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FORTY-FOURTH

PROGRESS REPORT

OF

THE FIRESTONE TIRE & RUBBER COMPANY

ON

BATTALION ANTI-TANK PROJECT

UNDER

Contract Nos. DA-33-019-ORD-33
DA-33-019-ORD-1202

ORDNANCE DEPARTMENT PROJECTS
TS4-4020—WEAPONS AND ACCESSORIES
TM1-1540—AMMUNITION

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COPY No. 54

THE FIRESTONE TIRE & RUBBER COMPANY
Defense Research Division
Akron, Ohio

MARCH 1954

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DOD 5200.1-R, DEC 78

REVIEW ON 28 MAR 74

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Armed Services Technical
Information Agency
Document Service Center
U. S. Building
Dayton, Ohio

Akron, Ohio
May 25, 1954

Subject: Corrections To Be Made In Forty-Fourth Progress Report (March) of Firestone Defense Research Division on Contracts DA-33-019-ORD-33 and DA-33-019-ORD-1202.

In the subject report which you have just received there are two errors which have been called to our attention and which we request that you correct in your copy or copies.

(1) Figs. 17 and 19 on pages 25 and 26 are transposed. The captions are correct as they appear but the plots and data immediately below are transposed. Beside the plot of Fig. 17 will you write "this should be Fig. 19" and beside the plot of Fig. 19 will you please write "this should be Fig. 17".

(2) A typographical error appears in Table XIV on page 44. In the right hand portion of the Table under Rotational Behavior the two rows of data are transposed in the last five columns. That is, under the headings 15, 30, 45, 60 and 90 rps columns the larger number should be in the top row, e.g. 19.06 ± 3.21 should exchange positions with 18.34 ± 1.45 and this same change in order (bottom number moves up to top row and top number moves to bottom row) should be made in the remaining four columns.

It will avoid considerable confusion if you will indicate these changes in your copy (or copies) and indicate that such changes have been made by signing one copy of this form and return to our attention. Place the other copy within the report to verify your changes.

Thank you for your assistance.

Very truly yours,

Stewart B. Steiner

Stewart B. Steiner

The above changes have been noted and corrected in the copies of this report for which I am responsible.

Signed ______________________________

SBS:mjm

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S 4A-1-55663

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FORTY-FOURTH

PROGRESS REPORT

OF

THE FIRESTONE TIRE & RUBBER CO.

ON

BATTALION ANTI-TANK PROJECT

Contract Nos.
DA-33-019-ORD-33 (Negotiated)
DA-33-019-ORD-1202

RAD Nos. ORDTS 1-12383
ORDTS 3-3955
ORDTS 3-3957
ORDTA 3-3952

THE FIRESTONE TIRE & RUBBER CO.
Defense Research Division
Akron, Ohio

MARCH, 1954

CONFIDENTIAL

INDEX

ABSTRACT

Weapon System - The requirements for a firing control system for the multi-gun ONTOS weapon system are presented. A simplified, single package electrical control system developed by Firestone is illustrated and the features are discussed.

T119 Projectile - Ten projectiles with double "O" ring obturators were fired from a smooth bore tube to determine the effect of obturation alone upon the accuracy of the projectile. The test results are given.

Nineteen projectiles with grooved nose caps (previously tested for impact sensitivity) were fired to evaluate the effect of the nose cap design on projectile accuracy. The test results indicate that the nose cap design does not have any detrimental effect upon the accuracy of the projectile.

Seventy rounds were fired to study the fin opening mechanism. A new piston stop design is illustrated. The series of tests were fired to establish the proper amount of interference between the stop and the housing. The dimension limits on piston and housing diameters that will permit consistent functioning of the tail assembly under the most extreme conditions are determined from these tests.

T171 Projectile - Four accuracy programs were fired at Erie Ordnance Depot involving T171E10 and T171E11 projectiles at ranges of 1000 and 1500 yards. The test data are presented and discussed.

T120 Projectile - Dynamic tests for determining the performance of projectiles with spin compensating cones are discussed. Preliminary firings with a projectile of the folding fin type were made to evaluate spin rate. Further tests are planned.

Six test bodies (for double body projectile studies) were fired with various wall thicknesses to determine the minimum wall thickness allowable in order to reduce weight. The test results are analyzed.

Penetration Studies - A study of the effect of cone angle and flash tube diameter upon the standoff and rotational penetration behavior of 3-inch copper cones has been completed. The test data are given and the results discussed.

Two series of tests were conducted under contract DAI-33-019-501-ORD (P)-16 but are summarized here because of the importance of the data to this contract: (a) comparison tests with "drawn" and "shear formed" P83580 Al cones, and (b) performance tests with double angle tapered wall copper cones.

THE WEAPON SYSTEM

ONTOS Firing System

Preliminary tests of the multi-gun ONTOS weapon by the using services emphasized the need for:

1. An indicator system to serve as a memory for the gunner. This indicator preferably should tell the gunner when a rifle is loaded and when empty.

2. A simpler and more reliable firing mechanism.

3. Better protection for personnel when loading and closing the rifle breeches.

4. Complete interchangeability between BAT and ONTOS rifles. In an effort to meet these requirements, several different systems have been manufactured and tested but have enjoyed only limited success.

The systems tested have employed:

1. A breech operating mechanism controlled from the inside of the vehicle.

2. An auxiliary firing system.

3. An auxiliary attachment which indicates when the rifles are fired.

It is understood that the breech operating mechanism is required for safety of personnel only. For example, in the T170 rifle the breech is closed on the loaded shell with a cocked firing pin and a malfunction can fire the shell as the breech reaches the locked position. This condition is particularly hazardous when working with a multi-gun system and has so far been overcome by the use of a breech operating mechanism which allows the personnel to remain under cover when the breeches are closed. All of the firing systems have provided a mechanism which operates through the cable system furnished with the rifle. In order to accomplish the desired result the mechanism becomes complicated. The most successful indicator system tested so far required a hole through the rifle barrel and auxiliary attachments both at that point and inside the vehicle.

In order to simplify and improve on the systems now being considered, Firestone has developed and tested a simple, single package electrical unit which meets all of the requirements listed in paragraph one. This unit (Figs. 1, 2 and 3) replaced three (3) items on the standard T170E1 rifle.

a. the firing pin

b. the firing pin cap

c. the firing pin spring

The changeover can be accomplished in less than one (1) minute and is fully reversible. Thus, the rifles may be changed back and forth and fired either with the electrical unit or with the standard percussion-unit.

The operation of the new unit is as follows:

a. Firing

A firing pin without a sear lobe replaces the standard firing pin. When the breech is opened and closed this firing pin rides the cocking cam up and down. Until the breech is safely closed the cocking cam provides a barrier which prevents accidental firing. Thus, with this unit the breeches are closed with an uncocked firing pin. Under these conditions it is believed that the breeches can be closed manually with safety, thus eliminating the need for the expensive mechanism now used to operate the breeches from inside the vehicle. In firing the rifles the firing pin is driven forward by a solenoid.

b. Indicator system

The indicator system operates off a cam attached to the rear end of the firing pin. A small on-off switch is actuated by this cam. Thus, if the breech is closed on an empty rifle (Fig. 4) the firing pin is pushed all the way forward and the cam operates the switch lighting a light in the control panel. If the breech is closed on a loaded gun (Fig. 5) the firing pin comes to rest on the primer and the cam again operates the switch and turns off the light on the control panel. When the rifle fires (Fig. 6) the primer is driven rearward by the chamber pressure. This force is sufficient to carry the firing pin rearward and again the cam operates the switch and lights the light in the vehicle. Fig. 7 is the wiring diagram and Fig. 8 shows the control panel in the vehicle.

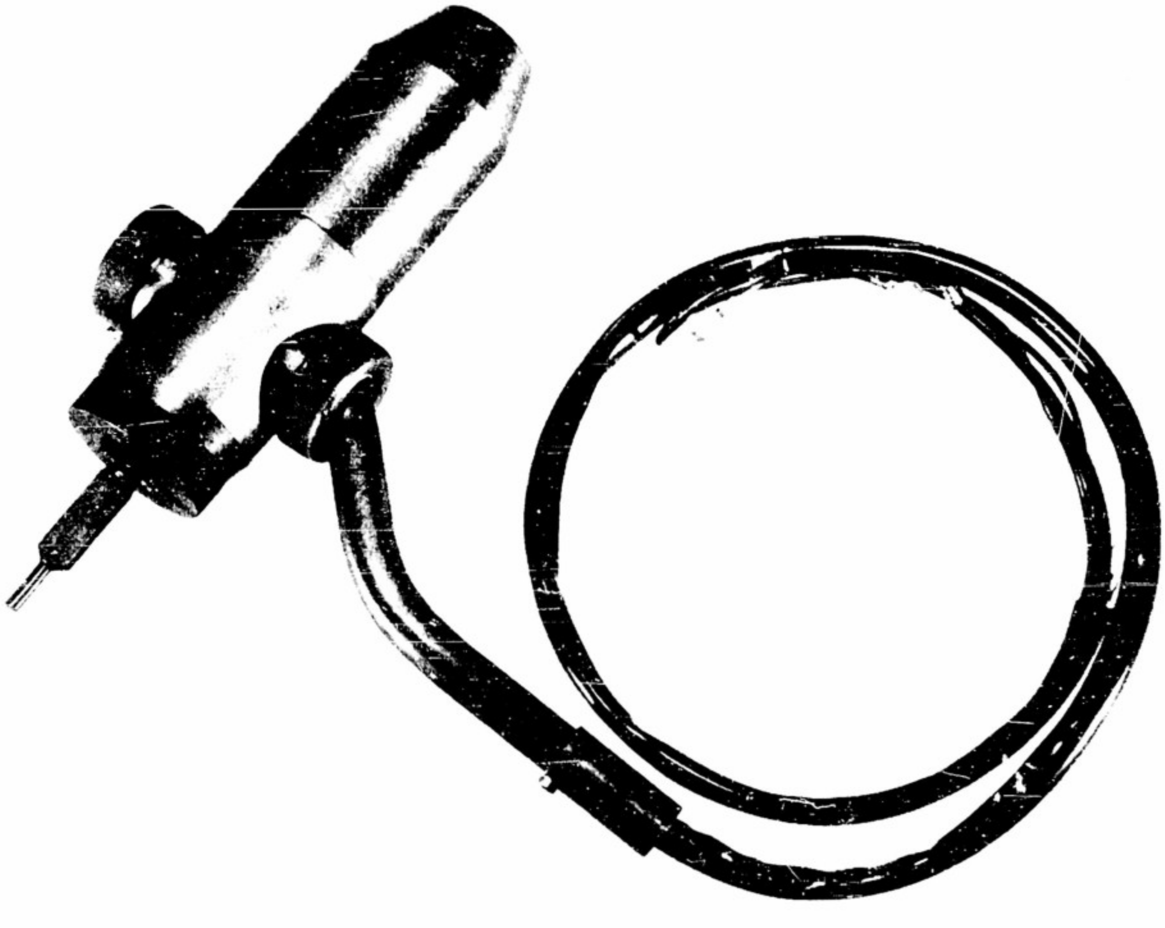

Fig. 1. Solenoid Firing Assembly.

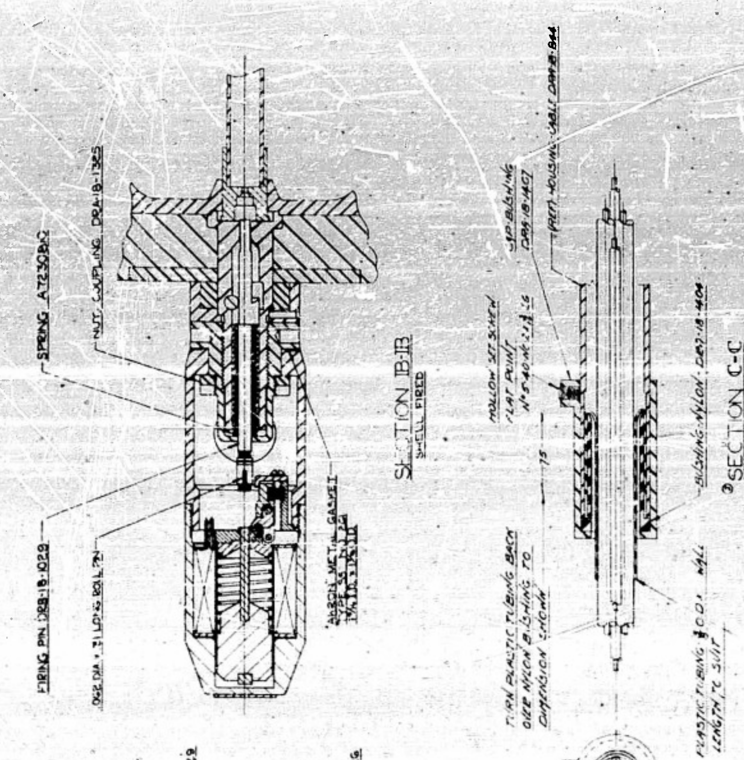
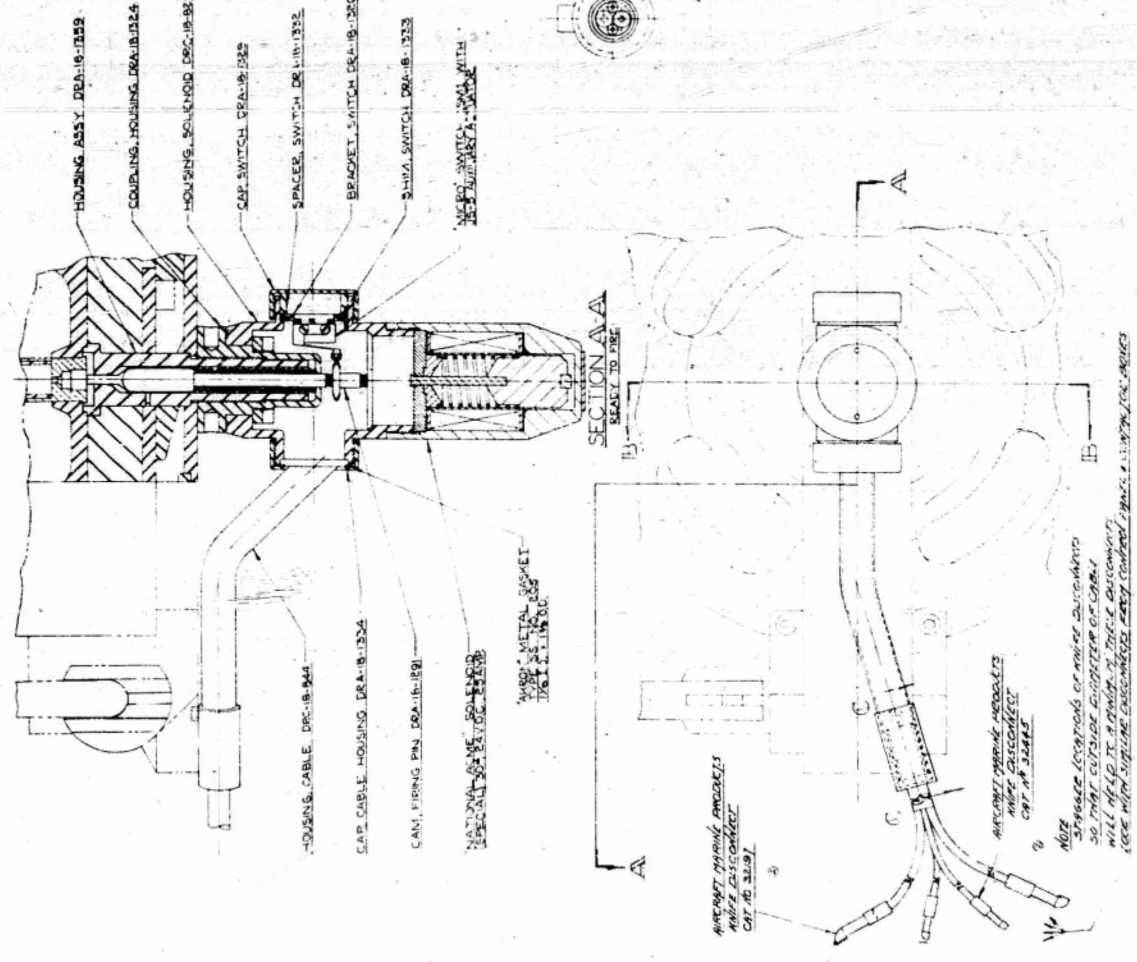

Fig. 2. Solenoid Firing Assembly.
Shown In T170 Breech Mechanism.

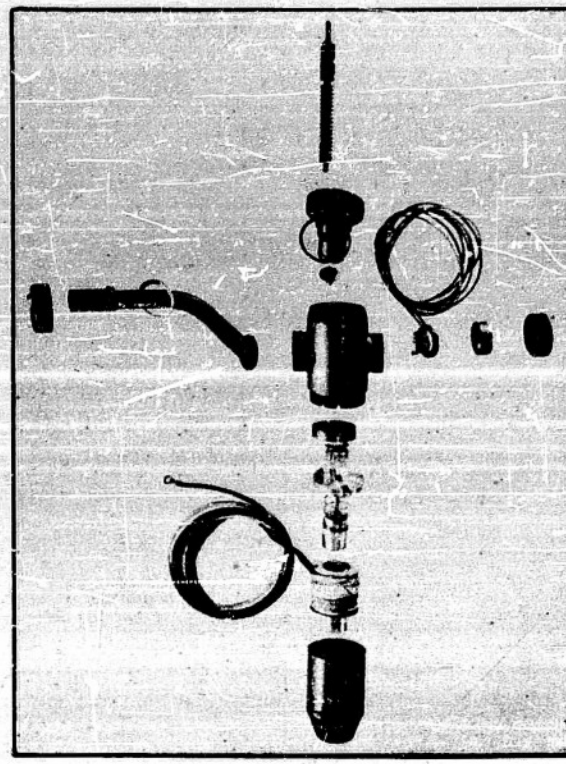

Fig. 3. Exploded View of Solenoid Firing Assembly.

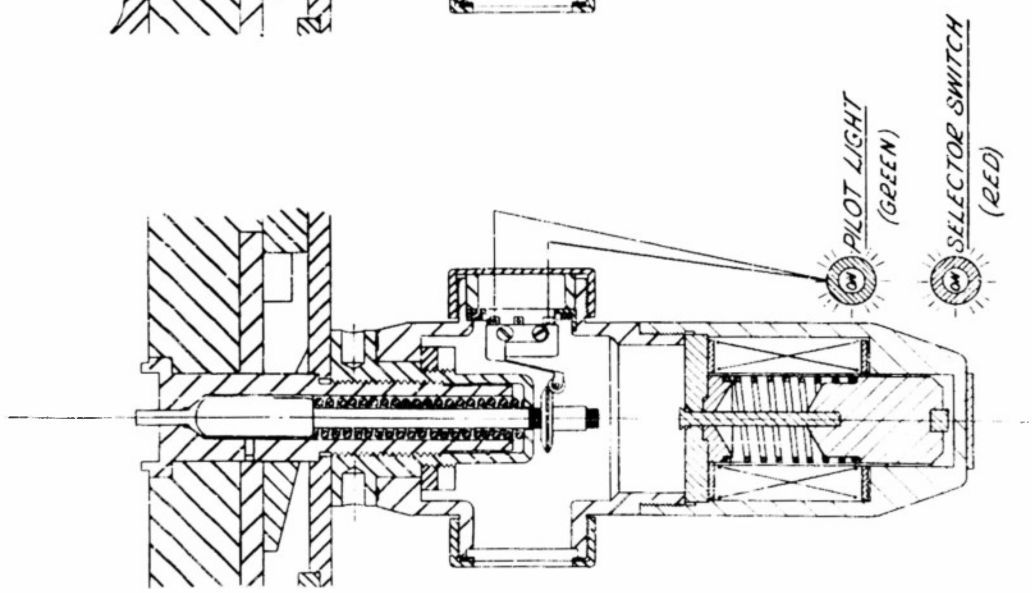

Fig. 4. Solenoid Firing System.
Rifle Empty.

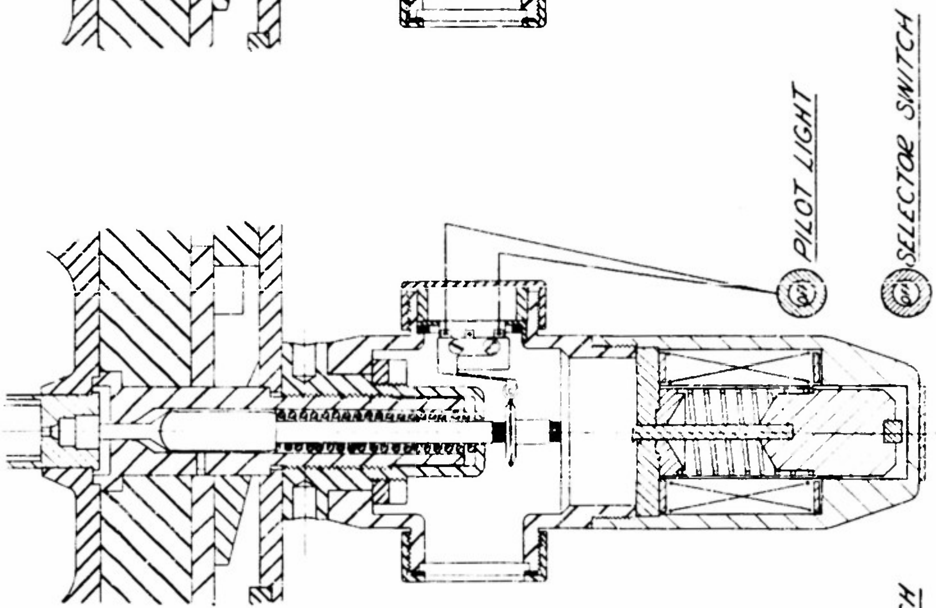

Fig. 5. Solenoid Firing System.
Rifle Loaded and Selected to Fire.

