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Report No. 8926-096

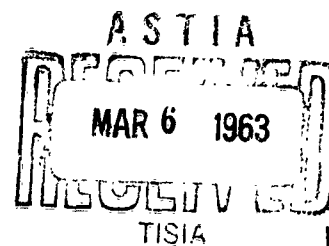
Materials - Laminates - Fiberglass - Polyester Resin
(No. 190-2, Fiberesin Plastics Co.)

Qualification Tests (Mil-P-8013C, Type I)

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Abstract

Fiberglass-polyester resin laminates consisting of twelve plies of No. 181 Volan A fiberglass fabric impregnated with No. 190-2 polyester resin (Fiberesin Plastics Co., Oconomowoc, Wisconsin) were fabricated by vacuum bag curing under 26 inches of mercury at 275°F for 1 hour. The results of the several tests made are as follows:

1. Room Temperature Conditions

Specific Gravity = 2.22

Resin Content = 40.4%

Barcol Hardness = 67.0

Flexural Flatwise Ultimate Strength, ksi = 64.9

Flexural Initial Modulus of Elasticity, $\text{psi} \times 10^6$ = 2.8

Compression Ultimate Strength Edgewise, ksi = 53.6

Tensile Ultimate Strength, ksi = 44.1

2. Wet Condition

Flexural Flatwise Ultimate Strength, ksi = 59.2

Flexural Initial Modulus of Elasticity, $\text{psi} \times 10^6$ = 2.6

Compression Ultimate Strength Edgewise, ksi = 50.8

Tensile Ultimate Strength, ksi = 43.5

References: Gardner, G. E., Jr., Bergstedt, P. W., Turner, H. C.,
"Qualification Test of Laminates of Fiberglass Cloth
No. 181, Volan A, With Polyester 190-2 Resin (Mil P-
8013C, Type I)," General Dynamics Convair Report
MP59-028, San Diego, California, 1 April 1959,
(Reference attached).



CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION
SAN DIEGO

REPORT MP 59-028
DATE 1 April 1959
MODEL ALL
T. N. MP-57-627

TITLE
REPORT NO. MP 59-028
QUALIFICATION TEST OF/
LAMINATES OF FIBERGLAS
CLOTH NO. 181 VOLAN, A, WITH
POLYESTER 190-2 RESIN.
MIL-P-8013c, TYPE I

MODEL: ALL

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of Structures & Materials Lab.

CHECKED BY _____ NO. OF PAGES 4

W. M. Sutherland, Jr.
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REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED
1	4-22-59	WMS	T.N. MP-57-627 added to Title Page	Title Page

ANALYSIS
PREPARED BY Gardner
CHECKED BY Bergstedt/Turner/Sutherland
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PAGE 1
REPORT NO. MP 59-028
MODEL All
DATE 4-1-59

OBJECT:

The qualification to Specification Mil-P-8013c, Type I, of laminates of fiberglass cloth No. 181 (CVAC-1000-5) impregnated with Polyester 190-2 Resin, manufactured at Convair, San Diego, California.

CONCLUSION:

Laminates of fiberglass cloth No. 181 (CVAC-1000-5) and Polyester 190-2 Resin, fabricated by Dept. 129, Convair, San Diego, California, satisfactorily conformed to minimum mechanical property requirements of Military Specification Mil-P-8013c, Type I.

TEST PANELS:

One panel, 0.132 inches in thickness by 15 inches square, was submitted to the Materials and Processes Laboratory on February 20, 1959 by the fabricator, the Production Plastics Manufacturing Dept. No. 129 of Convair, San Diego.

This laminate was submitted as a wet lay-up, nominally two feet square, consisting of twelve (12) plies of No. 181 glass fabric impregnated with Polyester 190-2 Resin.

The laminate was cured by employing the flat vacuum bag process. Contact pressure was maintained for one (1) hour at 24 inches of mercury; curing temperature was held at 275°F. ± 10°F. Laminating and curing procedures followed the resin manufacturer's (Fiber-Resin Corp.) process recommendations.

TEST SPECIMENS:

Ten (10) flexural, ten (10) compression, and ten (10) tensile specimens were machined from the submitted panel with the long direction parallel to the warp thread direction of the laminate. Prior to testing, five (5) specimens of each type were placed in boiling distilled water for two (2) hours. The second set of five (5) specimens of each type was tested in the standard condition.

