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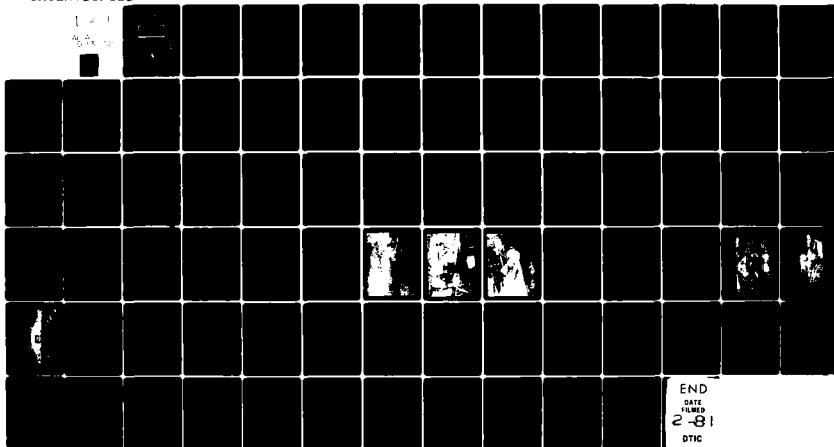
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DEVELOPMENT OF LOWER COST CRUSH ELEMENT FOR M577 FUZE.(U)
NOV 80 H J HARMER

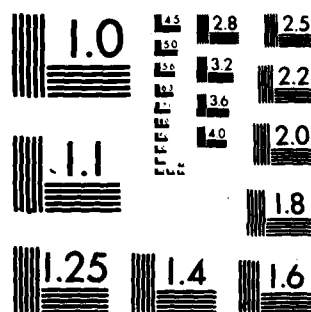
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LEVEL II

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DEVELOPMENT OF LOWER COST

CRUSH ELEMENT FOR M577 FUZE

BY

H. J. HARMER

Hamilton Technology, Inc.
P.O. Box 4787
Columbia Avenue
Lancaster, PA 17604

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17 November 1980

Final Report
Period June 1979 - October 1980

Prepared for
ARRADCOM

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6 DEVELOPMENT OF LOWER COST

CRUSH ELEMENT FOR M577 FUZE.

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H. J. HARMER

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Final Report.

Period June 1979 - October 1980.

Prepared for

ARRADCOM

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1.0 INTRODUCTION

This report describes the work accomplished by Hamilton Technology, Inc. for ARRADCOM under Task No. 1 of Contract DAAK10-79-C-0169 from June 1979 through October 1980.

The object of this task was to evaluate materials and manufacturing process changes in an effort to lower the costs associated with the mass manufacture of the M577 Fuze Crush Element (9236518).

Preliminary Investigation of several design configurations showed a brass thin-wall cylindrical Crush Tube expanded by a special Retainer Plug to be the most promising. These two components replace the present Crush Element and Crush Retainer and result in a savings of \$0.525 per fuze.

Drawings of the present design and new design Setting Key Assemblies and their detailed parts are shown in Appendix A.

2.0 SUMMARY OF ACCOMPLISHMENTS

A cylindrical thin-wall brass tube expanded by a taper plug was shown to be the best of several designs considered for improved replacement of the Crush Element. Compression tests were run to develop dimensions, tolerances and hardness of materials. Tests were then performed on Setting Key Assemblies to verify the assembly method, energy absorption, and effects of damaged Setting Keys. Shipping and Handling tests and Ballistic tests were performed on fuze assemblies. A Setting Key Assembly was developed which will save \$0.525 per fuze.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The new design Crush Tube and Retainer Plug passed all of the required tests except the Ballistic Air Gun Test at 30,000 G's. The test results and calculations indicate they will safely withstand 23,000 G's. Extensive tests were performed to verify acceptable performance of the new design in Setting Key Assemblies and with variations in piece-part tolerances.

The new design saves \$0.525 per fuze.

It is recommended the new design Crush Tube and Retainer Plug be incorporated into the M577 Fuze Technical Data Package.

4.0 PRELIMINARY DESIGNS

Several designs of the Crush Element were initially proposed, and are shown in Fig. 1. Calculations indicated that even the simplest of these designs (Fig. 1a) would require costly development of tools for about five deep-drawing steps in addition to final trimming to length. Samples of existing drawn eyelets, Fig. 1d, were subjected to compression tests and the load-deflection curves showed buckling at several nodes during the .400 inches of deflection and 100% change in load values from peak-to-valley of the nodes.

Four designs of thin-wall cylindrical tubes, Fig. 2, were then explored. Tubes of 3003-H14 Aluminum (.405 O.D. x .016 wall) and 70-30 Brass, 3/4H (.400 O.D. x .007 wall) were obtained. Samples of the plain cylinder design, Fig. 2a, were compression tested first. The aluminum tube crushed with 2-3 nodes but crush loads and peak-to-valley load variation exceeded the 190-305 lb. limits given on the Crush Element drawing. The brass tube crushed with 6 nodes; the peak-to-valley load variation was about 200 lb. and most of the valleys were above the 190-lb. limit, but the peaks exceeded the 305 lb. limit by about 60 lbs. Samples of the Necked Ring design, Fig. 2b, consisted of necking down the brass tube O.D. at 8 circumferential rings with no appreciable reduction in wall thickness, and samples of the Scored Ring design, Fig. 2c, consisted of cutting 9 circumferential grooves .002 - .004 deep on the brass tube O.D. The brass tube with Scored Ring design, Fig. 2c, showed the best load-deflection curve of the three designs, Fig. 2a, b, c. This design crushed with 8 nodes and the entire curve was within the load requirements, except for 2 nodes exceeding the 305-lb. limit by 15 lb. Samples of the Plain cylinder with Retainer Plug, Fig. 2d, consisted of forcing a tapered retainer plug through the cylindrical tube, thus expanding the tube. Retainer plugs .125 long with various diameters and tapered angles were tested in samples of the aluminum and brass tubes. The best results were obtained using 70-30 Brass, 3/4 H tube, .406 O.D. x .014 wall x .580 lg. with Retainer Plug .393 dia. x 30° tapered.

All of the load-deflection curves for the Plain Cylinder with Retainer Plug design, Fig. 2d, showed the load increased to a maximum value in the first .050-.100 inch of deflection, then remained fairly constant throughout the remaining deflection. Since this design showed the most promise of meeting the Crush Element requirements, it was decided to pursue further tests and evaluations.

5.0 DEVELOPMENT OF CRUSH TUBE & RETAINER PLUG

5.1 Compression Tests:

The Compression Tests were performed in a Tinius Olsen Electmatic Universal Test Machine with recorder and deflectometer, at not greater than .10-inches-per-minute deflection rate, and at ambient temperature. Fig. 3 shows a typical compression test setup. Load-deflection test curves are shown in Appendix B.

Initial compression tests were run using a Crush Tube (70-30 Brass, 3/4 hard) .406 O.D. x .014 wall x .580 long with Retainer Plug (416 Stainless Steel, Condition T) .393 O.D. x 30° taper with no extension below the taper. On some of these tests the Retainer Plug tilted causing a decrease in load, and the Crush Tube O.D. expanded until it touched the Key I.D. causing an increase in load. A skirt or extension was added below the taper on the Retainer Plug and a smaller diameter Crush Tube (.375 O.D. x .014 wall) and Retainer Plug (.385 Dia. x 20°) were used to correct this condition. The smaller diameter tube and plug required changing the taper to 20° on the Retainer Plug.

5.1.1. Dimensional Tolerances -

The effects of dimensional tolerances of the Crush Tube and Retainer Plug on the compression load was determined by running compression tests on the same size tubes (70-30 Brass, 3/4H, .375 O.D., .014 wall, .650 long) with various diameter Retainer Plugs. The compression load increased rapidly in the first .100 inch of deflection and then remained fairly constant for the remaining .305 inch of deflection. The constant load for the various diameters of Retainer Plugs was as follows:

<u>Dia. - Inches</u>	<u>Load - Pounds</u>
.3904	338
.3876	277
.3864	255
.3840	244
.3809	244

This data indicates the tolerances on the Retainer Plug O.D. (.3840 - .0005) and the Crush Tube I.D. (.347 $\pm$.002) and wall (.014 $\pm$.001) will not adversely affect the compression load.

5.1.2 Hardness of Crush Tube -

The effects of Crush Tube hardness variations on the compression load was investigated. Three 1-foot lengths of 70-30 Brass Tube, 3/4H, (.375 O.D., .014 wall) were used. One tube was used in the 3/4-hard condition; one tube was drawn to approximately 1/4-hard condition; and, the other tube was fully annealed. Tensile test and compression test samples were cut from each of the 3 tubes and then tested. The tensile yield load and compression load for these 3 conditions of hardness were as follows:

<u>Condition</u>	<u>Tensile Yield - Lb.</u>	<u>Compression - Lb.</u>
3/4 Hard	1070	250
1/4 Hard	400	212
Annealed	300	205

The annealed and 1/4-hard samples had a greater spread in test results, with some of the compression loads falling below the 190-lb. minimum requirement. The 3/4-hard samples had a narrower spread in compression loads and all were in the middle of the 190-305 lb. requirement limits. It should be noted that the hardness of the 3/4-hard samples was R_B 80, which is the minimum shown in ASTM B135, Alloy 260, hard-drawn Brass tubing. This data indicates that "hard drawn" tubing should be used for the Crush Tube.

5.1.3 Setting Key Assembly Tests -

Compression tests were run on the new design Setting Key Assemblies. Crush Tube and Retainer Plug were installed in the Setting Key, compressed to the required dimension, and the Setting Key diameter crimped. The Crush Tube (70-30 Brass, 3/4H, .375 O.D., .014 wall, .565 long) and Retainer Plugs (.416 SS, .384 Dia., 20° taper, with skirt) were made on production tools and the Setting Key Assembly operations performed on production machines. Clutch Drive Sleeves, P/N 9236520, were used in place of the test load bar and production Setting Keys were used in place of the test key shown in Fig. 3. At about .200-inch deflection, some samples showed a momentary increase in load. This was caused by the top of the Crush Tube hitting the top of the flats on the sides of the Clutch Drive Sleeve. The Crush Tube length was increased to .665 inches and this eliminated the condition. It was also found that the compression loads on these crimped Setting Key Assemblies was about 25-lbs. higher than on Setting Key Assemblies not crimped, due to friction between the Key and Drive Sleeve.

5.1.4 Repeatability Tests -

Fifty (50) samples of the final design of Crush Tube, P/N 9236730, and Retainer Plug, P/N 9236731, were compression tested for repeatability of load-deflection curves. All samples were made using production tools and methods. Twenty-five (25) samples were tested in open-ended test keys with test bars, as shown in Fig. 3, without pre-crushing to the .015 dimension required in Note 2 of Setting Key Assembly Drawing 9236729. The other twenty-five (25) samples were assembled per Setting Key Assembly Drawing 9236729 including pre-crushing the Crush Tube, reducing the diameter and

forming tabs on the Setting Key, and Clutch Drive Sleeves installed and then compression tested. The test curves of all twenty-five (25) samples not pre-crushed fell within the load-deflection requirements of Crush Element Drawing 9236518, except at the 190-lb. .050" point, where it took about .055"-.073" deflection before the load reached 190-lbs. This will not affect function in the fuze since pre-crushing during assembly exceeds this point. The test curves (Appendix "B") of the (25) samples pre-crushed were about 25-lb. higher than those samples not pre-crushed, due to friction between the Clutch Drive Sleeve and crimped end of the Setting Key. Hence the maximum load exceeded the 305-lb. limit on a few samples. If the Key-Sleeve friction force is subtracted, the loads on all (25) pre-crushed samples fall well within the 190-305 lb. limits.

5.2 Energy Drop Tests:

The purpose of this test was to compare the energy absorption of the present and new designs of Setting Key Assemblies. The test setup was similar to the Compression Test Setup, Fig. 3, except a 5-lb. weight was dropped from various heights onto the test bar. Nine (9) samples of the present design Crush Element and Crush Retainer, and nine (9) samples of the new design Crush Tube and Retainer Plug were tested. All samples were pre-crushed before inserting into the test key. A separate sample of each design was tested at 2-1/2" increments of drop heights from 7.25" up to 27.50". The deflection of each sample was measured and the dropped weight energy calculated. These values, plotted in Fig. 4, show the two designs to be comparable.

