	.493	2245	4549	10
3-G-14	C	"	.500	2215	4430	10
3-G-15	C	"	.498	2245	4307	20
3-G-16	C	"	.490	1890	3857	10
3-G-17	C	"	.457	2135	4670	5
Ave					4622	

CONDITIONS: C. R.T. Aged Panels - Controls For Exposure Tests
 E. Exposure Dry Panels - Pressure Tested



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SANDWICH PANELS TESTED AT R.T. AFTER EXPOSURE TO OUTDOOR WEATHERING
CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	BOND AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI	% COH. FAILURE
3-N-12	D	3 Years	.480	2450	5101	10
3-N-13	D	3 Years	.476	2340	4913	10
3-N-14	D	3 Years	.484	2510	5182	5
3-N-15	D	3 Years	.467	2210	4727	0
3-N-16	D	3 Years	.492	2485	5051	5
3-N-17	D	3 Years	.483	2560	5295	5
3-Y-12	D	3 Years	.486	2230	4588	5
3-Y-13	D	3 Years	.473	2380	5028	10
3-Y-14	D	3 Years	.491	2195	4464	5
3-Y-15	D	3 Years	.452	2020	4471	5
3-Y-16	D	3 Years	.469	2035	4342	15
3-Y-17	D	3 Years	.471	2025	4296	20
Ave.					4788	
3-R-12	E	3 Years	.490	2400	4889	0
3-R-13	E	3 Years	.480	2540	5284	10
3-R-14	E	3 Years	.466	2360	5062	0
3-R-15	E	3 Years	.477	2440	5108	10
3-R-16	E	3 Years	.470	2410	5118	0
3-R-17	E	3 Years	.473	2465	5207	5
3-S-12	E	3 Years	.477	2335	4897	5
3-S-13	E	3 Years	.481	1940	4032	20
3-S-14	E	3 Years	.473	1855	3923	5
3-S-15	E	3 Years	.465	2165	4655	5
3-S-16	E	3 Years	.468	2235	4771	10
3-S-17	E	3 Years	.469	2365	5041	5
3-T-12	E	3 Years	.468	2275	4856	5
3-S-13	E	3 Years	.471	2445	5190	10
3-S-14	E	3 Years	.481	2325	4837	15
3-S-15	E	3 Years	.480	2405	5014	5
3-S-16	E	3 Years	.503	2130	4235	20
3-S-17	E	3 Years	.473	2150	4544	15
Ave.					4815	

CONDITIONS: D. Exposure Panels - JP-4 Fuel Internal
 E. Exposure Dry Panels - Pressure Tested.



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LAPSHEAR STRENGTH RESULTS OF SPECIMENS CUT FROM BONDED 4FTW244-3
SANDWICH PANELS TESTED AT R.T. AFTER EXPOSURE TO OUTDOOR WEATHERING
CONDITIONS FOR VARIOUS PERIODS OF TIME

PANEL NO. 4FTW244- AND SPEC.	TEST COND.	EXPOSURE PERIOD	BOND AREA IN ²	ULT. LOAD LBS	ULT. STRESS PSI	% COH. FAILURE
3-U-12	E	4 Years	.490	2290	4673	5
3-U-13	E	4 Years	.510	2260	4431	0
3-U-14	E	4 Years	.480	1995	4156	5
3-U-15	E	4 Years	.490	1885	3847	5
3-U-16	E	4 Years	.500	2210	4420	0
3-U-17	E	4 Years	-	Metal Failure		-
3-V-12	E	4 Years	.500	2285	4570	5
3-V-13	E	4 Years	.490	2400	4898	5
3-V-14	E	4 Years	.480	2525	5260	5
3-V-15	E	4 Years	.490	2185	4459	10
3-V-16	E	4 Years	.480	2130	4437	30
3-V-17	E	4 Years	.490	2080	4245	20
3-W-12	E	4 Years	.500	2130	4260	10
3-W-13	E	4 Years	.460	2165	4765	20
3-W-14	E	4 Years	.460	2000	4348	5
3-W-15	E	4 Years	.460	2000	4348	5
3-W-16	E	4 Years	-	Metal Failure		-
3-W-17	E	4 Years	-	Metal Failure		-
Ave.					4474	
3-H-12	C	None	.478	1880	3933	5
3-H-13	C	(Controls	.479	1720	3590	45
3-H-14	C	For 5 Yrs	.474	2075	4377	50
3-H-15	C	Test)	.491	2330	4745	10
3-H-16	C	"	.511	2055	4021	70
3-H-17	C	"	.503	2035	4045	50
Ave.					4119	
3-Z-12	D	5 Years	.490	1990	4061	10
3-Z-13	D	5 Years	.491	2280	4644	80
3-Z-14	D	5 Years	.478	2025	4236	10
3-Z-15	D	5 Years	.480	1270	2646	0
3-Z-16	D	5 Years	.480	1885	3927	5
3-Z-17	D	5 Years	.471	1965	4163	15
Ave.					3946	
3-X-12	E	5 Years	.487	2145	4405	15
3-X-13	E	5 Years	.482	2070	4294	5
3-X-14	E	5 Years	.489	2095	4284	25
3-X-15	E	5 Years	.471	2120	4501	5
3-X-16	E	5 Years	.488	2030	4160	15
3-X-17	E	5 Years	.473	1955	4133	5
Ave.					4296	
CONDITIONS:	E	Exposure Dry Panels - Pressure Tested				
	C	R.T. Aged Panels - Controls For Exposure Test				
	D	Exposure Panels - JP-4 Fuel Internal				

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TABLE IX
FLATWISE TENSION RESULTS OF BONDED 4FTW 244-3 SANDWICH PANELS*
TESTED AT 260°F AFTER EXPOSURE TO OUTDOOR WEATHERING CONDITIONS
FOR VARIOUS PERIODS OF TIME

PANEL NO. AND SPEC. NO.	TEST COND.	EXPOSURE** PERIOD YEARS	LOAD TO FAIL (LBS)	LOAD TO FAIL PSI	TYPE FAILURE
3C-6-1	C	(Lab Exposure 1 year)	2815	896	Bond
3C-6-3	C		2375	756	Bond
Average				826	
3K-6-1	D	1	3040	968	Bond
3K-6-3	D	1	2390	760	Bond
Average				864	
3AC-6-1	E	1	2830	901	Bond
3AC-6-3	E	1	1630	519*	Bond
Average				901	
3W-3-1	E	4	2815	896	Bond
3W-3-3	E	4	2930	933	Bond
Average				915	
3-H-1	C	(Lab Exposure 5 years)	2550	812	Bond
3-H-3	C		3080	980	Bond
3-H-5	C		2785	886	Bond
Average				893	
3-Z-1	D	5	2505	797	Bond-Core
3-Z-3	D	5	2250	716	Bond-Core
Average				757	
3-X-1	E	5	3400	1082	Bond
3-X-3	E	5	3085	982	Bond
Average				1032	

CONDITIONS: C - R.T. aged Panels - Controls for Exposure Tests
D - Exposure Panels - JP-4 Fuel Internal
E - Exposure Dry Panels - Pressure Tested

* Value not included in average since specimen was damaged in machining operation.

