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Technical Report ARESI-TR-09001

POLYAM/POLYCOAT CERTIFICATION PROGRAM

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U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND
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14. ABSTRACT

The polylam/polycoat certification program was developed to eliminate a sole-source vendor by researching, testing, and approving alternative manufacturers for these materials. Concurrently, existing specifications and requirements were analyzed and improved to promote quality and competitiveness in awarding future contacts.

15. SUBJECT TERMS
Fiber tube Polylam Polycoat Packaging Mortars 60 mm, 81 mm
120 mm, Hand grenades

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CONTENTS

	Page
Introduction	1
Methods, Assumptions, and Procedures	1
Suppliers	1
Independent Evaluator	1
Results and Discussion	2
Conclusions and Recommendations	5
WVTR Requirement	5
Basis Weight Requirement	5
Distribution List	7

INTRODUCTION

The objective of the Alternative Polylam/Polycoat Qualification Program was to evaluate alternative suppliers in an effort to eliminate a potential single point failure in fiber containers used for ammunition packaging (for the 60, 81, and 120-mm mortar cartridges and M67 hand grenades). The impetus behind the elimination of a sole-source supplier is simply to lower cost, minimize risk, and improve quality by fostering competition between multiple suppliers. It is the goal of this program to analyze both manufacturers and the specifications outlined in drawing 12977500 to ensure that the Warfighter receives the highest quality product for the lowest price.

METHODS, ASSUMPTIONS, AND PROCEDURES

In order to complete this objective, potential alternative suppliers (as well as the sole source supplier) were contacted to provide samples developed in accordance to requirements found in drawing 12977500. The samples from the manufacturers were then sent to an independent laboratory for testing. The focus of the testing was concentrated on the inner material (polylam) and outer material (polycoat). Mechanical properties such as tensile strength, tear strength, and Mullen burst strength were performed on both inner and outer tube materials. Basis weight (per mil) and bursting strength (per mil) were additionally performed on the polylam inner layer materials. Coefficient of friction (COF) and water vapor transmission rate (WVTR) were additionally performed on the polycoat outer tube material. Two rounds of tests were performed, with results being provided to the manufacturers to inform them of any deficiencies in need of correcting.

Suppliers

Fortifiber Corporation (qualified supplier)

Jen-Coat Inc.

Covalence Coated Products

Independent Evaluator

All material specifications and testing methods for this program can be found in DTL 1297750, "Construction Details for Container, Ammunition, Fiber, Polyethylene Laminated, Spirally Wound for Mortar Cartridges and Hand Grenades."

Material Specifications

Polylam material: 40 lb Natural Kraft/14 lb low density polyethylene (LDPE)/70 lb Natural Kraft

Polycoat material: 70 lb Natural Kraft/20 lb black Polyolefin

Testing Specifications

Tear strength [cross direction (CD) and machined direction (MD)]: TAPPI T414 (at least 10 specimens per direction)

Tensile strength (CD and MD): TAPP1494 (at least 10 specimens per direction)

Mullen burst strength: TAPP T403 (at least five specimens "face up" and at least five specimens "face down")

COF (poly to poly): ASTM D1894 (test at least five specimens)

WVTR: TAPPI T523 (test at least two specimens and average the results together for each sample)

Basis weight: TAPPI T410 (at least six specimens per sample)

Bursting strength: TAPPI T810 (at least five specimens "face up" and at least five specimens "face down")

It should be noted that the specifications used for both material construction and testing were developed with input from the current qualified supplier. The performance requirements are considered to be of more importance than the material specifications for the purposes of this program as long as basis weight is met.

RESULTS AND DISCUSSION

Two rounds of testing were conducted on samples from the participating suppliers. The first round was completed in July 2008, with the second round being completed in April 2009. The results of the first test were sent to the suppliers with some recommendations on how to improve their materials. Due to time and cost restraints, the second test was the final round that had to be met in order to become a qualified supplier.