5.3 Damaged Fuze Test:

The purpose of this test was to determine the effects of a damaged fuze nose on the function of the Setting Key Assembly. Five (5) new design Setting Key Assemblies were installed in inert M577 Fuze Assemblies and attached to inert 105mm Projectiles. These assemblies were dropped in 45° nose-down attitude from various heights onto a steel plate. The Setting Key Assemblies were removed and the amount of compression measured.

<u>Sample No.</u>	<u>Drop Ht.-Ft.</u>	<u>Compression-In.</u>
1	2.50	.022
2	3.25	.052
3	5.0	.100
4	5.0	.061
5	5.0	.061

The Clutch Drive Sleeve on Sample No. 3 had tilted in the Key. All Key Assembly samples were then compression tested. Compression loads on Samples No. 1, 2, and 5 were within the 190-305 lb. limits. Loads on Samples No. 3 and 4 were within limits until the last .050" of compression when the load increased somewhat above the 305-lb. limit.

5.4 Liquid Impact Simulator

This piece of test equipment was intended to be used to perform preliminary tests in the laboratory on raindrop impact with Setting Key Assemblies. Drawings were obtained of a similar piece of equipment built and operated by NSWC (NOL). HTI proceeded to build such a piece of equipment, but found the velocity measuring instrumentation was no longer available. Substitute instrumentation was tested, but was not successful. ARRADCOM and HTI agreed to stop further efforts on this test equipment.

6.0 FUZE ASSEMBLY TESTS

The new design Setting Key Assemblies were built and installed in M577 Fuze Assemblies using production tools and processes. Sufficient quantities were built to perform the following tests required in the contract.

6.1 Jolt and Jumble Test -

Six (6) live Fuze Assemblies were built and tested per MIL-STD-331, Tests 102.1 and 101.2. All units were examined after testing and found to be safe to handle.

6.2 Static Propagation Test -

Thirty (30) live Fuze Assemblies were built and tested, with the SSD armed, per MIL-F-50983, Para. 3.7. All units functioned in accordance with the specification.

6.3 Five-Foot Drop Test -

Ten (10) live Fuze Assemblies (S/N 70-79) were built and tested per MIL-STD-331, Para. 111.2, two each in nose down, base down, 45° nose down, 45° base down, and horizontal attitude. All units were X-rayed after testing and were shown to be safe to handle.

These (10) units were then subjected to the Ballistic P.D. Tests (see Section 6.5).

6.4 Ballistic Air Gun Test -

Twelve (12) Inert Fuze Assemblies (S/N 1-12) containing the new design Setting Key Assembly and four (4) Inert Fuze Assemblies (S/N 13-16) containing the present design Setting Key Assembly were shipped to Picatinny Arsenal for Setback (20,000-30,000 G's) testing in the Air Gun. Test data is shown in Appendix C.

Upon completion of the tests, the Ogive was removed and the fuze elements examined. It was noted that the Firing Plates had been bent on three of the four present design units (S/N 13, 15, 16) and on nine of the twelve new design units (S/N 4-12). The Firing plate had deflected enough to hit the M55 Detonator on six of the new design units (S/N 5-9, 12). Although the large flange of the Setting Key had obviously hit the Firing Plate, examination showed the flange to be over .100" above the Firing Plate after the test. Measurements of the compression of the Drive Sleeve and Setting Key Assembly showed about .103" on the present design and .138" on the new design for those units subjected to more than 28,000 G's (S/N 3-16). The largest deflection on these units was .149", but per detailed drawing dimensions, the Setting Key flange must travel .233 +.0775 -.0135 or a minimum of .2195" before it will cause the Firing Plate to hit the detonator. This indicated some deflection and springback was occurring on other parts of the Fuze Assembly below the Clutch Drive Sleeve. Load-deflection tests were made on a Fuze Assembly without the Ogive, Setting Key Assembly and Drive Sleeve. Results were as follows:

<u>Load-Lb.</u>	<u>Deflection-In.</u>
500	.105
1000	.115
1500	.151

At 30,000 G's, the mass of the Setting Key Assembly and Drive Sleeve, plus other parts of the fuze, will exert a force sufficient to cause the .100" deflection and springback of fuze parts below the Firing Plate and account for the gap between the Setting Key Flange and the Firing Plate after the test. Calculations show that after the Setting Key has deflected .214 + .028 inches it loses lateral support in the Ogive and can tilt, causing its flange to hit one side of the Firing Plate sooner than the other side. This condition was noted on some of the test fuzes since one side of the Firing Plate was bent more than the other side.

The Air Gun Test Data (Appendix C) shows that samples of the New Design Setting Key Assembly will deflect the Firing Plate enough to hit the M55 Detonator at 28,638 G's, but will not hit at 26,258 G's. However, calculations (Appendix D) based on the minimum load the Crush Tube will support indicates the Crush Tube will withstand 23,059 G's before starts moving down over the Retainer Plug.

6.5 Ballistic PD Test -

Twenty (20) live Fuze Assemblies (S/N 50-59) plus the ten (10) live Fuze Assemblies (S/N 70-79) from 5-ft. Drop Test (Section 5.3), were shipped to Yuma Proving Grounds, Yuma, Arizona, and Ballistic PD tested. Test data (Appendix E) shows that all units functioned on the target.

6.6 Ballistic Water Impact Test -

Twenty-five (25) live Fuze Assemblies (S/N 17-41) containing the new design Setting Key Assembly and eight (8) live Fuze Assemblies (S/N 42-49) containing the present design Setting Key Assembly were shipped to Picatinny Arsenal for Ballistic Water Impact Testing. All units had the Lever Assembly (9236540) omitted from the SSD to enable quick arming of the fuze. The test setup and

test data are given in Appendix F. The present design units were not required for the test, but were used only for comparison. Only two of these (S/N 42-43) were tested, and both functioned at the water target. All (25) of the new design units functioned at the water target. Acceptance criteria is at least 20 of 25 units must function at the water target.

6.7 Ballistic Rainfield Test -

Fifty (50) live Fuze Assemblies (S/N 80-129) containing the new design Setting Key Assembly and eight (8) live Fuze Assemblies (S/N 130-137) containing the present design Setting Key Assembly were shipped to Holloman Air Force Base for Ballistic Rainfield Tests. All units had the Lever Assembly (9236540) omitted from the SSD to enable quick arming of the fuze. The test plan, test setup and test data are given in Appendix G. One M557 Control Fuze (which was to function in the Rainfield) was fired before and after each group of five M577 Test Fuzes. A total of (15) M557 Control Fuzes, (50) M577 Test Fuzes (new design), and (8) M577 Test Fuzes (present design) were fired. The I.R. film data showed the fuzes functioned as follows:

	M557 <u>Control</u>	M577 <u>New</u>	M577 <u>Present</u>
Rainfield	6		
Target	7	37	4
No Indication	<u>2</u>	<u>13</u>	<u>4</u>
TOTAL:	15	50	8

The first 10 rounds, which included (2) M557 Control Units and (8) M577 New Units, missed the target and hit the bunker, and are shown as "no indication." The remaining (9) "no indication" units are believed to have buried in the bunker and shielded the flash from the camera.

7.0 COST AND WEIGHT COMPARISON

The new Setting Key Assembly involves only the replacement of the present Crush Element and Crush Retainer with the new Crush Tube and Retainer Plug. Assembly operations are the same as for the present Setting Key Assembly, hence only the cost of the two detail parts is affected.

7.1 Cost Comparison -

Replacing the present Crush Element and Crush Retainer with the new Crush Tube and Retainer Plug saves \$0.525 per fuze, including labor, overhead and material.

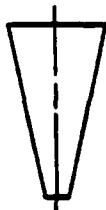
7.2 Weight Comparison -

	<u>New</u>	<u>Present</u>
Crush Element		.335
Crush Tube	1.450	
Crush Retainer		.520
Retainer Plug	<u>2.620</u>	<u> </u>
	4.070	- .855 = 3.215 gm.

Weight Increase per Fuze = 3.215 gm. = .0071 lb.



1a
DRAWN
CUP



1b
DRAWN
CONE



1c
STEPPED
CYLINDER



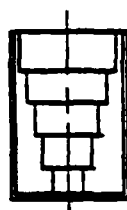
1d
DRAWN
EYELET



1e
SPIRAL
CYLINDER



1f



1g



1h

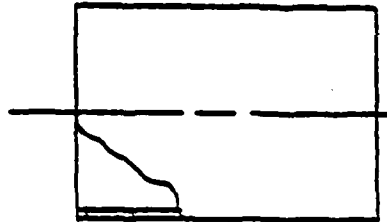


1j

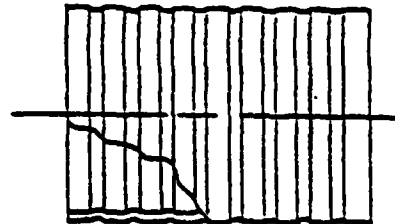
COMBINATIONS OF 1a-1e

FIG. 1

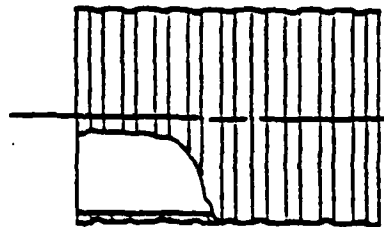
a. PLAIN CYLINDER



b. NECKED RINGS



c. SCORED RINGS



d. PLAIN CYLINDER WITH RETAINER PLUG.

