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UNITED STATES ARMY INFANTRY BOARD

FORT BENNING, GEORGIA

REPORT OF PROJECT

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PROJECT NR 2853

DATE 17 Aug 59

Evaluation of .30 Caliber Duplex Ammunition (DA Project 504-05-022)(U)

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UNITED STATES ARMY INFANTRY BOARD
Fort Benning, Georgia

17 August 1959

REPORT OF PROJECT NR 2853 EVALUATION OF .30 CALIBER DUPLEX AMMUNITION (DA PROJECT 504-05-022) (U)

1. (U) AUTHORITY.

a. Directive. Ltr, ATDEV-3 471/74 (24 Apr 59), Hq USCONARC, 24 Apr 1959, subject: "Evaluation of Caliber .30 Duplex Ammunition."

b. Purpose. To determine the comparative suitability for Army use of duplex ammunition with standard ammunition and to ascertain whether any substantial combat advantage would be secured through substitution of duplex loads for conventional single bullet loads.

c. Scope. The United States Army Infantry Board conducted the temperate phase of this project. No airborne or arctic testing will be conducted.

2. (U) REFERENCES. (See Annex D.)

3. (U) DESCRIPTION OF MATERIEL.

a. Test. Cartridge, Ball, Cal .30 (Duplex), Lot-Nr 252011, hereinafter referred to as the test item, contains two copper-plated lead projectiles, each weighing 96 grains, loaded in tandem. The cartridge contains 54.5 grains of WC 852 powder. When fired from a standard M1 rifle, the front projectile achieves a muzzle velocity of approximately 2,150 feet/second and the rear projectile achieves a muzzle velocity of approximately 2502 feet/second. Upon firing, the front and rear projectiles should provide controlled dispersion characterized by an accurate front projectile which strikes on the point of aim and a displaced rear projectile which should fall in a random circular pattern around the point of impact of the front projectile. The displacement of the rear projectile away from the point of impact of the front projectile is obtained by inclining the heel plane of the rear projectile at an angle (Annex C-1 and 2).

b. Control. Cartridge, Ball, Cal .30, M2, hereinafter referred to as the control item, is the standard M1 rifle cartridge (Annex C-1 and 2).

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4. (C) BACKGROUND.

a. PROJECT SALVO is an organized and concerted effort by a number of Army agencies to improve the combat performance of the man-rifle combination. The SALVO program is concerned with enhancing the effectiveness of the Infantry rifleman by increasing his hit probability. One of the primary techniques proposed for boosting this chance of hitting is the use of multiple projectiles.

b. The Operations Research Office, The Johns Hopkins University, commenced studies in 1951 which gave rise to Project SALVO. The ORO studies and programmed firing tests are too detailed and voluminous to be described in this background, however, they are thoroughly reviewed in reference 2c. The latest field experiment conducted by ORO is described in detail in reference 2d. Briefly, this field experiment was conducted using six types of test ammunition which included caliber .30, M2, ball; caliber .30, duplex; caliber .30, triplex; caliber 22-06, ball; caliber 22-06, duplex; and 12 gauge, AA-52, flechettes. Upon completion of this experiment, ORO concluded that as a combat load the .30 caliber duplex round is significantly superior to the present .30 caliber bullet and recommended that .30 caliber duplex rounds be procured for user test prior to possible adoption and that these rounds be fired from the US issue rifle (M1 or M14). Other conclusions and recommendations relating to further efforts in the SALVO program are found in reference 2d.

5. (C) SUMMARY OF TEST RESULTS. The Cartridge, Ball, Caliber .30 (Duplex), was tested to determine its characteristics and compare them with those of the standard Cartridge, Ball, Cal. .30, M2, and to determine whether any substantial combat advantage would be secured through the substitution of duplex loads for conventional single bullet loads. Applicable portions of the plan of test for Project 2812, Evaluation of NATO 7.62mm Duplex Ammunition (ref 6, Annex D), were used in the conduct of this evaluation.

a. The test and control items are comparable in these respects:

- (1) Effects on weapon functioning.
- (2) Performance under adverse conditions.
- (3) Effects on organizational maintenance.
- (4) Reliability.
- (5) Field firing under simulated combat conditions in total targets hit per rounds fired.
- (6) Position disclosing effects.

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b. The control item is superior to the test item in penetrating capabilities and effects of recoil and blast.

c. The control item is superior to the front projectile of the test item in accuracy under in-lead firing conditions when the firer uses a separate battle sight setting for each item.

d. The control item is superior to the test item in accuracy at known distance ranges in excess of 300 yards.

e. The test item is superior to the control item in transition firing and field firing under simulated combat conditions in total projectile hits per rounds fired.

f. Specific comments applicable to the test item:

(1) The circular dispersion of the rear projectile is fairly evenly distributed around the center of impact of the front projectile.