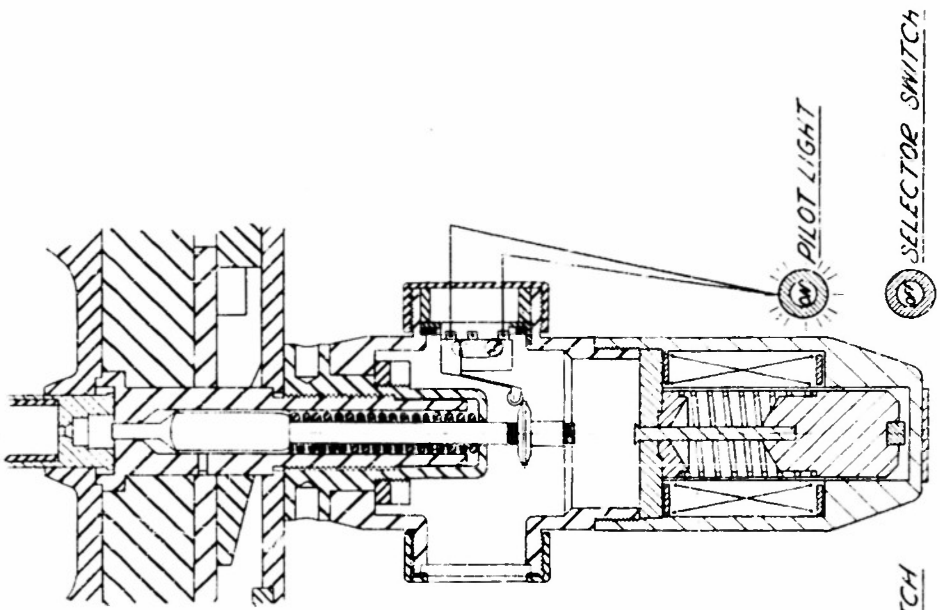

Fig. 6. Solenoid Firing System.
Rifle Fired.

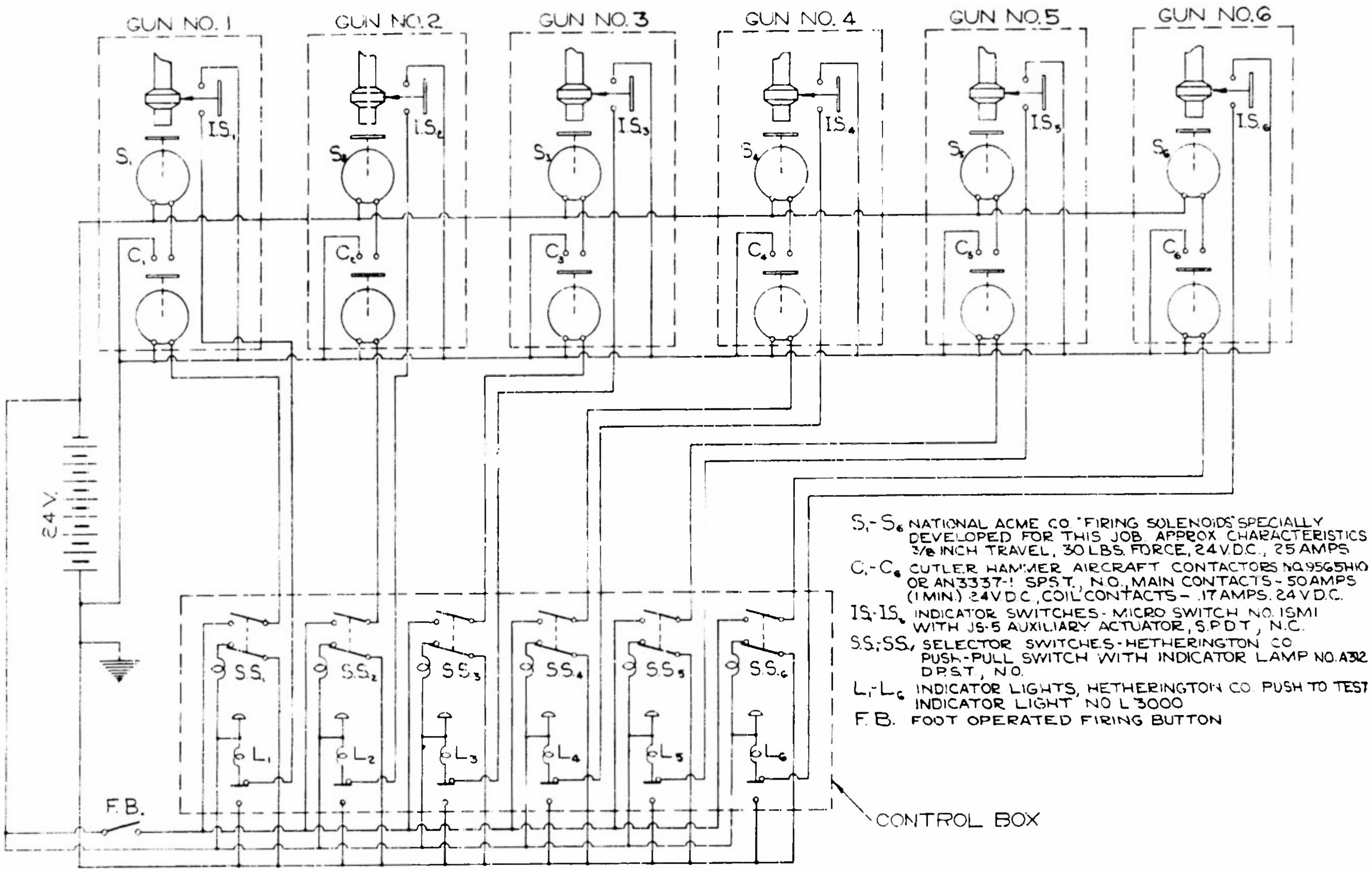

Fig. 7. Wiring Diagram.
ONTOS Firing System.

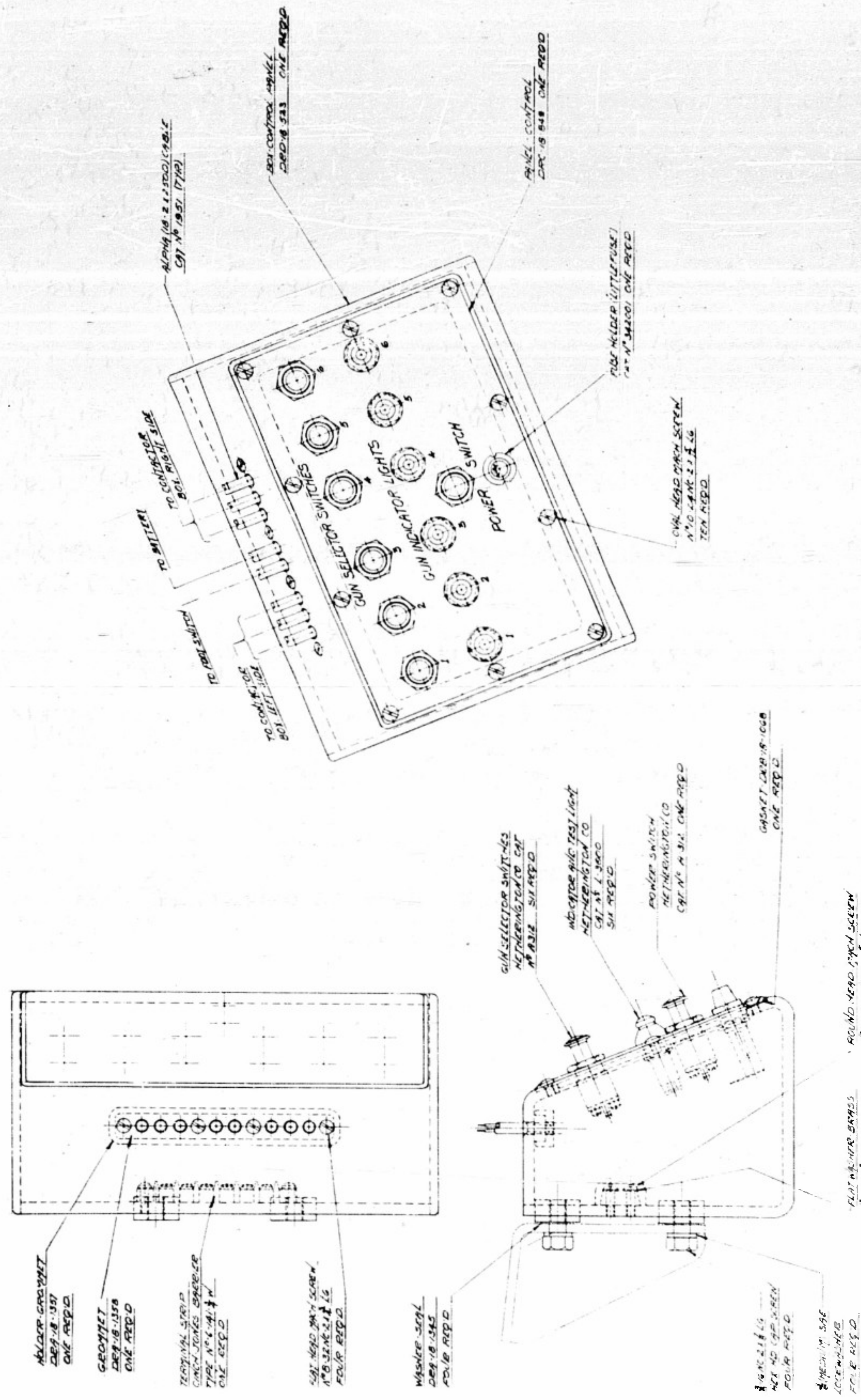

Fig. 8. Control Panel Assembly.
ONTOS Firing System.

Future Program

1. Continue test firing of ONTOS firing system for reliability of solenoid firing unit and projectile indicator unit.

2. Investigate the effect of obturation of proof slugs (with annealed copper obturating bands and rubber "O" rings) on the interior ballistics of the 90mm Test Rifle.

Projectiles With Double "O" Ring Obturators

Projectiles with two "O" ring obturators have been fired for spin measurements from a tube rifled 1/20 (see Forty-First Progress Report) and it has been suggested that the higher muzzle spin which results from the double obturator should improve the accuracy of the T119E11 projectile. It is also likely that the double ring will improve the obturation and this alone might improve the accuracy also. The effect of the increased obturation upon accuracy has been determined, independently of the increased spin, by firing ten projectiles of this type from a gun with a smooth bore tube.

Ten T119E11X projectiles, each with two "O" ring obturators and having short fins (6.92 in. long) were fired from a smooth bore tube fixed in a rigid mount, at an 18 ft by 18 ft target at 1000 yards. The range data are presented in Table I. All ten projectiles struck the target with probable errors of dispersion of ±.52 mil vertical and ±.37 mil horizontal. However, because of the unaccountably large dispersion in muzzle velocity, a vertical probable error, corrected for velocity, was calculated. A plot of vertical impact versus muzzle velocity is shown in Fig. 9. A correction factor determined by the least mean squares line, shown in Fig. 9, is 1.1819 in/fps. A vertical probable error of dispersion of ±.31 mil is re-calculated with the use of the correction factor.

A similar group of projectiles will be fired for accuracy, from a tube rifled 1/20, in order to determine the effect of spin.

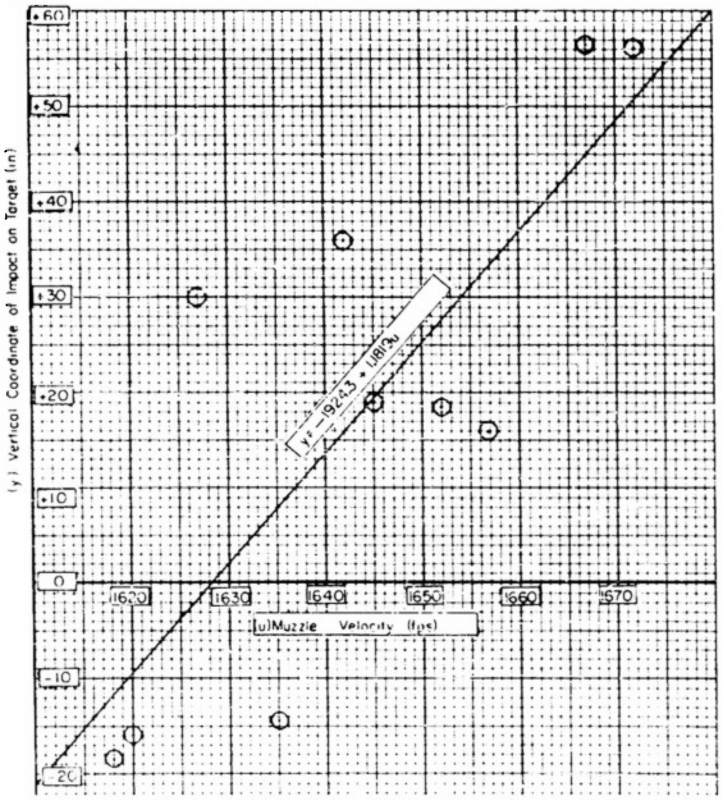

Fig. 9. Vertical Impact Versus Muzzle Velocity.
Least Mean Squares Line for Correction Of Vertical Impacts for 10 T119E11X Projectiles.

Table I
Range Data
Accuracy Of T119E11X Projectile With Short Fins and Two "O" Ring Ob[illegible]rators

Date of Test 8 March 1954
Erie Ordnance Depot

Purpose of Test Accuracy of T119E11X with Short (6.92 in) Fins & 2 "O" Ring Obturators
Program 111

PROJECTILE

55.87' — 47.88'

Model T119E11X
Type Ogive
Weight 17.4 lb (Nom)
CG Location
Bourrelet Dia 4.132 in -.002
Special Features Short Fins (6.92 in long) and 2 "O" Ring Obturators Parker No 5427-56

TEST GUN

Model T237E3
Type 105 mm Recoilless
Serial No 9
Chamber 22-B-56-1-G
Bushing (Vent) 22 C 126 H
Tube 22C 1435 (Smooth Bore)
Sighting Equipment Bore Sight and M-17 Elbow Telescope
Mount
Type Rigid Mount
Serial
1 mil = 35.82 in
Zero Elevation Reading - 526 mils

MISCELLANEOUS DATA

Range Target 998.9 yds
Propellant
Type MPM10 Web .035 in Weight 7 lb 8 oz
Lot No PA 30259
Primer M57
Shell Case T63E1
Liner DRC 479-1
Temperatures
Magazine
Max 73°F Min 71°F Present 72°F
Loading Room 64°F Ambient 40°F

Round No	Proj No	Proj Weight (lb.)	Powder Charge (lb-oz)	Wind Vel. & Dir. mph	Wind Vel. & Dir. deg	Chamber Pressure [illegible] (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Super Elev (a) (mils)	Azimuth (mils)	Position of Hit (inches) Vert	Position of Hit (inches) Horiz	Corrected Position of Hit — mils Vert	Corrected Position of Hit — mils Horiz	Recoil (in)	Observations
6916-1	1362	17.50	7-8	2	45	9400 9600	—	—	25.80	-1	-3	0	Warm Up Round Not Counted			Warm Up Round Good Flight
6917-2	1847	17.44	7-8	4	15	9300 9500	1626	1642	26.35	-1	+36	0	+1.01	0		Good Flight Muzzle End Bracket Loosened
6918-3	1848	17.44	7-8	6	6	9600 9400	1656	1672	26.25	-1	+56	+26	+1.56	+.73		Good Flight
6919-4	1855	17.45	7-8	6	35	9800 8500	1651	1667	26.25	-1	+56½	-5	+1.58	-.14		" "
6920-5	1866	17.36	7-8	7	60	9600 8800	1602	1618	26.25	-1	-18½	-2	-.52	-.06		" "
6921-6	1853	17.44	7-8	7	55	8800 8600	1604	1620	26.25	-1	-16	+25½	-.45	+.71		" "
6922-7	1842	17.40	7-8	8	40	9400 9300	1611	1627	26.50	-1	+30	-3	+.84	-.08		" "
6923-8	1850	17.42	7-8	7	50	8600 8700	1629	1645	26.50	-1	+19	-18	+.53	-.50		" "
6924-9	1861	17.42	7-8	7	55	9300 9400	1641	1657	26.50	-1	+16	-1½	+.45	-.04		" "
6925-10	1852	17.40	7-8	4	35	9200 9300	1636	1652	26.50	-1	+18½	9	+.52	+.25		" "
6926-11	1854	17.44	7-8	6	70	8200 7600	1619	1635	26.50	-1	-14½	42	-.40	-1.17		" "
	Avg	17.42			Avg	9100	Avg	1649								

Proj	Yaw	Fin Opening (b)
1847	—	—
1848	4⅛ x 4⅛	9¼ x 4 x 9¼
1865	4½ x 4⅛	9¼ x 9¼ x 9
1846	4½ x 4⅛	—
1853	4½ x 4⅛	9½ x 9½
1842	4½ x 4⅛	9½ x 9½
1850	4⅛ x 4⅛	—
1851	4½ x 4⅛	9½ x 9½
1852	4¼ x 4⅛	9½ x 9⅜
1854	4¼ x 4⅛	—

(a) Gun was rigidly mounted and locked in position. Variation in elevation may be due to uncontrollable error in reading quadrant

(b) Fin opening measurements difficult to measure because of shattered panels. The given measurements are approximate.

Center of Impact V = +.51 mil; H = -.03 mil
Probable Error — Vertical ±.52 mil Uncorrected; ±.31 (Corrected for variation in muzzle velocity)
Probable Error — Horizontal ±.37 mil Uncorrected

Proof Director E. Huffman
Observers R. Finucan
L. Sivaraly

Signed M. Manofsky

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Accuracy Of T119E11 Projectile With Grooved Nose Cap

A grooved nose cap, shown in Fig. 10, has been tested for impact sensitivity, using T119E11 HEAT shell (see Fortieth Progress Report) and the effect of the grooved cap upon accuracy has now been determined.

Nineteen T119E11 projectiles with grooved nose caps were fired for accuracy at an 18 ft by 18 ft target at 1000 yards. The range data are given in Table II.

Three rounds were used to establish the proper propellent charge and all of the remaining sixteen projectiles struck the target with a vertical probable error of ±.35 mil and a horizontal probable error of ±.36 mil. All of the projectiles were reported to fly well even though the fin markings left in the target by one round indicated that the fins were not completely opened. This test shows that the grooved nose cap does not have any detrimental effect upon the accuracy of the T119E11 projectile.

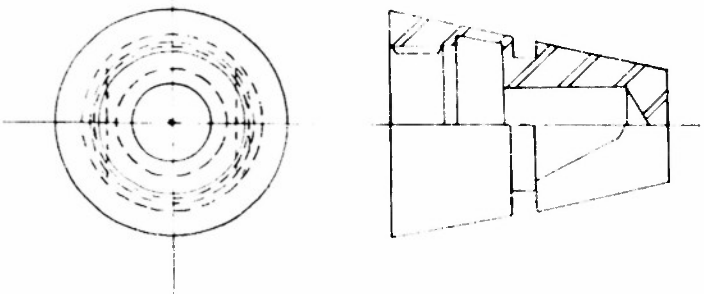

Fig. 10. Grooved Nose Cap.
Firestone Drawing DRA699.