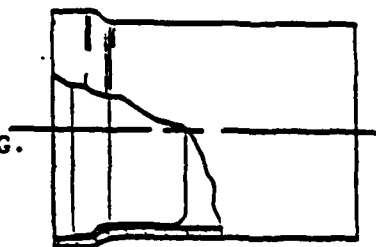


FIG. 2

COMPRESSION TEST SETUP

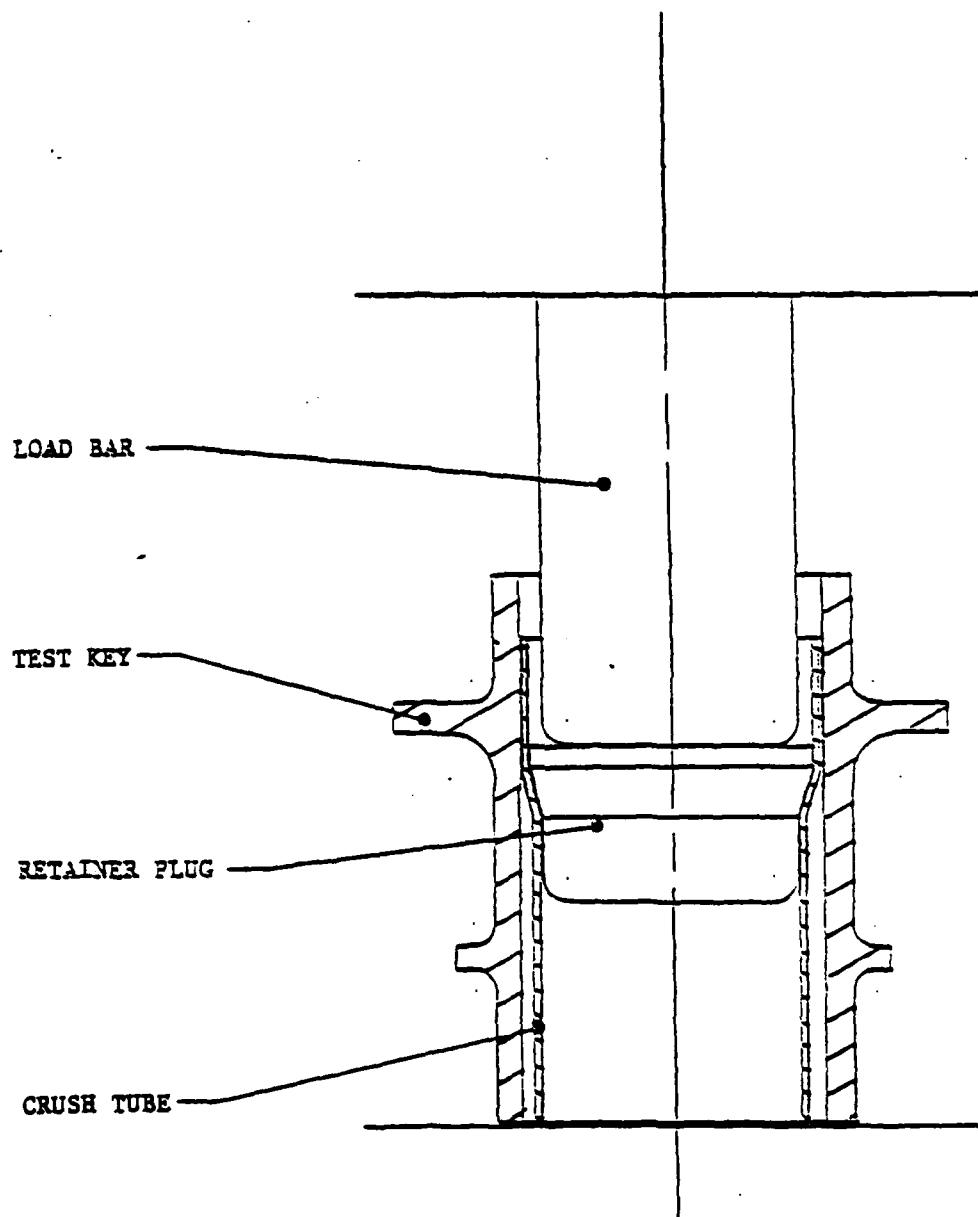


FIG. 3

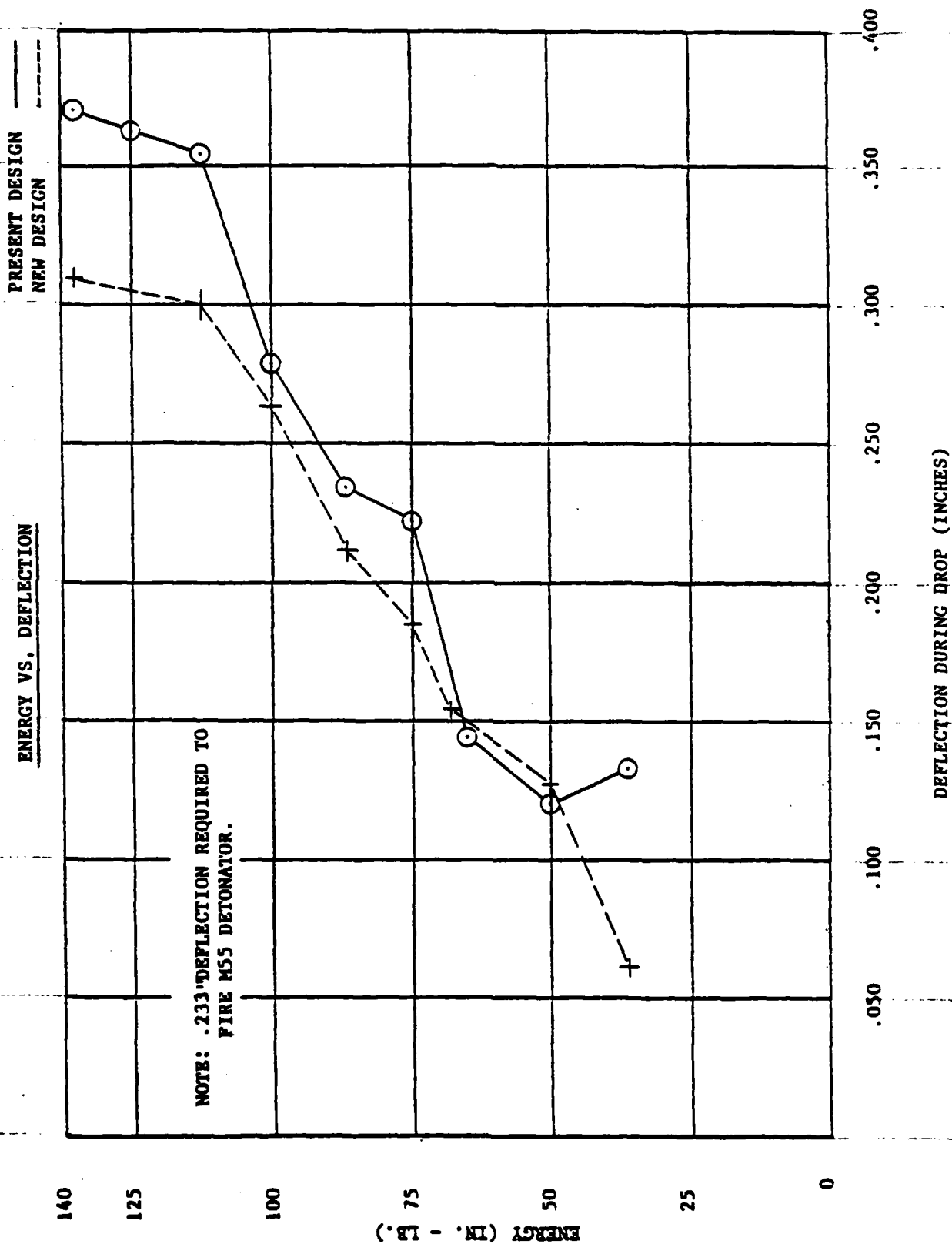


FIG. 4

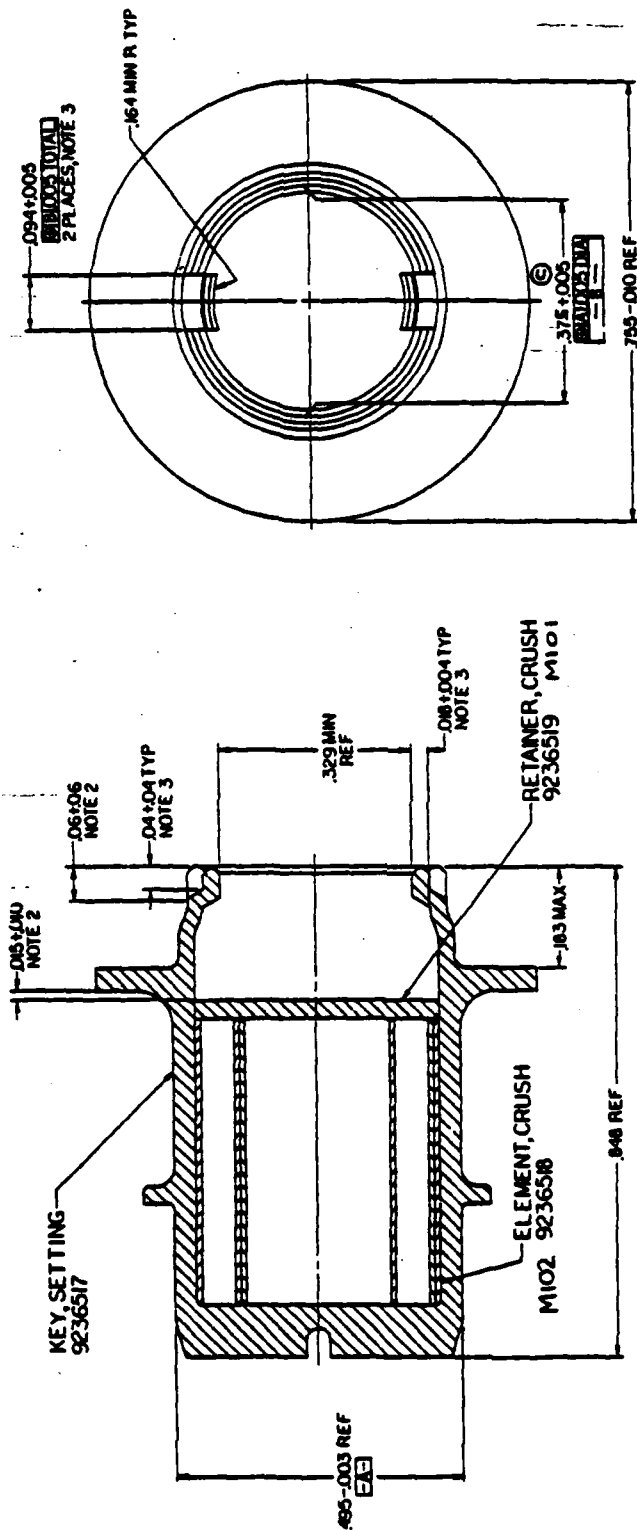
APPENDIX "A"

Drawings:

9236516	SETTING KEY ASSEMBLY (PRESENT)
9236517	SETTING KEY
9236518	CRUSH ELEMENT
9236519	CRUSH RETAINER
9236729	SETTING KEY ASSEMBLY (NEW)
9236730	CRUSH TUBE
9236731	RETAINER PLUG

NOTES:-

- 1-SPEC MIL-A-2550 APPLIES.
- 2-INSERT AND COMPRESS CRUSH ELEMENT WITH RETAINER IN PLACE TO DIMENSION GIVEN PRIOR TO REDUCING SETTING KEY TO .375±.005.
- 3-FORM TABS AS SHOWN, 2 PLACES.



REV	DATE	BY	CHKD	APP'D
1	10-15-74	WJ	WJ	WJ
2	10-15-74	WJ	WJ	WJ
3	10-15-74	WJ	WJ	WJ
4	10-15-74	WJ	WJ	WJ
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FOR ASSOCIATED LIST, SEE 9236516

