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Report 2470

Evaluation of Coated Fabrics for Pneumatic Equipment

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This report details the scope of work and results obtained in a program to evaluate the performance characteristics of typical commercial elastomer coated fabrics used to fabricate inflatable boats, such as those currently cited in MIL-B-53067 for 3-, 7-, and 15-person sizes. Comparison of the material test data with the criteria cited in the new combined specification indicates that conformance is attainable. Likewise, in-house evaluation of performance of seams constructed from the candidate fabrics was generally acceptable.

It is concluded that MIL-B-53067, as drafted, is acceptable for procurement of pneumatic boats in the specified sizes.

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PREFACE

The US Army uses inflatable boats in 3-person, 7-person, and 15-person capacities during reconnaissance, landing assault, and engineering bridging operations. These boats, designed in the early 1950s, were fabricated from neoprene-coated nylon in accordance with MIL-C-14505, and were autoclave-vulcanized under heat and pressure.

Current inflatable boat technology offers a variety of new materials and fabrication techniques. Because hypalon and urethanes have gained prominence, thermal bonding procedures are now being employed to reduce the high degree of labor-intensive operations involved. To open up competition to include these innovations, the Belvoir Research, Development and Engineering Center (BRDEC), in 1987, developed performance specification MIL-B-53067, wherein essential performance and design criteria are cited, but materials and fabrication methods are left to the contractor's discretion.

Concurrent with the promulgation of the new specification, an in-house program was conducted by the Materials, Fuels and Lubricants Directorate in FY87-88 to assess the conformance of commercial boat materials currently used by the end item fabricators. Materials and representative seam structures were solicited through a *Commerce Business Daily* announcement 15 September 1986. This report summarizes the results and conclusions derived from that effort.

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SECTION I. BACKGROUND

Historically, procurement of pneumatic boats in the 3-, 7-, and 15-person capacity classes has been in accordance with end item specifications MIL-B-13831, MIL-B-17775, and MIL-B-58022, respectively. These documents reference detailed configurational drawings; specific materials of construction—such as neoprene-coated nylon, conforming to MIL-C-14505 or MIL-C-17415; and end item performance requirements—such as leakage and inflation tests.

As directed by the Troop Support Command (TROSCOM), the Marine Division, Logistics Support Directorate, and the Rubber and Coated Fabrics Research Group, Materials, Fuels and Lubricants Directorate, jointly drafted, coordinated and issued MIL-B-53067, combining all three boat classes into one performance document which retains certain material controls and end item qualification procedures, but references no drawings. Thus, design is left open to the vendor, and procurement of off-the-shelf items is possible.

In order to ascertain the reasonableness of materials requirements, specifically for coated fabrics of MIL-B-53067, the Marine Division solicited samples of potential candidate materials and their representative seam structures from commercial boat fabricators. It intended to also include samples of actual coating compounds in the evaluation; however, industry was reluctant to comply, because they consider their compounds proprietary.

SECTION II. EXPERIMENTAL

A total of 17 coated fabric materials obtained from seven commercial boat suppliers were evaluated. All of these materials, designated as BF-1 through BF-17, except for two were derived from foreign sources. Corresponding representative seam structures were obtained for all candidate materials except BF-4. All tests were performed in accordance with Tables 1 and 2, with the exception of ***fungus resistance*** due to unavailable test facilities. Table 3 lists test paragraphs that detail the procedures for testing materials specified in Tables 1 and 2. Other test methods are in accordance with FED-STD-191 or American Society for Testing and Materials (ASTM) procedures as indicated in the tables.

Attempts made to prepare coating peel adhesion specimens which required an adhered reinforcing back-up strip to prevent stretching of the thin coating layer were unsuccessful. Having no knowledge of the coating composition, it was impossible to find compatible adhesives for the back-up strips. Skiving the coating to initiate separation was also unsuccessful. Thus, no ***coating adhesion*** data was obtained.

