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WAL 710/790

WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/790

Effect of Increase in Amount of Bonding Plastic on Resistance of a Plastic Laminate to Perforation by Fragment-Simulating Projectiles

BY

J. F. Sullivan
Assoc. Engineer

DATE 5 November 1945

WATERTOWN ARSENAL
WATERTOWN, MASS.

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Form No. SPOBE-38
L 18 July 1944

WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT NO. WAL 710/790

Partial Report on Problem B-7.16

5 November 1945

Effect of Increase in Amount of Bonding Plastic on Resistance of a Plastic Laminate to Perforation by Fragment-Simulating Projectiles

1. At the request of the Office, Chief of Ordnance[1], ballistic tests have recently been conducted at this laboratory on samples of a plastic laminate submitted by the Victory Plastic Company.

2. The ultimate resistance of the plastic laminate by fragment-simulating projectiles was not affected by increasing the weight ratio of the bonding plastic to the nylon laminae, but this change did increase the resistance of the laminate to delamination and thus effectively reduced the clearance necessary between such a protective material and the protectee.

3. Two samples of a nylon plastic laminate which were described by the requesting letter were received as follows:

"a. One 24" x 24" Laminated Nylon test panel. 3 layers 2 x 2 basket weave 13 oz. nylon laminated with approximately 20% by weight of Tenite 24-5 plastic.

"b. One 24" x 24" Laminated Nylon test panel. Same as "a" but containing about 30% plastic."

4. From these samples were cut 12" x 12" sections which were rigidly attached to wooden ballistic frames which provided unsupported impact areas. Into these impact areas there were fired cal. .22 fragment-simulating projectiles, T-37,[2] at normal incidence. The re-

1. O.O. 421/174 - Wtn. 421/534 - 22 October 1945

2. WAL 762/253

sults of the tests were as follows:

Sample	High Partial Penetration (P)	Low Complete Penetration (P)	Ballistic Limit (P)
a.	810	840	825 ± 15
b.	805	835	820 ± 15

5. From these data it is apparent that the difference in amount of bonding plastic used has had no appreciable effect on the resistance of this type laminate to perforation by these projectiles.

6. Figure 1 however illustrates the difference in delamination between the two samples. (Although at first glance it may appear that the excessive delamination of sample "a" is attributable to the retention of the projectile, overall examination of the samples indicates that, on the contrary, the retention of the projectile is a result of the excessive delamination.) This result is not unexpected, because where the amount of bonding plastic used is critical, the use of a smaller amount of it will result in a less effective bond and the resistance of the resultant laminate to delamination will decrease.

7. This difference in resistance to delamination may be a considerable factor where, as in the case of a helmet, a small clearance between an armoring material and the protectee (i.e. the distance between the inner helmet component and the skull) may be desirable. A material which resists delamination will require a shorter distance in which to bring an impacting projectile to rest and thus demands less clearance between armor and protectee. A smaller clearance requirement between helmet and head permits the use of a smaller armor area to protect a given head area and consequently allows either a saving in weight, if the thickness of the armor is held constant, or an increase in thickness (and, consequently, protection), if the weight is held constant. A material with good resistance to delamination is thus desirable as an inner component of the T21E1 helmet.

8. On the basis of the above discussion the use of a plastic laminate similar to sample "b" is to be preferred over the use of a plastic laminate similar to sample "a" in such an application.

J. F. Sullivan
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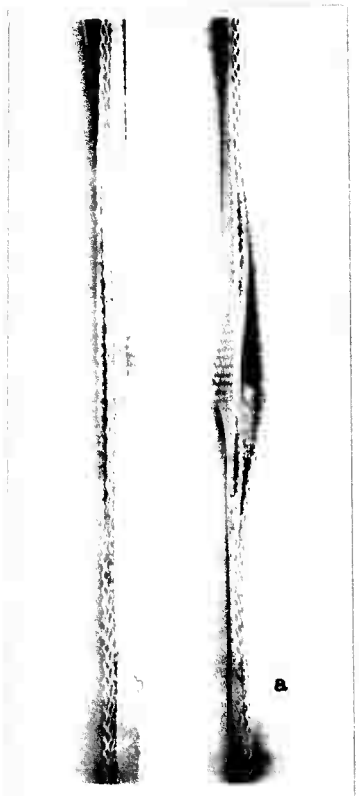

Figure 1. Comparative delamination of laminates a and b.

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