Table II
Range Data
Accuracy Of T119E11X Projectile With Grooved Nose Cap

Date of Test 31 March '49 — Purpose of Test: To Test Accuracy Of T119E11X with Grooved Nose Cap

PROJECTILE — Model T119E11X; Type Folding Fin; Weight 17.5 lb; CG Location ____; Bourrelet Dia 4.132; Special Features Grooved Nose Cap

TEST GUN — Model T122 [illegible]; Type 105 mm Recoilless; Serial No ____; Chamber [illegible]; Bushing (Vent) [illegible]; Tube [illegible]; Sighting Equipment M17 Telescope, Gunners Quadrant; Mount Type ____ Serial ____

MISCELLANEOUS DATA — Range 998.4 yds; Propellant Type [illegible] Web [illegible] Weight Varies; Lot No [illegible]; Primer ____; Shell Case ____; Liner ____; Temperatures: Magazine Max ____ Min ____ Present ____; Loading Room ____ Ambient ____

Round No	Proj No	Proj Weight (lb)	Powder Charge (lb-oz)	Wind Vel mph	Wind Dir deg	Chamber Pressure (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Total Elev (mils)	Azimuth (mils)	Position of Hit (inches) Vert	Position of Hit (inches) Horiz	Corrected Position of Hit – mils Vert	Corrected Position of Hit – mils Horiz	Yaw	Fin Opening	Observations
7011	1 x 1651	1750	7 62	4	350	8450 / 8400	1598	1614	271	0	-35½	+10	-93	+50	4⅛ x 4⅛	10⅝	Low Charge, Not used for P.E.
7012	2 x 1645	1750	7 62	5	5	8000 / 8200	1614	1630	271	0	-24	-30½	-67	-85	Not Meas	10½ x 10⅝	
7013	3 x 1612	1751	7 62	9	10	8500 / 8300	1587	1603	271	0	-84	+14½	-247	+30	4⅛ x 4½	10½ x 10⅝ x 10¾	
7014	4 x 1635	1750	7 75	7	30	9375 / 9300	1658	1674	271	0	-18	+27	-50	+75	4⅛ x 4⅛	[illegible]	2 oz propellent added
7015	5 x 1647	1748	7 75	4	25	9200 / 8900	1651	1667	271	0	+5	-21½	+14	-60	Not Measurable	10½	
7016	6 x 1682	1748	7 75	5	30	8900 / 8600	1657	1673	271	0	-9	-9	-22	-23		[illegible]	
7017	7 x 1607	1750	7 75	6	15	8500 / 8800	1637	1653	271	0	-29	-18	-42	-50		Not Measurable	
7018	8 x 1679	1750	7 75	7	5	9000	1634	1650	271	0	-45½	-1½	-126	-04			
7019	9 x 1642	1748	7 75	7	20	8900 / 8800	1648	1664	271	0	-22	-22½	-61	-62	4⅛ x 4⅛	10½ x 10½ x –	
7020	10 x 1670	1748	7 75	4	5	8700 / 8500	1645	1661	271	0	-39	+52½	-108	-146	4⅛ x 4⅛	See Sketch	Sketch: Hit No. 10
7021	11 x 1613	1750	7 75	7	30	8900 / 9000	1638	1654	271	0	-36	+16½	-1.00	+46	Not Measured	Not Measurable	
7022	12	1634	1752	7 75	8	20	8500 / 9300	1648	1664	271	0	-24½	+19	-68	+53	4⅛ x 4⅛	10⅝ x 10⅝ x 10⅝	
7023	13	1618	1750	7 75	7	15	8900 / 7700	1647	1663	271	0	-45½	-7	-126	-19	Not Measured	Not Measurable	
7024	14	1639	1751	7 75	5	10	9600 / 8600	1652	1668	271	0	-47	-10	-130	-28		10¾ x 10¾ –	
7025	15	1677	1748	7 75	4	10	8800 / 8800	1652	1668	271	0	-30	-11	-83	-21		10½ x 10¼ –	
7026	16	1668	1750	7 75	4	25	8500 / 8700	1645	1661	271	0	0	-17½	0	-24			
7027	17	1661	1749	7 75	4	15	9100 / 9100	1652	1668	271	0	+5	-3½	+14	-10	4⅛ x 4⅛	10¾ x 10⅝ x –	
7028	18	1650	1752	7 75	8	15	8200 / 8800	1649	1665	271	0	-3½	-22	-10	-61	Not Measured	10½ x [illegible]	
7029	19	1686	1748	7 75	7	10	8900 / 8700	1671	1687	271	0	-7½	+3	-26	+08		10⅝ x 10⅝ x 10⅝	
	Avg.	1750			Avg.	8700	1657	1657	271	0							

Center of Impact [illegible] mils, [illegible] mils. Probable Error Vertical ±.35 mil; Horizontal ±.36 mil.

Proof Director ____ Observers ____ Signed [illegible]

It was necessary to establish, by firing tests, the proper amount of interference between the stop and the housing. This interference is required to decelerate the fin opening action and to hold the fins open in flight. If the interference is too great, the fins do not open completely; and if the interference is too small, the inertia of the moving components may damage the fins when the stop reaches the limit of its travel.

Assemblies were made to determine, by firing tests, the permissible upper and lower limits of interference. Since the tolerance on the housing counterbore diameter is .004 in. and the tolerance on the stop interference diameter is .002 in., the range of interferences will be .006 in. Rather than manufacture new housings to determine the limits of interference, it was decided to use existing housings and to vary the diameters of the stops to produce the desired test interferences.

Three groups of assemblies, representative of tentative minimum diametral interferences of .006, .008 and .010 in., and three groups of assemblies representative of tentative maximum diametral interferences of .012, .014, and .016 in. were made. For the tentative maximum interference groups, 14S-T6 aluminum housings were used. The 14S-T6 material has been shown to offer greater resistance to full opening of the fins than does the alternative 24S-T4 aluminum. (See Fortieth Progress Report). The 24S-T4 material was used for the tentative minimum interference groups.

The extremes of the permissible piston-to-housing clearance were also incorporated in the tests. The fin assembly design tolerances permit piston-to-housing diametral clearances to vary from .001 to .007 in. Again, rather than manufacture new housings to the tolerance extremes of the base diameter, existing housings were used and the diameters of the pistons were varied to produce the desired extremes of piston-to-housing clearance.

Pistons for the .001 in piston-to-housing clearance were made from existing pistons by adding excess cadmium plate to the piston diameter and grinding to the required diameter. The assemblies with a nominal .001 in piston-to-housing diametral clearance were hand fitted and were generally as tight a fit as could be assembled without force. These tight piston-to-housing fits were used with the maximum stop-to-housing interference groups.

Pistons for the .007 in. piston-to-housing diametral clearance were made from existing pistons by remachining to reduce the piston diameter and replating.

These loose piston-to-housings fits were used with the minimum stop-to-housing interference groups.

The rounds with fin assemblies, incorporating the maximum stop-to-housing interference groups, were loaded with the normal propellent charge. These rounds were stored in a cold box to bring the propellent temperature below -40°F, and they were then fired from the 106mm T170 E1 rifle. The rounds with fin assemblies, incorporating the minimum stop-to-housing interference groups, were loaded with a propellent charge to give 115 per cent of the maximum rated pressure. The rounds were fired at ambient temperatures. The firing data are shown in Table III.

Twenty rounds with a nominal .012 in. stop-to-housing interference were fired at temperatures below -40°F. Three of the fin assemblies failed to open completely. Examination of the recovered projectiles showed that the piston had galled in the housing base. The fits between housing and piston were very close in all cases and these pistons also had abnormally thick cadmium plating to provide the required minimum clearance. The thick cadmium plating contributed to galling which caused the failure of the fins to open completely.

Ten rounds with a nominal .014 in. interference between stop and housing and ten rounds with a nominal .016 in. interference between the same two components were fired at temperatures below -40°F. Nine of the fin assemblies with .014 in. interference opened completely and one opened partially. Four of the tail assemblies with .016 in. interference opened completely, five opened partially and one did not open at all. Again, a severe galling, which was attributed to the abnormally thick cadmium plating, was detected on the only round with a nominal .014 in. interference which did not open completely. These results indicated that the .014 in. interference was satisfactory. The rounds with a nominal .016 in. stop-to-housing interference gave a higher rate of failure to open completely, indicating that .016 in. interference is too great.

Ten rounds with a nominal stop-to-housing interference of .006 in., ten with a nominal interference of .008 in. and ten with a nominal interference of .010 in. were fired with a propellent charge to give 115% of the maximum rated pressure at ambient temperature. Eight of the assemblies with .006 in. interference opened normally and two opened in excess of the designed spread. All twenty of the assemblies with .008 in and .010 in interference between stop and housing functioned normally.

It is evident from these results that an assembly of a housing made from 14S-T6 aluminum with a tapered stop which gives .016 in. interference will not consistently give complete fin opening, when fired at temperatures as low as -40°F. The test results also show that an assembly of a housing, made from 24S-T4 aluminum, with a tapered stop which gives a stop-housing interference of less than .006 in. may result in fin damage when the round is fired at 115% of maximum rated pressure.

An interference diameter of 1.824-.002 in. on the production stop, used with a housing counterbore diameter of 1.810 + .004 in. will give interference limits of .008 in. to .014 in. These limits should permit consistent functioning of the tail assembly under the most extreme conditions of pressure to be encountered and with either housing material.

Table III
Range Data
To Determine Stop Interference Diameter
T119E11 Projectile

Date of Test Dec. 9, 1953
Dec 10, 1953
Jan 13, 1954
Jan 14, 1954

Purpose of Test To Determine Stop Interference Dia
Program ______

PROJECTILE
Model T119
Type E11
Weight 17.50 lb (Nom)
CG Location —
Bourrelet Dia 4.132 in −.002
Special Features Max. and Min. Interferences in Tail Assy Using Production Stop DRA-14 1263-1

TEST GUN
Model T170E1 (M40)
Type 106mm Recoilless
Serial No 61
Chamber F-23
Bushing (Vent) F-26
Tube 22C-211-5
Sighting Equipment M17 Elbow Telescope
Mount
Type Pendulum
Serial ______

MISCELLANEOUS DATA
Range Recovery Box
Propellant
Type M10MP Web .035 in. Weight ______
Lot No PA30269 Unless otherwise noted
Primer M-57
Shell Case T53E1
Liner DRC479-1; DRC595 (3 6oz/4d²)
Temperatures
Magazine
Max 72°F Min 70°F Present 70°F
Loading Room 65°F Ambient 39°F

Round No	Proj No	Proj Weight (lb)	Powder Charge (lb-oz)	Muzzle Velocity (fps)	Chamber Pressure (psi Cu)	Temp (°F)	Fin Opening (in)	Shear Ring Thickns (in)	Stop-Housing Interference (in)	Piston-Housing Clearance (in)	Orifice Diameter (in)		Final Inspection and Observations		
MAX. INTERFERENCE (.012) GROUP FIRED AT -45°F ON DEC 9, 1953 (145-T6) HOUSING AND .001 PISTON-HOUSING CLEARANCE)															
6503	X1729	17.56	7-12	1519	6000 7000	-49	10 9/16-5/8-5/8	.0265	.0127	.00075	.196	NINE .012 INTERF. OK; ONE .012 INTERF. PARTIAL	Normal	Opening	
6504	X1716	17.58	7-12	1532	6100 6000	-98	7 3/4-3/8-3/8	.030	.0122	.0006			Partial	Opening	Fin Assy Med. Tight. Piston had to be hammered out. Galled
6505	X1713	17.58	7-12	1533	6800 6800	-47	10 1/2-5/8-5/8	.028	.0124	.00075			Normal	Opening	
6506	X1719	17.54	7-12	1505	6400 6300	-46	10 3/4-3/4-3/4	.027	.0134	.00075			Normal	Opening	
6507	X1714	17.54	7-12	1511	6000 6900	-46	10 7/8-7/8-7/8	.0291	.0120	.0009			Normal	Opening	
6508	X1712	17.54	7-12	1515	7100 6600	-44	10 7/8-3/4-7/8	.0275	.0127	.00055			Normal	Opening	
6509	X1722	17.54	7-12	1527	5400 7000	-44	10 7/8-7/8-1/2	.030	.0117	.0008			Normal	Opening	
6510	X1711	17.56	7-12	1510	—	-44	10 1/2-1/2-3/8	.031	.0122	.0006			Normal	Opening	
6511	X1721	17.54	7-12	1514	5100	-45	10 1/2-1/2-3/8	.0275	.0128	.0012			Normal	Opening	
6512	X1726	17.54	7-12	1524	5800 5600	-45	10 7/8-7/8-7/8	.0275	.0123	.0004			Normal	Opening	
MAX INTERFERENCE (.012) GROUP FIRED AT -60°F ON DEC 10, 1953 (145-T6 HOUSING AND .001 PISTON-HOUSING CLEARANCE)															
6513	X1720	17.58	7-12	1509	6800 7200	-60	9-9-9	.0245	.0129	.00075	.196	EIGHT .012 INTERF. OK; TWO .012 INTERF. PARTIAL	Piston had to be hammered out of housing. Backlash at fin tips .070 - .170. Taper length .160 - .180		
6514	X1725	17.55	7-3*	1453	6400 6400	-58	10 3/8-7/8-7/8	.027	.0125	.00056			Normal	Opening	
6515	X1728	17.54	7-3*	1473	7400 6000	-68	10 7/8-3/8-3/8	.029	.0122	.00050			Normal	Opening	
6516	X1724	17.54	7-3*	1465	7100 6400	-58	11 1/2-1/2-1/2	.028	.0125	.00060			Above Normal Opening - No Final Inspection		
6517	X1723	17.55	7-3*	1472	7200 7200	-58	10 3/8-3/8-1/2	.0285	.0120	.00100			Normal	Opening	
6518	X1730	17.56	7-12	1519	6000 6900	-58	10 1/2-1/2-5/8	.0295	.0124	.00085			Normal	Opening	
6519	X1717	17.54	7-3*	1466	6000 7200	-60	10 1/2-3/8-3/8	.0285	.0128	.00035			Normal	Opening	
6520	X1727	17.56	7-3*	1478	7000 5800	-60	10 1/4-1/4-1/2	.028	.0123	.00075			Normal	Opening	
6521	X1718	17.56	7-12	1489	7200 7200	-62	10 1/2-1/2-5/8	.0295	.0120	.00070			Normal	Opening	
6522	X1715	17.56	7-12	1514	6600 6200	-62	7 7/8-1/2-7/8	.030	.0120	.00070			Partial	Opening - No Final Inspection	
			* .0335 PROPELLENT LOT PA 30252												

Center of Impact ______
Probable Error — Vertical ______
Probable Error — Horizontal ______

Proof Director E. HUFFMAN
Observers R. Flaugan

Signed O. Miller

Sheet 1 of 4

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Table III (Cont'd)

Date of Test Dec. 9, 1953 / Dec. 10, 1953 / Jan 13, 1954 / Jan 14, 1954

Purpose of Test To Determine Stop Interference Dis.
Program ______

PROJECTILE

Model T119
Type E11
Weight 17.50 lb. (Nom.)
C.G. Location —
Bourrelet Dia 4.132 in. -.002
Special Features Max & Min Interferences in Tail Assy Using Production Stop DRA-19-1263-1

TEST GUN

Model T170E1 (M40)
Type 106 mm Recoilless
Serial No 61
Chamber F-23
Bushing (Vent) F-26
Tube 22C-511-5
Sighting Equipment M-17 Elbow Telescope
Mount
Type Pendulum
Serial ______

MISCELLANEOUS DATA

Range Recovery Box
Propellant
Type M10MP Web .035 in Weight
Lot No PA30259 Unless Otherwise Noted
Primer M-57
Shell Case T53E1
Liner ORC 479-1; ORC 545 (36 oz/yd²)
Temperatures
Magazine Max 72°F Min 70°F Present 70°F
Loading Room 65°F Ambient 39°F

Round No	Time of Flight	Proj Weight (lb.)	Powder Charge (lb-oz)	Muzzle Velocity (fps)	Chamber Pressure (psi Cu)	Temp. (°F)	Fin Opening (in)	Shear Ring Thickn's (in)	Stop-Housing Interference (in)	Piston-Housing Clearance (in)	Orifice Diameter (in)	Final Inspection and Observations
MIN. INTERFERENCE (.006) GROUP FIRED AT 115% OF M.R.P. ON DEC 10, 1953 (243-T4 HOUSING & .007 PISTON-HOUSING CLEARANCE												
6523	X1744	17.56	8-0	1692	9900 / 10300	AMBIENT	11-1/4-3/8	.028	.0051	.0075	.197	Stop could be pulled in by hand. Backlash 3/8. One tooth broken
6524	X1797	17.53	8-0	1684	10100 / 10100		11-1/8-1/8	.029	.0058	.0063	.199	Fin assembly slightly tight. Piston had to be hammered out
6525	X1741	17.54	8-0	1674	9900 / 9700		10 7/8-11-11	.030	.0055	.0050	.193	Fin assembly tight before closing, loose afterward. Backlash .180-.222.
6526	X1746	17.55	8-0	1691	10100 / 10000		10 7/8-11 1/8-12 1/8	.0285	.0057	.0085	.203	Fin assembly loose. Gas mark on stop. Stop can be pulled in by hand. Broken fin
6527	X1748	17.55	8-0	1677	10100 / 10200		10 7/8-11 1/4-11 1/4	.029	.0050	.0061	.197	Fins entangled - will not move. Backlash .200
6528	X1750	17.56	8-0	—	10400 / 10000		10 7/8-7/8-11	.029	.0054	.0073	.199	Fin Assy Loose. Backlash .240-.390
6529	X1742	17.52	8-0	--	9800 / 10300		11-11-11	.027	.0058	.0073	.199	Fin Assy Loose. Backlash .170-.340
6530	X1745	17.54	8-0	1691	9300 / 10000		11 1/4-7/8-1/2	.028	.0065	.0068	.19	Fin Assy tight before and after closing. Piston had to be hammered out because stop forced metal into bore.
6531	X1743	17.56	8-0	1677	8000 / 10000		10 7/8-7/8-11 7/8	.027	.0063	.0071	.201	Fin Assy Loose - Backlash .190-.280.
6532	X1749	17.54	8-0	1660	9800 / 10300		10 3/4-7/8-11	.0305	.0058	.0090	.197	Fin Assy Loose - Backlash .140-.250.
MIN INTERFERENCE (.008 and .010) GROUP FIRED AT 115% OF M.R.P. ON JAN 13, 1954 (243-T4 HOUSING AND .008 PISTON-HOUSING CLEARANCE)												
6679	X1775	17.60	8-3	—	10600 / 10800	AMBIENT	11-10 7/8	.0256	.0079	.0081	.196	Normal Opening
6680	X1783	17.59	8-3	1688	9600 / 9800		10 7/8-10 3/4	.0245	.0102	.0086	.193	Normal Opening
6681	X1782	17.59	8-3	1671	9200 / 9600		10 3/4-10 7/8	.0242	.0100	.0089	.193	Normal Opening
6682	X1777	17.58	8-3	1692	10200 / 10400		11 1/2-11 1/2	.0243	.0101	.0076	.195	Normal Opening
6683	X1766	17.64	8-3	1701	10600 / 10700		10 3/4-10 1/2	.0251	.0077	.0070	.195	Normal Opening
6684	X1773	17.61	8-3	—	10?00 / 10400		10 7/8-10 3/4	.0253	.0081	.0064	.1955	Normal Opening
6685	X1776	17.61	8-3	1702	10000 / 10200		10 3/4-10 7/8	.0255	.0102	.0070	.1935	Normal Opening
6686	X1767	17.64	8-3	1665	9600 / 10200		11 1/4-10 3/4	.0251	.0076	.0067	.1965	Normal Opening
6687	X1780	17.60	8-3	1704	10200 / 10800		10 7/8-10 3/4	.0255	.0095	.0061	.195	Normal Opening
6688	X1768	17.63	8-3	1712	9000 / 10000		10 7/8-10 3/4	.025	.0082	.0061	.195	Normal Opening

Handwritten vertical notes in table (first group): Eight .006 Interf. [illegible]; Two .006 Interference - over [illegible]; Ten fired by mistake at +70°F (?)
(second group): OK; OK; Five .008 Interf.; Five .010 Interf.

Center of Impact ______
Probable Error — Vertical ______
Probable Error — Horizontal ______

Proof Director E. Huffman
Observers R. Finucan
Signed O. Miller

Sheet 2 of 4

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Table III (Cont'd)

Date of Test: Dec 9, 1953; Dec 10, 1953; Jan 13, 1954; Jan 14, 1954

Purpose of Test: To Determine Stop Interference Data
Program: ______

PROJECTILE
Model: T119
Type: E11
Weight: 17.58 lb (Nom.)
CG Location: ______
Bourrelet Dia: 4.132 in $-.002$
Special Features: Max & Min Interferences in Tail Assy (Using Production Stop DRA 14-12634)

TEST GUN
Model: T170E1 (M40)
Type: 106-mm Recoilless
Serial No: 61
Chamber: F-23
Bushing (Vent): F-26
Tube: 22C-511-5
Sighting Equipment: M17 Elbow Tel.
Mount
Type: Pendulum
Serial: ______

MISCELLANEOUS DATA
Range: Recovery Box
Propellant
Type: M10MP   Web: .035 in   Weight: — unless otherwise noted
Lot No: PA 80254
Primer: M57
Shell Case: 153E1
Liner: DRC 474; DRC 545 (36 oz/yd²)
Temperatures
Magazine
Max: 72°F   Min: 70°F   Present: 70°F
Loading Room: 69°F   Ambient: 34°F

Round No	Proj No	Proj Weight (lb)	Powder Charge (lb-oz)	Muzzle Velocity (fps)	Chamber Pressure (psi Cu)	Temp (°F)	Fin Opening (in)	Shear Ring Thkness (in)	Stop-Housing Interference (in)	Piston-Housing Clearance (in)	Orifice Diameter (in)	Final Inspection and Observations			
MAX INTERFERENCE (.014 and .016) GROUP FIRED AT −40°F ON JAN 14, 1954 (145-T6 HOUSING AND .001 PISTON-HOUSING CLEARANCE)															
6684	X1788	17.56	7-12	1460	5000 5800	−40	7 - 7⅞	.0322	.0138	.0011	.176	Three .014 interf. partial / One .014 interf. open / Three .016 interf. … / One .016 interf. open (?)	Partial	Opening	Fin Assy medium tight. Piston had to be hammered out; galled.
6690	X1795	17.53	7-2	1465	5400 5400		10¼ - 10⅛	.032	.0134	.0014	.176		Normal	Opening	
6691	X1790	17.49	7-12	1464	5600 5820		10¼ - 10⅛	.0315	.0147	.001	.196		Normal	Opening	
6692	X1798	17.98	7-12	—	5500 6000		6 - 5⅞	.0315	.016	.0014	.1965		Partial	Opening	Piston had to be hammered out. Galled
6693	X1800	17.58	7-12	1955	5600 5700		0	.031	.0158	.0014	.196		Did not	open	Piston had to be hammered out. Galled
6694	X1803	17.53	7-12	1450	5600 5800		10⅛ - 10⅛	.0313	.0161	.0011	.1965		Normal	Opening	
6695	X1801	17.56	7-12	1466	5600 5900		6 - 6	.032	.0131	.0014	.200		Partial	Opening	
6696	X1792	17.53	7-12	1442	5400		10½ - 10½	.0322	.016	.0014	.193		Normal	Opening	
6697	X1802	17.53	7-12	1439	5700		6¼	.0301	.016	.0016	.195		Partial	Opening	
6698	X1799	17.57	7-12	1454	5600 5800		10⅛ 10½	.031	.0161	.001	.195		Normal	Opening	
MAX INTERFERENCE (.014 and .016) GROUP FIRED AT −40°F ON JAN. 14, 1954 (145-T6 HOUSING AND .001 PISTON-HOUSING CLEARANCE)															
6699	X1797	17.53	7-12	1482	6100 6300	−44	10⅜ - 10½	.032	.0158	.001	.198	Six .014 interf. OK / Two .014 interf. OK / Two .016 interf. partial (?)	Normal	Opening	
6700	X1787	17.52	7-12	1448	5600 5400	−43	10½ - 10½	.0305	.0138	.0014	.195		Normal	Opening	
6701	X1789	17.56	7-12	1415	5800 6000	−43	10½ - 10½	.031	.0139	.0014	.193		Normal	Opening	
6702	X1794	17.53	7-12	1498	5800 6000	−42	10½ - 10½	.0315	.0137	.001	.1945		Normal	Opening	
6703	X1796	17.59	7-12	1466	5600 6200	−44	10⅛ - 10¼	.0315	.016	.001	.193		Normal	Opening	
6704	X1786	17.52	7-12	1502	— 5800	−44	10⅛ - 10⅛	.032	.0133	.0014	.194		Normal	Opening	
6705	X1793	17.65	7-12	1437	5800 5800	−46	10¼ - 10⅛	.0328	.0137	.0011	.192		Normal	Opening	
6706	X1805	17.57	7-12	1951	5600 6000	−47	8 - 7⅞	.0312	.0167	.0014	.201		Partial	Opening	
6707	X1791	17.59	7-12	—	5400 6000	−49	10½ - 10¼	.033	.0131	.0015	.197		Normal	Opening	
6708	X1804	17.49	7-12	1483	6400 6200	−50	10 - 10	.0315	.0161	.0019	.201		Partial	Opening	Piston had to be hammered out. Galled