All test data are summarized in Tables 4 and 5. Since the candidate materials were not specifically submitted on the basis of conformance to either the 3-, 7-, or 15-person boat requirements, pass (P)

or fail (F) notations are included for each class. Actual MIL-B-53067 requirements are shown at the bottom of each test property column. The boat fabric materials designated BF-10, BF-11, BF-12, BF-13, and BF-14 were supplied with both longitudinal (L) and transverse (T) seams.

Table 1. Characteristics of Coated Fabrics, MIL-B-53067 (ME)

ITEM	PROPERTY	TYPE REQUIREMENT PERSON CAPACITY 3 (I)	7 (II)	15 (III)	TEST PARAGRAPH OR TEST METHOD OF FED-STD-191
1	Weight (oz/sq yd)	14 (MIN)	30 (MIN)	30 (MIN)	5041
2	Tearing strength warp and fill (lb [MIN])	8	25	25	5134
3	Breaking strength — warp — fill (lb/in [MIN])	 225 180	 350 335	 350 335	5102
4	Weathering resistance after 500 hours exposure at 5% elongation, warp and fill (percent retention of initial breaking strength [MIN])	80	80	80	5804/5102*
5	Puncture resistance (lb [MIN])	90	110	110	4.5.2.9/5120
6	Low temperature crease resistance: Appearance after unfolding	No cracking, peeling or delamination			4.5.2.10
7	Porosity (air retention)	No leaks	No leaks	No leaks	4.5.2.13
8	Fungus resistance	No cracking, blistering or delamination of coating. Retention of breaking strength 50% (MIN)			5762**
9	Blocking	Specimens to separate within 5 seconds			4.5.2.11
10	Coating adhesion (initial) (lb/in [MIN])	12	20	20	4.5.2.12
11	Coating adhesion after immersion in distilled water at 160°F ± 2°F for the following durations: 14 days (lb/in) 42 days (lb/in)	 8 6	 10 8	 10 8	 4.5.2.12 4.5.2.12

* Specimens shall have exterior coating facing carbon arc. Alternate corex D filters shall be removed.

** Except specimens shall be prepared per method 5102 and the number of specimens reduced from 40 to 5 warp and 5 fill. Leaching of specimens is unnecessary. The specimens shall be exposed to the soil for 8 weeks.

MIN = Minimum

Table 2. Characteristics of Seams, MIL-B-53067 (ME)

ITEM	PROPERTY	TYPE REQUIREMENT PERSON CAPACITY 3 (I)	7 (II)	15 (III)	ASTM TEST METHOD OR TEST PARAGRAPH
1	Breaking strength (initial) (lb/in [MIN]) *	190	300	300	D 751** 4.5.2.14
2	Breaking strength after immersion in distilled water at 160°F ± 2°F for the following durations:				
	14 days (lb/in)	180	280	280	D 751/D 471/4.5.2.14
	42 days (lb/in)	90	140	140	D 751/D 471/4.5.2.14
3	Dead load shear resistance under 50 lb/in stress at 200°F for 24 hours	0.1 inch slippage (MAX)			4.5.2.15
4	Peel adhesion (initial) (lb/in [MIN])	12	20	20	D 413 machine method 4.5.2.14
5	Peel adhesion after immersion in distilled water at 160°F ± 2°F for the following durations:				
	14 days (lb/in)	8	10	10	D 413 machine method D 471/4.5.2.14
	42 days (lb/in)	6	8	8	D 413 machine method D 471/4.5.2.14

* All specimens must break in the coated fabric. Failure of any specimen in a seam area at any value shall constitute failure of this test.

** Except specimens shall be 2 inches wide.

MIN = Minimum
MAX = Maximum

Table 3. Test Paragraphs of MIL-B-53067 (ME)

4.5.2.9 **Puncture resistance.** FED-STD-191, method 5120 applies except that the ring clamp mechanism shall have an internal diameter of 3.00 inch, and the ball shall be replaced by a piercing instrument shaped like a flared, flat-tip screwdriver, having a width of 0.312, ± 0.010 inch, and a thickness of 0.031, ± 0.004 inch, at the extreme tip. The piercing tip edges shall be rounded to a 0.010 inch radius. The piercing instrument shall be oriented to intercept the warp and fill threads at an angle of approximately 45 degrees. The average of three test specimens shall be reported. Nonconformance to [Table 1 of this report] shall constitute failure of this test.