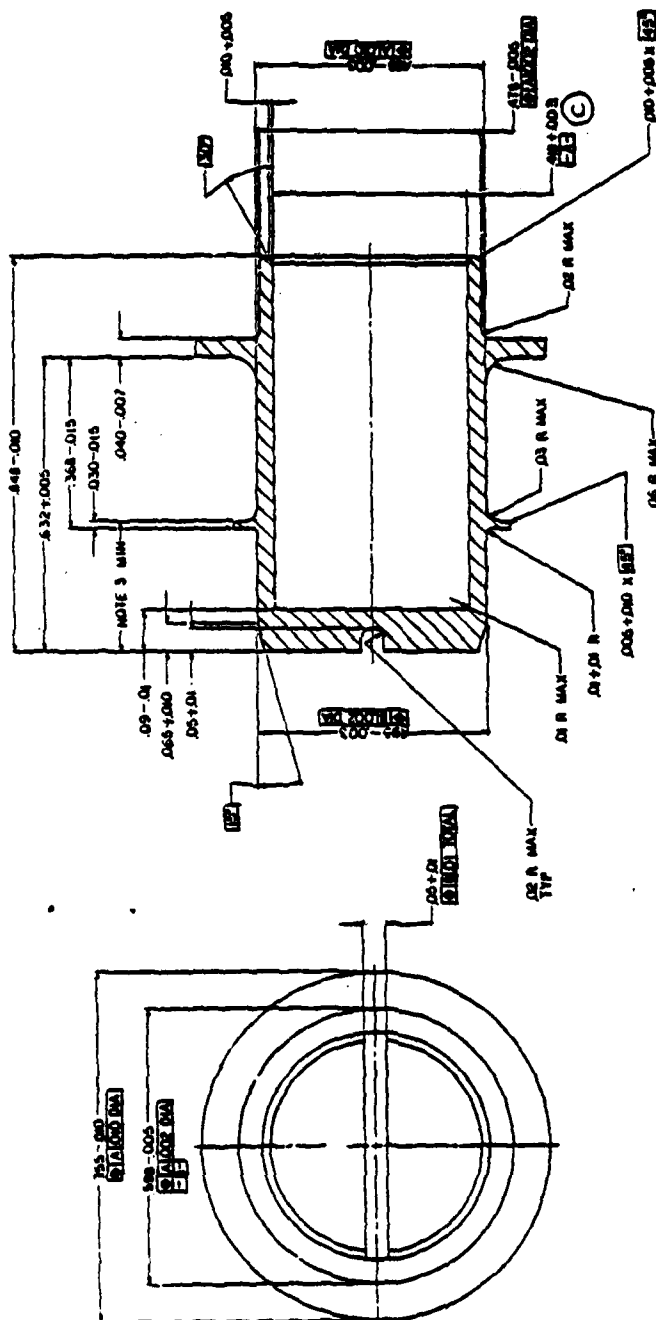
PART NO. 9236516

U.S. ARMY AMMUNITION CENTER FACILITY: ARLV, BOXES, RCD 2-27 0753	
SETTING KEY ASSEMBLY	
QTY	9236516
DATE	19203
SCALE	10/1
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DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS ARE DECIMALS FRACTIONS ARE ANGLES	
28 AUG 1972	
HARRIS H. HOGANSON	
DANIEL TARAVELLA	
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FUZE M577	
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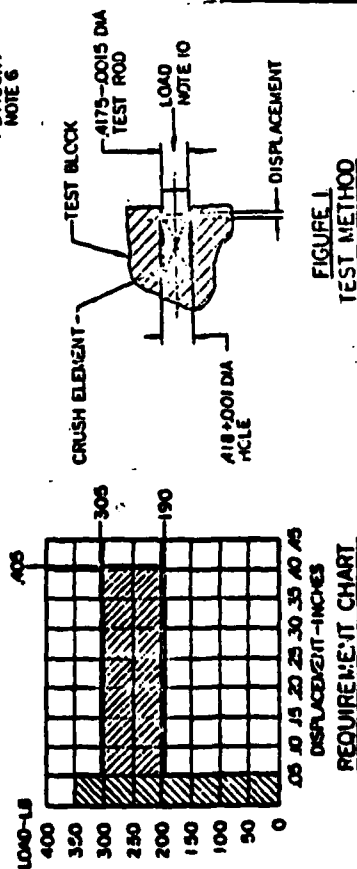
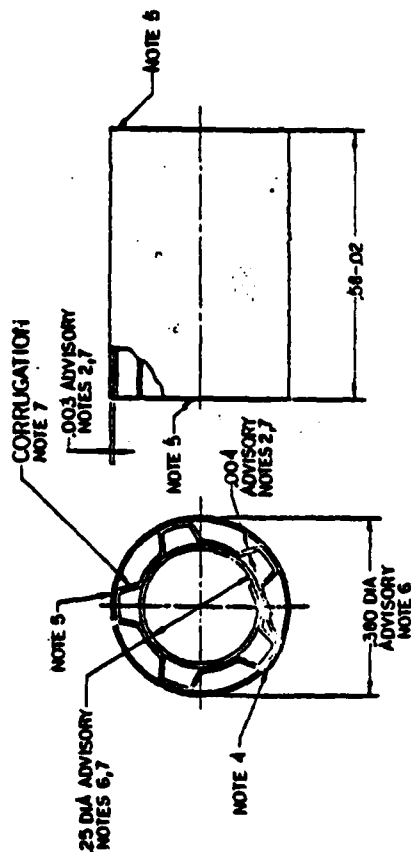
- NOTES:-
- 1- SPEC MIL-A-2550 APPLIES.
 - 2- MATERIAL - ALUMINUM-ALLOY
 - 3- PROTECTIVE FINISH- FINISH 722 OF MIL-STD-171, BLACK NO. 37036, MANDATORY ON ALL EXTERNAL SURFACES TO MINIMUM LENGTH INDICATED, OPTIONAL ON BALANCE OF PART, EXCEPT PART SHALL BE EXPOSED TO A SALT SPRAY FOR A MINIMUM OF 96 HOURS IN LIEU OF 336 HOURS PER PARAGRAPH 4.6.31 OF MIL-A-8623. SALT SPRAY REQUIREMENTS APPLY TO EXTERNAL SURFACES INDICATED.
 - 4- UNLESS OTHERWISE SPECIFIED FILLETS ARE TO BE .005 R MAX AND CORNERS ARE TO BE .005 R MAX OR .005 MAX X 45° BASIC.
 - 5- 125° ALL OVER.

[illegible]

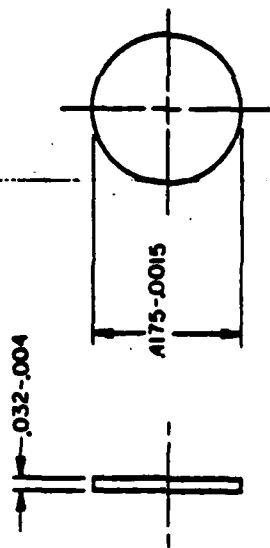
NAME	ALIAS	DOB	DOB-YY
..	EAN 72003461 (M)	1971	09-25-71

-S:JOK

- 1 - SPEC WE-A-2550 APPLIES.
- 2 - MATERIAL: ALUMINUM-ALLOY SHEET AND PLATE, ALLOY 5052, ASTM B209 (ADVISORY:- FABRICATE FROM 2 PIECES).
- 3 - ALTERNATE MATERIALS: ALUMINUM-ALLOY 5052, PLATE AND SHEET, SPEC QQ-A-250/8.
- 4 - BOND ALL OVERLAPPING JOINTS AND/OR SEAMS AND INDICATED AREAS FOR ENTIRE LENGTH (50'-02"), ALSO BETWEEN COILS OF CASE AND TUBE AS REQUIRED WITH ADHESIVE: EPOXY RESIN, TYPE III, SPEC MIL-A-134.
- 5 - ADHESIVE ON INDICATED SURFACES SH. L NOT BE CAUSE FOR REJECTION.
- 6 - THICKNESSES AND CONCENTRICITY OF .360 DIA AND .25 DIA WITH RESPECT TO EACH OTHER IS MANUFACTURE (NOTE 8)
- 7 - ADHESIVE DIMENSIONS NEED NOT BE GAGED (NOTE 9).
- 8 - OUT OF ROUNDNESS OF .360 DIA MUST FIT LOOSELY INTO .418 DIA HOLE.
- 9 - LOAD DISPLACEMENT RELATIONSHIP MUST LIE WITHIN SHADED AREA OF RECRUITMENT CHART WHEN SUBJECTED TO TEST ILLUSTRATED IN FIGURE 1 (NOTE 10).
- 10 - APPLY AXIAL STATIC LOAD AT RATE NOT GREATER THAN 20 INCHES PER MINUTE OF ROD TRAVEL.

[illegible]

REV	DESCRIPTION	DATE	APPROVAL
1	ERR7200346-1 (REL)	06-28-72	

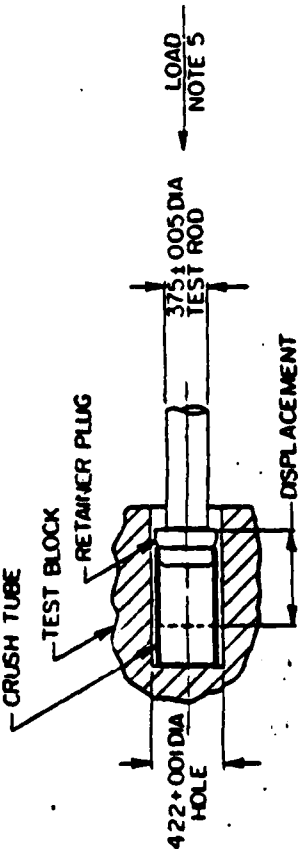


NOTES:-

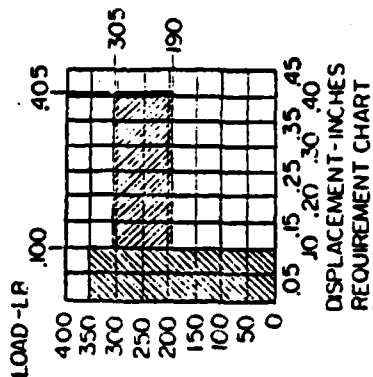
- 1- SPEC MIL-A-2550 APPLIES.
- 2- MATERIAL:- HIGH-STRENGTH STAINLESS AND HEAT-RESISTING CHROMIUM-NICKEL STEEL, SHEET AND STRIP, TYPE 301, FULL HARD, ASTM A177.
- 3- ALTERNATIVE MATERIAL:- STEEL, CORROSION-RESISTANT (18-8), PLATE, SHEET AND STRIP (ASG), COMPOSITION 301, 302 OR 304 CONDITION FULL HARD, SPEC MIL-S-5059.
- 4- 125/ALL OVER, EXCEPT AS NOTED.
- 5- DRAWDOWN AND /OR DIEBREAK TOTAL .024 MAX. (NOTE 6)
- 6- 25% PERMITTED ON DRAWDOWN AND/OR DIEBREAK.

PART NO. 9236519

U.S. ARMY MATERIALS COMMAND		LOCATION: FEDERAL BOWEN NEW JERSEY 07004	
RETAINER, CRUSH		M	
ITEM CODE IDENT NO.	C 19203	SCALE	4/1
9236519		9236519	
U.S. ARMY		SHEET	
ORIGINAL DATE OF DRAWING		28 AUG 1972	
DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED	
DIMENSIONS ARE IN INCHES		TOLERANCES ON DIMENSIONS:	
FRACTIONS & DECIMALS		ANGLES &	
MECHANICAL PROPERTIES		DRAWN BY	
TENSILE		CHECKED	
YIELD		EVEN	
ELONG		EVEN	
HARDNESS		HARDNESS	
APPROVAL		APPROVAL	
FUZE, M582		FUZE, M582	
FUZE, M587		FUZE, M587	
USED ON		USED ON	



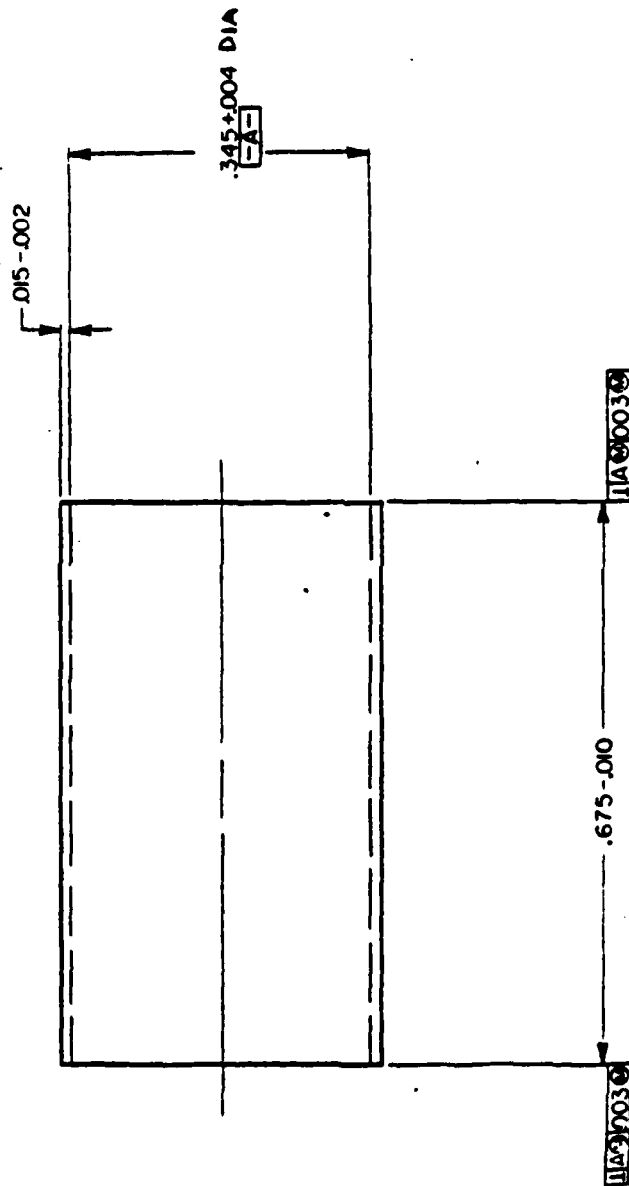
1. SPEC. MIL-A-2550 APPLIES.
2. INSERT AND COMPRESS CRUSH TUBE WITH RETAINER PLUG IN PLACE TO DIMENSION GIVEN PRIOR TO REDUCING SETTING KEY TO .375±.005.
3. FORM TABS AS SHOWN, 2 PLACES.
4. LOAD (DISPLACEMENT) RELATIONSHIP MAINTAIN WITHIN SHADED AREA OF REQUIREMENT CHART WHEN SUBJECTED TO TEST ILLUSTRATED IN FIGURE 1 (NOTE 5)
5. APPLY AXIAL STATIC LOAD AT RATE NOT GREATER THAN .10 INCHES PER MINUTE OF ROD TRAVEL.