(2) The field firing technique of adjusting aimed rifle fire by observation of the strike of the bullet is extremely difficult with the test item. At most ranges it is difficult to differentiate between front and rear projectile strikes.

(3) In transition firing and in field firing under simulated combat conditions, a substantial number of the targets hit by the test item were hit only by the rear projectile of the test item.

6. (C) DISCUSSION.

a. The test item did not produce a substantial improvement in hit probability over the control item. In Test Nr 6, Annex A, "Transition Firing," the control item produced a 4.9 per cent gain in targets hit per rounds fired and in Test Nr 7, Annex A, "Field Firing Under Simulated Combat Conditions," the control item produced a 1.0 per cent gain in targets hit per rounds fired.

b. The failure of the test item to produce a substantial improvement in hit probability over the control item can be related to the following facts determined in this evaluation.

(1) The considerable drop in the trajectory of the lead round at ranges greater than 300 yards is such that a firer cannot effectively use hold-off at these ranges (Test Nr 6, Annex A).

(2) The front projectile of the test item is not as accurate as the projectile of the control item when firing each type item with a separate battle sight setting (Test Nr 6, Annex A).

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7. If the front projectile of the test item and the control item were comparable in accuracy when firing with appropriate battle sight settings, an increase in hit probability attributable to single rear projectile hits could be expected. In most combat situations where the accuracy of aimed fire is degraded, an even greater improvement in hit probability would result by the substitution of duplex loads for single bullet loads.

7. (C) CONCLUSIONS. *ball cartridge*
it is concluded that the
~~The Cartridge, Ball, Cal. 30 (Duplex), is not suitable for~~
Army use.

~~The Cartridge, Ball, Cal. 30 (Duplex), does not offer a sub-~~
stantial combat advantage over the standard ~~Cartridge, Ball, Cal. 30, M2~~ *ball cartridge*
~~The substitution of duplex loads for conventional single~~
bullet loads should offer a substantial combat advantage upon correction
of the major deficiencies ~~listed in Annex B.~~

8. (C) RECOMMENDATIONS. It is recommended that development be continued to provide an improved duplex load for the Cartridge, Ball, Cal. 30, M2, designed to correct the deficiencies listed in Annex B and sufficient quantities be furnished to the US Army Infantry Board for further test.

ANNEXES

- A. Details of Test
- B. Deficiencies and Suggested Modifications
- C. Photographs and Charts
- D. References

Henry B. Tunz
HENRY B. TUNZIG
Colonel, Infantry
President

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ANNEX A - DETAILS OF TEST

Report of Project Nr 2853

Test Nr 1. PHYSICAL CHARACTERISTICS.

1. (U) PURPOSE. To determine and compare the physical characteristics of the test and control items.

2. (U) METHOD. Ten rounds of the test and control items were inspected, weighed and measured. These rounds were then disassembled and components (projectiles, propellant and case) were weighed and measured. Available data was studied and appropriate photographs made of the test and control items (Annex C-1 and 2).

3. (C) RESULTS.

a. Weights (Grains):

	<u>Projectile</u>	<u>Propellant</u>	<u>Case</u>
Test Item	96.1 (Front) 96.4 (Rear)	53.6	190.0
Control Item	150.9	48.0	200.7

b. Dimensions:

(1) Length (Inches):

	<u>Projectile</u>	<u>Case</u>	<u>Overall</u>
Test Item	0.698 (Front) 0.680 (Rear)	2.488	2.884
Control Item	1.096	2.484	3.329

(2) Diameter (Inches):

	<u>Projectile</u>
Test Item	0.308 (Front) 0.308 (Rear)
Control Item	0.308

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Test Nr 2. ACCURACY SEMIAUTOMATIC FIRE.

1. (U) PURPOSE. To determine and compare the semiautomatic fire accuracy of the test and control items and to determine the rear projectile dispersion of the test item.

2. (U) METHOD.

a. After zeroing rifles, three experienced riflemen each fired three 10-round shot groups at 100 yards ("A" target) from a bench rest using the control items.

b. Without changing the zero of the weapon after rifles cooled to ambient temperatures, each rifleman fired three 10-round shot groups at 100 yards ("A" target) using the test item.

c. Rifleman then exchanged weapons, re-zeroed, and repeated a and b, above, until each rifleman had fired each of three rifles.

d. The procedure listed in a, b, and c was repeated at 300 yards ("A" target) and 500 yards ("B" target) with the control item. The same procedure was repeated with the test item except that the target size was increased to 12' x 12' (the "A" and "B" bull's-eyes were still used) and each firer fired total of 30 rounds with each of three rifles (not fired in 10 round shot groups) at each range.

e. The horizontal and vertical coordinates of a, b, c, and d were recorded with the front and rear projectile hits of the test item recorded separately. The maximum spread, mean radii and centers of impact were computed for the test and control items with separate computation for the front and rear projectile files of the test item.