4.5.2.10 **Low temperature crease resistance.** Fold two coated fabric specimens (each 8 inches square) in half in each direction so that a folded corner occurs in the center of each specimen. Place each folded specimen under a 4-pound load and condition at -60°F for 46 hours. At the end of the conditioning period, unfold the specimens while still at a temperature of -60°F and examine visually. Signs of cracking, peeling, or delamination of any coating material or, nonconformance to [Table 1 of this report] shall constitute failure of this test.

4.5.2.11 **Blocking.** Place two coated fabric specimens 6 inches by 1 inch in an oven on a smooth surface in such a manner that the ends are overlapped 1 inch. Place a 4-pound weight directly on the overlapped area. After conditioning at a temperature of 158 ± 2°F, for 4 hours, remove the weight and take the specimens from the oven and condition for 1 hour at 73 ± 3°F. Attach one end of the specimen in a suitable clamping device allowing the free end to hang down. Suspend a 4-ounce weight from the free end of the specimens. Inability of the strips to separate within 5 seconds under 4-ounce load shall constitute failure of this test.

4.5.2.12 **Coating adhesion.** Samples of coated fabric shall be bonded face-to-face to provide specimens for determining adhesion between the cloth and exterior coating(s), between the cloth and interior coating(s), between laminations of interior coatings and barrier (if used), and between laminations of exterior coatings. In forming this bond the specimens shall be subjected to no heat or pressure other than that normally encountered in curing the coated fabric, except for minimal pressure necessary to ensure contact while the bond is setting.

4.5.2.12.1 **Test procedure.** The adhesion shall be determined in accordance with ASTM D 413, machine method except that the specimens shall be 2 inches wide. The specimens shall be of sufficient length to conduct adhesion tests for both initial values and after water immersions. The adhesion results obtained on each immersed specimen shall be compared with the initial adhesion of the same specimen to determine percentage of adhesion retained. The reported adhesion and percent retention shall be the average on not less than two specimens. Attempts shall be made to cut the coating back to the cloth and to determine the adhesion value at the coating-to-cloth interface. However, if a specimen separates at a plane other than the bond of the coating to cloht (such as between layers of coating materials or between barrier film and coating) the adhesion value and the plane of failure shall be recorded. Immersed specimens shall be conditioned in distilled water at 73 ± 5°F, for 30 to 90 minutes before testing. Testing of immersed specimens shall be compared within 3 minutes after removal from the conditioning water. Immersion of specimens shall be in accordance with ASTM D 471. Nonconformance to [Table 1 of this report] or any obvious bond failure evident after immersion but before stressing, even if the plane of failure is not sandwiched between the layers of fabric, shall constitute failure of this test.

4.5.2.13 **Porosity test - (air retention).** Three specimens (13 inches in diameter) of the coated cloth for each boat type shall be individually tested on the test jig as shown in figure 1. The specimen shall be placed, (coated side up), on the holder and the plate collar tightly bolted thereon. Care should be taken to ensure a leaktight fit. Water shall be poured on top of the specimen, sufficient to keep the top of the specimen completely covered at all levels of pressure. The specimen shall be inflated to an air pressure of 10 psi for 5 minutes. The air bubbles on the cloth surface produced by air pressure closing the spaces between the cloth and coating shall be removed. The cloth shall show no signs of leakage as evidenced by continued production of air bubbles.