** All 1 and 4 year specimens were cut from unfailed portions of tested panels. The first 2 digits of specimen number designates the panel while the 3rd digit indicates the specimen from which the flatwise tension specimens were taken. All 5 year test specimens were cut from original panel as shown in Figure 2.

*See note page 16.



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TABLE X

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
FMS0015 (SHELL 422J) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH FAILURE
A-3	1 Week	.530	1545	2915		50
A-5	"	.530	1410	2665		60
B-3	"	.540	1340	2480		75
B-5	"	.530	1340	2530		60
Ave.				2648		
A-4	1 Weeks	.530	1135		2140	95
A-6	"	.520	1105		2130	95
B-4	"	.530	1135		2140	95
B-6	"	.520	1200		2300	95
Ave.					2178	
C-3	2 Weeks	.500	1350	2700		80
C-5	"	.510	1325	2600		70
D-3	"	.500	1385	2770		70
D-5	"	.500	1315	2630		80
Ave.				2675		
C-4	2 Weeks	.500	1180		2360	95
C-6	"	.500	1170		2340	95
D-4	"	.500	1115		2230	95
D-6	"	.500	1095		2190	95
Ave.					2280	
Controls:						
A-1	None	.530	1435	2710		90
A-2	"	.500	1200		2400	85
B-1	"	.510	1435	2815		90
B-2	"	.500	1080		2160	85
Ave.				2763	2280	
C-1	None	.500	1470	2940		90
C-2	"	.490	1215		2480	80
D-1	"	.510	1575	3090		90
D-2	"	.490	1150		2350	90
Ave.				3015	2415	
E-3	3 Weeks	.500	1350	2700		85
E-5	"	.500	1250	2500		80
F-3	"	.490	1205	2460		85
F-5	"	.480	1250	2610		80
Ave.				2568		



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TABLE X (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
FMS0015 (SHELL 422J) ADHESIVE BONDED 2024T3 ALCALD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH FAILURE
E-4	3 Weeks	.500	1135		2270	95
E-6	"	.490	1125		2290	95
F-4	"	.490	1075		2195	95
F-6	"	.490	1090		2225	90
Ave.					2245	
G-3	4 Weeks	.490	1215	2480		70
G-5	"	.490	1285	2625		65
H-3	"	.520	1230	2365		70
H-5	"	.510	1290	2530		65
Ave.				2500		
G-4	4 Weeks	.500	1130		2260	95
G-6	"	.500	1180		2360	95
H-4	"	.500	1125		2250	95
H-6	"	.500	1080		2160	95
Ave.					2258	
Control:						
E-1	None	.520	1400	2690		90
E-2	"	.500	1070		2140	90
F-1	"	.490	1370	2795		90
F-2	"	.470	1130		2410	80
Ave.				2743	2275	
G-1	None	.500	1295	2590		90
G-2	"	.500	1335		2670	80
H-1	"	.520	1240	2385		90
H-2	"	.510	1245		2440	80
Ave.				2488	2555	
I-3	8 Weeks	.510	1315	2578		60
I-5	"	.510	1510	2960		50
J-3	"	.520	1305	2510		50
J-5	"	.510	1350	2647		50
Ave.				2674		
I-4	8 Weeks	.510	1205		2410	95
I-6	"	.510	1250		2500	90
J-4	"	.500	1125		2210	95
J-6	"	.500	1100		2160	100
Ave.					2320	



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TABLE X (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
FMS0015 (SHELL 422J) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH FAILURE
K-3	4 Months	.510	1330	2620		70
K-5	"	.490	1450	2960		70
L-3	"	.500	1340	2680		80
L-5	"	.500	1310	2620		80
Ave.				2720		
K-4	4 Months	.520	1100		2115	-
K-6	"	.510	1045		2049	-
L-4	"	.500	1145		2290	-
L-6	"	.500	1140		2280	-
Ave.					2184	-
Controls:						
I-1	None	.510	1320	2590		90
I-2	"	.500	1220		2440	85
J-1	"	.510	1325	2600		90
J-2	"	.510	1170		2300	90
Ave.				2595	2370	
K-1	None	.510	1300	2550		90
K-2	"	.500	1135		2270	80
L-1	"	.510	1290	2530		85
L-2	"	.500	1175		2350	80
Ave.				2540	2310	
M-3	6 Months	.500	1320	2650		70
M-5	"	.500	1330	2660		55
N-3	"	.520	1400	2705		65
N-5	"	.500	1360	2720		80
Ave.				2684		
M-4	6 Months	.490	1115		2275	70
M-6	"	.500	1040		2175	70
N-4	"	.500	1120		2240	60
N-6	"	.500	1125		2245	70
Ave.					2234	
O-3	1 Year	.510	1375	2696		80
O-5	"	.512	1355	2646		95
P-3	"	.508	1295	2549		90
P-5	"	.508	1310	2579		90
Ave.				2618		
O-4	1 Year	.514	1130		2198	100
O-6	"	.506	1080		2134	100
P-4	"	.511	1100		2153	100
P-6	"	.515	1060		2058	100
Ave.					2136	