3. (C) RESULTS.

a. Shown below is the average mean radius, mean horizontal and vertical spreads, and maximum spread for the firing conducted at 100, 300, and 500 yards.

Item	Range	MR	MH	MV	MS
Test	100 yd	Front 2.04" *Rear 9.46"	Front 4.92" Rear 16.84"	Front 6.12" Rear 18.24"	Front 6.96" Rear 21.24"
Control	100 yd	1.68"	4.08"	4.92"	5.76"
Test	300 yd	Front 7.56" *Rear 27.04"	Front 19.44" Rear 60.00"	Front 22.68" Rear 63.72"	Front 26.16" Rear 68.09"
Control	300 yd	5.64"	12.00"	17.40"	19.32"
Test	500 yd	Front 12.12" *Rear 45.96"	Front 37.32" Rear 110.04"	Front 40.20" Rear 114.17"	Front 46.32" Rear 126.72"
Control	500 yd	9.48"	20.76"	27.96"	31.56"

*Note: Measured from center of impact of the front projectiles.

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b. Shown below is the difference in location of centers of impact for the test and control items for firing conducted at 100, 300 and 500 yards.

(1) At 100 yards the center of impact of the front projectiles of the test items was located 0.38 inches to the right and 1.20 inches higher than the center of impact of the control items.

(2) At 300 yards the center of impact of the front projectiles of the test items was located 2.08 inches to the right and 0.96 inches lower than the center of impact of the control items.

(3) At 500 yards the center of impact of the front projectiles of the test items was located 8.28 inches to the right and 48.12 inches lower than the center of impact of the control items.

c. The dispersion of the rear projectiles located with respect to the centers of impact for the front projectiles for firing conducted at 100, 300 and 500 yards is shown in Charts 1, 2 and 3 (Annex C-3, 4 and 5).

d. The angular location of rear projectile impact with respect to the center of impact of the front projectiles for firing conducted at 100, 300 and 500 yards is also shown in Charts 1, 2 and 3 (Annex C-3, 4 and 5).

4. (C) ANALYSIS.

a. At 300 and 500 yards the front projectile accuracy of the test item is inferior to that of the control item.

b. Due to the difference in the location of the center of impact of the lead projectiles of the test item and the control item at ranges greater than 300 yards, the two rounds cannot be fired at these ranges with the same sight setting.

c. The rear projectile impacts produce the desired random circular dispersion pattern about the center of impact of the lead projectiles.

Test Nr 3. POSITION DISCLOSING EFFECTS.

1. (U) PURPOSE. To determine and compare the relative position-disclosing effects of the test and control items.

2. (U) METHOD.

a. Alternately using the test and control items, three rounds were fired from a rifle in a machine rest from an exposed non-tactical position during both daylight and darkness.

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Observers approached the weapon position at safe distances from the front and flanks and noted the ranges at which smoke and flash could be observed. Observations were made with the unaided eye and with 6 x 30 binoculars. Results were recorded and compared.

3. (U) RESULTS. Ranges at which the smoke and flash could be detected are shown below.

a. Daylight. Smoke could be observed at a range of 400 yards from the weapon position with both the unaided eye and with 6 x 30 binoculars when both test and control items were fired.

b. Darkness. Flash could be observed at a range of 350 yards from the weapon position when the test item was fired and at a range of 400 yards when the control item was fired, with both the unaided eye and 6 x 30 binoculars.

4. (U) ANALYSIS. Both test and control items produce excessive smoke and flash.

Test Nr 4. PENETRATION.

1. (U) PURPOSE. To determine and compare the relative penetration effects of the test and control items.

2. (U) METHOD.

a. The test and control items were fired into 10 gauge mild steel plate (SAE 1010 maximum hardness Rockwell C-32) at ranges of 25, 100, 300 and 500 yards. Layers of 1 inch thick commercially dressed (actual measurement 3/4 inch thick) pine witness boards, spaced at 1 inch intervals, were placed behind the steel plate. Ranges at which perforation and penetration of the steel plate and the witness boards were achieved in 8 out of 10 fair hits (hits of at least three calibers from any edge or distortion of the plate) for the test and control items were recorded.

b. Ten rounds of the test and control items were fired at ranges of 300 and 600 yards into layers of 1 inch thick commercially dressed (actual measurement 3/4 inch thick) pine boards, spaced at 1 inch intervals. Number of boards perforated by the test and control items at each range was recorded.

c. The test and control items were fired at standard US steel helmets and body armor at 500 and 600 yards. Firing was conducted until ten fair hits (strikes more than 1 inch in from the periphery of the profile of the helmet) were obtained with the test and control items. Number of hits and perforations obtained with both items was recorded.