11 COMMERCIAL PARTS LIST - 9235729

PART NO. 9236729		U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND DOWRY, NEW JERSEY 07111		ORIGINAL DATE OF DRAWING RD - 016 - 15		SETTING KEY ASSEMBLY		SIZE D		CODE IDENT NO 19200		9236729	
DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		DATE 08/11/68		CHECKED BY JGK		TOLERANCES ON DIMENSIONS FRACTIONS IN ANGLES IN		TOLERANCES ON DIMENSIONS FRACTIONS IN ANGLES IN		SCALE 4/1		SHEET NO. 4/1	
MECHANICAL PROPERTIES		TYP 15		TOLERANCES ON DIMENSIONS FRACTIONS IN ANGLES IN		TOLERANCES ON DIMENSIONS FRACTIONS IN ANGLES IN		TOLERANCES ON DIMENSIONS FRACTIONS IN ANGLES IN		TOLERANCES ON DIMENSIONS FRACTIONS IN ANGLES IN		TOLERANCES ON DIMENSIONS FRACTIONS IN ANGLES IN	
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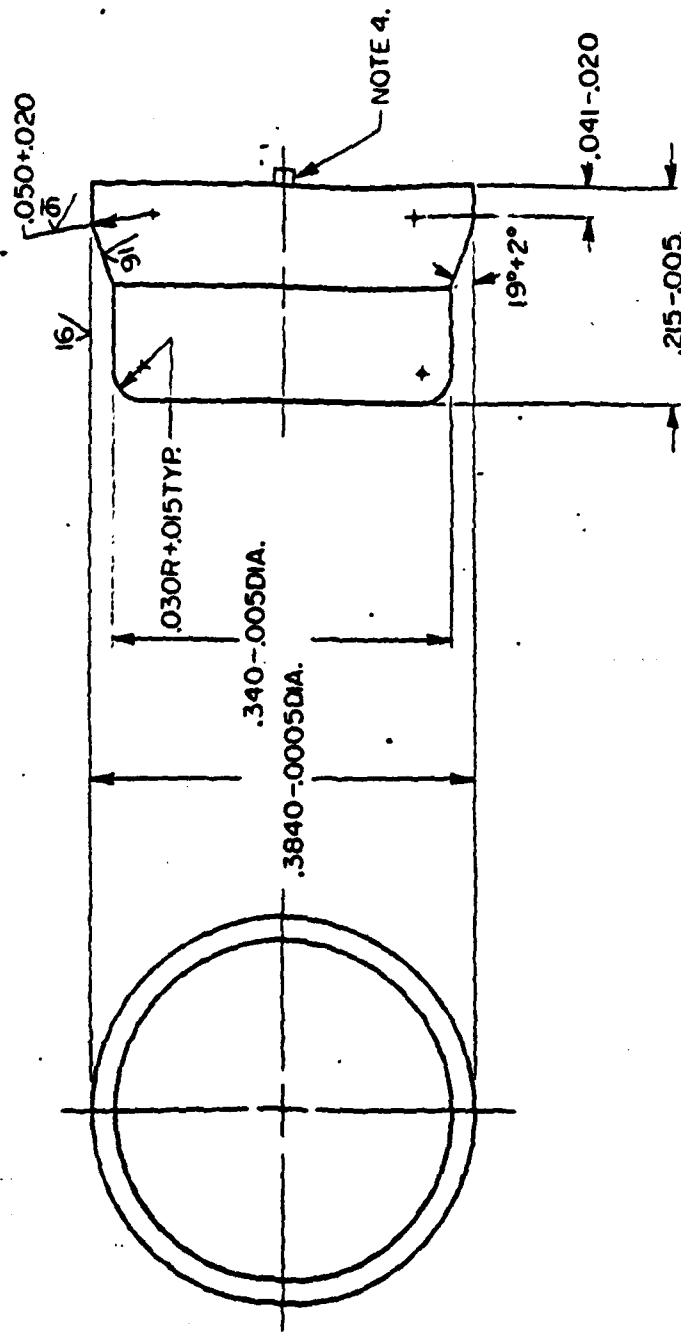
NOTES:
 1. SPEC. MIL-A-2550 APPLIES.
 2. MATERIAL - SEAMLESS BRASS ALLOY TUBE, ALLOY 260,
 HARD DRAWN, ASTM B135



PART NO. 9236730		U.S. ARMY AMMUNITION RESEARCH AND DEVELOPMENT COMMAND DEVIL, NEW JERSEY 07001	
DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: FRACTIONS: .005 .010 .015 .020 .030 .040 .050 .060 .070 .080 .090 .100 .125 .150 .175 .200 .250 .300 .375 .500 .625 .750 .875 1.000 1.250 1.500 1.750 2.000 2.500 3.000 3.750 4.000 5.000 6.000 7.000 8.000 9.000 10.000		ORIGINAL DATE OF DRAWING 80-06-16 DRAWN BY: JES CHECKED BY: JES INCHES: 1/2 FRACTIONS: 1/2	
MECHANICAL PROPERTIES		TUBE, CRUSH	
SIZE: M-42 FUSE: M577 USED ON: 1		DATE: 19200 CODE: 9236730	
APPLICATION		SCALE: 10/1 SHEET: 1	

NOTES:

1. SPEC. MIL-A-2550 APPLIES.
2. MATERIAL - FREE-MACHINING STAINLESS AND HEAT-RESISTING STEEL WIRE TYPE 416 OR 416Se, COND.T, ASTM A581.
3. 63/ FINISH ALL OVER AS NOTED.
4. CUTOFF BURR PERMISSIBLE .02 DIA. MAX. X .015 LG. MAX. THIS END ONLY.



PART NO 923673J		Q 3 ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND BOYER, NEW JERSEY 07001	
DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS =	DATE OF DRAWING 80-06-16	DRAWN BY D5	
MECHANICAL PROPERTIES	DATE OF DRAWING	CHECKED BY	
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APPENDIX "B"

COMPRESSION TEST CURVES:

PAGE

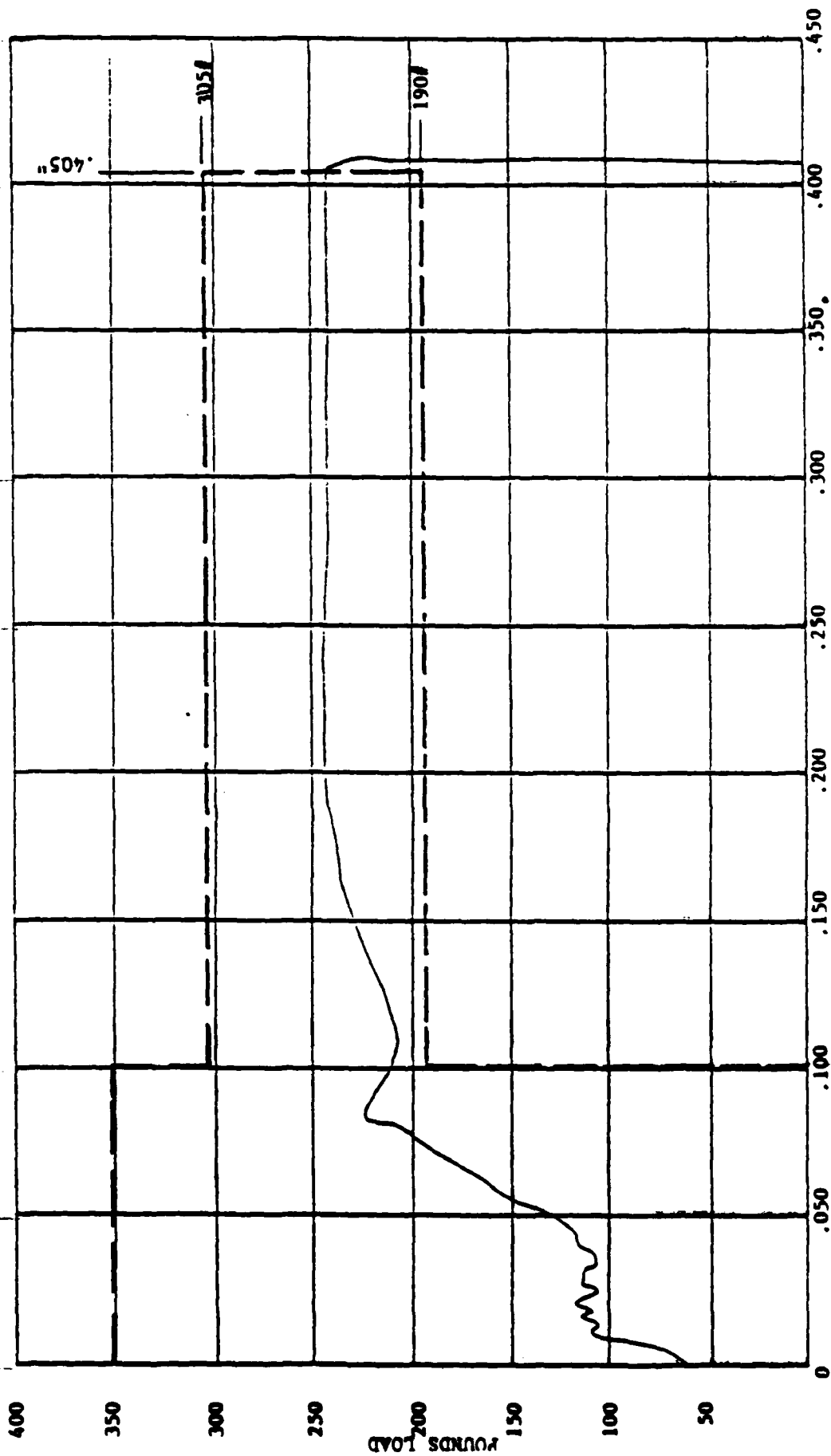
NOT PRE-CRUSHED

B-1

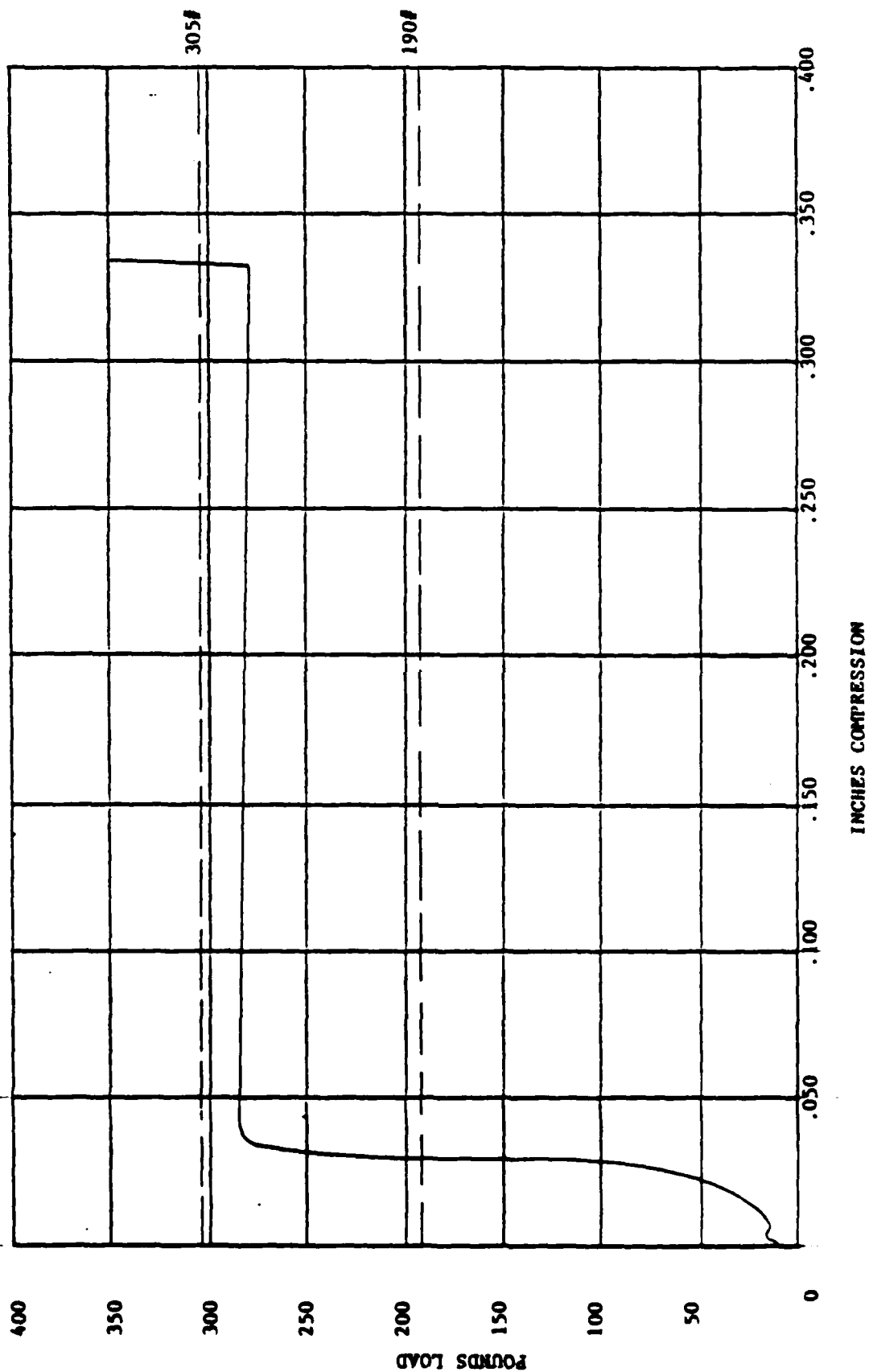
PRE-CRUSHED

B-2

COMPRESSION TEST (NOT PRE-CRUSHED)