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TABLE X (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
FMS0015 (SHELL 422J) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH FAILURE
Control:						
M-1	None	.510	1310	2570		90
M-2	"	.500	1085		2170	80
N-1	"	.510	1285	2520		90
N-2	"	.500	1160		2320	85
Ave.				2545	2245	
O-1	None	.510	1310	2570		90
O-2	"	.500	1115		2310	85
P-1	"	.500	1255	2510		90
P-2	"	.500	1060		2120	80
Ave.				2540	2215	
Q-3	2 Years	.503	1380	2744		80
Q-5	"	.512	1460	2852		60
R-3	"	.483	1335	2764		60
R-5	"	.499	1315	2635		60
Ave.				2749		
Q-4	2 Years	.510	1185		2324	85
Q-6	"	.502	1205		2400	80
R-4	"	.500	1090		2180	85
R-6	"	.495	1100		2222	80
Ave.					2282	
S-3	3 Years	.494	1330	2690		90
S-5	"	.485	1350	2760		90
T-3	"	.488	1370	2805		90
T-5	"	.483	1315	2725		90
Ave.				2745		
S-4	3 Years	.502	1060		2110	100
S-6	"	.502	1075		2140	100
T-4	"	.486	1075		2210	100
T-6	"	.478	1075		2250	100
Ave.					2178	
Controls:						
Q-1	None	.520	1430	2750		90
Q-2	"	.500	1110		2220	80
R-1	"	.490	1480	3020		85
R-2	"	.490	1230		2510	80
Ave.				2885	2365	



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TABLE X (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
FMS 0015 (HSELL 422J) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH FAILURE
S-1	None	.510	1400	2745		90
S-2	"	.490	1205		2460	80
T-1	"	.510	1390	2725		95
T-2	"	.490	1120		2290	75
Ave.				2735	2375	
U-3	4 Years	.502	1095		2180	100
U-5	"	.497	1085		2185	100
V-3	"	.490	1215		2480	100
V-5	"	.487	1080		2215	100
Ave.					2265	
U-4	4 Years	.504	1340	2659		100
U-6	"	.501	1300	2575		100
V-4	"	.482	1390	2884		100
V-6	"	.481	1355	2817		100
Ave.				2734		
W-3	5 Years	.508	1280	2520		95
W-5	"	.526	1250	2376		95
X-3	"	.502	1315	2620		95
X-5	"	.510	1330	2608		90
Ave.				2531		
W-4	5 Years	.513	1045		2037	90
W-6	"	.504	1000		1984	95
X-4	"	.504	1080		2143	95
X-6	"	.516	1060		2054	95
Ave.					2054	
Controls:						
U-1	None	.510	1390	2725		90
U-2	"	.490	1085		2210	85
V-1	"	.500	1470	2940		85
V-2	"	.480	1090		2275	75
Ave.				2833	2243	
W-1	None	.520	1340	2575		90
W-2	"	.500	1045		2090	80
X-1	"	.510	1385	2716		95
X-2	"	.510	1135		2230	80
Ave.				2646	2160	



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TABLE XI

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
FMS0016 (PLASTILOCK 620-626) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	%COH. FAILURE
A-3	1 Week	.500	2320	4640		60
A-5	"	.500	2360	4720		65
B-3	"	.500	2260	4520		65
B-5	"	.490	2275	4650		60
Ave.				4633		
A-4	1 Week	.500	1260		2520	98
A-6	"	.510	1150		2260	90
B-4	"	.500	1085		2170	95
B-6	"	.490	1180		2410	85
Ave.					2340	
C-3	2 Weeks	.490	2235	4561		25
C-5	"	.500	2250	4500		20
D-3	"	.500	2265	4530		20
D-5	"	.500	2290	4580		30
Ave.				4543		
C-4	2 Weeks	.490	1095		2240	90
C-6	"	.480	1065		2220	85
D-4	"	.500	1135		2270	90
D-6	"	.490	1075		2220	85
Ave.					2238	
Controls:						
A-1	None	.500	2245	4490		60
A-2	"	.490	1025		2092	90
B-1	"	.500	2275	4550		65
B-2	"	.480	1090		2271	95
Ave.				4520	2181	
C-1	None	.490	2220	4530		60
C-2	"	.490	1085		2214	90
D-1	"	.500	2330	4660		40
D-2	"	.480	1090		2271	95
Ave.				4595	2243	



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TABLE XI (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
 ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
 FMS0016 (PLASTILOCK 620-626) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH. FAILURE
E-3	3 Weeks	.520	2350	4519		80
E-5	"	.520	2380	4587		80
F-3	"	.490	2290	4673		90
F-5	"	.490	2250	4592		85
Ave.				4593		
E-4	3 Weeks	.520	1050		2020	75
E-6	"	.520	1155		2220	75
F-4	"	.500	1100		2200	80
F-6	"	.500	1110		2220	80
Ave.					2165	
G-3	4 Weeks	.500	2215	4430		70
G-5	"	.500	2235	4470		90
H-3	"	.490	2165	4418		80
F-5	"	.490	2185	4459		80
Ave.				4444		
G-4	4 Weeks	.500	1025		2050	
G-6	"	.500	900		1800	
H-4	"	.500	1120		2240	
H-6	"	.490	985		2010	
Ave.					2025	
Controls:						
E-1	None	.500	2225	4450		35
E-2	"	.500	1135		2270	95
F-1	"	.500	2245	4490		35
F-2	"	.470	1030		2191	95
Ave.				4470	2231	
G-1	None	.500	2185	4370		60
G-2	"	.490	1060		2163	95
H-1	"	.500	2175	4350		55
H-2	"	.470	1100		2340	98
Ave.				4360	2251	



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TABLE XI (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
 ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
 FMS0016 (PLASTILOCK 620-626) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T. 260°F	% COH FAILURE
J-3	8 Weeks	.500	2265	4480	10
J-5	"	.500	2215	4430	10
K-3	"	.490	2210	4448	10
K-5	"	.490	2150	4388	10
Ave.				4337	
J-4	8 Weeks	.510	1000	1960	40
J-6	"	.510	1040	2000	40
K-4	"	.500	1060	2120	40
K-6	"	.500	1045	2105	40
Ave.				2046	
L-3	4 Months	.500	2225	4406	80
L-5	"	.498	2173	4363	60
M-3	"	.498	2249	4761	80
M-5	"	.498	2253	4524	80
Ave.				4514	
L-4	4 Months	-	-	-	No value
L-6	"	.500	970	1940	-
M-4	"	.500	990	1980	
M-6	"	.500	1050	2100	
Ave.				2007	
Controls:					
J-1	None	.500	2300	4600	60
J-2	"	.480	1050	2188	95
K-1	"	.490	2265	4640	35
K-2	"	.480	1085	2309	95
Ave.				4620	2248
L-1	None	.500	2235	4470	40
L-2	"	.490	1100	2245	98
M-1	"	.500	2350	4700	30
M-2	"	.490	1110	2265	95
Ave.				4585	2255