The results of the first round of testing can be seen in table 1 (polycoat) and table 2 (polylam). As can be seen in table 1, all three participants had deficiencies in various categories in regards to their polycoat materials: Fortifiber missed WVTR, Jen-Coat missed both WVTR and CD - tear strength, and Covalence missed kinetic coefficient (CoE). Table 2 shows the test results for the polylam materials. It should be noted that certain tests were not performed (tensile strength and tear strength) in the first round. Fortifiber also did not submit specimens for testing. However, both Jen-Coat and Covalence passed all other requirements in the first round of testing for polylam.

Following the first round of tests, the suppliers were given time to improve their material designs in order to improve in areas where they were found to be deficient. Improved samples of both polylam and polycoat were again requested. It should be noted that all three manufacturers simply sent additional samples of the polylam material used in the first round as they had no need to improve or change the formulation following the first round of tests. Tests for the polycoat specimens remained the same, while tests for polylam specimens were expanded to include the previously omitted tear strength and tensile strength tests. The results of the tests can be seen in table 3 (polycoat) and table 4 (polylam).

As can be seen in table 3, manufacturer Fortifiber passed all given requirements. Jen-Coat passed the previously failed CD-tear strength test, but again failed the WVTR requirement. The Covalence test results were far more curious as they resolved deficiencies in one category (CoE-kinetic), while showing new deficiencies in others: MD - tear strength and WVTR. It is believed that they switched from polypropylene to polyethylene for use as their polyolefin material, which may explain the deficiencies.

Table 1
Polycoat test results from first round of testing

	Fortifiber	Jen-Coat	Covalence	DTL12977500 requirement	Test method
Tensile strength (lb/in.) (MD)	62.00	53.00	73.00	≥41	TAPPI T494
(CD)	28.00	32.00	33.00	≥23	
Tear strength (g) (MD)	184.00	146.00	155.00	≥144	TAPPI T414
(CD)	208.00	149.00	180.00	≥161	
Mullen burst strength (psi)	80.00	72.00	96.00	≥50	TAPPI T403
Coefficient of friction (static)	0.47	0.50	0.25	≥0.29	ASTM D1894
(kinetic)	0.35	0.48	0.20		
WVTR @ 73°F/50% RH (g/m ² /24 hrs)	1.80	1.77	1.34	≤1.76	TAAPI T523
Thickness (mil)	8.20	7.50	5.00	n/a	TAPPI T411

Table 2
Polylam test results from first round of testing

	Fortifiber	Jen-Coat	Covalence	DTL12977500 requirement	Test method
Thickness (mils)	n/a	10.00	10.00	n/a	TAPPI T411
Basis weight (g/cm ²)	n/a	0.0197	0.0197	n/a	TAPPI T410
Mullen burst strength (psi)	n/a	138.30	140.70	≥99	TAPPI T403
Basis weight per mil (lb/1 mil thickness/100 ft ²)	n/a	4.00	4.00	≥3	n/a
Burst strength per mil (psi/1 mil thickness)	n/a	13.80	14.10	≥2	TAAPI T810

Table 3
Polycoat test results from second round of testing

	Fortifiber	Jen-Coat	Covalence	DTL12977500 requirement	Test method
Tensile strength (lb/in.) (MD)	63.00	75.00	68.00	≥41	TAPPI T494
(CD)	33.00	48.00	30.00	≥23	
Tear strength (g) (MD)	170.00	174.00	129.00	≥144	TAPPI T414
(CD)	230.00	198.00	179.00	≥161	
Mullen burst strength (psi)	95.00	89.00	86.00	≥50	TAPPI T403
Coefficient of friction (static)	0.51	0.47	0.39	≥0.29	ASTM D1894
(kinetic)	0.35	0.45	0.30		
WVTR @ 73°F/50% RH (g/m ² /24 hrs)	1.43 ±0.29	2.08 ±0.15	2.42 ±0.11	≤1.76	TAAPI T523
Thickness (mil)	8.00	8.20	7.20	n/a	TAPPI T411

