WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/718

Resistance of Various Numbers of Plies of .020" and .025" Sheets of Aluminum Alloy (AN-A-13 24ST) to Perforation by Various Fragment-Simulating Projectiles

BY
M. A. BROUGH
Proof Technician

DATE 15 January 1945

WATERTOWN ARSENAL
WATERTOWN, MASS.

WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT NO. WAL 710/718

Thirty-First Partial Report on Problem B-8.2

15 January 1945

Resistance of Various Numbers of Plies of .020" and .025" Sheets of Aluminum Alloy (AN-A-13 24ST) to Perforation by Various Fragment-Simulating Projectiles

1. At the request of the Office, Chief of Ordnance,[1,2] ballistic limit tests using simulated-fragment projectiles have been conducted at this arsenal.

2. Results of tests using the (cal. .30) G-1-S[3] flak-simulating projectile show that when compared to a single sheet of 24ST aluminum of equal weight-per-unit area, the plied sheets exhibit a much lower ballistic limit.

3. The ballistic limit with the (cal. .22) G-2[4] flak-simulating projectile, however, is not as variable.

4. When compared to previous tests conducted at this arsenal[5] on plies of .020" aluminum alloy the subject material is found to be inferior and offers less resistance to perforation by the cal. .22.

5. Twelve 24" x 24" sheets of Reynolds Pureclad 24ST aluminum were received from Aberdeen Proving Ground, Maryland. By error, six sheets were of .025" thickness, instead of .020" thickness that had been intended. However, tests were conducted on both the .020" and .025" sheets for comparison.

---

1. O.O. 471.9/1932 - Wtn 470.5/101 - 14 November, 1944.
2. O.O. 471.0/1971 - Wtn 400.112/3704 - 27 November, 1944.
3. WAL 762/247
4. WAL 762/253(c)
5. WAL 710/516

6. The aluminum sheets were cut down to 12" x 12" size and then separated into various plies. Twenty-four sheets of .020" thickness were separated into six, eight, and ten ply, and twenty-two sheets of .025" thickness were separated into four, five, six, and seven ply.

7. The various plies were then closely and firmly clamped to a wood and steel ballistic holder (closely clamped to prevent any introduction of variables to be expected from spacing). The plied assembly was subjected to fire by the G-2 and G-1-S fragment-simulating projectiles. The cal. .45 steel-jacketed ball projectile could not be used because of the limited space on the aluminum alloy sheets. The results and comparisons of these tests are found in Table I.

8. The superiority of a single sheet over the equivalent weight of plied sheets in resistance to perforation by the G-1-S is noticeable in that aluminum plate of .125" thickness fired at by the G-1-S, cal. .30 projectile had a ballistic limit of 860 f/s, whereas the five-ply or five sheets of .025" thickness (combined to a total of .125") had a ballistic limit of 670 f/s (a spread of almost two hundred feet). However, in using the G-2, cal. .22 projectile, the single plate (.125") had a ballistic limit of 827 f/s, and the five-ply (total combined thickness - .125") a ballistic limit of 850 f/s.

9. It is apparent that under impact by the cal. .30 fragment-simulating projectile, the resistance of the solid plate is superior to that of the plied sheets. Resistance of the plied sheets to the cal. .22, however, is about the same as that of an equivalent weight of similar material in a single plate.

10. It is interesting to note that a given weight of the .020" sheets afforded resistance to perforation superior to an equivalent weight of the .025" sheets. The superiority of the thinner sheets would seem to indicate the variability of the quality of the two lots of aluminum alloy.

11. Inasmuch as the resistance of the subject material is lower than that of previously tested materials, it is not recommended for substitution for the lot currently used in recovery boxes in the standard triangular fragmentation test to obtain information on the retained velocities of fragments.

M. A. Brough

M. A. BROUGH
Proof Technician

APPROVED:

E. L. Reed.

E. L. REED
Research Metallurgist
Acting Chief, Armor Section

---

6. WAL 710/713

TABLE I

Summary of Ballistic Tests Conducted at Watertown Arsenal

on Samples of AN-A-13 Aluminum Sheets at Various Plies

Type	Sample No.	Ply	Nominal Gauge 1 Ply	Grams/ Sq.Ft.	Equiv. Steel Gauge	Ballistic Limits f/s G-2[1]	Ballistic Limits f/s G-1-S[2]
AN-A-13	A-6	6	.020"	755	.040"	820±15	700±15
" "	A-8	8	.020"	1007.2	.054"	1030±30	782± 7
" "	A-10	10	.020"	1273.7	.069"	1253±12	923± 3
" "	B-4	4	.025"	660	.036"	763± 3	568±18
" "	B-5	5	.025"	823	.044"	850±15	670±20
" "	B-6	6	.025"	968.7	.052"	928±13	725±15
" "	B-7	7	.025"	1153	.062"	1145±20	815±10
FOR COMPARISON:							
Aluminum[3] Alloy (ave.)		6	.020"	----	.043"	927	---
Aluminum[4] 24ST(ave.)	Single Plate		.125"	835	.045"	827	860

1. Cal. .22 fragment-simulating projectile - 17 grains

2. Cal. .30 fragment-simulating projectile - 34 grains

3. WAL 710/516 4. WAL 710/713