Center of Impact ______
Probable Error — Vertical ______
Probable Error — Horizontal ______

Proof Director: E. Hoffman
Observers: R. Vincent, M. Manofsky
Signed: O. Miller
Sheet 3 of 4

Table III (Cont'd)

Date of Test Dec 9, 1953; Dec 10, 1953; Jan 13, 1954; Jan 19, 1954

Purpose of Test To Determine Stop Interference Did
Program ________

PROJECTILE

Model T119
Type E11
Weight 17.50 lb (Nom)
CG Location —
Bourrelet Dia 4.132 in. -.002
Special Features Max & Min Interferences in Tail Assy Using Production Stop DRA 19-1163-1

TEST GUN

Model T170E1 (M40)
Type 106mm Recoilless
Serial No 61
Chamber [illegible] 23
Bushing (Vent) [illegible] 26
Tube 22 C 511 3
Sighting Equipment M12 Elbow Telescope
Mount
Type Pendulum
Serial

MISCELLANEOUS DATA

Range Recovery Box
Propellant
Type M10 MP Web .0[illegible] in Weight — Unless otherwise noted
Lot No PA30259
Primer M57
Shell Case T53-E1
Liner DRC 479-1; DRC595 (3.6 oz/yd²)
Temperatures
Magazine
Max 72°F Min 70°F Present 70°F
Loading Room 62°F Ambient 37°F

Round No	Pro No	Proj Weight (lb.)	Powder Charge (lb-oz)	Muzzle Velocity (fps)	Chamber Pressure (psi Cu)	Temp (°F)	Fin Opening (in)	Shear Ring Th'k'ss (in)	Stop-Housing Interference (in)	Piston-Housing Clearance (in)	Orifice Diameter (in)	Final Inspection and Observations		
MIN. INTERFERENCE (.008 and .010) FIRED AT 115% OF MRP ON JAN 19 1954 (1.40-14 HOUSING AND .007 PISTON-HOUSING CLEARANCE														
6709	X1781	17.55	8-3	1720	0400 / 10600	Amb	1 1/8-10 5/8	.020	.0049	.0012	.195	Normal	Opening	Not Recovered
6710	X1778	17.62	8-3	1695	4800		10 3/8-10 3/8	.0257	.0096	.0061	.195	Normal	Opening	
6711	X1774	17.64	8-3	1702	9600 / 10200		10 7/8-10 3/4	.0245	.0081	.0075	.193	Normal	Opening	
6712	X1785	17.56	8-3	—	10200 / 10900		10 1/8-10 3/4	.0242	.0103	.0068	.204	Normal	Opening	Not Recovered
6713	X1779	17.60	8-3	1696	10400 / 10600		10 5/8-10 3/4	.0257	.0102	.0059	.146	Normal	Opening	
6714	X1784	17.61	8-3	1716	9800 / 10200		11-10 5/8	.025	.0099	.0063	.142	Normal	Opening	
6715	X1769	17.60	8-3	1717	10200 / 10700		10 1/8-10 7/8	.023	.0080	.0026	.142	Normal	Opening	
6716	X1771	17.63	8-3	1712	10600 / 10600		10 5/8-10 3/8	.0242	.0080	.0083	.1425	Normal	Opening	
6717	X1772	17.63	8-3	172[illegible]	10400 / 10200		10 1/2-10 3/8	.0241	.0080	.0072	.142	Normal	Opening	
6718	X1770	17.60	8-3	1719	10600 / 11000		10 3/4-10 3/8	.0237	.0079	.0065	.1415	Normal	Opening	

Five .008 Interf. OK
Five .010 Interf. OK

Center of Impact ________
Probable Error — Vertical ________
Probable Error — Horizontal ________

Proof Director E. Huffman
Observers M. Manetak, R. [illegible]
W. McMullen
Signed O. Miller
Sheet 4 of 4

CONFIDENTIAL

Future Program

1. Accuracy firings are planned for the following three groups of projectiles.

(a) One group with short bodies, short ogives, rounded nose caps and T119E11 tail assemblies.

(b) One group with short bodies, long ogives, rounded nose caps, and T119E11 tail assemblies.

(c) One group with short bodies but otherwise standard T119E11 shell.

Groups (a), (b) and (c) will be tested to determine the effect of variable body and ogive lengths on flight performance.

2. Projectiles with two "O" ring obturators will be fired from a rifled tube for spin both at the muzzle and at the target, and for accuracy at 1000 yards.

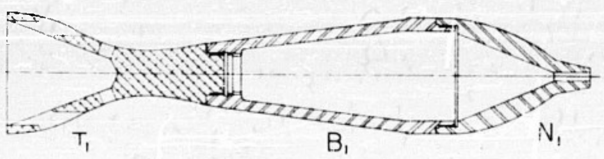
3. Twenty T119E11 projectiles with gilding metal obturating bands are being manufactured. These projectiles will be fired for accuracy using a smooth bore tube.

T171 PROJECTILE

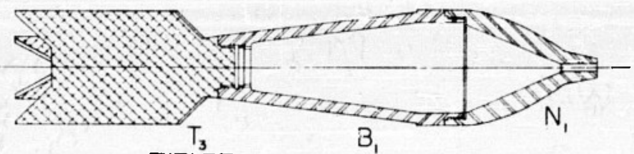
A change in nomenclature has been made for T171 projectile modifications. The letters MD, previously affixed to the modification number, have been replaced with the letter E; the numbers for the modifications remain the same.

Table IV contains the revised nomenclature for the T171 projectiles; Table V lists the symbols used and the component parts.

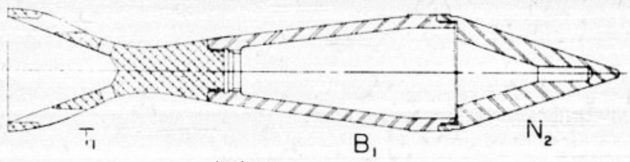
Table IV
Revised Nomenclature For T171 Projectiles



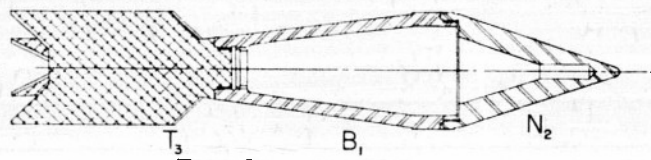
T171E3



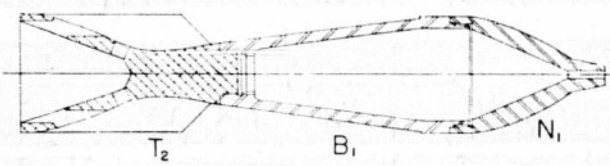
T171E7



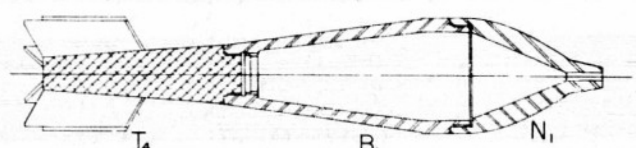
T171E4



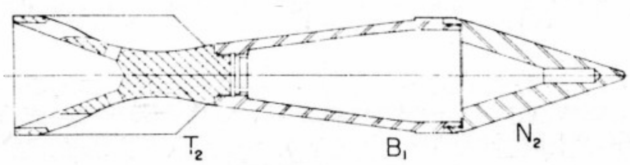
T171E8



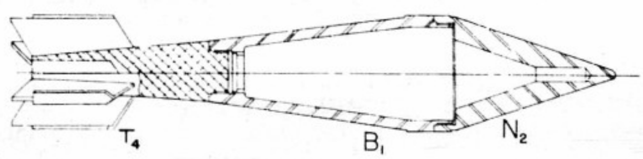
T171E5



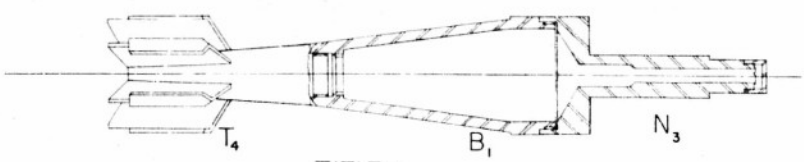
T171E9



T171E6



T171E10



T171E11

Table V
Explanation Of Symbols
T171 Projectile Modifications

Symbol	Title	Drawing No.
N_1	Smooth Nose	DRB182-2
N_2	Conical Nose	DRB183-1
N_3	Spike Nose	DRC328-1
B_1	Body	DRC193-4
T_1	Egg Cup Tail	DRC31-3
T_2	Finned Egg Cup Tail	DRC175-2
T_3	6-Finned Tail	DRC130-3
T_4	6-Finned Tail, End-plated	DRC132-2

Accuracy Tests

Four T171 projectile accuracy programs were conducted at Erie Ordnance Depot. Three of these programs were with T171 E10 projectiles, and the fourth was with T171E11 projectiles. All of these rounds were equipped with nylon obturators (DRA 14-1281), which imparts a spin of approximately 19 rps (Forty-Third Progress Report). The projectiles were assembled in the shell cases as shown in Fig. 13 with the projectile seated at the obturating band, and the fins positioned with a nylon alignment ring, (DRA14-1280). A modified T19 rifle with a 1/20 twist tube was used for all firings, the target was 18 ft by 18 ft for all programs.

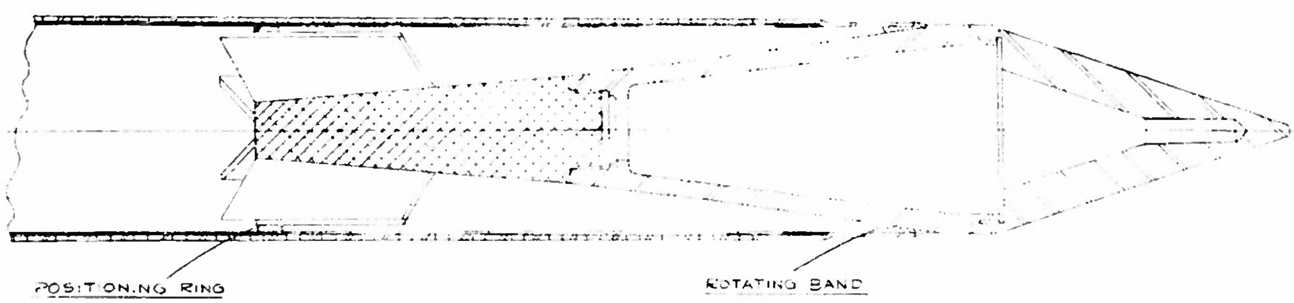


Fig. 13. T171 Projectile In Shell Case.

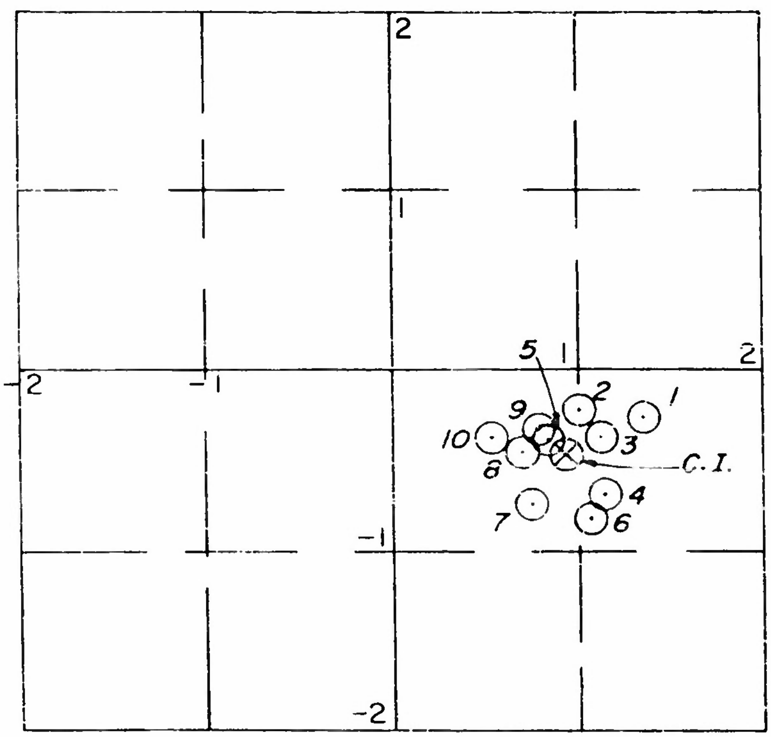
T171E10 At 1,000 Yards (T19 Rifle, Rigid Mount)

For this firing, the T19 rifle was placed on the rigid mount (Fig. 26, of the Forty-First Report). All ten rounds hit the target, giving probable errors of ±.17 mil horizontally and ±.14 mil vertically. This group of rounds, fired at an elevation of 23.5 mils and 1.2 mils left azimuth, with an average muzzle velocity of 1743 fps, had a center of impact .46 mil below, and .93 mil to the right of the center of the target. No correlation was found between vertical hit and muzzle velocity variation, or between horizontal hit and normal wind component, indicating that the dispersion of this group is larger than the effects of wind and velocity variation. The average retardation for this group of rounds is .221 fps/ft. The firing record for this program is found in Table VI, and the target plot is shown in Fig. 14.

T171E10 At 1,500 Yards (T19 Rifle, Rock Island Mount)

For this firing of ten rounds the T19 rifle was mounted on the Rock Island mount. The first round, fired at an elevation of 43 mils, hit 5 ft in front of the target. The elevation was raised to 45 mils and the remaining nine rounds hit the target, giving probable errors of ±.28 mil horizontally and ±.40 mil vertically. This group of rounds, fired at an elevation of 45 mils and average muzzle velocity of 1706 fps, had a center of impact .20 mil to the left of, and .61 mil above the target center (with azimuth reduced to 3 mils right).

The larger than expected vertical probable error is caused by round 9 falling below the rest of the group. An examination of the firing record shows that this round had a muzzle velocity 22 fps less than the average for the other eight rounds.



Center of Impact:	Horiz. = +.93 mil	Probable Error:	Horiz. ±.17 mil
	Vert. = -.46 mil		Vert. ±.14 mil

Fig. 14. Target Plot.
T171E10 At 1,000 Yards.

This is shown clearly in Fig. 15, in which the vertical positions of the hits are plotted against muzzle velocities. Using the ballistic coefficient previously determined for this configuration (Thirty-Seventh Progress Report) the slope of the elevation muzzle velocity curve, for this velocity and range, is found to be .049 mil/ft/sec and is designated as line A in Fig. 15). Fitting a straight line to this data, (line B), a slope of .035 mil/ft/sec is obtained. It is then apparent that the primary reason for round 9 falling below the rest of the group is its low muzzle velocity. Using the slope of line A, the vertical probable error becomes ±.23 mil; using the slope of line B, it is ±.30 mil. It is not intended to imply here that either of these values represents the probable error of this program, but to show that the approximate vertical hit on the target could have been estimated had the muzzle velocity been known, and to indicate what the dispersion would be with more consistent muzzle velocities. The firing record for this program is shown in Table VII; the target plot is illustrated in Fig. 16.

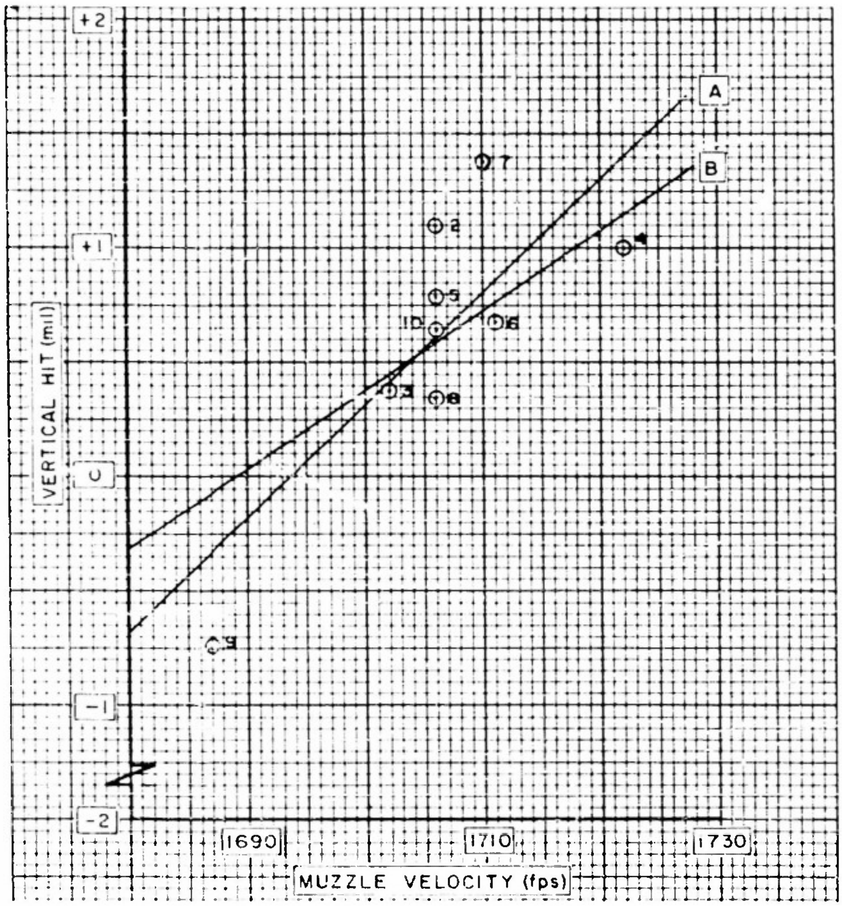
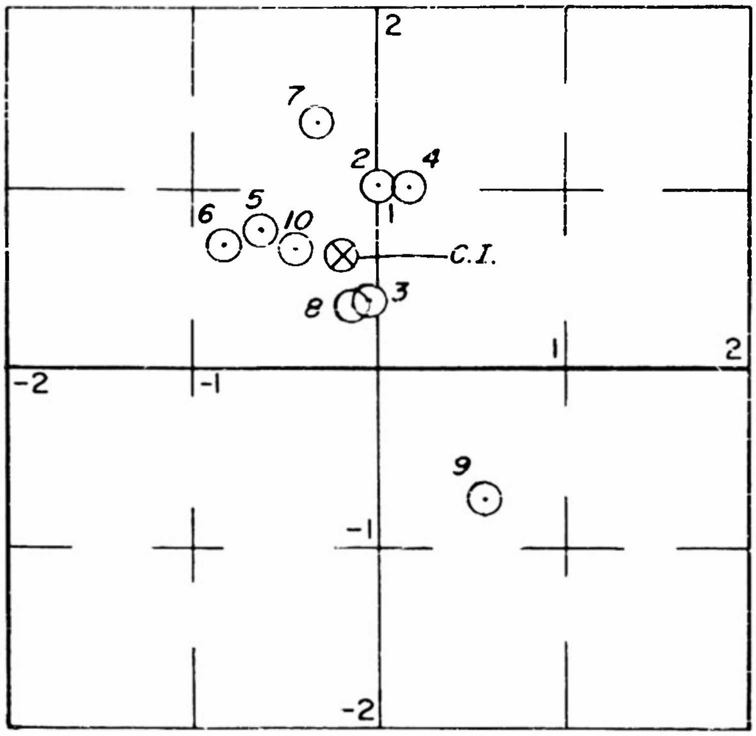


Fig. 15. Vertical Hits Versus Muzzle Velocity.
T171E10 At 1,500 Yards.



Center of Impact:	Horiz.=-.20mil Vert. =+.61mil	Probable Error:	Horiz. ± .28mil Vert. ± .40mil

Fig. 16. Target Plot.
T171E10 At 1,500 Yards.

T171E11 At 1,000 Yards (T19 Rifle, Rock Island Mount)

One T171 E11 projectile was fired from the T19 rifle mounted on the rigid mount, and it hit one mil from the left edge of the target. The rifle was then moved to the Rock Island mount, so that it would be possible to compensate for wind variations by changing azimuth. The remaining ten projectiles hit the target, giving probable errors of ±.11 mil horizontally and ±.30 mil vertically. This group of rounds, fired with average muzzle velocity of 1708 fps, had a center of impact .18 mil above and 1.15 mils to the right of the target center, (when hits are reduced to an elevation of 24.7 mils and 2 mils right azimuth). No correlation of target hits with wind velocity or muzzle velocity was found. The firing record is in Table VIII and the target plot is shown in Fig. 17.