Table 3. Test Paragraphs of MIL-B-53067 (ME) (Continued)

4.5.2.14 **Seam tests.** The bonding together of any two or more pieces of coated fabric (such as lap joints, butt joints, and closure, chafing or reinforcing patches, coated fabric flanges of valves, etc.) shall be considered as seams and shall be subjected to all seam tests specified herein, except chafing patches which will only be tested for peel. The average breaking strength of five specimens for each type seam for each test shall be reported for conformance to [Table 2 of this report]. Breaking strength specimens shall be 2 inches wide (parallel to the seam) and shall extend (perpendicular to the seam) 3 inches beyond both edges of the seam. No part of the test specimens shall be coated or covered during the water immersion periods. Specimens shall be cooled in the immersion fluids at 73 ± 5°F, for 30 to 90 minutes before testing. Testing of immersed specimens shall be completed within 3 minutes after removal from the immersion fluids. The average peel adhesion strength of two specimens for each type seam shall be reported for conformance to [Table 2 of this report] . Peel adhesion specimens shall be of sufficient length to determine both the initial and after water adhesion values on the same specimen. If seam construction involves the use of binding thread, then the peel specimen shall be prepared with threads removed. Nonconformance to [Table 2 of this report] shall constitute failure of this test.

4.5.2.15 **Dead load shear resistance.** The test specimens shall be 1.0 inch, ±0.020-inch wide, (parallel to the seam) and coated fabric shall extend a minimum of 3 inches (perpendicular to the seam) on each side of the seam. One index mark shall be scribed on each side of the seam to facilitate observation and measurement of slippage. Each specimen shall be subjected to a constant (dead load) tension force of 50 ± 1/2 pound, at 200 ± 5°F. After 24 hours examine each specimen while still under tension for signs of slippage or separation. Three specimens shall be tested for each determination. Slippage, by any specimen, greater than specified in [Table 2 of this report] shall constitute failure of this test.

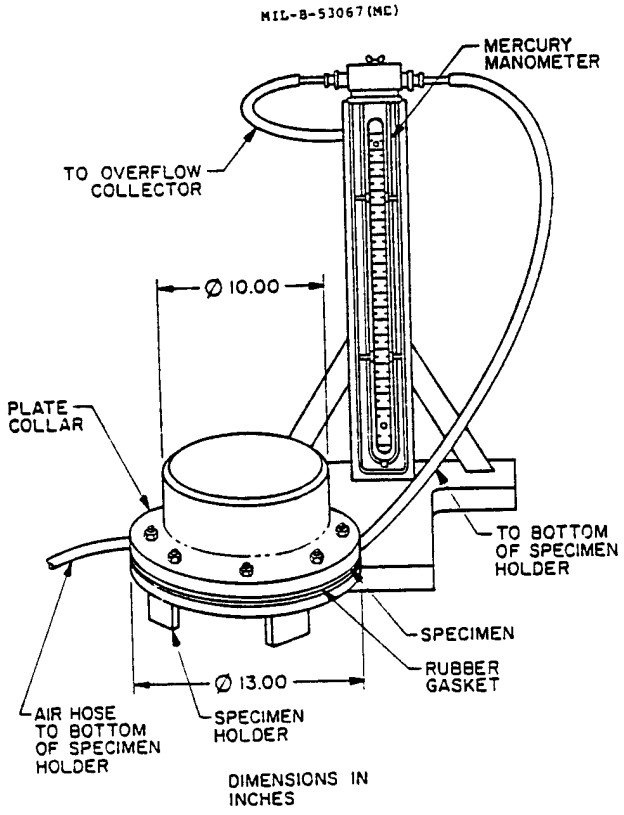

FIGURE 1. Air leakage test jig.