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TABLE XI (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
 ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
 FMS0016 (PLASTILOCK 620-626) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH FAILURE
N-3	6 Months	.514	2250	4377		90
N-5	"	.517	2245	4342		90
P-3	"	.500	2125	4250		85
i-5	"	.500	2095	4190		90
Ave.				4290		
N-4	6 Months	.498	1110		2229	40
N-6	"	.499	1090		2184	40
P-4	"	.516	1190		2306	40
P-6	"	.515	1245		2417	60
Ave.					2284	
Q-3	1 Year	.490	2140	4367		90
Q-5	"	.490	2060	4204		85
R-3	"	.486	2200	4527		90
R-5	"	.486	2185	4496		90
Ave.				4399		
Q-4	1 Year	.491	1085		2209	85
Q-6	"	.490	1020		2082	80
R-4	"	.484	1080		2231	90
R-6	"	.477	1110		2327	85
Ave.					2212	
Controls:						
N-1	None	.510	2290	4500		60
N-2	"	.500	1085		2170	95
P-1	"	.500	2170	4340		60
P-2	"	.480	1055		2198	98
Ave.				4420	2184	
Q-1	None	.510	2170	4350		55
Q-2	"	.490	1120		2286	95
R-1	"	.500	2245	4490		60
R-2	"	.490	1100		2245	98
Ave.				4420	2266	



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TABLE XI (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
FMS0016 (PLASTILOCK 620-626) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T.	260°F	% COH. FAILURE
S-3	2 Years	.488	2135	4375		95
S-5	"	.485	2075	4278		95
T-3	"	.490	2135	4357		95
T-5	"	.491	2110	4297		95
Ave.				4327		
S-4	2 Years	.485	1085		2237	90
S-6	"	.482	1145		2376	90
T-4	"	.491	1240		2525	90
F-6	"	.492	1180		2398	90
Ave.					2384	
U-3	3 Years	.486	2175	4475		80
U-5	"	.486	2155	4435		80
V-3	"	.483	2235	4630		80
V-5	"	.485	2175	4485		80
Ave.				4506		
U-4	3 Years	.485	1240		2555	80
U-6	"	.486	1210		2490	80
V-4	"	.485	1270		2620	80
V-6	"	.484	1260		2605	80
Ave.					2568	
Controls:						
S-1	None	.500	2205	4410		65
S-2	"	.480	1085		2260	98
T-1	"	.500	2270	4540		65
T-2	"	.490	1115		2276	100
Ave.				4475	2268	
U-1	None	.500	2230	4460		65
U-2	"	.500	1125		2250	100
V-1	"	.500	2305	4610		40
V-2	"	.490	1055		2153	98
Ave.				4535	2202	

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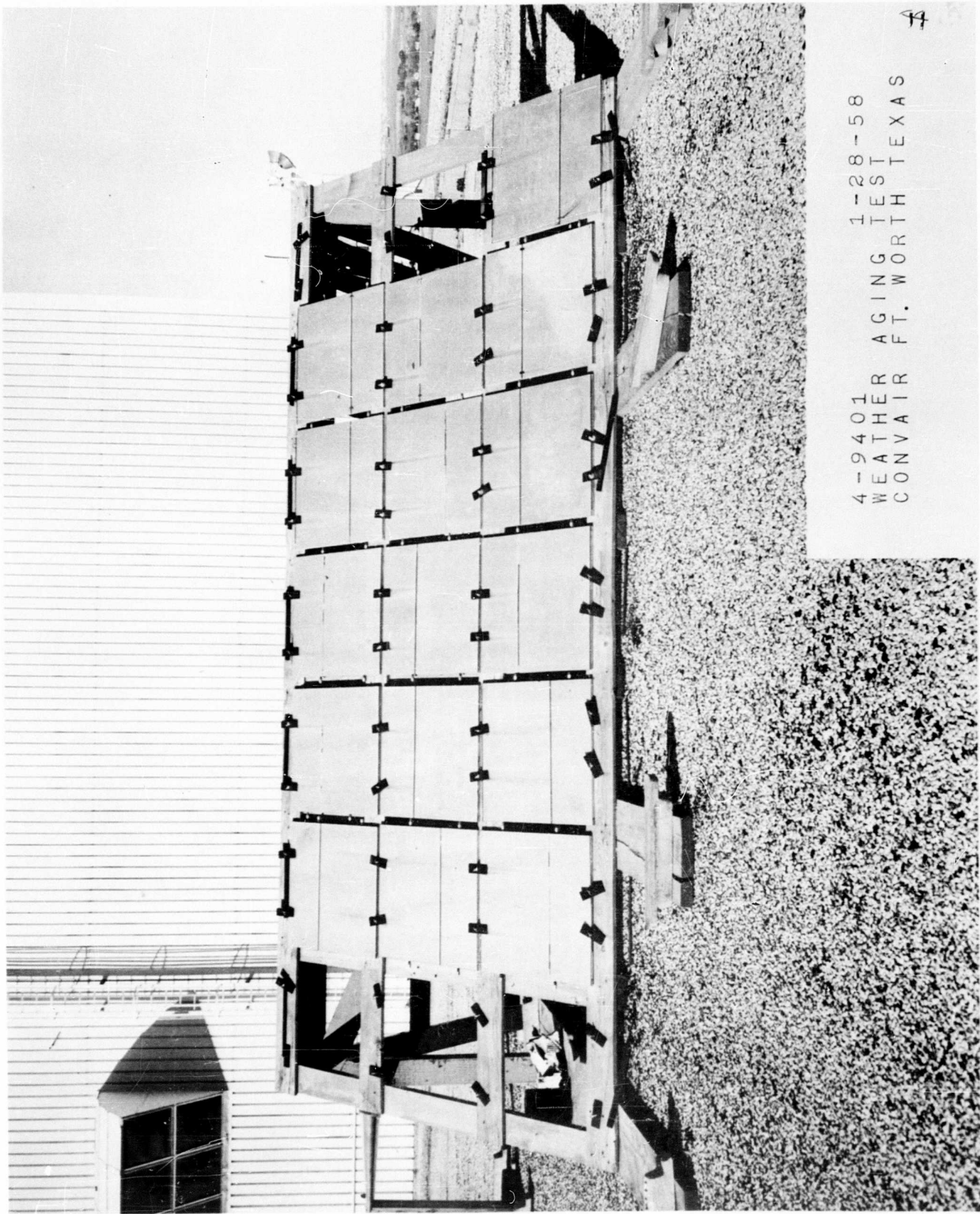
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TABLE XI (Continued)