T171E10 At 1,000 Yards (T19 Rifle, Rock Island Mount)

This program of 10 rounds was fired with the T19 rifle mounted on the Rock Island mount All ten rounds hit the target, giving probable errors of ±.38 mil horizontally an ±.26 mil vertically. This group of rounds, fired with an average muzzle velocity of 1757 fps, had a center of impact, .01 mil below, and 1.21 mils to the left of the target center, (when target hits are reduced to 22.5 mils elevation and zero azimuth).

The high horizontal probable error can be attributed to the varying wind velocity. The horizontal impact is shown plotted against normal wind component in Fig. 18. The slope of the least squares line fit to these data is .090 mil per mile per hour. Reducing the horizontal impacts to zero wind velocity, a probable error of ±.27 mil results, which is in closer agreement with the results of the previous T171 E10 firing at 1000 yards.

The firing record is in Table IX and Fig. 19 is the target plot.

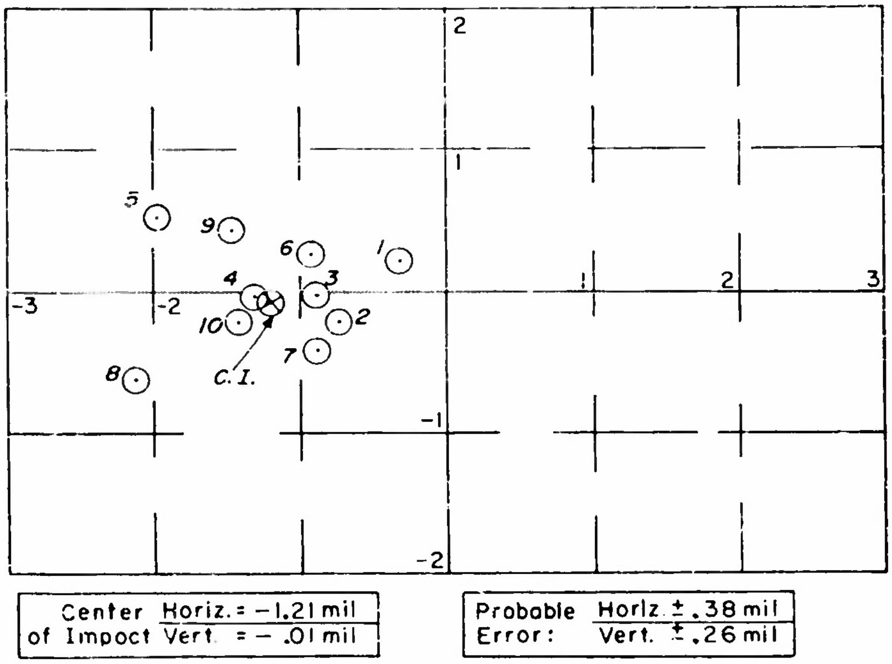


Fig. 17. Target Plot.
T171E11 At 1,000 Yards.

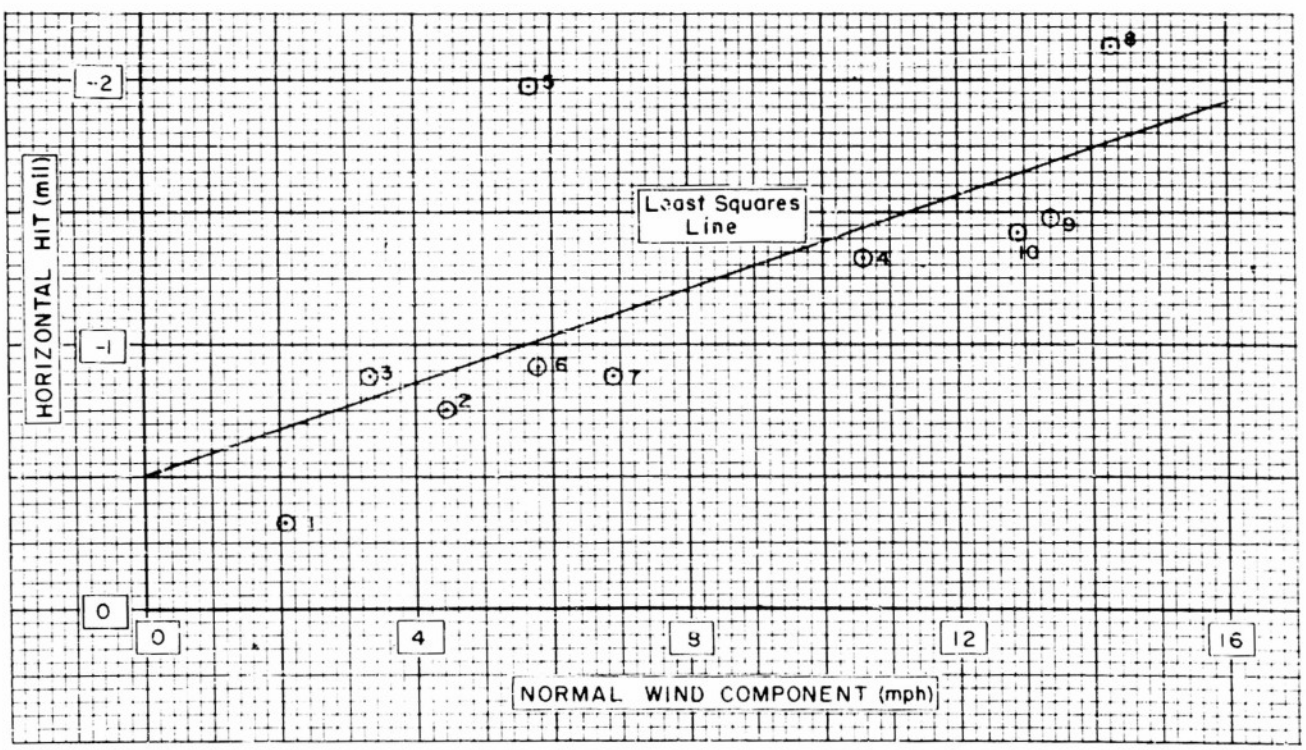
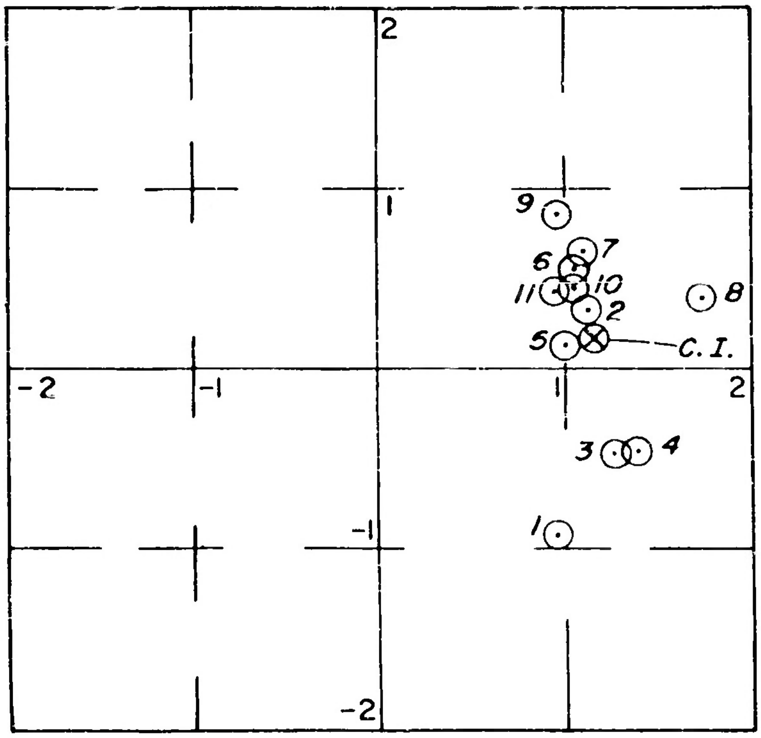


Fig. 18. Horizontal Impact Vs. Normal Wind Component.



Center of Impact:	Horiz.=+1.146 mil Vert. =+.297 mil	Probable Error:	Horiz. ±.11 mil Vert. ±.38 mil

Fig. 19. Target Plot.
T171E10 At 1,000 Yards.

Future Program

1. Determine accuracy of T171E10 projectile, as shown in Fig. 13 at 2000 yard range.

2. Determine roll damping rate of T171 projectiles for ranges of 1000 yards and 1500 yards.

3. Design and test T171 projectiles with increased ogive length.

Table VI
Range Data
To Determine Accuracy and Flight Characteristics
T171E10 Projectile At 1,000 Yards

Date of Test March 10, 1954
Erie Ord Depot

Purpose of Test To Determine Accuracy and Flight Characteristics of T171E10

PROJECTILE
Model T171
Type E10
Weight 17.5 lb (Nom)
Retardation 0.22 fps/ft.
Bourrelet Dia 4.132 in
Special Features None
Air density: 1.255 x 10^{-3} gm/cc
Rounds loaded as single unit

Gun — 54.92' — 4th — 47.93' — 2nd — 40.27' — 3rd — 39.63'
Velocity Coils

TEST GUN
Model T19
Type 105mm Recoilless Rifle
Serial No 6
Chamber 26694-1-12931
Bushing (Vent) 7230826
Tube 2532-7-12162 (1/20 Twist)
Sighting Equipment Bore Sight, Telescope M17, Gunners Quadrant, M1
Mount
Type Rigid (Concrete Base)
Serial
Firing - Solenoid Rds 1-6; Electric Rds 7-10

MISCELLANEOUS DATA
Range 1000 yd Target
Propellant
Type M10MP Web .035 in. Weight 8 lb 0 oz
Lot No RA 30259
Primer M57 (13 in. long)
Shell Case T53E1
Liner T6 Special
Temperatures
Magazine Max 73°F Min 71°F Present 71°F
Loading Room 60°F Ambient 37°F

Round No	Proj. No.	Proj. Weight (lb.)	Powder Charge (lb-oz)	Wind Vel. & Dir. mph degrees	Chamber Pressure (Cu) (M3) (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Azim (mils)	Elevation (mil) zero-super	Position of Hit (Inches) Vert	Position of Hit (Inches) Horiz	Corrected Position of Hit — mils Vert	Corrected Position of Hit — mils Horiz	Yaw (In.)	Observations
6927	65 L	17.53	8 - 0	8 - 000	10,000 9100		1747	-1.2(L)	5.8 - 23.5	- 9	+48 1/2	-0.251	+1.354	4 1/8 x 4 3/16	M17 Azimuth before firing - 1.2 (L) with bore sight
6928	63 L	17.52		8 - 345	9900 9900		1746		—	-7 1/2	+36	-0.209	+1.005	No A.Y. *	
6929	72 L	17.52		10 - 010	10,200 ** 7400		1755		—	-13 1/2	+40 1/2	-0.377	+1.131	4 1/8 x 4 3/16	Misfired Shimmed firing spring and refired
6930	64 L	17.51		8 - 355	9800 8900		1740		—	-24 1/2	+41 1/2	-0.684	+1.159	4 1/8 x 4 3/16	
6931	61 L	17.57		8 - 005	10,100 9900		1752		—	-14	+30 1/2	-0.391	+0.852	No A.Y	
6932	55 L	17.52		11 - 015	10,300 10,200		1758		—	-29	+38 3/4	-0.810	+1.082	4 1/8 x 4 1/4	
6933	74 L	17.51		12 - 020	10,100 10,000		—		—	-26 1/2	+27 1/2	-0.740	+0.768	No A.Y.*	Misfired New firing pin.
6934	69 L	17.54		11 - 010	10,300 10,000		1748		—	-16 1/2	+25	-0.461	+0.698	4 1/8 x 4 1/4	
6935	70 L	17.55		7 - 340	9600 10,200		1733		—	-11	+28 1/2	-0.307	+0.796	No A.Y.*	
6936	68 L	17.53		8 - 000	7500 10,300		1751		—	-12 1/2	+19	-0.349	+0.530	4 1/8 x 4 1/4	
Averages		17.53			9910		1748								Good flight for all rounds
															* No appreciable Yaw
															** Not included in average

Center of impact V: -4.58 mil; H: +.938
Probable Error — Vertical ± 0.14 } By
Probable Error — Horizontal ± 0.17 } RMS

Proof Director E. Huffman
Observers W. O Davies
Lyle Swoobly
Signed W. Mc Millan

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Table VII
Range Data
To Determine Accuracy and Flight Characteristics T171E10 Projectile At 1,500 Yards

Date of Test March 11, 1954 Erie Ord Depot

Purpose of Test Determine Accuracy and Flight Characteristics of T171E10

PROJECTILE

Model T171

Type E10

Weight 17.5 lb (Nom)

Retardation 0.221 fps/ft

Bourrelet Dia 4.132 in

Special Features None

Air Density 1.234 x 10⁻³ gm/cc.

Base Line Stake to 1500 yd Target: 4422.56'

Gun — 49.4' — 1st — 47.43' — 2nd — 9.5' — Base Line Stake

Velocity Coils

TEST GUN

Model T19

Type 105mm Recoilless Rifle

Serial No 6

Chamber 26694-1-12931

Bushing (Vent) 7230826

Tube 2532-7-12162

Sighting Equipment Elbow Telescope, M17; Bore Sight; Gunners Quadrant, M1

Mount

Type M75

Serial 541

Fired Electrically

MISCELLANEOUS DATA

Range 1500 yd Target

Line of Fire: 30° clockwise from magnetic north

Propellant

Type M10MP Web .035 in Weight 7 lb. 14 oz

Lot No PA30259

Primer M57 (13 in long)

Shell Case T53E1

Liner T6 Special

Temperatures

Magazine Max 73°F Min 71°F Present 71°F

Loading Room ______ Ambient 38°F

Round No	Proj No.	Proj Weight (lb.)	Powder Charge (lb-oz)	Wind Vel. mph	Wind Dir. deg	Chamber Pressure (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Azim. (mils)	Elevation (mils) zero	Elevation (mils) super	Position of Hit (inches) Vert	Position of Hit (inches) Horiz	Corrected Position of Hit — mils Vert	Corrected Position of Hit — mils Horiz	Yaw (in.)	Observations
6937	58L	17.53	7-14	9	085	8100	1?74	1690	+1R	2.9	430	—	—	—	—	—	Missed, hit 5ft short at approx -118V, -72H
						9305											
6938	60L	17.50	↓	8	065	9600	1?90	1706	+1R	2.9	450	+54 1/2	-108	+1.003	+0.013	4 3/8 x —	
						9600											
6939	73L	17.53		12	075	8900	1?86	1702	+3R	2.9	450	+20	-4 1/2	+0.368	-0.083	4 1/4 x —	
						9100											
6940	62L	17.54		8	080	9300	1706	1722	+3R	2.9	450	+54	+9 1/4	+0.994	+0.170	4 3/16 x 4 7/8	
						9100											
6941	71L	17.52		15	070	9500	1690	1706	+3R	2.9	450	+42 1/2	-36	+0.782	-0.662	4 1/8 x 4 7/8	
						8700											
6942	59L	17.53		13	080	9300	?695	1711	+3R	2.9	450	+36 1/2	-43 1/2	+0.672	-0.800	Cannot measure	
						9100											
6943	56L	17.54		15	065	8900	1?94	1710	+3R	2.9	450	+74	-18 1/2	+1.362	-0.340	4 3/16 x 4 1/4	
						9300											
6944	67L	17.55		14	065	9900	1690	1706	+3R	2.9	450	+18 1/2	-9	+0.3?0	-0.166	5 x —	
						9000											
6945	57L	17.54		14	065	9300	1671	1687	+3R	2.?	450	-39 1/2	+29 1/2	-0.7?7	+0.543	5 1/8 x —	
						8800											
6946	66L	17.53	↓	13	055	9600	1689	1705	+3R	2.9	450	+35	-24 1/2	+0.644	-0.451	Cannot measure	1/2 in of fin showing on target panel
						9200											
																	Good flight on all rounds.
Averages						9180		1705									All rounds loaded as single units

Center of Impact $V + 0.766$; $H - 0.197$ mil

Probable Error — Vertical ± 0.40 } By R.M.S.

Probable Error — Horizontal ± 0.28 } By R.M.S.

Proof Director E. Huffman

Observers W. O. Davies, L. Swaebly

Signed W. McMillan

Table VIII
Range Data
To Determine Accuracy and Flight Characteristics T171E11 Projectile At 1,500 Yards

5443 4144 4024 2469 Rd 1
3726 4790 4028 3460 Rds 2-11

Date of Test 11 March 1954

Purpose of Test To Determine Accuracy And Flight Characteristics Of T171E11 Projectile
Program 110

PROJECTILE
Model T171
Type E11
Weight 17.38 lb
CG Location -
Bourrelet Dia 4.132 in
Special Features No Special Features

Average Retardation 0.216 Ft/Sec/Ft.
Electric Firing
Line of Fire: 28° Measured Clockwise from Magnetic North

TEST GUN
Model T19
Type 105mm Recoilless
Serial No 6
Chamber 26694-1-12931 Chamber Liner Used
Bushing (Vent) 7230826
Tube FGE 2532-7-12162 1:20 Twist
Sighting Equipment Elbow Telescope, M17 No 132275; Quadrant, Gunners, M1, No 2?3243
Mount Type Ridgid Rd 1 Only; Rds 2-11: 105mm Rifle, M75
Serial Rd 1 Conc? To; Rds 2-11: 641
All hits corrected to +2.0(R) Azimuth

All Air Density Readings: 1.234×10⁻³ gm/cc
Ammunition Loaded as single unit

MISCELLANEOUS DATA
Range 1000 Yd. Target: Rd 1, 1001.2 yd; Rds 2-11, 995.3 yd
Propellant
Type MP M10 Web 0.035 Weight 7 lb 14 oz.
Lot No PA 30259
Primer Black M57
Shell Case T53 Modified
Liner T-6 Special
Temperatures in Degrees F
Magazine Max 73 Min 71 Present 71
Loading Room 62 Ambient 38

Round No	Projectile Number	Proj Weight (lb.)	Powder Charge (lb - oz)	Wind Vel & Dir (mph - degree)		Chamber Pressure M? Cu (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Azimuth (mils)	Elevation (mils)	Position of Hit (inch) Vert	Position of Hit (inch) Horiz	Corrected Position of Hit – mils Vert	Corrected Position of Hit – mils Horiz	Yaw (inch)	Observations
6947 - 1	28	17.38	7-14	13	065	8700	Retardation Taken - Instrument Velocities for Each Round on Recording Sheet Actual Shown is Average of Two	1709	0.0	6.7 24.7	-33½	31	-0.930	+0.962	No A.Y. ©	Lost on Target: Changed Mounts. Not Used in
						9000										Computation of P.E.
6948 - 2	23*	17.38	7-14	18	055	9500		1726	+3.0(R)	6.7 24.7	+12	+78	+0.335	+1.177	4½ x 4½	
						9700										
6949 - 3	29	17.38	7-14	18	065	9300		1675	+2.0(R)	6.7 24.7	-17	+45½	-0.475	+1.270	4¾ x 4½	
						8800										
6950 - 4	27	17.39	7-14	16	060	6300 ©		1701	+2.0(R)	6.7 24.7	-16½	+49½	-0.461	+1.382	4¼ x 4¼	
						9300										
6951 - 5	24	17.37	7-14	12	065	9100		1704	+2.0(R)	6.7 24.7	+5	+[illegible]	+0.140	+1.005	No A.Y. ©	
						-										
6952 - 6	34	17.38	7-14	16	070	9300		1721	+2.0(R)	6.7 24.7	+20½	+38	+0.572	+1.061	Cannot Measure	
						9300										
6953 - 7	25	17.38	7-14	16	075	9500		1716	+2.0(R)	6.7 24.7	+23¼	+39½	+0.649	+1.102	4¼ x 4½	
						9300										
6954 - 8	23*	17.38	7-14	16	055	9100		1704	+2.0(R)	6.7 24.7	+14½	+52½	+0.405	+1.465	No A.Y. ©	
						9100										GENERAL NOTES
6955 - 9	30	17.38	7-14	10	060	9400		1718	+2.0(R)	6.7 24.7	+32	+35	+0.893	+0.977	4¼ x 4½	
						9700										Bolt setting opening set at 0.743"-0.744"
6956 - 10	32	17.38	7-14	18	060	9300		1707	+2.0(R)	6.7 24.7	+10½	+38	+0.461	+1.061	Cannot Measure	with Std. bolt using flats of heads as measurement
						9100										
6957 - 11	31	17.38	7-14	20	060	9100		1706	+2.0(R)	6.7 24.7	+16	+34½	+0.447	+0.963	Cannot Measure	Slight yaw on some: see column to left.
						8200				Total 31.4						Good flight on all rounds.
																© No A.Y. = No Appreciable Yaw
Averages		17.38				9190		1708								

* One of these should be 33
© Omitted from average

Center of Impact V+0.297, H+1.146
Probable Error — Vertical ±0.30 mil } By RMS
Probable Error — Horizontal ±0.11 mil

Proof Director: Edward Hoffman
Observers W.O. Davies

Signed William W. McMillan

Table IX
Range Data
To Determine Accuracy and Flight Characteristics T171E10 Projectile At 1,000 Yards

Date of Test 18 March 54
Erie Ordnance Depot

Purpose of Test To Determine Accuracy and Flight Characteristics of T171E10
Program 109

PROJECTILE
Model T171E10
Type Exper Projectile
Weight 17.53 lbs (Nom)
C.G. Location —
Bourrelet Dia 4.132 in.
Special Features None

36.14' 1st Coil — 47.85' 2nd Coil

Electric Firing System
Line of Fire: 28° measured clockwise from magnetic North

TEST GUN
Model T19
Type 105mm Recoilless
Serial No 6
Chamber 26694-1-12931
Bushing (Vent) YA884 (7230826)
Tube 12792-2456-2 (1-20 twist)
Sighting Equipment Gunners Quadrant M1 No. 113243, M17 Elbow Telescope No. 132276, 20 power Scope, Bore sight case
Mount
Type 105mm Rifle M75
Serial 541

MISCELLANEOUS DATA
Range 994.9 yds.
Propellant
Type MPM10 Web 0.035 Weight 2/6-14oz.
Lot No FA3024-9
Primer 13in M57
Shell Case T23 Modified
Liner T-6 Special
Temperatures
Magazine
Max 73°F Min 71°F Present 72°F
Loading Room 65°F Ambient 66°F

Retardation: 0.22 ft/sec/ft. Electric Firing System.