PROCEDURE:

The length of each flexural specimen was equal to the span length plus two inches, and the width was three-fourths (3/4) of an inch. The span length had a constant length/thickness ratio of 16-18 to 1. The specimens were center-loaded, and load-deflection data were taken until failure. The speed of testing was regulated to produce a unit rate of outer-fiber strain of 0.010 inch per inch per minute. Tests were conducted in accordance with Method 1031 of Federal Specification LP-406B.

PROCEDURE: (Continued)

Tensile tests were performed in a Tinius Olsen Tensile Machine, and a uniform crosshead travel of 0.05 inch per minute was applied until failure. Tests were conducted in accordance with Method 1011 (LP-406B).

Compression specimens were loaded in a compression jig at a speed of 0.050 inches per minute cross-head travel until failure. Tests were conducted in accordance with Federal Specification LP-406B.

The examinations for percent of resin content and specific gravity were determined by procedures in Method 5011 (Specific Gravity) and Method 7061 (Resin Content) of Federal Specification LP-406B.

Barcol hardness was determined by direct reading with a Barcol Impresor.

RESULTS:

The results of tension, compression, and flexural tests in the standard condition are shown in Table I. The results of tension, compression, and flexural tests on specimens subjected to two (2) hours in boiling distilled water (wet condition) are shown in Table II. The results of observations made on the submitted panel for specific gravity, resin content, and Barcol Hardness are shown in Table I.

NOTE: The data from which this report was prepared are recorded in Materials & Processes Laboratory Notebook No. 996.

ANALYSIS
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TABLE I

QUALIFICATION TEST FOR LAMINATED (181)
 GLASS FABRIC MADE WITH POLYESTER 190-2

TESTED UNDER STANDARD CONDITIONS

SPECIFIC GRAVITY ----- 2.22

RESIN CONTENT ----- 40.4 %

BARCOL HARDNESS READING ----- 67.0

TYPE OF TEST	SPEC. NO.	MIN. REQUIREMENTS	TEST RESULTS
FLEXURAL FLATWISE ULTIMATE STRENGTH, PSI.	1	50,000	66,800
	2		62,100
	3		64,000
	4		66,500
	5		65,200
	AVERAGE		64,900
FLEXURAL INITIAL MODULUS OF ELASTICITY, PSI.	1	2.7 X 10 ⁶	2.8 X 10 ⁶
	2		2.9 X 10 ⁶
	3		2.8 X 10 ⁶
	4		2.8 X 10 ⁶
	5		2.7 X 10 ⁶
	AVERAGE		2.8 X 10 ⁶
COMPRESSION ULTIMATE STRENGTH EDGEWISE, PSI.	1	35,000	55,600
	2		50,600
	3		54,300
	4		52,700
	5		55,600
	AVERAGE		53,600
TENSILE ULTIMATE STRENGTH, PSI.	1	40,000	43,000
	2		46,200
	3		42,700
	4		44,900
	5		43,500
	AVERAGE		44,100

TABLE II

QUALIFICATION TEST FOR LAMINATED (181)
 GLASS FABRIC MADE WITH POLYESTER 190-2

TESTED UNDER WET CONDITION

TYPE OF TEST	SPEC. NO.	MIN. REQUIREMENTS	TEST RESULTS
FLEXURAL FLATWISE ULTIMATE STRENGTH, PSI.	1	45,000	57,700
	2		59,300
	3		60,800
	4		59,100
	5		58,900
	AVERAGE		59,200
FLEXURAL INITIAL MODULUS OF ELASTICITY, PSI.	1	2.5×10^6	2.6×10^6
	2		2.6×10^6
	3		2.6×10^6
	4		2.6×10^6
	5		2.6×10^6
	AVERAGE		2.6×10^6
COMPRESSION ULTIMATE STRENGTH EDGEWISE, PSI.	1	30,000	49,100
	2		52,400
	3		47,900
	4		53,200
	5		51,600
	AVERAGE		50,800
TENSILE ULTIMATE STRENGTH, PSI.	1	38,000	41,300
	2		43,800
	3		43,700
	4		43,500
	5		45,300
	AVERAGE		43,500