X-4695

Table 4. Coated Fabric Test Results

SAMPLE ID.	WEIGHT (oz/yd^2)		TEAR STRENGTH (lb)				BREAKING STRENGTH (lb/In WIDTH)				WEATHERING RESISTANCE (% RET)			
			WARP		FILL		WARP		FILL					
	3 PERSON	7-15 PERSON	3 PERSON	7,15 PERSON	3 PERSON	7,15 PERSON	3 PERSON	7, 15 PERSON	3 PERSON	7, 15 PERSON	WARP		FILL	
BF-1	P 35.62	P	P 25.6	P	P 19.2	F	P 349.3	F	P 272.4	F	105	P	113	P
BF-2	P 35.82	P	P 26.5	P	P 32.5	P	P 474.7	P	P 442	P	98	P	88	P
BF-3	P 40.23	P	P 74.6	P	P 78.2	P	P 760.3	P	P 661	P	94	P	97	P
BF-4	P 20.46	F	P 34.8	P	P 35.4	P	P 227.5	F	F 150.6	F	93	P	98	P
BF-5	P 32.41	P	P 25.0	P	P 28.8	P	P 417	P	P 381	P	89	P	104	P
BF-6	P 37.71	P	P 28.3	P	P 26.1	P	P 433	P	P 490	P	104	P	91	P
BF-7	P 45.76	P	P 37.1	P	P 44.4	P	P 555	P	P 465	P	100	P	98	P
BF-8	P 35.16	P	P 23.9	F	P 35.0	P	P 408	P	P 370	P	100	P	97	P
BF-9	P 44.43	P	P 54.9	P	P 66.2	P	P 652	P	P 620	P	97	P	98	P
BF-10	P 26.75	F	P 28.3	P	P 29.9	P	P 360	P	P 290	F	108	P	93	P
BF-11	P 27.0	F	P 22.4	F	P 32.7	P	P 363	P	P 308	F	100	P	98	P
BF-12	P 39.5	P	P 84.7	P	P 121.9	P	P 622	P	P 503	P	97	P	96	P
BF-13	P 49.11	P	P 51.8	P	P 59.0	P	P 684	P	P 687	P	97	P	93	P
BF-14	P 45.91	P	P 56.4	P	P 38.6	P	P 642	P	P 547	P	98	P	93	P
BF-16	P 18.55	F	P 26.0	P	P 19.5	F	P 292	F	P 224	F	93	P	123	P
BF-17	P 45.42	P	P 101.7	P	P 61.8	P	P 804	P	P 866	P	79	F	98	P
MIL-B-53067 REQ.	14	30	8	25	8	25	225	350	180	335	80		80	

Table 4. Coated Fabric Results (Continued)

SAMPLE I.D.	PUNCTURE (lb) RESISTANCE (% RET) 3 PERSON		7, 15 PERSON	LOW TEMP CREASE 3, 7, 15	POROSITY 3, 7, 15	BLOCKING 3, 7, 15
BF-1	P	108	F	F	P	F
BF-2	P	109	F	F	P	F
BF-3	P	157	P	F	P	F
BF-4	F	70	F	P	P	F
BF-5	P	97	F	P	P	F
BF-6	P	124	P	F	P	F
BF-7	P	133	P	F	P	F
BF-8	P	95	F	F	P	P
BF-9	P	125	P	F	P	F
BF-10	F	86	F	F	P	P
BF-11	P	101	F	F	P	F
BF-12	P	126	P	F	P	P
BF-13	P	220	P	F	P	F
BF-14	P	110	P	F	P	P
BF-16	F	81	F	P	P	F
BF-17	P	215	P	P	P	F
MIL-B-53067 REQ.	90		110	NO CRACKS	NO LEAKS	SEPARATION WITHIN 5 SECONDS