Round No	Proj No.	Proj Weight (lb.)	Powder Charge (lb-oz)	Wind Vel.	Wind Dir.	Chamber Pressure (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Azim (mils)	Elevation (mils) B.S.	Elevation (mils) Super	Position of Hit Vert	Position of Hit Horiz	Corrected Position of Hit — mils (Corrected to 0.0 mil Azimuth and 24.5 mils elevation) Vert	Corrected Position of Hit — mils Horiz	Time Of Flight (sec)	Observations
6976-1	49H	17.50	7-14	7	195	10100 10500	1749	1762	0.0	7.6	24.5	+80	-12	+0.234	-0.385	2.08046	on M17 Scope +0.2 Azim. (R)
6977-2	48H	17.52	7-14	5	195	10100 10300	1744	1757	0.0	7.6	23.5	+28	-27	-0.218	-0.754	2.09888	
6978-3	53H	17.53	7-14	9	050	9000 10400	1750	1763	0.0	7.6	23.5	+34½	-32	-0.037	-0.893	—	
6979-4	54H	17.53	7-14	12	090	10100 9200	1741	1754	0.0	7.6	23.5	+34½	-48	-0.037	-1.340	—	
6980-5	51H	17.55	7-14	6	100	10300 9960	1745	1758	0.0	7.6	22.5	+19	-71½	+0.531	-1.996	2.09359	
6981-6	46H	17.52	7-14	11	060	12300 10100	1751	1764	0.0	7.6	22.5	+10½	-33	+0.293	-0.921	—	
6982-7	45H	17.55	7-14	18	060	9400 9900	1746	1759	0.0	7.6	22.5	-15	-32	-0.419	-0.893	2.10043	
6983-8	52H	17.53	7-14	16	090	9600 9800	1737	1750	0.0	7.6	22.5	-24	-76½	-0.670	-2.136	2.10804	
6984-9	50H	17.52	7-14	17	080	10200 10200	1747	1760	H.O (R)	7.6	22.5	+16	-17	+0.447	-1.475	—	— GENERAL NOTES —
6985-10	47H	17.53	7-14	14	095	10000 9900	1734	1747	H.O (R)	7.6	22.5	-7½	-15½	-0.209	-1.433	—	Rebore sight 75 mils elev and M17 Scope -0.2 (L)
																	Good flight on all rounds
AVERAGES		17.53				9970		1757									Vent ring bolt openings 0.492 - 0.495
																	No appreciable yaw on any round

Center of Impact V = +0.009; H = -1.218
Probable Error — Vertical ±0.26 mil Root Mean Square; ±0.27 mil
Probable Error — Horizontal ±0.38 mil Root Mean Square; ±0.27 mil Corrected for Wind Only

Proof Director E. Huffman
Observers Col Butler, Messrs. Wirth, Stadler, Miller, Cox, Sweebly, Davies, O.Miller, Manofsky.

Signed William W. McMillan

CONFIDENTIAL

Dynamic Tests Of Compensating Liners

The problem of dynamically determining the performance of projectiles with spin compensating cones presents some unusual difficulties. The projectile must have a target spin equal to the optimum spin rate of the liner being tested, must not interfere with or reduce the penetration and must have a reliably accurate flight for at least 400 to 600 ft at spin rates ranging from about 25 rps to 100 rps. The actual spin rate in any one test is determined by the cone whose performance is being evaluated.

The T138E57 projectile would seem to be an excellent choice except that the present tee design does not provide enough free space in front of the cone and the penetration is reduced. A new tee could be designed but since an adequate number of metal parts already exist this procedure is not an attractive one. Therefore, a cylindrical section has been designed for the T138E57 projectile which will fit between the tee and body of the present design and provide the added clearance required for penetration. Sleeves are being made and accuracy tests are planned.

A sufficient number of T119E11 projectile components are also available for use in dynamic penetration tests. However, the fins need to be redesigned so as to have an equilibrium spin rate equal to the desired target spin rate and the projectiles need to be fitted with rotating bands so that the shell can be fired from a suitably rifled tube at the spin rate being tested. Because of the large torque applied to the projectile by the rifling the fins would need to be strengthened. This can be accomplished conveniently by shortening the fins. Five T119E10 projectiles have been equipped with modified fins shortened to 4.93 inches and twisted to have an effective cant angle of 2.105° (DRD-14-489-3). The assembled projectile is shown in Fig. 20. These

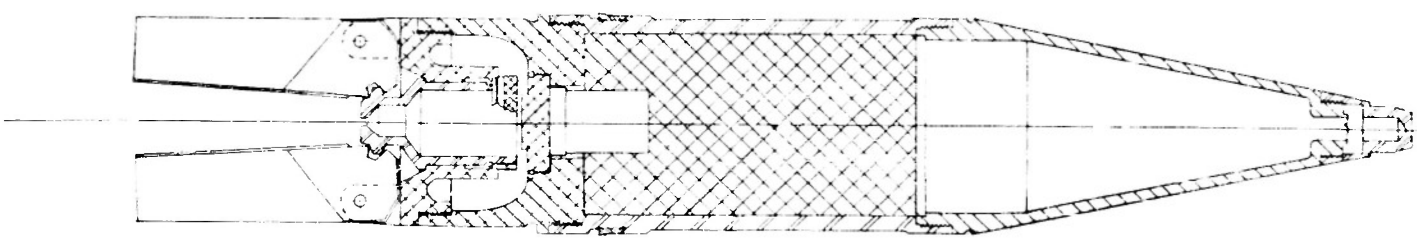


Fig. 20. T119E10 Projectile With Modified Fins.

five projectiles were fired from a T137 E3 rifle equipped with a tube with a 1/80 twist so as to have a muzzle spin rate of 60 rps at 1700 fps. Four projectiles were fired through yaw cards for spin determination, two at screens approximately 100 ft from the muzzle and two approximately 496 ft from the muzzle. The spin data are shown in Fig. 21 and Table X shows the firing record. The fifth projectile was equipped with a blunt nose and was fired through yaw cards into the recovery box. No evidence of fin damage was observed. None of the projectiles had any severe yaw but did have a noticeable right drift.

These data show that the fins were not canted sufficiently to maintain the muzzle spin and further tests are planned with fins canted approximately 3° and 4°.

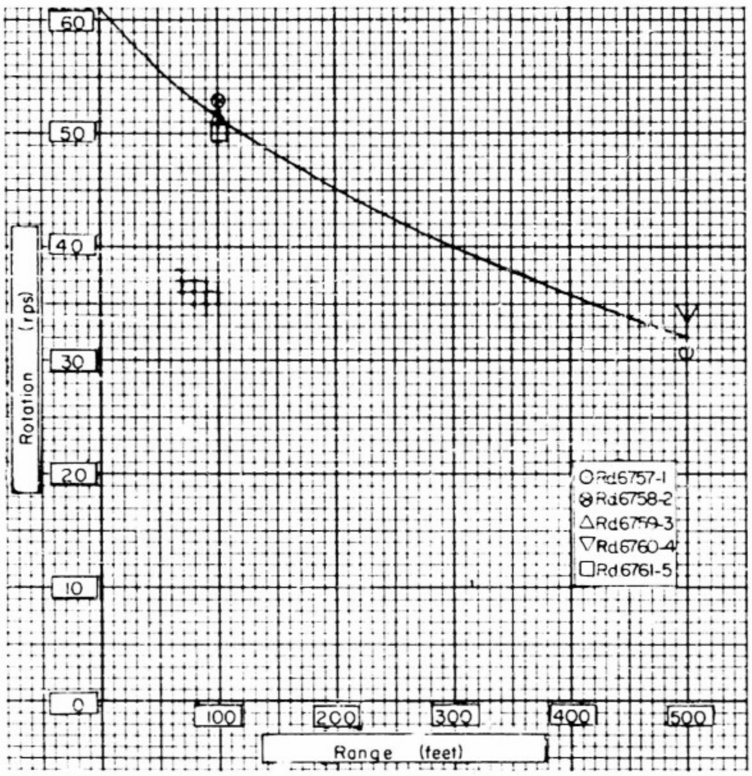


Fig. 21. Spin Data.
RPS Versus Range.

Table X
Range Data
T119 Projectile With Short, Canted Fins

RANGE DATA

Date of Test 28 January 1954

Gun — 1st Coil 63'-1" — 2nd Coil 47'-10½"

Purpose of Test T119 Short Fin Accuracy (500 FT)

Program

PROJECTILE

Model T119E10X
Type Fin Stabilized
Weight 17.60 lb (Nom.)
CG Location
Bourrelet Dia 4.132 in.
Special Features Short Fins, Rotating Bands

TEST GUN

Model T137E3
Type 105mm Recoilless
Serial No 6
Chamber 228-441-0-A
Bushing (Vent) D-370 (228-441-0-A)
Tube 228 345 E 1/180 Twist
Sighting Equipment T183 Mount Telescope No 9; M62E4 Elbow Telescope No 18006
Mount
Type T152E5
Serial

MISCELLANEOUS DATA

Range 500 ft (approx) 50 in. × 50 in. target
Propellant
Type M10MP Web .036 in Weight 8 lb
Lot No PA 80259
Primer M57
Shell Case T53E1
Liner DRC 479
Temperatures
Magazine
Max 73°F Min 71°F Present 72°F
Loading Room 61°F Ambient 25°F

Target 28° Clockwise from magnetic North, solenoid fired

Round No	Time of Flight	Proj Weight (lb)	Powder Charge (lb-oz)	Wind Vel (mph)	Wind Dir (deg)	Chamber Pressure M3 Int (Cu) (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Elev (mils)	Azimuth (mils)	Position of Hit Corrected (inches) Vert	Position of Hit Corrected (inches) Horiz	Corrected Position of Hit – mils Vert	Corrected Position of Hit – mils Horiz	Recoil (in)	Observations
6757-1	F-4	17.61	7-14	6	260	10,000 / 10,300		1651	0		+10	-8				Hit Target
6758-2	F-3	17.61	8-0	8	310	10,600 / 10,400		1708	0		+26	9½				Missed Target. Nicked right edge
6759-3	F-2	17.61	8-0	6	010	10,600 / 10,902		1682	0		+20½	7½				Hit right edge of target
24 JANUARY 1954 COIL DISTANCES 63'-1" and 47'-10½" BETWEEN COILS. AMBIENT TEMP. 31°F																
6760-4	F-1	17.61	8-0	10	175	10,700 / 10,200		1691	Top of Target	Left Edge of Target	+21	19½				Hit target
INTO BOX FOR RECOVERY. COIL DISTANCE Gun to Coil 61'-8" between Coils 57'-2" Ambient Temp 36°																
6761-5	F-5	17.30	8-0	—		11,200 / 10,000		1653	—	—	Retardation = 4 ft/sec/ft					Blunt Nose replaced ogive, new weight 17.30 lb. Fired into recovery box. Recovered

YAW CARD DISTANCES

Round No	muzzle to card 1	card 1 to 2	2 to 3
6758-2, 6759-3	53.08'	4.83'	47.46'
6761-5	50.13'	11.53'	51.17'
6757-1, 6758-2, 6759-3, 6760-4	493' (approx)	5.67' (1 to 2)	

Note: Charge was increased from 7 lb-14 oz to 8-0 to give desired velocity. Last round was fired into recovery box to check fins.

Center of Impact
Probable Error – Vertical
Probable Error – Horizontal

Proof Director E. Huffman
Observers
Signed Roy W. F[illegible]

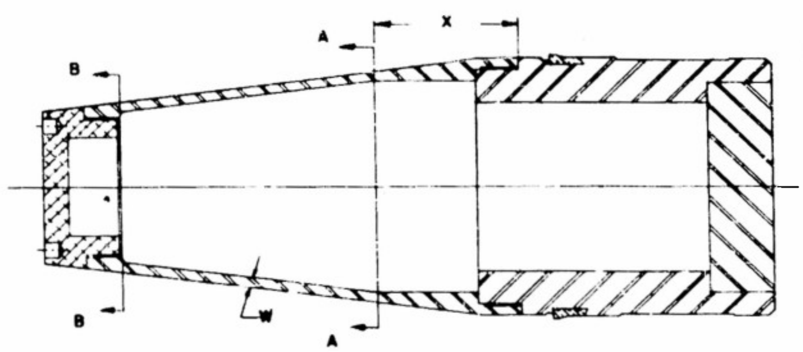
Double Body Projectiles

Various methods for reducing the weight of the double body projectile (Supplement to the Thirty-Seventh Progress Report) from 24 lb to 17.5 lb have been considered. One of the methods considered was to reduce the wall thickness of the non-rotating body. It was considered desirable to determine the minimum permissible wall thickness. Pages 49 and 50 of the Forty-First Progress Report presents results of firing tests using projectile bodies with wall thicknesses of .220, .180, and .140 in. The latter of these represents a decrease in wall thickness of 17.9% and a decrease in rear body weight of 44%. It was reported that none of these test bodies failed and further tests have now been conducted.

Strength Of "Non-Rotated" Body

In the present experiment six test bodies were fired with wall thicknesses of .120, .080, and .060 in. These are shown in Fig. 22. Their weight was adjusted to 17 lb and they were equipped with rotating bands. A modified T19 rifle with 1/20 twist tube was used for the test. Nominal muzzle velocity of 1700-1750 fps was specified. Table XI is the firing record for the test. All rounds showed some degree of failure as shown by pictures, Fig. 23. Stress analysis calculations have been made and the data are presented in Fig. 22. The data disclose the fact that these projectiles were all overstressed and should fail in the observed fashion. However, it should be pointed out that even though the setback calculations for projectiles TS-39 thru TS-44, as reported in the Forty-First Progress Report, clearly showed a marginal safety factor, and that no visable signs of failure were found, a complete stress analysis was not made until completion of this program. The results of the combined stresses as plotted against wall thickness, Fig. 24, now show that even the .140 in wall has borderline strength and therefore a minimum wall thickness greater than .140 in must be selected.

A sample calculation made at sect. B-B indicated the resultant stress would be lower here than at sect. A-A, therefore, stress calculation at this section for remaining rounds were not made.



Proj. Number	Body, Rear	Wall (W) Thick. (in.)	Stress Calculations (psi) Sect. A-A: Set-back	Hoop	Radial	Resultant	X (In.)	Stress Calculations (psi) Sect. B-B: Set-back	Hoop	Radial	Resultant
TS-43	DRC-643	.220	29,200	76,840	11.000	58,000	1.67				
TS-40	DRC-642	.180	35,800	96,008	11,700	78,000	2.00				
TS-44	DRC-641	.140	47,150	123,835	12,705	115,000	2.33				
TS-45	DRC-22-766	.120	75,550	148,125	13,380	121,000	2.49	72,550	87,655	13,380	70,000
TS-46	DRC-22-766	.120	78,500	159,150	13,980	128,000	2.49				
TS-47	DRC-22-767	.080	120,700	195,020	12,670	160,000	2.82				
TS-48	DRC-22-767	.080	140,500	228,220	15,000	172,000	2.82				
TS-60	DRC-22-769	.060	145,400	279,385	13,440	224,000	2.99				

Fig. 22. Test Slug.
To Evaluate Wall Thickness Of After-Body.

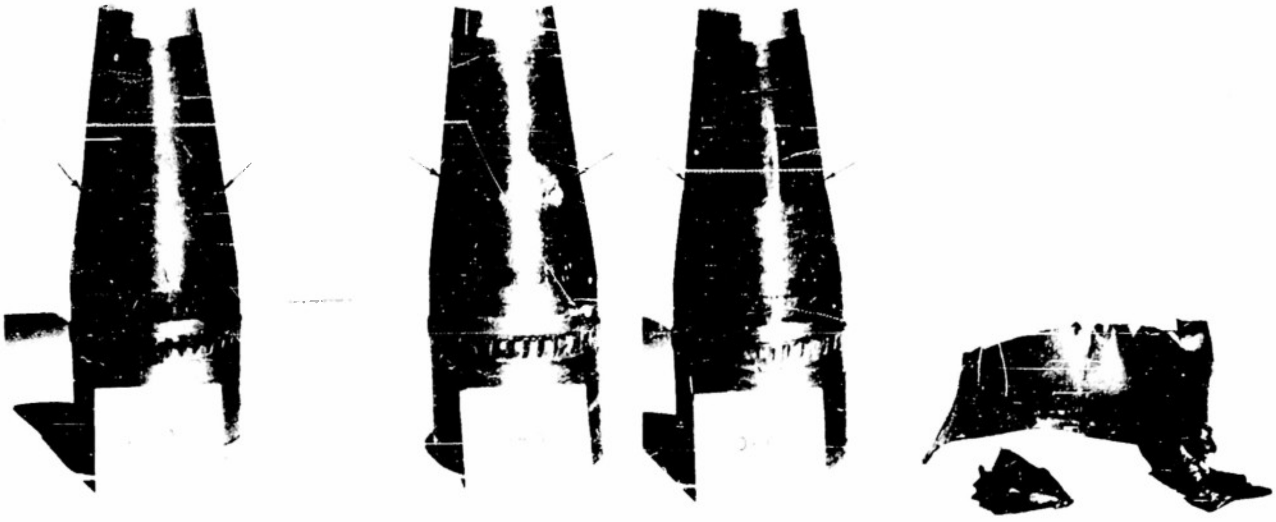


Fig. 23. Recovered Test Slugs.

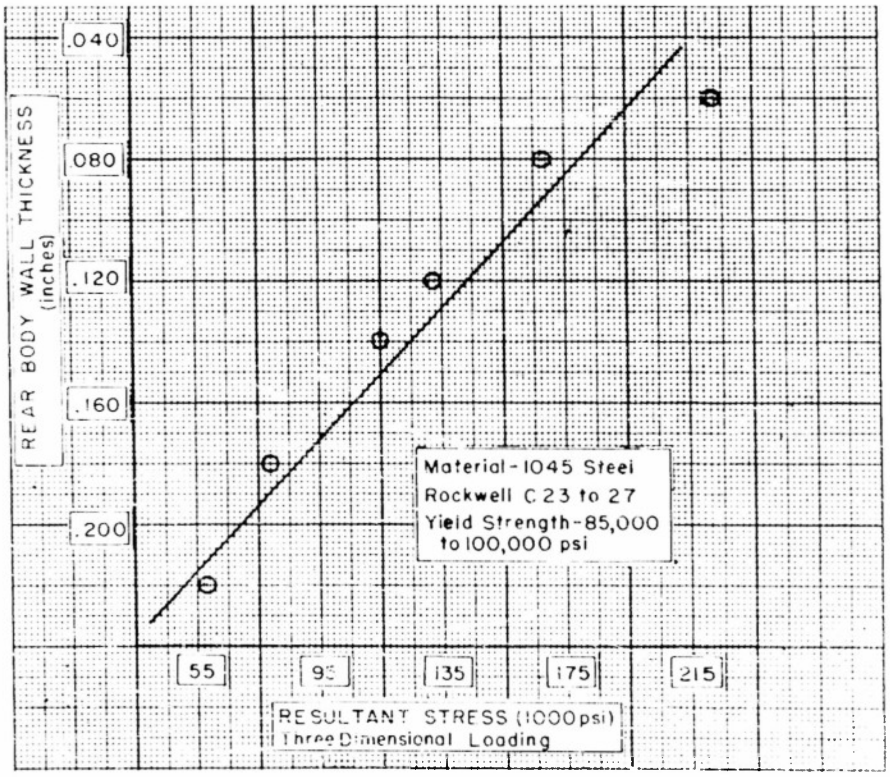


Fig. 24. Resultant Stress Versus Wall Thickness.
After Body Of Test Slug.