Table 4
Polylam test results from second round of testing

	Fortifiber	Jen-Coat	Covalence	DTL12977500 requirement	Test method
Thickness (mils)	8.00	8.20	7.20	n/a	TAPPI T411
Basis weight (g/cm ²)	0.02	0.0199	0.0197	n/a	TAPPI T410
Mullen burst strength (psi)	136.00	151.00	140.00	≥99	TAPPI T403
Basis weight per mil (lb/1 mil thickness/100 ft ²)	4.10	4.00	3.90	≥3	n/a
Burst strength per mil (psi/1 mil thickness)	12.00	15.00	14.00	≥2	TAAPI T810
Tensile strength (lb/in.) (MD)	96.00	111.00	90.00	≥77	TAPPI T494
(CD)	56.00	54.00	52.00	≥36	
Tear strength (g) (MD)	282.00	224.00	238.00	≥221	TAPPI T414
(CD)	334.0	280.00	306.00	≥234	

CONCLUSIONS AND RECOMMENDATIONS

As discussed in the previous section, the results of the second round of laboratory testing show that manufacturer Fortifiber Corp (the current supplier) was the only one to have passed both tests for polylam and polycoat. Jen-Coat came closest to meeting the polycoat requirements by only failing to meet the water vapor transmission rate (WVTR) requirement. Covalence had the poorest showing after doing worse during the second round of tests. All three manufacturers met requirements to produce polylam materials.

It is the finding of this program that there is a need to adjust the requirements set out in drawing 12977500 in order to qualify all three suppliers. The requirements, as they are currently established, were developed with input from the qualified supplier Fortifiber Corp to conform to material they had producing for Government contracts. Therefore, the specification was not developed using empirical needs based on a given requirement, but rather using manufacturer provided data based on their production capabilities. Thus, it is the recommendation of this office that the requirement values be changed to allow a range of acceptable values to accommodate material produced from alternate manufacturers. The requirements recommended to be adjusted are WVTR and basis weight of paper; as follows:

Water Vapor Transmission Rate Requirement

The WVTR would be changed from the current value of ≤ 1.76 to ≤ 2.48 g/m²/24 hrs. This was done because the current requirement was deemed too restrictive without providing an improvement on performance. Originally, when these materials came into use in fiber tubes, the requirement was 3.2 g/m²/24 hrs. The 2.48 g/m²/24 hrs was selected as it provides the desired performance without being overly restrictive and inhibiting producibility of the material.

Basis Weight Requirement

Evidence has shown that the original supplier, Fortifiber, has not been producing polylam/polycoat materials to their own established requirements. Testing shows that they have been producing polylam 70 lb Natural Kraft/28 lb low density polyethylene (LDPE)/40 lb Natural Kraft; doubling the amount of LDPE from the specified 14 lb paper weight. Furthermore, they have been producing the polycoat at 70 lb Natural Kraft/29 lb black polyolefin, which has increased the weight of polyolefin from the specified 20 lb weight. It is believed that producing these materials with the increased weights has given Fortifiber an unfair advantage over potential competitors. It is the recommendation of this office to make the new basis requirements as follows:

- Polycoat - 79 ± lb Natural Kraft Paper/25 ± 5 black polypropylene
- Polylam - 42.5 ± 2.5 lb Natural Kraft paper/21 ± 7 lb LDPE/72.5 ± 2.5 lb Natural Kraft paper

By allowing for a range of values, the manufacturers of these materials can determine which paper weights to use to meet the performance requirements.

In conclusion, if all three changes are implemented, then two suppliers (Fortifiber and Jen-Coat) would be allowed to qualify as sources for both polylam and polycoat materials. Covalence would be qualified as a supplier for polylam only.

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