EFFECT OF IMMERSION IN JP-4 FUEL AT 140°F ON THE
 ROOM TEMPERATURE AND 260°F SHEAR STRENGTH OF
 FMS0016 (PLASTILOCK 620-626) ADHESIVE BONDED 2024T3 ALCLAD ALUMINUM

SPEC. NO.	IMMERSION PERIOD	AREA IN ²	ULTIMATE LOAD (LBS)	ULTIMATE STRESS (PSI) R.T. 260°F	% COH. FAILURE
W-3	4 Years	.503	2320	4612	20
W-5	"	.508	2270	4468	10
X-3	"	.502	2466	4900	20
X-5	"	.504	2300	4563	25
Ave.				4636	
W-4	4 Years	.501	1050	2095	85
W-6	"	.505	1020	2019	85
X-4	"	.503	1075	2137	85
X-6	"	.505	1030	2040	85
Ave.				2073	
Y-3	5 Years	.510	2140	4196	20
Y-5	"	.506	2230	4407	10
Z-3	"	.503	2145	4264	15
Z-5	"	.508	2250	4429	20
Ave.				4324	
Y-4	5 Years	.508	1020	2008	100
Y-6	"	.507	1080	2130	100
Z-4	"	.505	1110	2190	100
Z-6	"	.506	1140	2253	100
Ave.				2145	
CONTROLS:					
W-1	None	.510	2295	4500	60
W-2	"	.510	1210	2373	98
X-1	"	.510	2355	4620	40
X-2	"	.490	1090	2224	98
Ave.				4560 2299	
Y-1	None	.500	2260	4520	35
Y-2	"	.490	1110	2265	95
X-1	"	.500	2315	4630	40
Z-2	"	.490	1125	2296	90
Ave.				4575 2281	



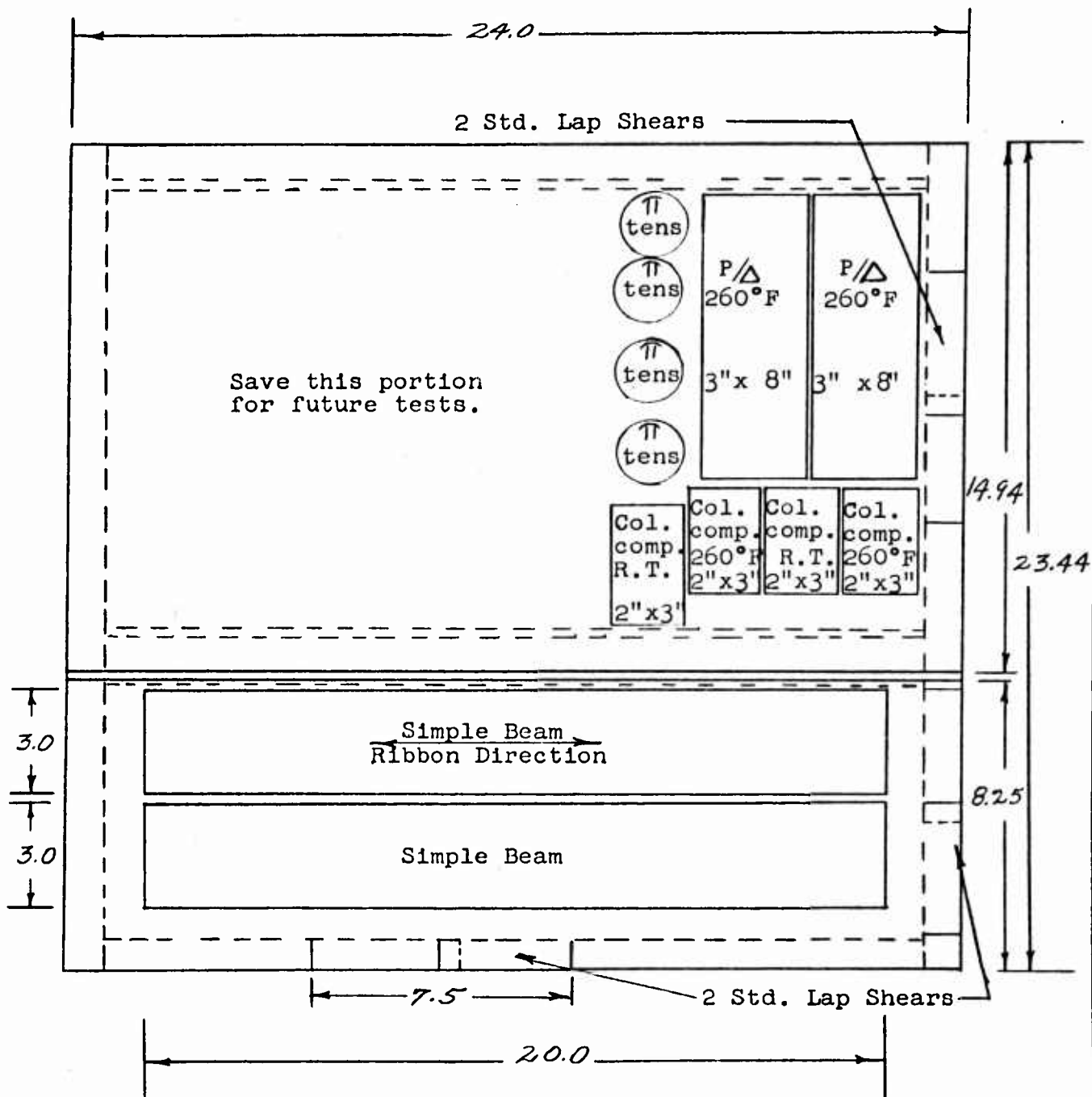
4-9401 WEATHER AGING TEST CHAMBER
CONVAIR FT. WORTH TEXAS

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION
(FORT WORTH)

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FIGURE 2



SPECIMEN CUTTING DIAGRAM FOR 4FTW-244-3-2 PANEL (5 YEAR WEATHER AGED WITH JP-4 INSIDE) SHOWING RELATIVE POSITION OF SPECIMENS AND PORTION SAVED FOR FUTURE TESTS

FIGURE 3

EFFECT OF OUTDOOR WEATHERING AND JP-4 FUEL ON THE
LAP SHEAR, CORE SHEAR, SIMPLE BEAM, AND FLATWISE TENSION
STRENGTHS OF 4FTW-244-3 BONDED SANDWICH PANELS.