COMPRESSION TEST (PRE-CRUSHED)



APPENDIX "C"

BALLISTIC AIR GUN TEST DATA

Fuze S/N	Plate Size-In.	Pressure - psi		Accel. G's	Key Ht. - In.		Key - In. Travel	
		Breech	Muzzle		Before	After		
NEW DESIGN								
1	.270	9,500	120	26,258	0	+.142	.142	
2	.290	7,800	120	21,499	0	+.124	.124	
3	.300	10,350	120	28,638	-.016	+.138	.154	
4	.310	10,950	80	30,429	-.004	+.154	.158	X
5	.310	11,200	120	31,017	-.001	+.153	.154	(X)
6	.310	10,350	120	28,638	-.004	+.172	.176	(X) Δ
7	.310	10,350	120	28,638	+.002	+.202	.200	(X)
8	.310	10,800	120	29,898	+.004	+.172	.168	(X) Δ
9	.310	10,900	160	30,066	-.004	+.174	.178	(X) Δ
10	.310	10,800	120	29,898	-.007	+.143	.150	X
11	.310	10,950	120	30,318	+.007	+.145	.138	X
12	.310	10,900	120	30,178	-.013	+.179	.192	(X) Δ
PRESENT DESIGN								
13	.310	10,850	100	30,094	+.008	+.136	.128	X Δ
14	.310	11,000	120	30,457	+.002	+.122	.120	
15	.310	10,850	120	30,038	+.003	+.135	.132	X Δ
16	.310	10,500	90	29,142	0	+.144	.144	X Δ

$$G's = \frac{P \times A}{W}$$

$A = 19.635 \frac{in^2}{2}$
 $W = 7.014 \text{ lb. Projective Weight}$
 $P = (\text{Breech Press.}) - (\text{Muzzle Press.})$
 $= \text{psi Effective Pressure}$

NOTES:

- (-) Top of Key Above Ogive
- (+) Top of Key Below Ogive
- X Firing Plate Deflected
- (X) Firing Plate Deflected to Detonator
- Δ One side of Firing Plate Deflected more than the other side.

APPENDIX "D"

CALCULATION OF SETBACK FORCES

Weight of Parts:

	<u>gm.</u>	<u>lb.</u>
Setting Key	2.780	.0061279
Crush Element	.335	.0007384
Crush Retainer	.520	.0011462
Crush Tube	1.450	.0031962
Retainer Plug	2.620	.0057752

Setback Force on Crush Retainer:

$$F = W \frac{a}{G} \quad \frac{a}{G} = 30,000$$

$$W = .0061279 + .0007384 = .0068663 \text{ lb.}$$

$$F = .0068663 \times 30000 = 206 \text{ lb.}$$

Setback Force on Retainer Plug:

$$W = .0061279 + .0031962 = .0093241 \text{ lb.}$$

$$F = .0093241 \times 30000 = 280 \text{ lb.}$$

Maximum Acceleration Crush Tube will Stand:

$$F = 215 \text{ lb. (Minimum load to Crush Tube is the Lower Limit of 190 lb. on Crush Tube drawing, plus 25 lb. Friction of Setting Key with Drive Sleeve.)}$$

$$W = .0093241 \text{ lb.}$$

$$\frac{a}{G} = \frac{F}{W} = \frac{215}{.0093241} = 23,059 \text{ G's}$$

APPENDIX "E"

BALLISTIC PD TEST DATA

21 JUL 1980

DEPARTMENT OF THE ARMY
U.S. Army Yuma Proving Ground
Yuma, Arizona 85364

FIRING REPORT NO. 14826

Fuze, MTSQ, M577

Date of Firing: 2 July 1980

Manufacturer: Hamilton Technology
Inc, Lancaster, PA

Authority: Letter, TECOM, DRSTE-
CM-F dated 9 January 1979 and
Supplement 27 to TPR LCN-T-2341
dated 25 March 1980

Product Improvement Test

TECOM Project No. 2-MU-007-577-033
1v

1. ITEM UNDER TEST

Fuze, MT, SQ, M577, lot No. HAT80F000E024

2. SUPPORTING MATERIEL AND EQUIPMENT

2.1 AMMUNITION

Projectile, 155-mm, M107, Inert, lot No. LOP-E-116
Propelling Charge, 155-mm, M3A1, lot No. RAD-68860
Pellet, Tetryl, A5, lot No. MA78K000E129
Charge, Spotting, T-2, lot No. LOP-2-20

2.2 WEAPON

Carriage, 155-mm, M1A1, Towed, serial No. 1042
Recoil Mechanism, 155-mm, M6, serial No. 5203
Gun, 155-mm, M1A1, serial No. 7456
Tube, 155-mm, M1A1, serial No. 11157

2.3 EQUIPMENT

Plywood targets
X-ray equipment
Polaroid camera

3. OBJECTIVE

To test a special lot of M577 fuzes that were assembled with a new crush element design.

4. PROCEDURE

Thirty test fuzes were fired in accordance with Supplement No. 27 to TPR LCN-T-2341 (Incl 1). The fuze x-rays were provided to the U.S. Army Armament Research and Development Command (ARRADCOM) representative for evaluation. Polaroid photographs of the fuze setting were made and given to the representative.

5. RESULTS

The 30 test fuzes were assembled to the projectiles and fired against a 2-inch thick plywood target. All rounds functioned on the target. A copy of the preliminary firing data was furnished the contractor's representative.

6. OBSERVER

Mr. H. J. Harmer, Hamilton Technology, Inc, Lancaster, PA

SUBMITTED:

Harold G. Eades
HAROLD G. EADES
Project Engineer

REVIEWED:

for Graham Stallenbarger
WILLIAM T. VOMOCIL
Chief, Munitions and Weapons
Engineering Branch

APPROVED:

William L. Snider
WILLIAM L. SNIDER
Chief, Test Engineering Division

- 2 Incl
1. TPR-2341, Supplement 27
2. Distribution List

TPR-2341, SUPPLEMENT 27

COPY

R 0512Z00Z JUN 80
FM CDRARRADCOM DOVER NJ //DRDAR-LCN-T//
TO RUWJHUA/CDRYPG YUMA AZ //STEYP-MTD//
INFO RUCIAFB/CDRARRCOM ROCK ISL IL //DRSAR-LEW//

BT

UNCLAS

FOR W. VOMOCIL, R. BARTLETT
SUBJ SUPPLEMENT 27 TO TPR-2341

1. REQUEST THE FOLLOWING BALLISTIC TEST TO BE CONDUCTED ON THIRTY (30) EA M577 FUZES OF HAMILTON SPECIAL ENGINEERING LOT HAT-80F000E024. THE ABOVE LOT TO BE FIRED AS FOLLOWS:
155MM, M1, 21, PLUS 70 DEGREES, PD FUNCTION, 30 EA
2. THE FOLLOWING DATA WILL BE RECORDED FOR ALL ROUNDS:
 - A. POLAROID PHOTO (FUZE SETTINGS)
 - B. PEAK CHAMBER PRESSURES
 - C. X-RAY ALL FUZES
3. HAMILTON PERSONNEL WILL WITNESS TEST.
4. FUNDS AVAILABLE UNDER SUBJECT TPR.
5. THIS SPECIAL FUZE LOT ASSEMBLED WITH A NEW CRUSH ELEMENT DESIGN.
6. PER AR-200-1 THE EIA ACTION IS NOT MAJOR. A SIGNIFICANT ENVIRONMENTAL IMPACT WILL NOT RESULT FROM THE ACTION AND THE IMPLEMENTATION OF THE PLAN OR ACTION WILL NOT BE ENVIRONMENTALLY CONTROVERSIAL.

BT

67262

Incl 1

Sup # 27

Fuze, mT, SQ, M577
Lot No. HAT80F-000E024

3004-3234-91

July 80 Clearance No. 25

820 ft - 5
TARGET Function

Tube Rd No	Time Fired	Sample No	Elev	Function	Miss Target
1 4831	1540	S	31.0	Right To Left	NA
2 4832		S	32.0		NA
3 4833		S	30.6		NA
4 4834		Test 50	31.0	OK	
5 35		51	31.0	OK	
6 36		52	31.0	OK	
7 37		53	30.8	OK	
8 38		54	30.8	OK	
9 39		55	30.6	OK	
10 40		56	30.6	OK	
11 41		57	30.6	OK	
12 42		58	30.6	OK	
13 43		59	30.6	OK	
14 44		60	30.4	OK	
15 45		61	30.2	OK	
16 46		62	30.2	OK	
17 47		63	30.2	OK	
18 48		64	30.2	Left To Right	OK
19 49		65	30.2	OK	
20 50		66	30.0	OK	
21 51		67	30.0	OK	
22 52		68	30.0	OK	
23 53		69	30.0	OK	
24 54		70	30.0	OK	
25 55		71	30.0	OK	
26 56		72	30.0	OK	
27 57		73	30.0	OK	
28 58		74	30.0	OK	
29 59		75	29.8	OK	
30 60		76	29.8	OK	
31 61		77	29.8	OK	
32 62		78	29.8	OK	
33 4867	1805	79	29.9	OK	