Table XII
Range Data
Strength Evaluation Of Non-Rotated Body

Date of Test 3 February 1954

Purpose of Test Strength Evaluation Of Non Rotated Body
Program

PROJECTILE
Model T120
Type
Weight 20 lb (Nominal)
C G Location
Bourrelet Dia 4.132 in
Special Features Rotating Bands
Ret. rotation .4 ... /ft

TEST GUN
Model T19
Type 105mm Recoilless
Serial No 6
Chamber 6 (Liner in Chamber)
Bushing (Vent) VA884 (Vent Open .740 in)
Tube 2232-7-12167
Sighting Equipment M17 Elbow Telescope
Mount
Type Pendulum
Serial

Electrical Firing

MISCELLANEOUS DATA
Range Recovery Box
Propellant
Type M5 MP Web .040 in Weight 7 lb-14 oz
Lot No RAD 16445
Primer M57 (13 in long)
Shell Case T53E1
Liner DRC479
Temperatures
Magazine
Max 73°F Min 71°F Present 69°F
Loading Room 60°F Ambient 35°F

Round No	Proj No.	Proj Weight (lb.)	Powder Charge (lb - oz)	Wind Vel & Dir	Chamber Pressure (lb/sq in)	Muzzle Velocity ft/sec Instr	Muzzle Velocity ft/sec Actual	Elev (mils)	Azimuth (mils)	Position of Hit Vert	Position of Hit Horiz	Corrected Position of Hit — mils Vert	Corrected Position of Hit — mils Horiz	Recoil (in)	Observations
6787-1	T5-49	16.68	7-14		11,000 / 10,000	—	—							23 F	Projectile broke up in flight. Recovered part of projectile
6788-2	T5-48	16.84	7-14		12,100 / 12,100	1808	1842						(Approx)	24 F	Out of recovery box
6789-3	T5-50	16.74	7-14		11,300	1785	1814							16 F	Out of recovery box Recovered
6190-4	T5-46	17.33	7-14		[illegible]	1756	1790							26 F	Recovered
6791-5	T5-45	17.36	7-14		11,400 / 10,900	1746	1780							22 F	Out of recovery box
6792-6	T5-47	16.96	7-14		10,300 / 10,800	1766	1800							19 F	Out of recovery box Recovered

AVERAGES
Projectile Weight 16.98 lb
Chamber Pressure 11,140 psi
Muzzle Velocity 1806 fps
Recoil 22.5 in

Center of Impact
Probable Error — Vertical
Probable Error — Horizontal

Proof Director E. HUFFMAN
Observers
Signed Ray Finucan

Future Program

1. Serrated Liners

a. Effect of Index Angle

Two lots of cones of the DRD78 type, described in the Supplement to the Thirty-Fourth Progress Report, having index angles of 5° and 20°, and having minimum wall thicknesses of .100 in. are scheduled for firing in April.

b. DRD433 item 2 and item 3 cones (Index angle 6° and 2°, respectively) are being inspected. These cones have 50 "matching" flutes .034 in. deep at the base datum and a wall thickness of .100 in.

c. DRD429 item 2. These cones have 16 "matching" flutes, .034 in. deep at the base datum and a wall thickness of .100 in. Index angle is 6°. Flute orientation is the reverse of DRD78.

d. DRD434 item 2. Same as (c) except flute depth is .060 in.

e. Scaling Studies

DRD267 (3.5 in. base x .100 in. wall); DRB704 (3.0 in. base x .087 in. wall); DRB703 (2.5 in. base x .071 in. wall). These cones to have 60 flutes machined in outside to a depth of .010 in., .0085 in. and .0069 in. at base datum for each of three sizes have been manufactured and inspected.

f. Threaded Cones

DRB998, threaded inside, 60°V threads 28/in., .0097 in. deep, .0357 in. pitch.

DRB999, triple threaded inside, 60°V threads, 84/in., .0097 in. deep, .0119 in. pitch, .0357 in. lead.

DRB1000, threaded outside, 60°V threads, 28/in., .0357 in. pitch. 0097 in. deep .

DRB1001, triple threaded outside, 60°V threads, 84/in. .0357 in. lead, .0119 in. pitch, .0097 in. deep.

The above cones have been manufactured and inspected.

g. DRD393 HW1, - This cone has 50 flutes machined on the outside surface only to a depth of .0149 in. at base datum and .0051 at apex datum. Nominal wall thickness is .100 in. Cones are scheduled for firing during April.

h. DRD-16-492 - 45° angle, 50 flutes machined on the outside only to a depth of .0070 in. at the base datum and .0026 in. at the apex datum. These cones are designed for use in the T108E40 round and are to be prepared from P83580A1 cones. Cones are scheduled for testing in April.

i. Ten T119 short fin test projectiles with fin cant angles 1 1/2 and 2 times as great as those previously fired are being inspected and assembled for firing tests.

j. Fifteen T138 test projectiles are being inert loaded and will be fired incorporating two types of tee spacers to test their usability as a carrier for a serrated liner in future dynamic firing tests.

2. Double Body Projectile Study

a. Test double body projectiles of the DRC429-1 type for spin rate and flight behavior. The total projectile weight will be reduced possibly to as little as 17.5 lb. and the strength of the ogive will be increased.

b. Six projectiles are to be fired to complete the study of the determination of minimum wall thickness required in non-rotated body. The projectiles have wall thicknesses as follows:

(1) 2 rounds with .180 in. wall (alum) in rear body.

(2) 2 rounds with .120 in. wall (alum) in rear body.

(3) 2 rounds with .060 in. wall (alum) in rear body.

c. Determination of Strength of Tee Or Boom. Tees of five different designs and strength, using both aluminum and steel, are to be tested. Manufacture is completed and tests are scheduled for May.

d. Evaluate efficiency of DRA218 and DRA215 bearing system treated with #4253 Lube-Lok base coat and #4396 Lube-Lok top coat. Rounds have been fired but the data have not been evaluated.

Effect Of Cone Angle and Flash Tube Diameter Upon Penetration

The systematic evaluation of the effect of cone angle and flash tube diameter upon the standoff and rotational penetration behavior of 3-inch copper cones has been completed. This work was conducted under Contract DAI-33-019-501-ORD (P)-16, Firestone Tire and Rubber Company, and the complete data are discussed in the Eleventh Progress Report under that contract. Because of the direct application of this work to the BAT project the data are summarized in Table XII and Figs. 25, 26 and 27. For detailed information concerning these tests it is advisable to consult the referenced report.

The following two groups of cones were included in this study.

a. Central tube .628 in. O.D.; 27.5°, 30°, 35° and 42° included angle; overall height 5 in.

b. Central tube 1.000 in. O.D.; 23°, 25°, 30°, 35° and 42° included angle; overall height 5 in.

All cones were assembled in DRC506 test assemblies using No. 2 nose rings.

Table XII
Summary Of Penetration Data
Effect Of Cone Angle and Flash Tube Diameter

Cone	Apex Angle	STANDOFF (in.) ROTATION (0 rps)					ROTATIONAL BEHAVIOR (rps) 8.6 in. STANDOFF					
		4.0	8.6	12.0	16.0	24.0	0	15	30	45	90	180
CENTRAL TUBE 0.628 IN.												
DRB830	27.5°	16.86 ± .28	18.22 ± 1.90	----	16.05 ± 5.74	----	----	----	----	----	----	----
DRB834	30°	17.55 ± .38	18.46 ± .73	----	18.59 ± 1.95	18.41 ± 2.72	18.46 ± .73	16.19 ± .58	----	7.10 ± 2.16	5.08 ± 1.20	3.39 ± .26
DRB838	35°	16.30 ± .44	18.85 ± .38	----	18.52 ± 5.02	----	----	----	----	----	----	----
DRB842	42°	16.25 ± .96	18.10 ± 1.30	----	19.55 ± .40	18.98 ± .57	18.78 ± 2.30	17.27 ± .71	----	9.65 ± 1.55	6.36 ± .53	4.72 ± .36
CENTRAL TUBE 1.000 IN.												
DRB828	23°	16.20 ± .52	17.09 ± 3.28	----	17.11 ± 2.02	----	----	----	----	----	----	----
DRB832	25°	16.86 ± 1.02	19.00 ± 2.06	----	17.06 ± 2.23	----	----	----	----	----	----	----
DRB836	30°	17.22 ± .47	17.71 ± 1.54	----	20.55 ± .87	----	17.71 ± 1.54	17.03 ± .97	10.69 ± 1.26	7.94 ± .81	5.48 ± 1.51	3.55 ± .22
DRB840	35°	15.82 ± .92	18.28 ± 1.64	----	18.03 ± 1.17	----	----	----	----	----	----	----
DRB844	42°	----	17.86 ± 1.52	18.16 ± 1.42	----	20.16 ± .98	17.86 ± 1.52	17.90 ± .72	11.28 ± 1.27	9.99 ± .89	6.60 ± .86	3.58 ± .96

Note:
Penetrations are reported as averages into mild steel target plate. Standard deviations are shown for each penetration value.

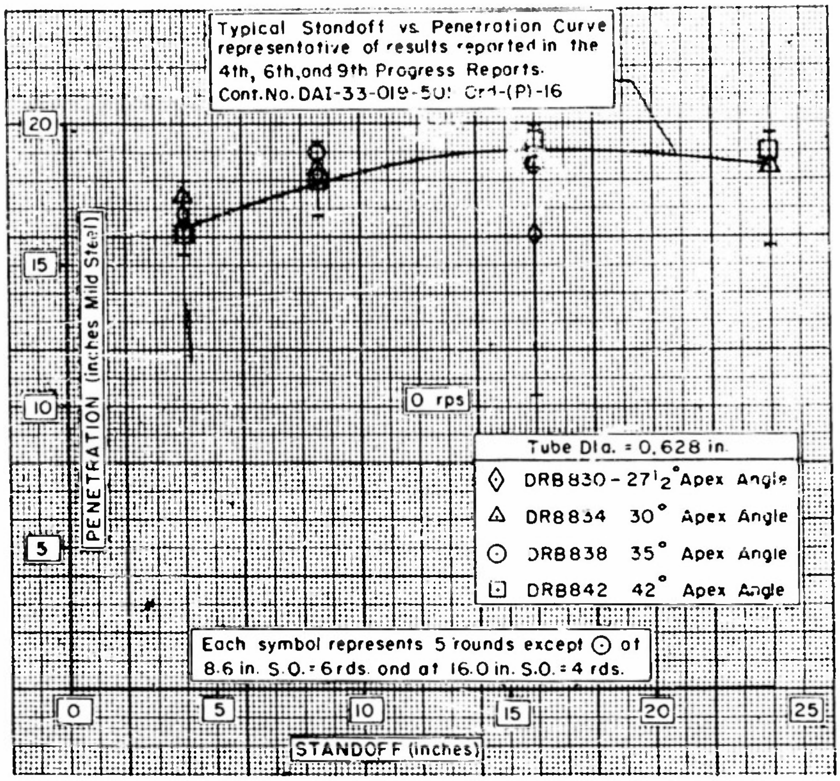


Fig. 25. Penetration Versus Standoff.
Effect Of Cone Angle.

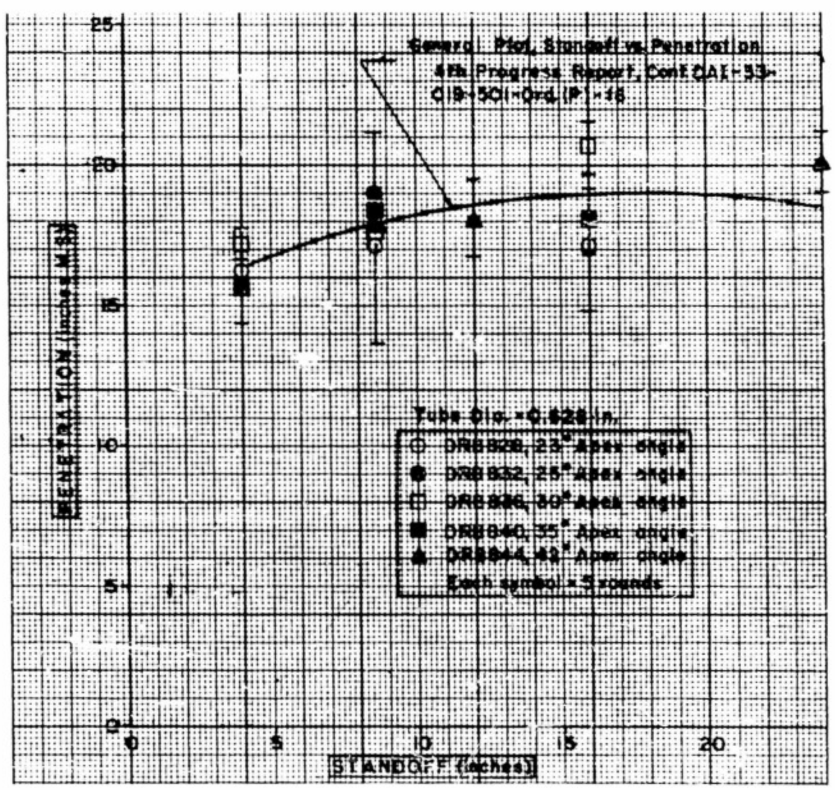


Fig. 26. Penetration Versus Standoff.
Effect Of Cone Angle.

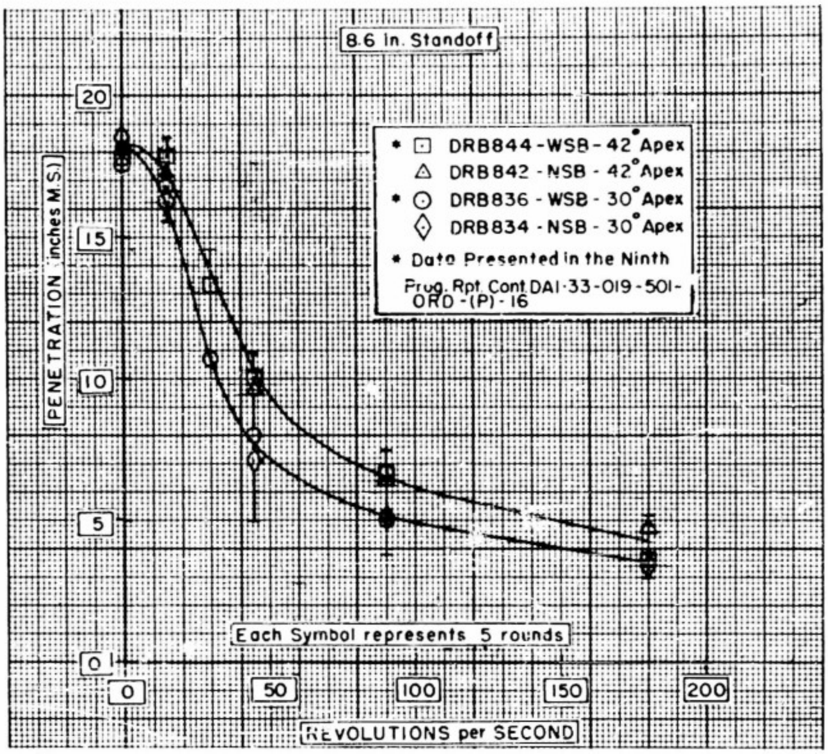


Fig. 27. Penetration Versus Rotation.
Effect Of Variations In Cone Angle and Spitback Tube Diameter.

Summary Of Study

STANDOFF BEHAVIOR

As shown in Figs. 25 and 26, there is no systematic variation in the standoff behavior with cone angle. The test data agree well with the solid curve, a typical standoff-penetration curve presented in previous reports. The reduction in the flash tube diameter from 1.000 in. O.D. size to 0.625 in. O.D. did not cause any apparent change in the standoff performance of these cones.

EFFECT OF ROTATION

Only 30° and 42° cones were tested. The penetration of the smaller angle cone falls off more rapidly with rotation as shown in Fig. 27. The spitback tube diameter has no effect. The 42° cone behavior agrees excellently with a generalized plot presented in the Thirty-Seventh Progress Report, when the longer standoff used in this study (8.6 in. vs. 6.4 in) is taken into account.

DISCUSSION This experiment is of considerable interest since the data in certain respects are in excellent agreement with earlier work in this and other laboratories, but in other respects differs markedly from earlier work. For example, the behavior of the 42° copper cones agrees well with expected behavior and the effect of cone angle upon degradation caused by rotation agrees well with earlier experiments. But, the effect of cone angle upon both standoff behavior and penetration at fixed standoff are not in agreement with experiments with 105mm test assemblies. (See Twentieth and Twenty-Eighth Progress Reports). Also, the lack of any effect of spitback tube diameter upon penetration does not agree with data for 105mm assemblies as presented in the Twenty-Second Progress Report. There is no readily apparent reason for the lack of agreement and further tests would be required to solve the problem.

Comparison Of The Drawn and Shear Formed P83580 A1 Cone

Two separate groups of P83580 A1 cones have been manufactured, one by shear forming, the other by deep drawing, and compared for penetration behavior. A portion of the shear formed cones were annealed to evaluate the effect of the treatment. This work was conducted under contract DAI-33-019-501-ORD (P)-16 and are presented in the Eleventh Progress Report. Because the data are of importance in the BAT project the results of the study are summarized in Table XIII and Figs. 28 and 29 of this report. For detailed information concerning these tests consult the referenced report. All cones were assembled in DRC506 test assemblies using No. 2 nose rings.

Table XIII
Summary Of Penetration Data
Comparison Of The Drawn and Shear Formed P83580 A1 Cone

	STANDOFF (in) Rotation (0 rps)						ROTATIONAL BEHAVIOR (rps) Standoff 6.4 in								
	6.4	8.6	12.9	21.4	30	40	-30	0	15	30	45	60	90	120	180
SHEAR FORMED GROUP NO. I 5TH PROG. RPT. Cont. DAI-33-019-501-ORD (P)-16	12.52 ±.59		14.00 ±1.19	12.80 ±1.22	9.61 ±1.71	6.57 ±3.08	9.14 ±.78	12.52 ±.59	13.58 ±.04	13.73 ±1.02	13.54 ±.73	11.06 ±.33	8.35 ±1.11	---	5.83 ±.67
SHEAR FORMED GROUP NO. II 9TH PROG. RPT. Cont. DAI-33-019-501-ORD (P)-16	12.58 ±.48	---	13.81 ±1.17	14.37 ±1.40	12.42 ±4.70	9.94 ±1.44									
SHEAR FORMED AND ANNEALED 1 HR. AT 900°F 9TH PROG. RPT. Cont. DAI-33-019-501-ORD (P)-16	14.37 ±1.16	---	16.96 ±.36	17.29 ±2.52	---	---	11.52 ±3.06	14.37 ±1.16	13.77 ±.34	12.50 ±.16	9.98 ±.69	8.36 ±1.42			
DEEP DRAWN 11TH PROG. RPT. Cont. DAI-33-019-501-ORD (P)-16	15.32 ±.96	15.83 ±.46	16.95 ±.85	14.42 ±1.43	----	---	---	15.12 ±.96	14.11 ±1.21	12.44 ±.30	9.28 ±.33	7.95 ±.95	---	8.45 ±.52	

Note:
Penetrations are reported as averages into mild steel target plate. Standard deviations are shown for each penetration value.

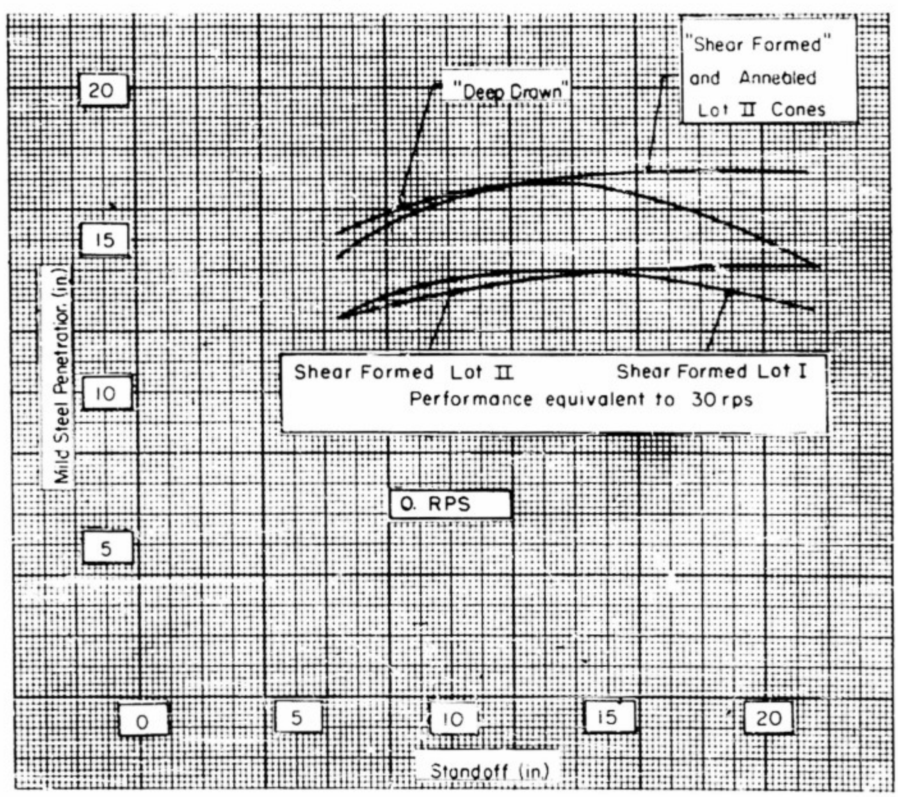


Fig. 28. Penetration Versus Standoff.
P83580 A1 Cone Study.

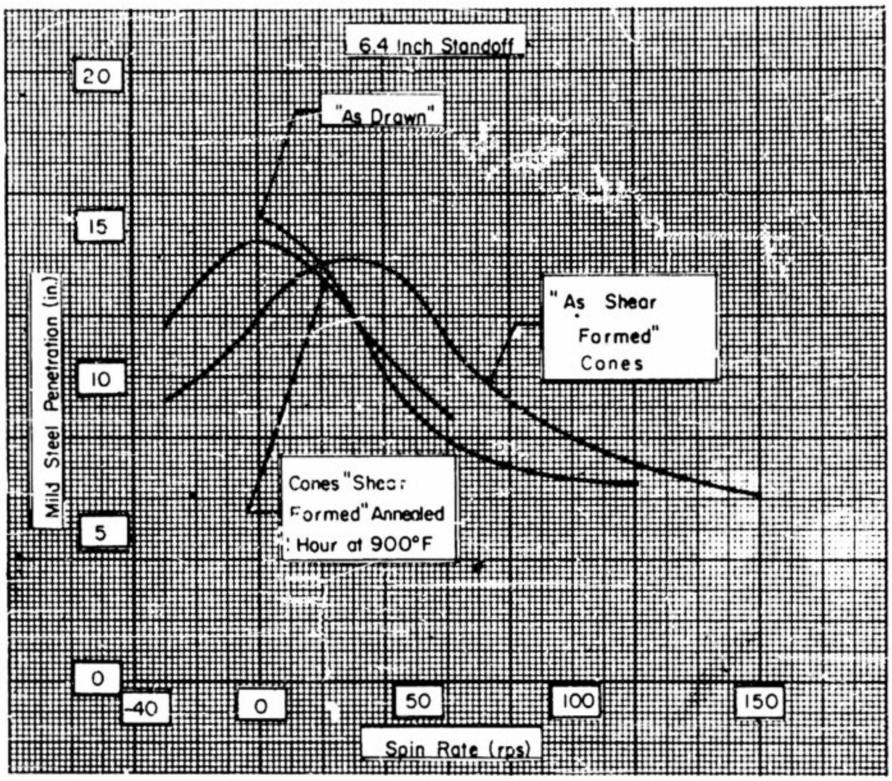


Fig. 29. Penetration Versus Rotation.
P83580 A1 Cone Study.