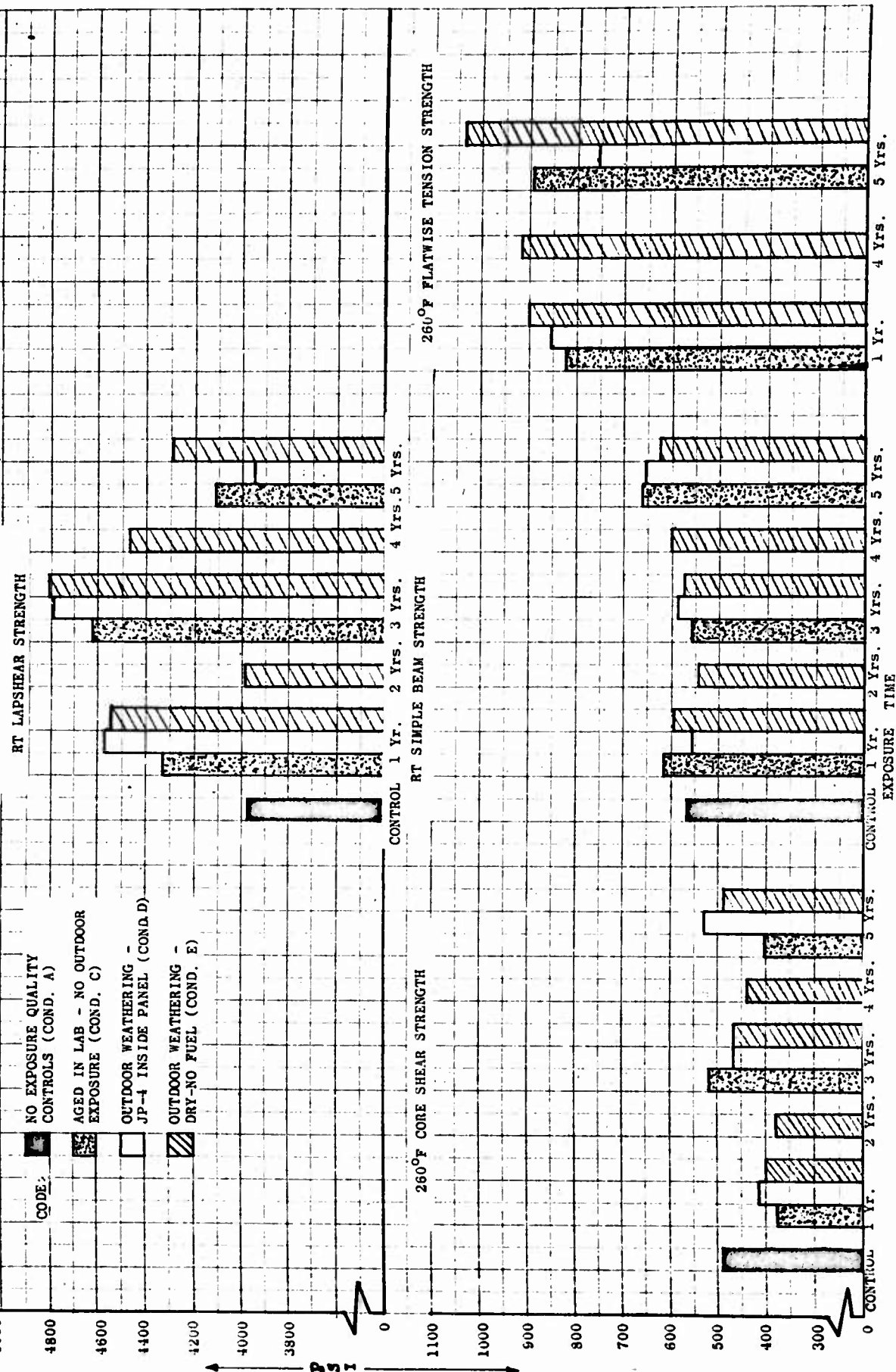
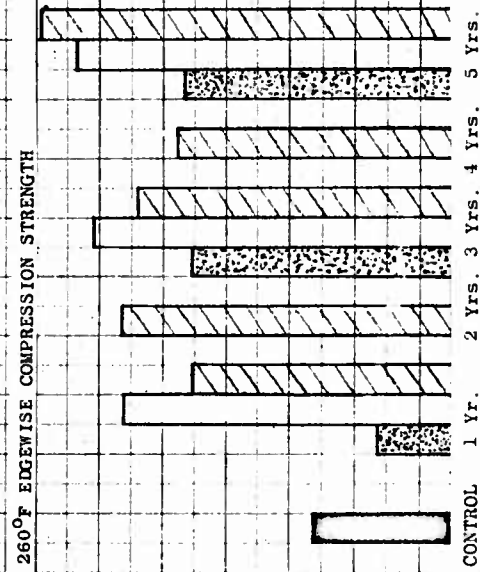


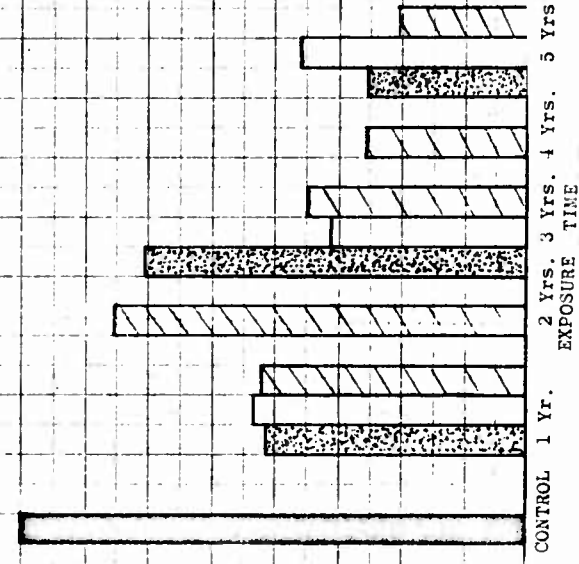
FIGURE 4

FIGURE 4

EFFECT OF OUTDOOR WEATHERING AND JP-4 FUEL ON THE
EDGEWISE COMPRESSION AND SHEAR MODULUS OF RIGIDITY
STRENGTHS OF 4FTW-244-3 BONDED SANDWICH PANELS