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d. Five each of the test and control items were fired into a box constructed of $\frac{1}{2}$ inch plywood containing 6 inches of sand, at ranges of 20, 40, 100 and 300 yards. A witness plate constructed of 1 inch thick commercially dressed (actual measurement $\frac{3}{4}$ inch thick) pine boards was placed 1 foot in rear of the target. Penetration effects were recorded for each range.

e. The front and rear projectile performance of the test item was recorded separately.

3. (C) RESULTS.

a. Ranges at which the test and control items perforated 10 gauge mild steel plate and the average number of pine boards perforated with the same projectiles are shown below:

<u>Range (Yards)</u>	<u>Type Ammunition</u>	<u>Steel Plate Perforated</u>	<u>Average Nr Pine Boards Perforated</u>
25	Test Item		
	Front Projectile	Yes	3.0
	Rear Projectile	Yes	3.1
	Control Item	Yes	5.9
100	Test Item		
	Front Projectile	Yes	2.5
	Rear Projectile	Yes	1.5
	Control Item	Yes	4.9
300	Test Item		
	Front Projectile	No	0
	Rear Projectile	No	0
	Control Item	Yes	3.7
*225	Test Item		
	Rear Projectile	Yes	1.0
*275	Test Item		
	Front Projectile	Yes	1.0
300	Control Item	Yes	2.3

*Note: Firing was conducted at intermediate ranges between 200 and 300 yards after it was determined that the test item would not perforate the steel plate at 300 yards. The maximum range was determined at which perforation of the steel plate was obtained with the front and rear projectiles of the test item.

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b. Number of pine boards perforated by the test and control items is shown below.

<u>Range (Yards)</u>	<u>Type Ammunition</u>	<u>Average Nr Pine Boards Perforated</u>
300	Test Item	
	Front Projectile	7.2
	Rear Projectile	6.1
	Control Item	14.1
600	Test Item	
	Front Projectile	4.3
	Rear Projectile	2.1
	*Control Item	15.3

*Note: The results obtained for the penetration of the pine boards at 300 and 600 yards with the control item are not completely accurate due to the fact that 1 round perforated the total number of 19 boards in both instances. Therefore the average number of pine boards perforated is larger than that listed and cannot be accurately determined.

c. The test and control items both perforated body armor at 500 and 600 yards.

d. Ranges at which the test and control items perforated standard US steel helmets with liners are shown below:

<u>Range (Yards)</u>	<u>Type Ammunition</u>	<u>Perforation of Steel Helmets w/liner</u>		
		<u>Both Sides</u>	<u>Front Only</u>	<u>Nr of Fair Hits</u>
500	Test Item			
	Front Projectile	1	0	10
	Rear Projectile	1	0	10
	Control Item	10	0	10
600	Test Item			
	Front Projectile	0	0	10
	Rear Projectile	0	0	10
	Control Item	10	0	10
*500	Test Item			
	Front Projectile	6	9	23
	Rear Projectile	6	6	13

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Perforation of Steel Helmets w/ Liner

Range (Yards)	Type Ammunition	Both Sides	Front Side Only	Nr of Fair Hits
*250	Test Item			
	Front Projectile	9	1	10
	Rear Projectile	5	7	12
*200	Test Item			
	Front Projectile	10	0	10
	Rear Projectile	10	0	10

*Note: Firing was conducted at various ranges between 200 and 500 yards after it was determined that the test item would not perforate the steel helmets and liners at 500 and 600 yards. The maximum range was determined at which the front and rear projectiles of the test item perforated both sides of the steel helmet and liner.

e. Number of rounds of the test and control items that perforated 6 inches of sand within a box constructed of $\frac{1}{2}$ inch plywood.

Range (Yards)	Type Ammunition	Nr of Perforations of Sand	Nr of Perforations of Witness Boards
20	Test Item		
	Front Projectile	4	1
	Rear Projectile	4	4
	Control Item	5	5
40	Test Item		
	Front Projectile	5	5
	Rear Projectile	5	5
	Control Item	5	5
100	Test Item		
	Front Projectile	5	5
	Rear Projectile	5	5
	Control Item	5	5
300	Test Item		
	Front Projectile	5	5
	Rear Projectile	5	5
	Control Item	5	5

4. (C) ANALYSIS. The capability of the front or rear projectiles of the test item to penetrate various mediums except sand is significantly less than that of the control item.

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Test Nr 5. EFFECTS ON WEAPON FUNCTIONING.

1. (U) PURPOSE. To determine and compare the relative effect of the test and control items on weapon functioning.
2. (U) METHOD.
 - a. Throughout all tests, care was taken to observe the extent of fouling, carbonisation and other factors affecting weapon functioning.
 - b. Four hundred and eighty rounds each of test and control items were fired at the rate of 16 rounds per minute for 30 minutes.
 - c. Malfunctions and/or stoppages were recorded and resulting data analyzed and compared.
3. (C) RESULTS. No malfunctions attributed to the ammunition occurred and no adverse effects were noted during firing of the test and control items.