Table 5. Seam Test Results

SAMPLE I.D.	ORIGINAL BREAKING STRENGTH (lb/in) 3 PERSON		7, 15 PERSON	BREAKING STRENGTH 14 DA/$H_2$0 IMMERS./160°F 3 PERSON		7, 15 PERSON	BREAKING STRENTH 42 DA/$H_2$0 IMMERS./160°F 3 PERSON		7, 15 PERSON	DEAD LOAD 3, 7, 15
BF-1	P	266.6	F	P	234.5	F	P	217.0	P	P
BF-2	P	364.9	P	P	309.2	P	P	300.0	P	P
BF-3	P	577.8	P	P	328.8	P	P	196.4	P	P
BF-5	P	427.4	P	P	402.8	P	F	74.0	F	P
BF-6	P	714.7	P	P	689.0	P	P	181.0	P	P
BF-7	P	523.3	P	P	459.6	P	P	211.5	P	P
BF-8	P	357.3	P	P	332.9	P	P	182.0	P	P
BF-9	P	554.7	P	P	424.9	P	P	393.0	P	P
BF-10T	P	391.2	P	P	321.7	P	F	63.5	F	F
BF-10L	P	335.8	P	F	136.5	F	F	39.9	F	F
BF-11T	P	323.2	P	P	249.0	F	F	67.0	F	F
BF-11L	P	312.7	P	P	191.7	F	F	28.0	F	F
BF-12T	P	472.3	P	P	281.1	P	F	66.7	F	F
BF-12L	F	*397.4	F	P	313.9	P	F	76.0	F	F
BF-13T	P	638.9	P	P	349.0	P	P	329.5	P	P
BF-13L	P	621.9	P	P	483.9	P	P	484.0	P	P
BF-14T	F	*566.9	F	P	439.3	P	P	345.5	P	P
BF-14L	P	635.7	P	P	631.4	P	P	575.9	P	P
BF-16	P	247.0	F	F	175.5	F	F	73.3	F	F
BF-17	P	570.0	P	P	534.4	P	P	564.7	P	P
MIL-B-53067 REQ.	190		300	180		280	80		140	0.1" SLIP

* = Broke in seam.

Table 5. Seam Test Results (Continued)

SAMPLE I.D.	ORIGINAL PEEL ADHESION (lb/in) 3 PERSON		7, 15 PERSON	PEEL ADHESION 14 DA/$H_2$0 IMMERS./160°F 3 PERSON		7, 15 PERSON	PEEL ADHESION 42 DA/$H_2$0 IMMERS./160°F 3 PERSON		7, 15 PERSON
BF-1	P	15.2	F	P	10.3	P	F	2.9	F
BF-2	P	18.3	F	F	7.4	F	F	4.0	F
BF-3	P	14.7	F	F	5.4	F	F	2.0	F
BF-5	P	13.6	F	F	4.7	F	F	0.0	F
BF-6	P	16.6	F	F	7.9	F	F	5.7	F
BF-7	P	20.5	P	P	10.8	P	F	4.9	F
BF-8	P	20.9	P	P	10.9	P	F	5.9	F
BF-9	P	20.4	P	F	7.4	F	P	6.7	F
BF-10T	P	18.5	F	F	5.6	F	F	0.0	F
BF-10L	P	30.7	P	P	8.2	F	F	0.0	F
BF-11T	P	23.9	P	P	11.4	P	F	0.0	F
BF-11L	P	28.5	P	F	5.6	F	F	0.0	F
BF-12T	P	18.1	F	P	10.0	P	F	0.0	F
BF-12L	P	25.9	P	P	15.0	P	F	0.0	F
BF-13T	P	21.7	P	P	11.4	P	P	7.9	F
BF-13L	P	21.1	P	P	10.1	P	F	4.8	F
BF-14T	P	24.6	P	P	12.7	P	P	8.6	P
BF-14L	P	22.8	P	P	14.1	P	P	8.9	P
BF-16	F	6.5	F	F	3.8	F	F	0.0	F
BF-17	P	16.9	F	P	15.8	P	P	13.8	P
MIL-B-53067 REQ.	12		28	8		10	6		8

SECTION III. RESULTS AND DISCUSSION

As shown in Tables 4 and 5, none of the candidate coated fabrics nor their respective seam structures met all MIL-B-53067 requirements. The most frequently failed coated fabric tests were the ***low temperature (-60°F) crease resistance,*** and ***blocking***. For reasons described earlier, no data was obtained on ***coating adhesion*** for these materials. Regarding the ***low temperature crease resistance*** requirement at -60°F, it is believed that material qualification at -25°F and -40°F should be determined with a view toward amending MIL-B-53067 to provide for three classes of service. Most Army procurements have historically required -25°F serviceability, and only the Air Force has a need for -60°F serviceability.