260°F SHEAR MODULUS OF RIGIDITY STRENGTH



NOTE: THE LOWEST SHEAR MODULUS VALUE
EXCEEDED THE 22 KSI MINIMUM
VALUE STIPULATED IN GD/FW
FMS 0013B SPECIFICATION

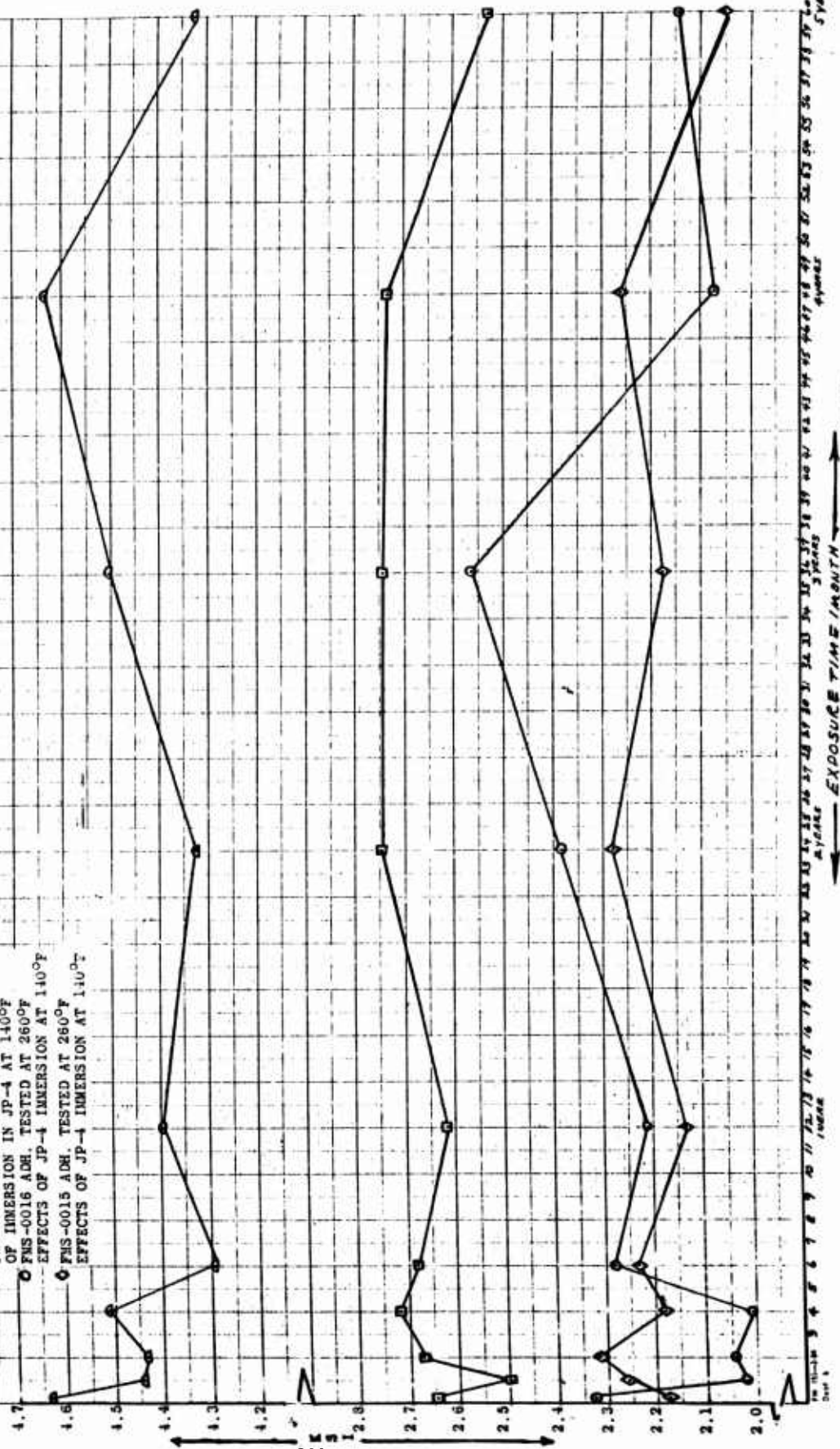
CONVAIR
SOUTHWEST DIVISION
FORT WORTH, TEXAS

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FIGURE 5

EFFECTS OF IMMERSION IN JP-4 FUEL AT 140°F ON
FMS-0016 AND FMS-0015 ADHESIVES AS BONDED LAP-
SHEAR SPECIMENS UP THROUGH A FIVE YEAR PERIOD

FMS-0016 ADH. TESTED AT RT EFFECTS
OF JP-4 IMMERSION AT 140°F
FMS-0015 ADH. TESTED AT RT EFFECTS
OF IMMERSION IN JP-4 AT 140°F
FMS-0016 ADH. TESTED AT 260°F
EFFECTS OF JP-4 IMMERSION AT 140°F
FMS-0015 ADH. TESTED AT 260°F
EFFECTS OF JP-4 IMMERSION AT 140°F



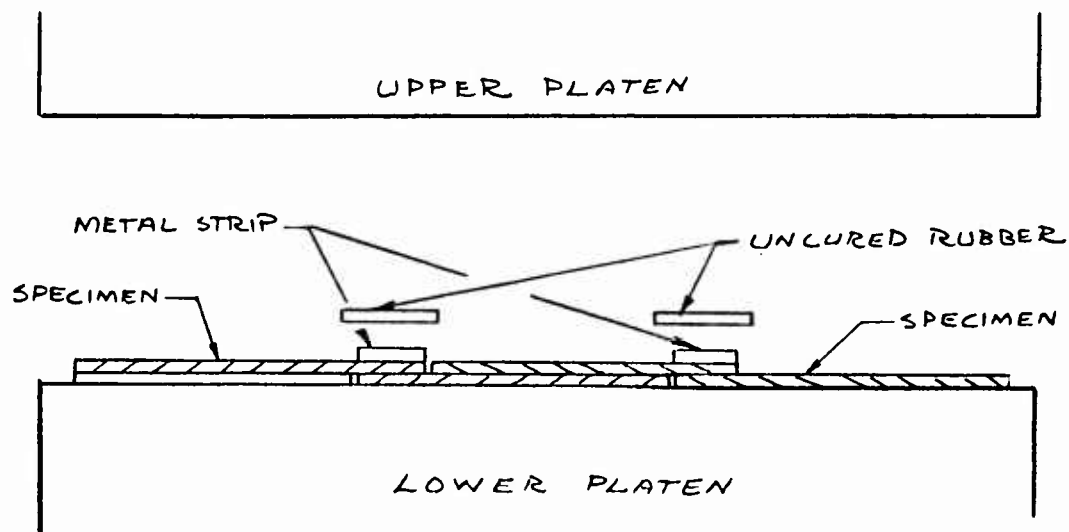
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Arrangement of Specimens During Bonding (Reference FGT-2855 page 9)