Test Nr 6. TRANSITION FIRING.

1. (U) PURPOSE. To determine and compare the accuracy of the test and control items under transition range firing conditions.
2. (U) METHOD.
 - a. After zeroing at a range of 300 yards, twelve average riflemen each fired one clip (8 rounds) of both the test and control items at ranges of 100, 200, 300, 400 and 500 yards. The purpose of this firing was to familiarize the rifleman with the amount of hold-off necessary to hit the targets at each range. After this familiarization firing the twelve riflemen each fired a modified transition course using the test item and then repeated this procedure using the control item. Each firer completed three runs of the course with each item.
 - b. The modified transition course consisted of 10 targets located at ranges from 50 to 500 yards with a 25' to 40' fan. Each rifleman was allowed one round per target. All targets were exposed simultaneously. A time limit of 45 seconds for this course, based upon 4 seconds exposure for each target and 5 seconds to load the second clip, was allowed each firer for completion of the course. Each firer engaged the bank of 10 targets once from each of three supported field firing positions.
 - c. All targets were checked to determine the number of front and rear projectile hits of the test item and the hits of the control item.

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3. (C) RESULTS.

a. In order to hit the target with the lead round of the test item at ranges greater than 300 yards it was necessary to aim over the target.

b. Shown below are the results of semiautomatic fire. A total of 1080 rounds of each type item was fired.

Item	T A R G E T S H I T							Total Pro- jectile Hits
	Column I	Column II	Column III	Column IV	Column V	Column VI	Column VII	
	By Front Project- ile Only	By Both Project- iles of the Same Round	Total by Front Pro- jectile (Col I + Col II)	By Rear Project- ile Only	Total Targets Hit (Col III + Col IV)	% Targets Hit (Front Projectile) Per Rds Fired (Col III/1080)	% Targets Hit Per Rds Fired Col V/ 1080	(Col I + 2x Col II + Col IV)
Test	236	247	483	66	549	44.7	50.8	796
Control	602	-	-	-	602	55.7	55.7	602

4. (C) ANALYSIS.

a. In transition firing the front projectiles of the test item and the control item are not comparable in accuracy when firing with a battle sight setting at unknown distances. Front projectile hits of the test item were 44.7 per cent of total rounds fired while the control item hits were 55.7 per cent of total rounds fired.

b. The total number of targets hit by the test items is considerably less than the total number of targets hit by the control items.

c. The test item produces a substantial improvement over the control item in total projectile hits. This increase in total projectile hits of the test item over the control item is primarily attributable to targets hit by both projectiles of the same round of the test item.

d. If the front projectile of the test item and the control item were comparable in accuracy, an increase in hit probability attributable to single rear projectile hits could be expected.

e. The excessive drop in the trajectory of the lead round of the test item at ranges greater than 300 yards is such that a firer cannot effectively use hold-off at these ranges.

f. A graphic illustration of the results of semiautomatic fire is shown in Annex C-6 and 7.

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Test Nr 7, FIELD FIRING UNDER SIMULATED COMBAT CONDITIONS

1. (U) PURPOSE. To determine and compare the effective accuracy of the test and control items when fired at surprise targets.

2. (U) METHOD.

a. Twelve average rifleman fired a TRAINFIRE Record Course using both the test and control items. Firing was conducted on a TRAINFIRE range in accordance with FM 23-71, Rifle Marksmanship Course, TRAINFIRE I. The course was fired twice for record with both test and control items. Six of these riflemen fired RECORD I the first morning of firing and then fired RECORD II the afternoon of the second day. Six other riflemen fired RECORD I the first afternoon of firing and then fired RECORD II the morning of the second day. Throughout the first day of firing, each rifleman fired alternately 16 rounds of control ammunition and 16 rounds of test ammunition for three sequences, then fired eight rounds of control ammunition followed by eight rounds of test ammunition. On the second day of firing, this procedure was repeated except that the firing sequence of the test and the control items was reversed.

b. Prior to firing the TRAINFIRE course, each rifleman zeroed his rifle at 300 yards range with both test and control items. During the conduct of this test each rifleman used the appropriate battle sight setting.

c. All targets were checked to determine the number of front and rear projectile hits of the test items and the hits of the control items.

3. (C) RESULTS. Shown below are the results of field firing under simulated combat conditions. In this test, 1222 rounds of the test item and 1247 rounds of the control item were fired.