Effect Of Standoff

It can be seen from Fig. 28 that the standoff-penetration behavior of the deep drawn cone is similar to that of the annealed shear formed cone in the lower standoff regions. At longer standoffs the performance level of the shear formed cone is maintained at a fairly constant level while the performance of the drawn cone falls off.

The relative performance of machined and drawn 3.5 inch, DRB398 copper cones was described in the Twenty-Seventh Progress Report. It was shown that the machined cones retained their level of penetration at very long standoff distances much better than did the drawn cones. The difference was attributed to the wall waviness of the drawn cone. A similar effect is noted in comparing the P83580 A1 shear formed and drawn cones.

The following tabulation is a summary of the inspection data for the drawn cones and two lots of shear formed cones.

	Drawn	Shear Formed I	Shear Formed II
Wall Thickness (in)			
Max	.0941	.0956	.0929
Min	.0882	.0922	.0913
Avg.	.0913	.0939	.0920
Trans. Variation	.0022	.0026	.0010
Long. Variation	.0053	.0027	.0012
Wall Waviness			
Outside (in)	.0012	.0013	.0013
Inside (in)	.0057	.0034	.0027
Concentricity (T.I.R. in.)			
Base Datum	.0027	.0024	.0012
Apex Datum	.0022	.0027	.0012
Assembly	.0062	.0062	.0051

Fig. 28 reveals that the penetration of these cones becomes poorer at long standoff in the order, Shear Formed Lot II (Best), Shear Formed Lot I (Medium), Drawn (Poorest). It is probably more than coincidence that the inspection data show the precision of manufacture of these cones to be in the same relative order. The longitudinal wall thickness variation, wall waviness and concentricity all arrange the cones in the same order of precision.

The standoff curves for all three types of cones were determined at 0 rps. As will be described in the next section of this report the shear formed cones are spin compensating and have their best penetration at 30 rps. Therefore, the standoff curve for the shear formed cones must be compared with that of a drawn cone measured at 30 rps.

Effect Of Rotation

The penetration spin rate behavior of the drawn and annealed shear formed cones is quite normal and agree well with one another. The behavior of the shear formed cones, however, was most unexpected in that they exhibit spin compensation. Instead of having a maximum penetration at 0 rps these cones penetrated best at 30 rps. At this spin rate the penetration obtained (14 inches of mild steel) is about 93% that of the non rotated drawn or annealed shear formed cones and had a penetration equal to or greater than that of the drawn cones at all spin rates above 20 rps. The difference is nearly 4 inches at 40 rps. It is believed that the shear forming method of manufacture causes an inclined elongated grain or crystal structure which results in the spin compensating effect. Annealing of the cones completely destroys the effect. Further tests are in progress under Contract DAI-33-019-501-ORD (P)-16 and these tests show that the direction of spin compensation and the amount of the shift in optimum rotational frequency can be varied by changing the manufacturing conditions.

Double Angle Tapered Wall Cone

The performance of double angle, tapered wall thickness copper cones has received considerable attention and extensive study at Picatinny Arsenal. The excellent performance reported by Picatinny has led to an evaluation of these cones under Contract DAI-33-019-501-ORD (P)-16. The data are summarized here. Two separate groups of these cones were manufactured one by shear forming- the other by deep drawing and compared for penetration behavior. The test results are presented in the 11th Progress Report, Contract No. DAI-33-019-501-ORD-(P)-16), Firestone Tire and Rubber Co. A summary of these results is presented in Table XIV and Figs. 31 and 32. For detailed information concerning these tests it is advisable to consult the referenced report.

Table XIV
Summary Of Penetration Data
Double Angled, Tapered Wall Cones DRB-23-973

	STANDOFF (In) 0 rps			ROTATIONAL BEHAVIOR (rps) 8.6 In. Standoff							
	6.4	8.6	12.9	-30	-15	0	15	30	45	60	90
SHEAR FORMED 11TH PROG. REP. Cont. DAI-33-019-501-ORD (P)-16	16.75 ±.76	17.54 ±.76	16.90 ±1.50	5.96 ±1.72	13.81 ±.65	17.54 ±.76	18.[illegible]4 ±1.45	16.48 ±1.12	11.27 ±1.13	10.29 ±1.75	6.44 ±1.16
DEEP DRAWN 11TH PROG. REP. Cont. DAI-33-019-501-ORD (P)-16	19.08 ±1.54	19.18 ±2.14	14.74 ±3.82	----	----	19.18 ±2.14	19.06 ±3.21	20.55 ±.56	18.59 ±2.46	17.23 ±.90	10.12 ±.80

Note:
Penetrations are reported as averages into mild steel target plate. Standard deviations are shown for each penetration value.

The Picatinny tests were made using a 3.23 in. diameter copper cone in M28 A2, 3.5 in. rockets. In this assembly the cone is brazed in and in their tests drawn and shear formed cones behaved similarly. The cones in the present tests were mounted in DRC506 test assemblies with No. 2 nose rings and are not brazed into the shell.

Fig. 30 shows both the Picatinny Cone (PX-8-929A1) and the modifications which were made (DRB-23-973).

Effect Of Rotation

The spin rate-penetration curve for the two cones is shown in Fig. 31. Like the shear formed P83580 A1 cones the DRB-23-973 shear formed cones show a spin compensating effect and have their best penetration, 20.5 inches of mild steel (6.84 effective charge diameters), at 30 rps. The drawn cones, on the other hand, show a maximum penetration of 19.3 inches (6.43 C.D.) at 0 rps. In each case the tests were conducted at a standoff of 8.6 inches (2.86 C.D.). At all spin rates above 10 rps the shear formed cones are superior to drawn cones.

Effect Of Standoff

The standoff-penetration curve is shown in Fig 32. The optimum standoff distances are 8 in. for the drawn cones and 10 in. for the shear formed cones. Since the standoff measurements were made at 0 rps the level of penetration shown by the shear formed cones is low, just as that of the drawn cones would have been had the test been conducted at 30 rps. In spite of this disadvantage in effective spin rate it appears that the shear formed cone will maintain its penetration considerably better than the drawn cone at long standoffs even though there is very little difference in the precision with which the two types of cones appear to be manufactured. It is to be expected that the shear formed cones would show to better advantage after annealing but would not have any spin compensating effect.

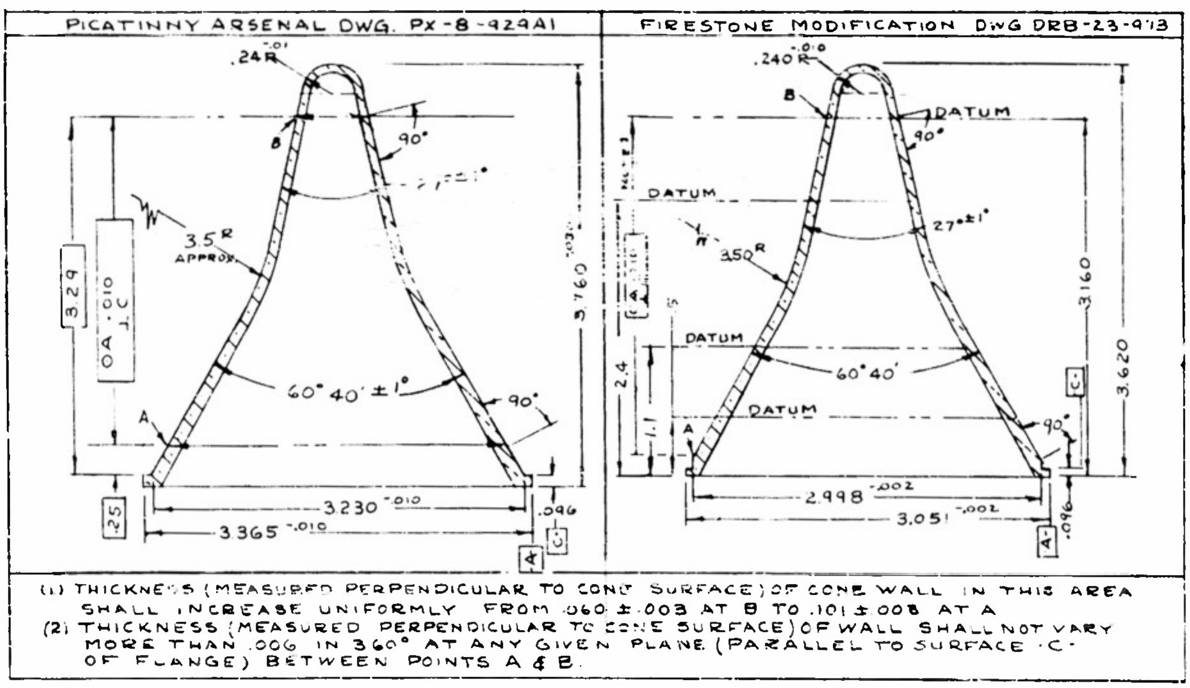


Fig. 30. Double Angle Cones.
Picatinny Arsenal Cone PX-8-929 A1 and Firestone Modification DRB-23-973.

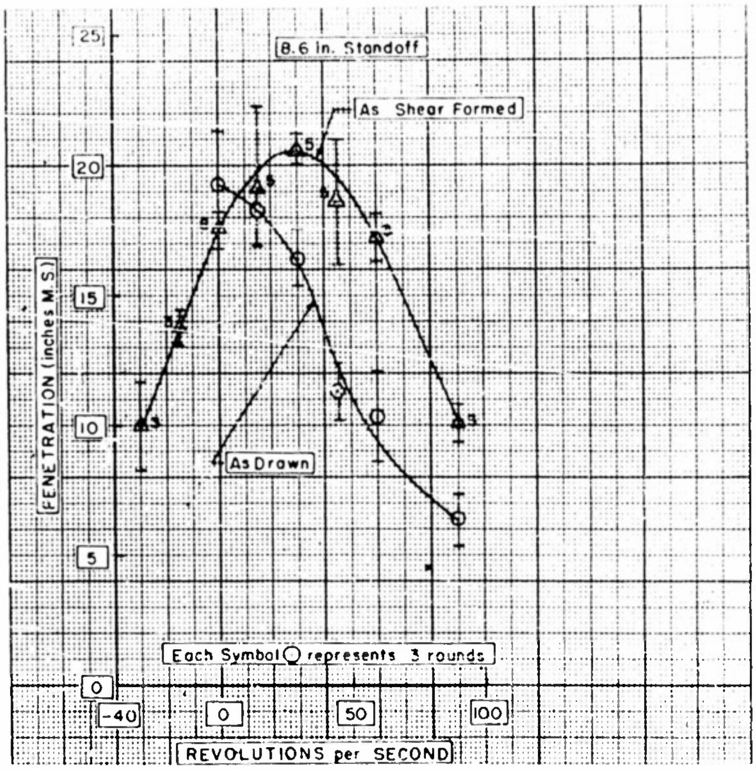


Fig. 31. Penetration Versus Rotation.
Double Angle Cones.

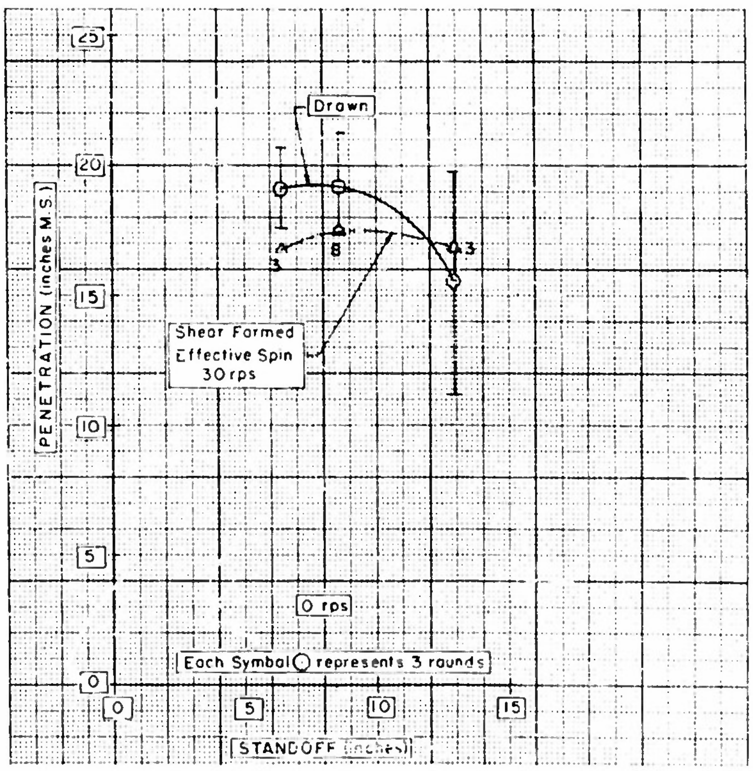


Fig. 32. Penetration Versus Standoff.
Double Angle Cones.

Comparison With Picatinny Arsenal Data

The performance of PX-8-929A1 cones in M28 A2 static test assemblies has been determined at Picatinny Arsenal and a portion of the data are presented in the "Minutes of Shaped Charge Committee" for 6 Jan. 1954, Tables II and IV. These data are compared with the Firestone data in Figs. 33 and 34. The standoff data, Fig. 33, show good agreement between the data for Picatinny annealed shear formed cones with Firestone drawn cones. Since they were not annealed the Firestone data for shear formed cones should not be compared with the Picatinny data.

The effect of rotation, shown in Fig. 34 is interesting. The performance of the double angle cone is not reduced with spin as rapidly as is a regular 42^o or 45^o conical liner. Also, the rate of loss in penetration with spin increases with standoff. In the single instance where the standoff distance is comparable, the Picatinny Arsenal and Firestone spin data agree quite well.

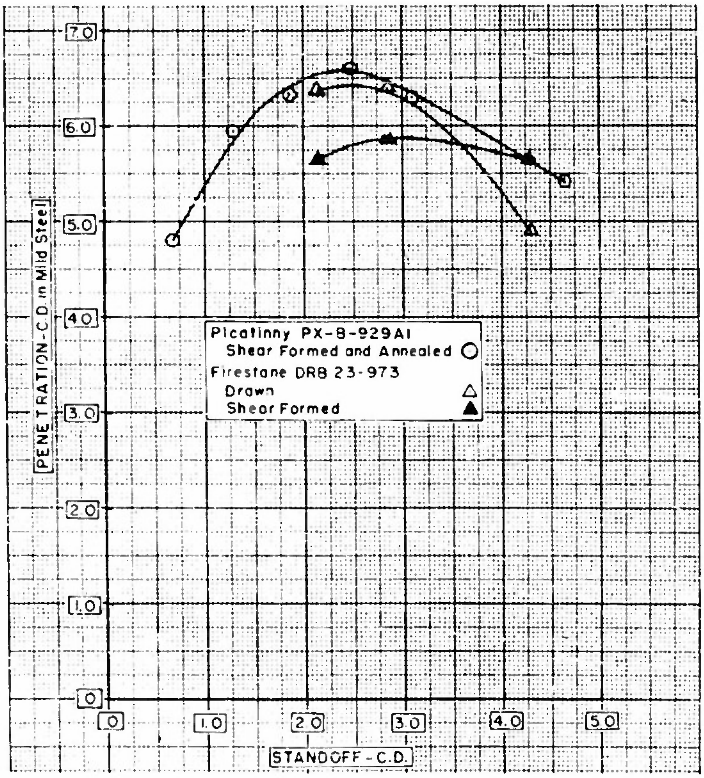


Fig. 33. Penetration Versus Standoff.
Units In Cone Diameters.

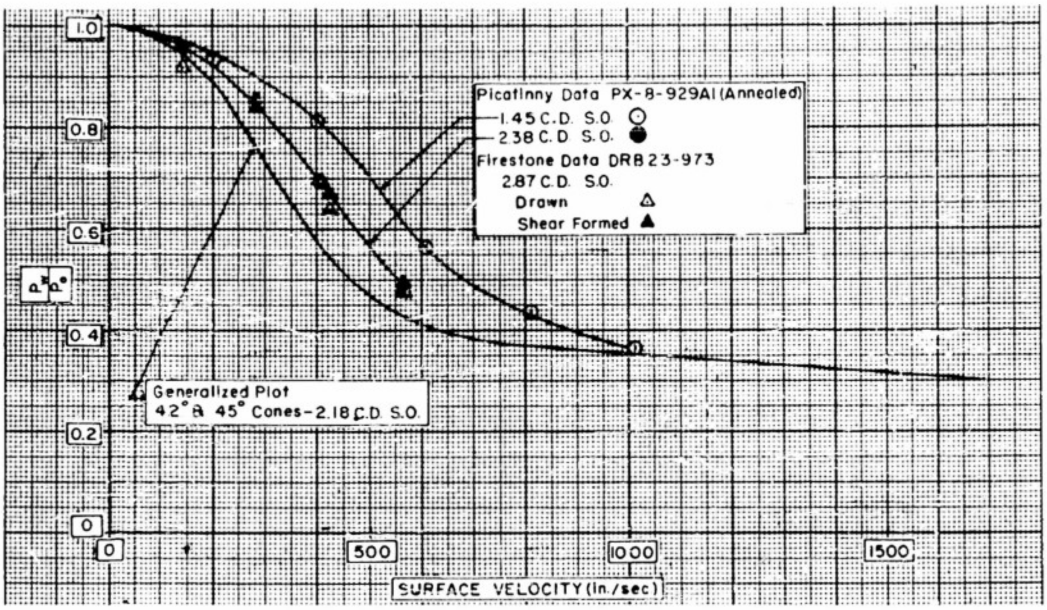


Fig. 34. Penetration Versus Surface Velocity.

Future Program

1. Composite Cone Study

A series of bimetal cones with aluminum half shell inserts (.020 in. thick) and copper outer shells (DRB398HW3 item 1) will be assembled to evaluate penetration performance at standoffs of 2, 4 and 6 in. and at varying rotational rates.

2. Evaluation of Cones Made By Electroforming

A series of DRB 268-5 copper cones, made by an electroforming method, have been manufactured for comparison with machined cones of like design. The electroformed cones are finished and the controls are being machined.

3. The Effect of Rotation on Aluminum Cone Performance

A series of DRB398HW3 item 1 and item 4 cones, machined from 2S-F aluminum bar, will be tested at various spin rates 0, 30, 45 and 60 rps at 7.5 in. standoff. A second series will be tested at the same rotational velocities but at the optimum standoff of about 42 in.

4. Penetration Into Mild Steel Versus Homogeneous Armor

A series of penetration test rounds composed of DRB398 HW3 item 1 cones in DRC-376 test bodies have been loaded and will be tested for penetration into homogeneous armor and mild steel at various spin rates.

5. Evaluation of Cones Made By Zinc Die Casting

A series of DRB398HW3 cones have been made by die casting zinc alloy Zamak 3. Standoff and spin tests are planned.

6. Evaluation of the DRB398 HW3 Item 1 Copper Drawn Cone in Various Stages of Manufacture.

A series of cones have been obtained

having varying geometric configurations. These cones represent the various steps in the deep drawing of the DRB398 HW3 item1 copper cone. Six of the eight drawing stages are included. Standoff and spin tests are planned.

7. Evaluation of Optimum Wall Thickness for Cones with Various Apex Angles.

This study is being conducted using 3.0 in. charges. The length of the spitback tube (.625 in. dia.) will be varied to give the cone a over-all height of 5.00 in.

a. Cone drawing number DRB834-1, apex angle 30°, wall thickness .050 in., .070 in., .086 in. and .110 in.

b. Cone drawing number DRB16-976, apex angle 45°, wall thickness, .050 in., .110 in. and .150 in.

c. Cone drawing number DRB16-972, apex angle 60°, wall thickness, .070 in., .110 in. and .150 in.

These cones are being manufactured.

MANUFACTURING SUMMARY

In addition to the experimental material prepared for the research and development work under contracts DA-33-019-ORD-33 and DA-33-019-ORD-1202, described in preceding progress reports and in the preceding pages of this report, the following have been manufactured and shipped to the installations indicated.

Firestone's Defense Research Division, in shipping these items, transfers custody and control of the items to the receiving agencies. However, personnel of Defense Research Division will continue to collaborate with personnel of the other installations.

I. Cartridges, HEAT, 106mm, M344 (T119E11) Without Fuzes T208E7

Prior to	March 1, 1954	16,715	All Shipments
	March 24, 1954	267 (Live)	Picatinny Arsenal
	Total	16,982	

II. Rifles, T170E1 for ONTOS

Prior to	March 1, 1954	69	All Shipments
	March 27, 1954	3	Aberdeen Proving Ground
	Total	72	

III. Mounts, T173 and T26 Tripod for ONTOS

Prior to	March 1, 1954	22	All Shipments
No Shipments in March			

IV. BAT Systems less Jeep, T170E1 (M40) Rifle, T149E3 (M79) Mounts (with latest modifications).

Prior to	March 1, 1954	25	All Shipments
No Shipments in March			

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