PRELIMINARY
INFORMATION
SUBJECT TO
CONFIRMATION
BY FINAL REPORT

Harold L. Farmer

30 for 30

E-5

Scratches -

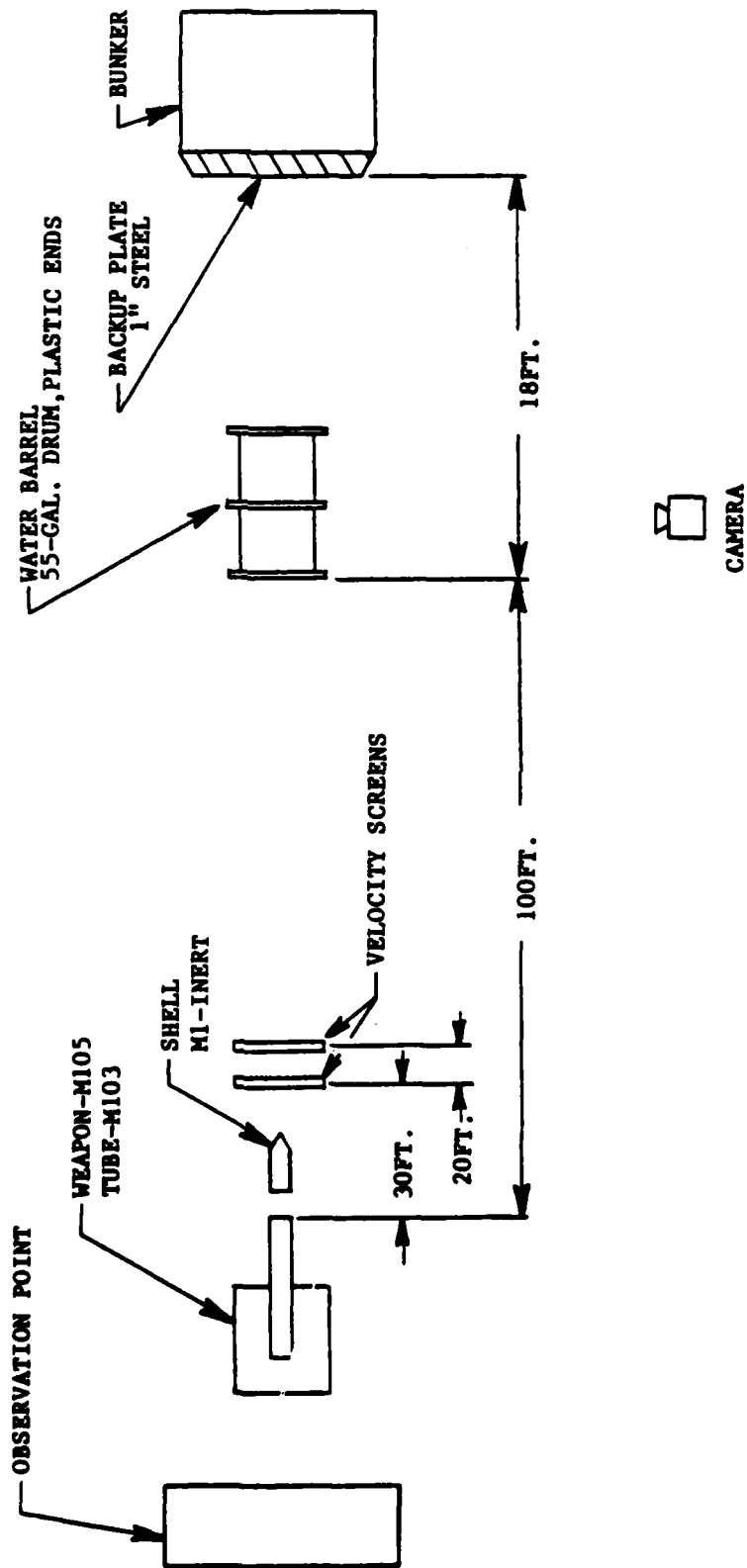
Proj. Lot No. LOP-E-116
Proj Lot No. M3A1 - RAD-68860
TR - LOP-2-20 } 10EA
 TOP-5-2 } 20EA
AS Test. 1 - M378K 000 E 129
Primers MX2A4 Perc - LS-186-15

APPENDIX "F"