Item	T A R G E T S H I T							Total Projectile Hits
	Column I By Front Projectile Only	Column II By Botn Project- iles of the Same Round	Column III Total by Front Pro- jectile (Col I + Col II)	Column IV By Rear Project- ile Only	Column V Total Targets Hit (Col III + Col IV)	Column VI % Targets Hit (Front Projectile (Col III/ Per Rounds Fired)	Column VII % Targets Hit (Col V/Per Hds Fired)	
Test	273	91	364	124	488	29.7	39.9	579
Control	511	-	-	-	511	40.9	40.9	511

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4. (C) ANALYSIS.

a. In field firing under simulated combat conditions, the front projectiles of the test items and the control items are not comparable in accuracy when firing with a battle sight setting at unknown distances. Front projectile hits of the test item were 29.7 per cent of total rounds fired while the control item hits were 40.9 per cent of total rounds fired.

b. The total number of targets hit by the control items was slightly higher than the total number of targets hit by the test items.

c. The test item produces a slight improvement over the control item in total projectile hits.

d. If the front projectiles of the test items and the control items were comparable in accuracy, an increase in hit probability attributable to single rear projectile hits could be expected.

Test Nr 8. FIRER'S REACTION.

1. (U) PURPOSE. To determine the firer's reaction to the test item.

2. (U) METHOD. All firers employed during the tests were questioned to determine the significant differences in the user's reaction to the test item as compared with the control item.

3. (U) RESULTS. Numerous firers noted that when using a battle sight setting in engaging targets at unknown ranges, it was difficult to adjust their aimed fire by observation of the strike of the projectile since they were unable to ascertain whether the strike of the projectile observed was the strike of the front or rear projectile.

4. (C) ANALYSIS. Use of the test item would make the "strike of the bullet" method of fire adjustment extremely difficult.

Test Nr 9. PERFORMANCE UNDER ADVERSE CONDITIONS.

1. (U) PURPOSE. To determine and compare the performance of the test and control items under adverse conditions.

2. (U) METHOD.

a. Hot and Cold Chamber.

(1) One hundred and four rounds of each type ammunition were stored in a hot chamber at 125°F for 72 hours.

(2) One hundred and four rounds of each type ammunition were stored in a cold chamber at -25°F for 72 hours.

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(3) After being subjected to each of the above conditions, the test and control items were examined to determine their condition. The test and control items were then transported in insulated containers to a range and fired.

b. One hundred and four rounds each of the test and control items were subjected to the adverse conditions noted below. Prior to firing, the ammunition was shaken and wiped by hand as normally accomplished under combat conditions.

(1) Waterproofing. Submerged for 10 days under at least 6 inches of clear water.

(2) Outdoor Storage. Placed in open storage for a period of 30 days.

(3) Salt Water. Submerged for 15 minutes in salt water then left exposed in open storage for 72 hours.

5. (C) RESULTS. No malfunctions attributable to the test and control items were noted.

Test Nr 10, EFFECTS ON ORGANIZATIONAL MAINTENANCE.

1. (U) PURPOSE. To determine and compare the effects of the test and control items on organizational maintenance.

2. (U) METHOD. The wear on parts, breakages, time and materials required for cleaning, etc., of weapons utilized in the test were recorded.

3. (C) RESULTS. No significant difference exists in the maintenance required on weapons after firing test or control items.

Test Nr 11, EFFECTS OF RECOIL AND BLAST.

1. (U) PURPOSE. To determine and compare the effects of recoil and blast on the firer when firing the test and control items.

2. (U) METHOD. At the conclusion of test firing all men who had fired were queried as to which type ammunition produced the most and which the least recoil and muzzle blast. Data on test and control items were recorded and compared.

3. (C) RESULTS. All firers noted more recoil from the test item than from the control item.

4. (C) ANALYSIS. The test item would cause more shooters to flinch and thus increase this particular training problem.

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Test Nr 12. RELIABILITY.

1. (U) PURPOSE. To determine and compare the reliability of the test items with that of the control items.
2. (U) METHOD. Data recorded during testing was studied and compared to determine whether the reliability of the test item is less, equal to, or greater than that of the control item.
3. (C) RESULTS. No appreciable difference in the relative reliability of the test and control items was noted.

Test Nr 13. COMPARISON OF PERFORMANCE CHARACTERISTICS OF TEST AND CONTROL AMMUNITION.

1. (U) PURPOSE. To determine and compare the performance characteristics of the test and control items.
2. (U) METHOD. The performance characteristics of the test items as determined in preceding tests were compared with the performance characteristics of the control items.
3. (C) RESULTS.
 - a. The test and control items are comparable in the following respects:
 - (1) Effects on Weapon Functioning (Test Nr 5).
 - (2) Performance Under Adverse Conditions (Test Nr 9).
 - (3) Effects on Organizational Maintenance (Test Nr 10).
 - (4) Reliability (Test Nr 12).
 - (5) Transition firing and field firing under simulated combat conditions in total targets hit per rounds fired (Test Nr 7).
 - (6) Position Disclosing Effects (Test Nr 3).
 - b. The control item is superior to the test item in penetrating capabilities (Test Nr 4) and effects of recoil and blast (Test Nr 11).
 - c. The control item is superior to the front projectile of the test item in accuracy under field firing conditions where the firer uses a separate battle sight setting for each item.
 - d. The control item is superior to the test item in known distance accuracy at ranges in excess of 300 yards (Test Nr 2).