The high incident of failures for the ***blocking*** test is most likely due to the thermoplastic nature of the coating materials provided for this study. Although the coating compositions were not known, it is believed many were thermoplastic, thus explaining their "tackiness" after heat aging.

Among the ***seam*** tests, failures most frequently occurred in the seam breaking strength and peel adhesion after 42 days immersion in distilled water at 160°F. Both tests are recognized as being somewhat severe, but they are nevertheless considered critical in assessing end item boat performance.

The only materials that passed the above ***seam*** tests were BF-14L and BF-17. However, BF-17 had low initial seam peel strength, failed the ***blocking*** test, and had marginal weathering resistance in the warp direction (1% below the required 80% retention). BF-14T (and BF-12L) broke significantly above the required 300 pounds but, because the samples broke in the seam, failure was indicated. With the additional exception of ***low temperature crease resistance,*** BF-14 performed well.

It was noted that BF-5, BF-10L&T, BF-11L&T, BF-12L&T, and BF-16 all exhibited zero peel adhesion after immersion in water for 42 days at 160°F. Adhesion values recorded for each material after 14 days immersion indicated that the long term water exposure test is requisite to assure seam integrity. Each seam material, with the exception of BF-5, also failed the ***dead load*** test. It was evident that these seams not only failed due to the presence of water, but they were also sensitive to the 200°F temperature. In an earlier, nonpublished study using MIL-C-14505 and MIL-C-17415 coated fabrics, ***dead load*** tests were also run at 180°F in both dry and humid (86% relative humidity) environments. The use of more than one temperature, plus wet and dry conditions, would have provided more meaningful performance information.

In any case, these results signify that the quality of a supplier's seams is variable and highly dependent upon the nature of coating materials, adhesives, and seaming processes used.

It is also noted that the percent retention of breaking strength after 500 hours exposure in the Weatherometer at 5% elongation was based on original observed breaking strength of the coated

fabric. This was regardless of whether the material passed or failed the initial (unaged) test. The breaking strength of the composite structure was essentially contributed by the textile reinforcement. Thus, values greater than 100% are most likely attributable to within-sample variations in the fabric strength or to experiment error.

SECTION IV. CONCLUSIONS

Data generated in this state-of-the-art evaluation of vendor's off-the-shelf coated fabrics for manufacture of pneumatic floatation equipment indicate that the materials and seam requirements of MIL-B-53067 are realistic and attainable. Performance in some tests was marginal and some materials did poorly in seam peel and/or ***low temperature crease resistance***. However, it is believed that with slight modifications in formulations, coating processes, and adhesion techniques, acceptable, conforming end items can be produced. It is also concluded that:

- Although this laboratory was unable to obtain ***coating adhesion*** values, the test should be retained in the specification and vendors should be required to provide data.

- Coated fabric tear strength requirements appear to be somewhat low. It is known that tear strength is inversely proportional to coating adhesion strength. Since ***coating adhesion*** was not obtainable, rationale for adjusting tear strength requirements is unavailable at this time.

- Only the Air Force has requirements for -60°F service (stowage in high altitude aircraft). Consideration should be given to categorizing end items for -25°F , -40°F , and -60°F service, as has been the previous history of TROSCOM procurements.

- Ponton floats and bridge erection rollers, currently procured as formerly prescribed for the 3-, 7-, and 15-person boats, should also be considered as end items amendable to acquisition in the manner now possible under MIL-B-53067.

- Current Army Materiel Command (AMC) thrusts emphasize further extension of the shelf/service life of petroleum, oil and lubricants (POL) and pneumatic coated fabric end items. Concurrent with this philosophy, extending the duration of the accelerated weathering (Weatherometer) test—from 500 to 1500 hours—merits investigation. Results obtained in this study were not deemed sufficiently discriminating.

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