Lap shear specimens are cured two at a time as shown in the sketch below:





Abstract of Test Procedures Per FZM 169 (Reference FGT 2855 page 11)

Core Shear and Modulus of Rigidity

1. Specimen size: 3" x 8", cut from the 4FTW 244-3 panel
2. Test temperature: 260°F
3. Span: 6", single point loading
4. Load deflection curve is obtained by O.S. Peters Electronic Load-Strain Recorder Using a KSM Extensometer.
5. Load rate: 500 pounds per minute.

Simple Beam

1. Specimen size: 3" x 20"
2. Test temperature: Room temperature
3. Span: 18" with double point loading (10.94" between pads). Beam supported one inch from each end.
4. Load rate: 500 pounds per minute

Column Creep

1. Specimen size: 15" x 3.5", ends milled flat and parallel with panel edge member extending $3/32$ " beyond skins.
2. Test temperature: 260°F
3. Specimen is loaded simultaneously in column compression and beam loading. Beam loading is double point loading with 10" between load points. Support points are 1" from each end.
4. Load rate: Specimens are tested through 7 load combinations or until failure. Each load combination is held 3 hours.

Column Compression (Edge Compression)

1. Specimen: 2" x 3"
2. Test temperature: 260°F
3. Ends of specimens are milled flat and parallel
4. Load rate: 8000 pounds per minute

Lap Shear

1. Specimen: 7.5" x 1" cut from edge member area of panel. Edge member is milled to same thickness as panel skin (.040"). Specimen is notched to provide 1/2" x 1" test area in center of specimen.
2. Test procedures per MIL-A-5090B except time at temperature is 30 minutes prior to test.



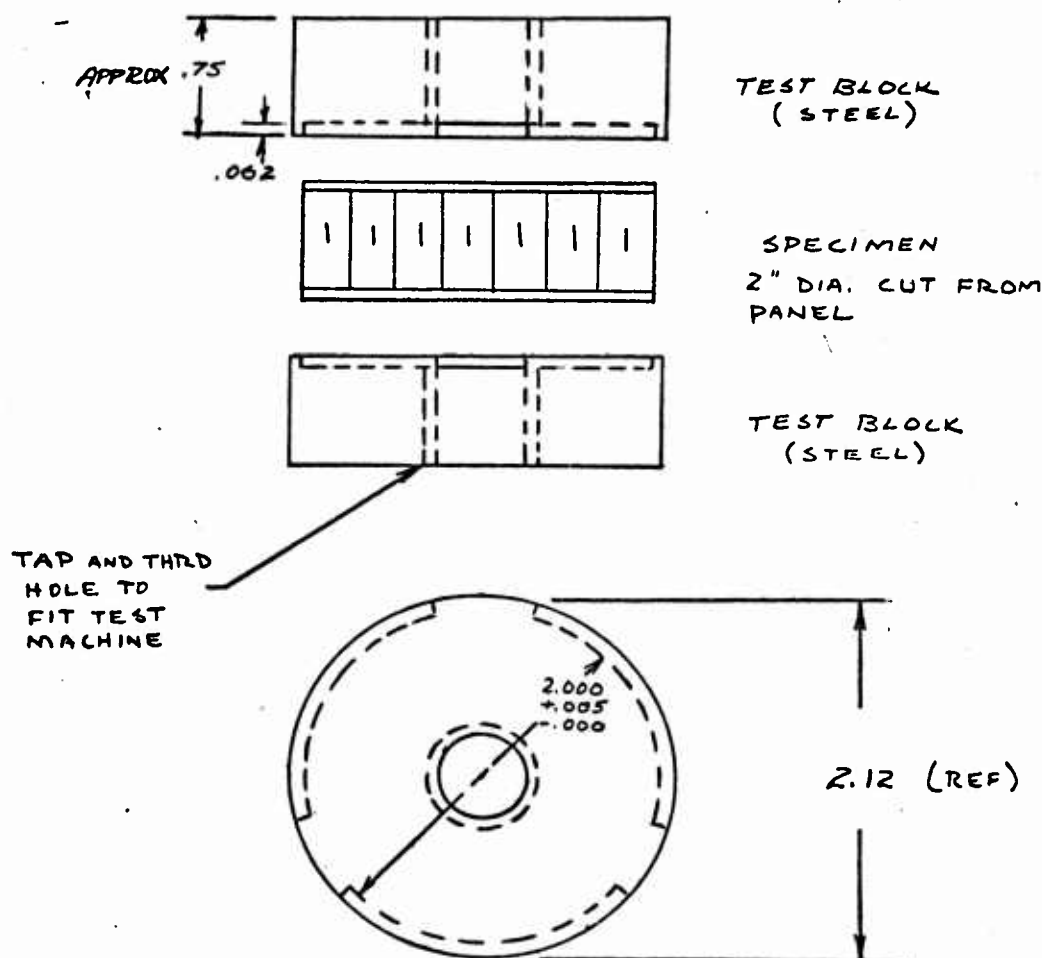
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FLATWISE TENSION TEST PER FMS-0015

(Ref. FGT-2855, page 13)

1. Bond specimen into test blocks with Aerobond 422-J Adhesive (Adhesive Engineering, San Carlos, California). Cure Adhesive at $350^{\circ} \pm 10^{\circ}\text{F}$ for 30 minutes while under 45 psi.
2. Before bonding, faces of specimens must be flat and parallel to each other. Faces of test blocks must be flat and perpendicular to the center line of the block.
3. Specimens to be stabilized at test temperature 30 minutes prior to test.
4. Load rate to be 4000 lb/min. $\pm$ 500 lb/min.



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