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e. The test item is superior to the control item in transition firing and field firing under simulated combat conditions in total hits per rounds fired (Tests Nr 6 and 7).

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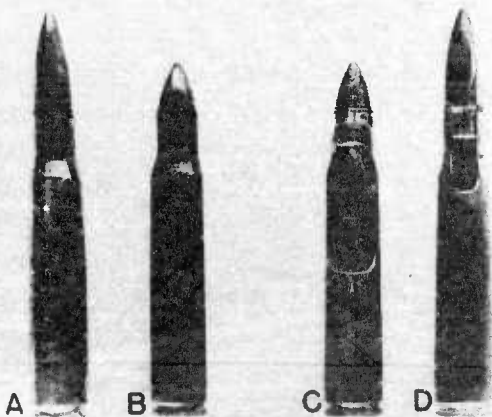
ANNEX B - DEFICIENCIES AND SUGGESTED MODIFICATIONS

Report of Project Nr 2453

(C) The deficiencies listed in this annex are those that remain uncorrected at the completion of this project. They are listed in two categories: major deficiencies and minor deficiencies. The former are those deficiencies which must be corrected to make the item suitable for Army use. The latter are those deficiencies, the correction or elimination of which will increase the efficiency or desirability of the item, but which need not be corrected to make the item suitable for Army use.

<u>Major Deficiency</u>	<u>Results</u>	<u>Suggested Modification</u>
1. The front projectile of the test item is not sufficiently accurate at ranges over 300 yards (Test Nr 2).	Reduces hit probability.	Correct.
2. Test item does not possess sufficient penetrating capabilities (Test Nr 4).	Does not meet the required military characteristics for small arms ammunition.	Correct.
3. The front projectile of the test item is not sufficiently accurate under field firing conditions using a battle sight setting (Tests Nr 6 and 7).	Reduces hit probability.	Correct.

<u>Minor Deficiency</u>	<u>Results</u>	<u>Suggested Modification</u>
4. Trajectory of lead projectile of test item and control item is radically different at ranges in excess of 300 yards (Test Nr 2).	Test and control ammunition cannot be fired alternately without sight changes.	Correct.
5. The smoke and flash of the test item are excessive (Test Nr 3).	Discloses firer's position.	Correct.
6. Recoil caused by the test item is excessive (Test Nr 11).	Causes shooter discomfort and resultant tendency to flinch.	Correct.



**UNITED STATES ARMY INFANTRY BOARD
FORT BENNING, GEORGIA**

PROJECT NR
2855

DATE
25 May 59

NEGATIVE NR
07-166-876, A3-59

EVALUATION OF .30 CALIBER DUPLEX AMMUNITION

- A. Cartridge, Ball, .30 Cal, M2.
- B. Cartridge, Ball, .30 Cal (Duplex).
- C. Outaway of Cartridge, Ball, .30 Cal (Duplex)
- D. Outaway of Cartridge, Ball, .30 Cal, M2.



UNITED STATES ARMY INFANTRY BOARD FORT BENNING, GEORGIA

PROJECT NR
2853

DATE
25 May 59

NEGATIVE NR
Ug-166-857 AJ-59

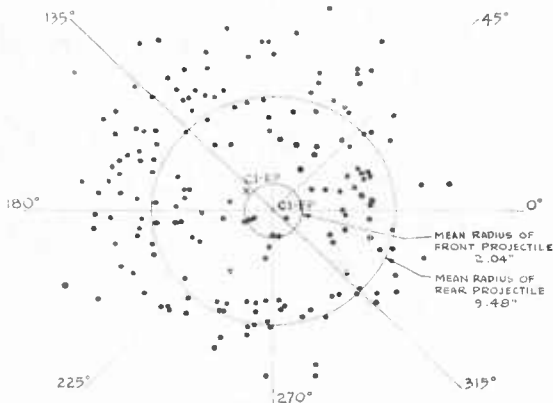
EVALUATION OF .50 CALIBER DUPLEX AMMUNITION

- a. Projectile of Cartridge, Ball, .50 Cal, M2.
- b. Front Projectile of Cartridge, Ball, .50 Cal (Duplex).
- c. Rear Projectile of Cartridge, Ball, .50 Cal (Duplex).
- d. Projectile of Cartridge, Ball, .50 Cal, M2.
- e. Front Projectile of Cartridge, Ball, .50 Cal (Duplex).
- f. Rear Projectile of Cartridge, Ball, .50 Cal (Duplex).

ATTACH G-2

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90°



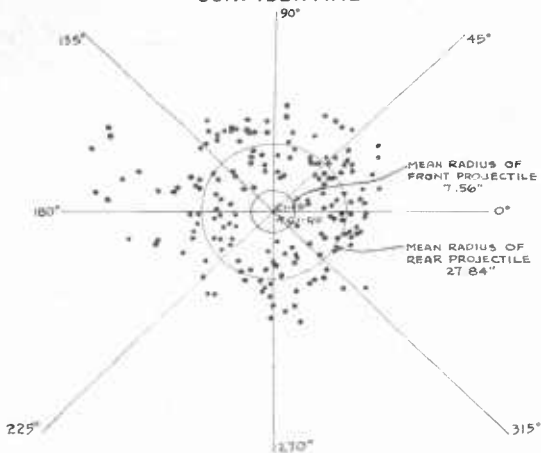
ANGULAR LOCATION	REAR PROJECTILE IMPACTS	PER CENT OF TOTAL
0-45°	-21	11.6
45-90°	-23	12.6
90-135°	-27	14.8
135-180°	-31	17.0
180-225°	-27	14.8
225-270°	-24	13.2
270-315°	-12	6.6
315-360°	-17	9.4
TOTAL	-182	100%

REAR PROJECTILE
DISPERSION
100 YARDS
SEMI-AUTOMATIC
FIRE ACCURACY

ANNEX C-4

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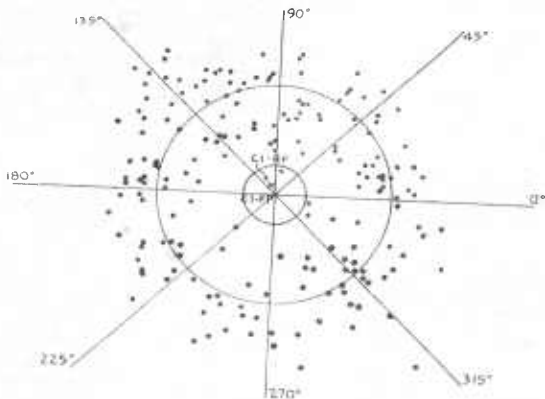
ANGULAR LOCATION	READ PROJECTILE IMPACTS	PER CENT OF TOTAL
0 - 45°	31	17.2
45 - 90°	21	11.7
90 - 135°	28	15.6
135 - 180°	22	12.2
180 - 225°	23	12.8
225 - 270°	16	8.9
270 - 315°	17	9.4
315 - 360°	22	12.2
TOTAL	180	100 %

READ PROJECTILE
DISPERSION
300 YARDS
SEMI-AUTOMATIC
FIRE ACCURACY

ANNEX C-4

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ANGULAR LOCATION	REAR PROJECTILE IMPACTS	PER CENT OF TOTAL
0-45°	-26	14.1
45-90°	-22	11.9
90-135°	-33	17.8
135-180°	-28	15.1
180-225°	-19	10.3
225-270°	-16	8.6
270-315°	-19	10.3
315-360°	-22	11.9
TOTAL	-185	100 %

REAR PROJECTILE
DISPERSION
500 YARDS
SEMI-AUTOMATIC
FIRE ACCURACY

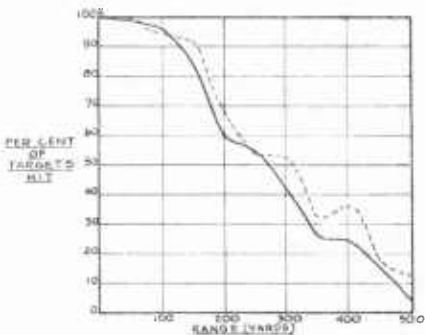
ANNEX C-5

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SUMMARY OF
TRANSITION FIRING

KEY ——— TOTAL TARGETS HIT BY
TEST ITEM
- - - TOTAL TARGETS HIT BY
CONTROL ITEM



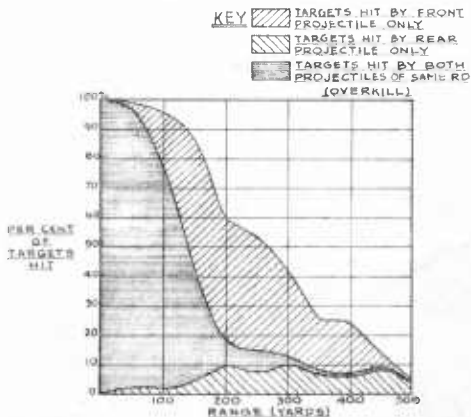
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TARGETS HIT

TEST ITEM

TRANSITION FIRING



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ANNEX D - REFERENCES

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5. Final Narrative Summary Report. Olin Mathieson Chemical Corporation, Winchester-Western Division, undated, subject: "Engineering, Development and Fabrication of Cartridge. Caliber 7.62mm Duplex, Contract Nr DA 19-059-507-ORO-2672 (U) "
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7. Report of Project Nr 2812, US Army Inf Bd, 20 May 59, Evaluation of NATO 7.62mm Duplex Ammunition (U)."

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