BALLISTIC WATER IMPACT
TEST DATA

BALLISTIC WATER IMPACT

TEST SETUP



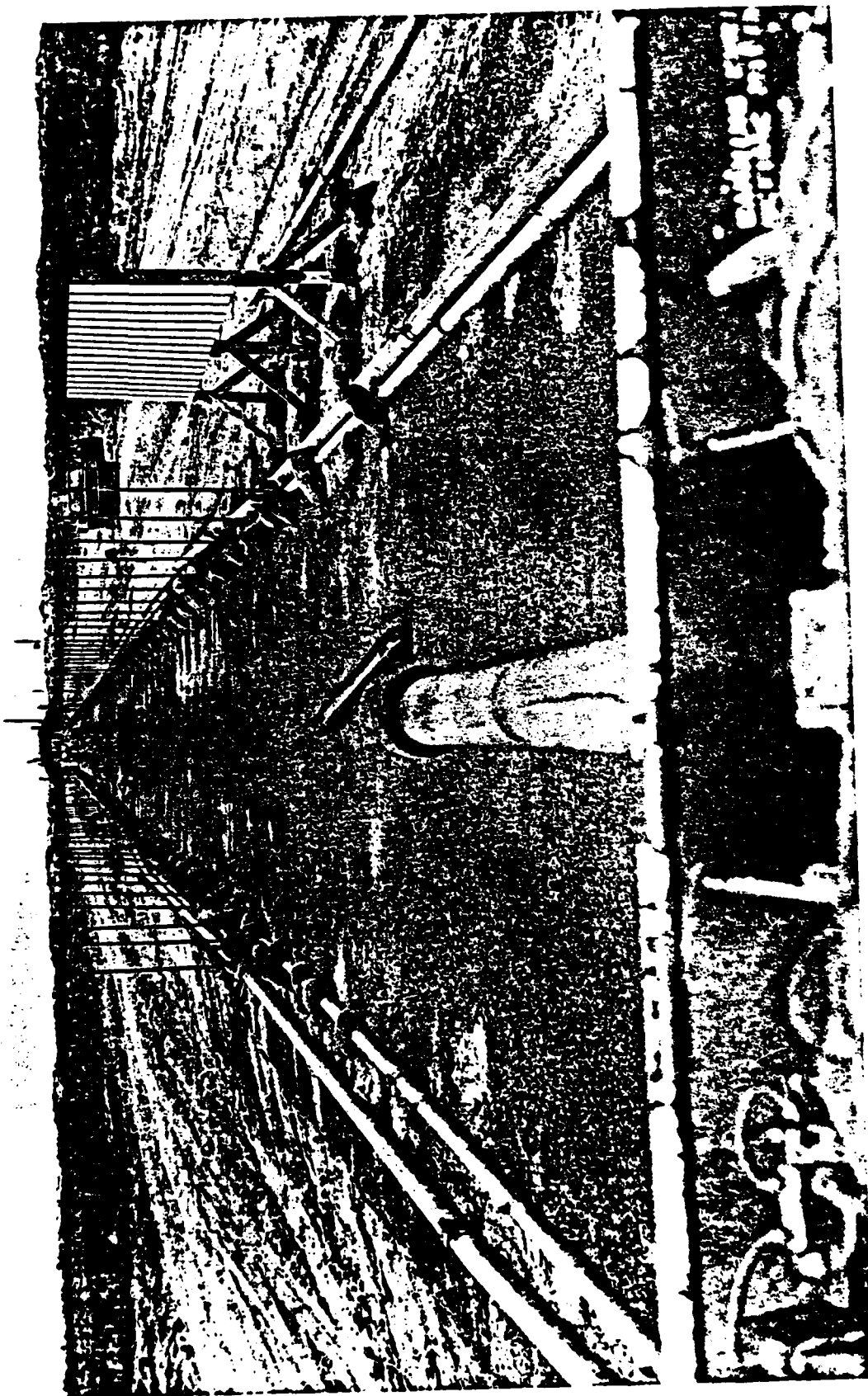


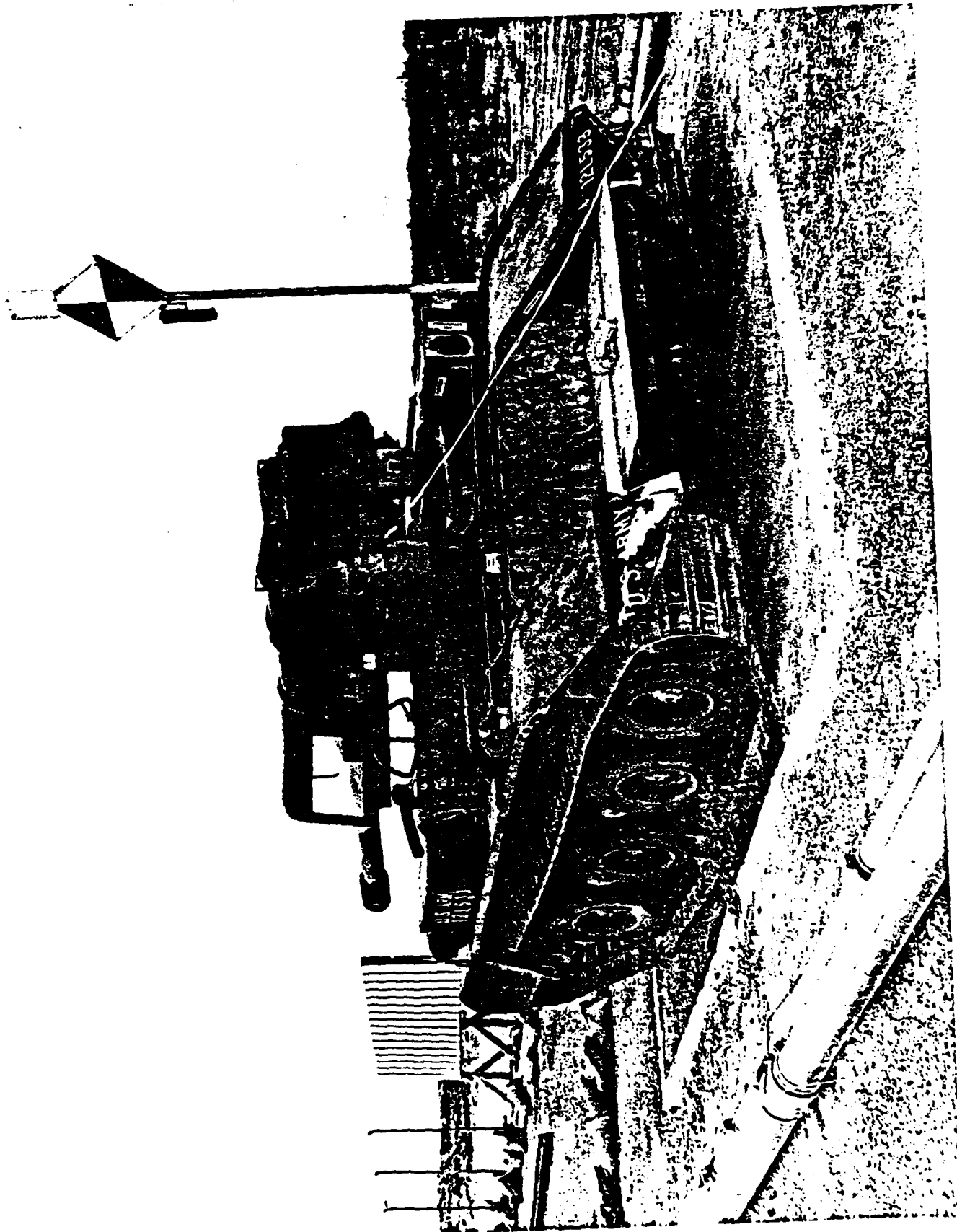


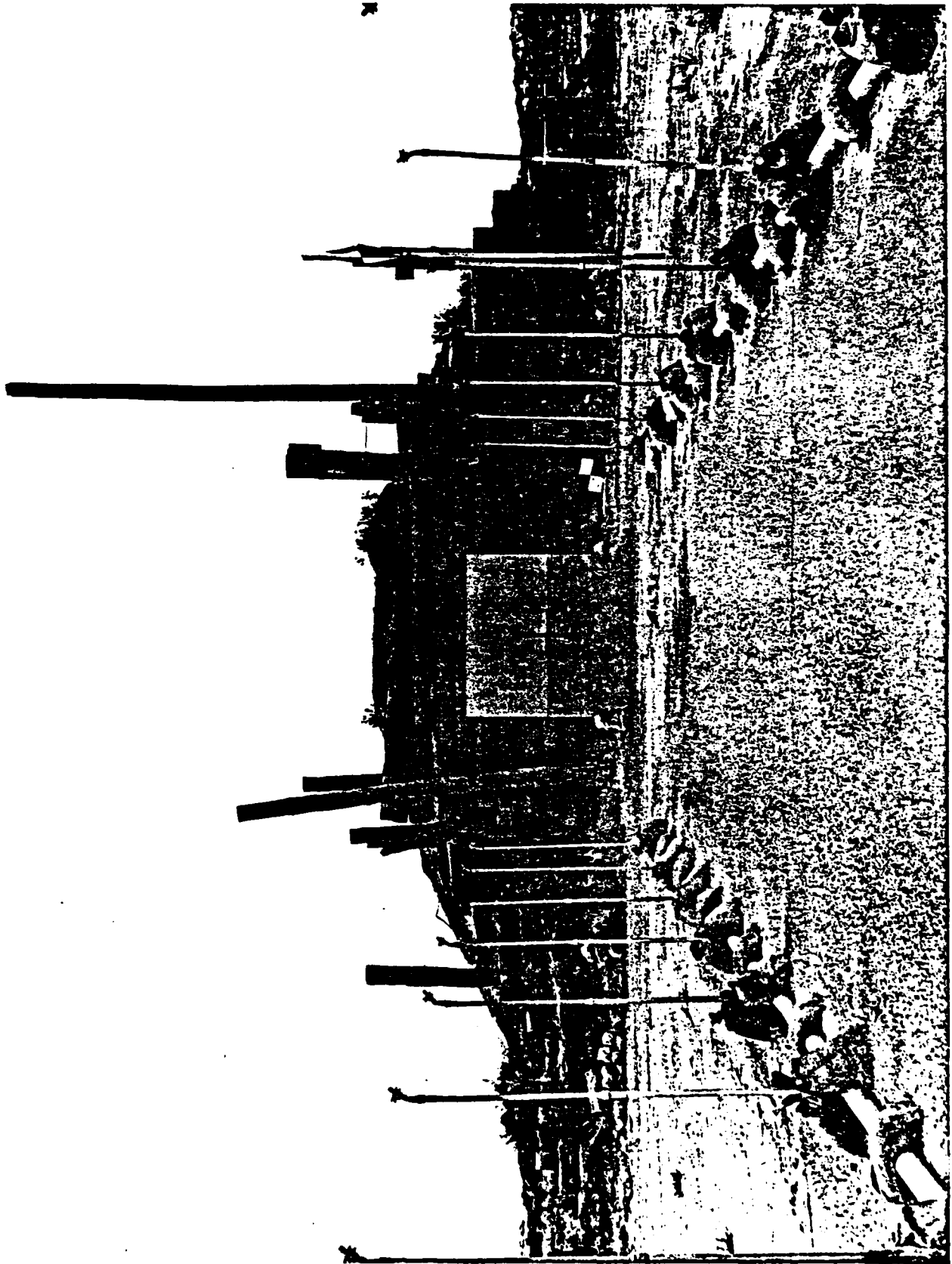


APPENDIX "G"

BALLISTIC RAINFIELD
TEST DATA







TEST TRACK DIVISION
OPERATIONS PLAN

OPLAN No: 63R-A

JON: 921CSY45

DATE: 18 July 1980

TITLE: M577 MTSQ Fuze Tests

CUSTOMER: ARRADCOM

SECURITY CLASSIFICATION: Unclassified

AUTHORITY: Test Directive dated 16 Jun 80

OBJECTIVE: To evaluate the performance of the M577 MTSQ Fuze in a simulated heavy rain environment.

DESCRIPTION: The test will be conducted on the Haydraw Ballistic Rainfield. A maximum of 100 90mm rounds will be fired from a M56 self-propelled 90mm gun. The rainfield will provide a simulated rain rate of 20 to 35 inches-per-hour over a length of 1200 feet. Approximately 50 M577 fuzes (test) and 20 M557 fuzes (control) will be tested. One control fuze (M557) will be fired before and after each group of five test fuzes (M577). Muzzle - 2700 FPS velocity will be measured on five rounds using photo-optical techniques. The gun muzzle will be located approximately 50 feet from rainfield entrance. Two burster screens will be located at equal distances between rainfield exit and the bunker. Each burster screen will be eight ft by eight ft plywood, the first one 1/2 inch thick and the second two inches thick. Volumetric rain rate data will be collected pre and post-test. Wind velocity data will be monitored by three anemometers located along the length of the rainfield. The maximum allowable crosswind will be three knots. All projectiles will be inert. However, the M577 fuze will contain a booster charge which will result in fuze fragmentation upon functioning. The M557 fuze will contain a spotting charge. The control fuze (M557) is expected to function in the rain. Fuze performance will be monitored by K-38 IR cameras and visual observation. The IR cameras and observers will be located 1000 ft south of the range.

LAUNCH POINT: Ballistic Range

HAZARD AREAS: North/South Boundary: 1000 feet either side of the Ballistic Rainfield
East/West Boundary: West Track Road to 10,000 feet west of bunker

NOTE: All personnel will be required to be behind protective blocks for each round fired. Unmanned vehicles will be considered safe 150 feet behind the gun. No personnel will be allowed within the hazard area except those required to conduct the test within the vicinity of the gun (behind the gun during firings).

AREA CLEARANCES: Initial: T-1 hr Final: T-10 mins

EOD: As Required

TEST SUPPORT:

1. TKI: Provide anemometers and Tipping Bucket rain gauge support as required by WE.

OPLAN 63R-A

2. TKS:

- a. Set up and operate the Ballistic Rainfield.
- b. Position bunkers and assist with gun positioning as required.
- c. Provide portable light carts and generators as required.
- d. Fabricate velocity measurement target board and burster screens as required. Replace or repair burster screens as required.

TEST MANAGER: Mr D. M. Severson, ext 2162 *msf*

CUSTOMER REP: Mr E. M. Ivankce, ARRADCOM/DRDAR-TSE-IL, AV 880-3355

J. C. Key, Jr.

J. C. KEY, Jr., Major, USAF
Acting Chief, Operations Branch

- 2 Atch
1. Annex "A"
2. Countdown

ANNEX "A" TO OPLAN 63R

DATE July 30, 1980

- I. INSTRUMENTATION ENGINEER: R.L. Saenz
- II. DATA MANAGER: _____
- III. LAUNCH FACILITY: NONE TRACK STATION: Ballistic Range
RAILS TO BE USED: 1 2 3 NOT USED
- IV. INSTRUMENTATION SUPPORT:
- T - TRACK C - CUSTOMER N/R - NOT REQUIRED
1. TRANSDUCERS: N/R
2. SIGNAL CONDITIONING: N/R
3. TELEMETRY: N/R
4. ON-BOARD RECORD: N/R
5. VELOCITY MEASUREMENT:
- A. SLEDBORNE OPTICAL: N/R
- B. SLEDBORNE MAGNETIC: NR
- C. TRACKSIDE MAGNETIC: NR
FROM T.S. _____ TO T.S. _____
- D. SPECIAL: NR
DESCRIPTION: _____

6. SLEDBORNE INSTRUMENTATION CONTROL: NR
- A. SIDE PULL UMBILICAL: _____
- B. FIRST MOTION UMBILICAL: _____
- C. COMMAND SYSTEM: _____
7. UMBILICAL RETRACTOR: NR
LARGE: _____
SMALL: _____
8. SPECIAL MARKERS OR SWITCHES: NR
MAGNETIC SENSORS: _____
LOCATIONS: T.S. _____
BREAKWIRES: _____
LOCATIONS: T.S. _____
BREAKSTICKS: _____
LOCATIONS: T.S. _____
9. SPECIAL TIMING & EVENT PROGRAMMING: N/R
(SEE CHART #1 IF REQUIRED)

10. TELEMETRY TAPE RECORDING: NR
(SEE CHART #2 IF REQUIRED)
11. TELEMETRY DATA: NR
(SEE CHART #3 IF REQUIRED)
12. QUICK LOOK OSCILLOGRAPHS: NR
(SEE CHART #4 IF REQUIRED)
13. COMMUNICATIONS: NR
- A. BLOCKHOUSE: _____
1) STANDARD: _____
2) SPECIAL: (DESCRIPTION) _____
- B. MOBILE LAUNCH: _____
1) STANDARD: _____
2) SPECIAL: (DESCRIPTION) _____
- C. TRACKSIDE: _____
1) (DESCRIPTION) _____
- D. TELEMETRY VAN: _____
1) (DESCRIPTION) _____
14. SPECIAL SCREENBOXES: NR
- A. LOCATIONS: T.S. _____
15. METEOROLOGICAL MEASUREMENTS: T
- A. FIXED ANEMOMETERS: NR
LOCATIONS: T.S. _____
- B. PORTABLE ANEMOMETERS: T
LOCATIONS: T.S. Ballistic Range (See Meteorological Personnel for specific locations)
- C. TEMPERATURE: C
LOCATIONS: T.S. _____
- D. BAROMETRIC PRESSURE: C
LOCATIONS: T.S. _____
- E. HUMIDITY: C
LOCATIONS: T.S. _____

SUPPLEMENT TO ANNEX C

OPLAN NO.: 63R

JON: 921CSY45

DATE PREPARED: 30 July 80

RAINFIELD DATA

RAINFIELD LENGTH 1200 feet T.S. Ballistic TO T.S. 15ft Separation

RAINFIELD CONTROL STATIONS N/A

VOLUMETRIC RAIN RATE 20 min to 36 in/hr .25 in/hr avg centerline

EQUIVALENT NATURAL RAIN RATE N/A

WIND RESTRICTIONS: DWNTRK - 5K CRSTRK 3K

<u>MANIFOLD:</u>	<u>INSIDE</u>	<u>OUTSIDE</u>
NOZZLE TYPE	<u>H 1/2 U80200</u>	<u>N/A</u>
NOZZLE ANGLE	<u>50°</u>	<u>N/A</u>
NOZZLE PRESSURE	<u>3 PSIG</u>	<u>N/A</u>
MANIFOLD PRESSURE	<u>6 PSIG</u>	<u>N/A</u>
RISER HEIGHT	<u>7 ft</u>	<u>N/A</u>

COMMENTS: 2.75 - 3.15 min mean diameter drop size.

Test Track Division
18 July 1980

MASTER COUNTDOWN

OPLAN 63R-A

F - FISHER

Q - QUAILWALK

H - HARMONY

S - SAFETY

T - TOBOGGAN

CALL SIGN

FUNCTION

F-40	Timer/Programmer
F-42/43	Trackside Instrumentation
F-44/45	Sled Instrumentation
F-46	TDC TM
F-47	TM Mobile Van/Arc Building TM
F-50	TV Camera
F-57	Instrumentation Engineer/Sled Instrumentation Chief
H-35	Launch Supervisor
H-36	Track Support Supervisor
H-37/38	Heavy Equipment Operator
T-39	Senior Controller
T-41/42	Test Manager
T-43/44	Sled Launch Crew Chief
T-45	Alignment Supervisor
T-72	Rainfield Operator
T-73	TKE Engineer
T-74	Customer
S-1	Mobile Safety
S-2	Mobile Safety
S-3	Helicopter Safety
S-4	Launch Pad Safety
Q-31	Laser Camera Operator
Q-34	Photo-Optical Supervisor
TC	Track Control

NOTE: T-41/42
T-44, T-42

Requires action by either call sign
Requires action by both call signs
*Radio Call Not Required

C. M. Severson
C. M. SEVERSON
Test Manager/TKO

Countdown 63R-A

L-1 DAY COUNTDOWN

<u>Time</u>	<u>Item</u>	<u>Agency</u>
0800	1. Rainfield ready.	T-72
	2. Pillboxes, light carts positioned.	H-36, H-37
	3. Gun positioned and leveled.	H-37, T-45
1600	4. Targets positioned.	T-41

L-DAY GUN SIGHTING AND MUZZLE VELOCITY MEASUREMENT COUNTDOWN

<u>Time T-</u> <u>Hr Min Sec</u>	<u>Item</u>	<u>Agency</u>
01 00 00	1. Initial area clearance.	S-1, S-2
45 00	2. Weapon ready; ammunition available.	T-74
	3. Generators operational and full of fuel.	Q-34, H-36
20 00	4. Camera loaded and ready.	Q-34
	5. Begin announcing T-time.	TC
10 00	6. Final area clearance.	S-1, S-2
	7. Announce count.	TC
05 00	8. Announce count.	TC
02 00	9. Verify hazard area clear.	S-1, S-2
	10. T-41 cleared to load gun.	TC
60	11. Announce count.	TC
	12. Gun loaded.	T-41
05	13. Initiation 05 second count to fire.	T-41
00 00 00	14. Fire.	T-74
	15. Record fire time and round number.	TC
	16. Verify gun safe.	T-41
	17. Reload camera.	Q-34
	18. Repeat Steps 12 through 17, as required, to complete gun sightings and/or velocity measurements.	T-41, TKOC

L-DAY RAIN TEST COUNTDOWN

<u>Time T-</u> <u>Hr Min Sec</u>	<u>Item</u>	<u>Agency</u>	
10 00	1. Volumetric rainfield calibrations complete.	T-72	_____
	2. Rainfield ready.	T-72	_____
	3. Verify final area clearance.	S-1, S-2	_____
05 00	4. Announce count.	TC	_____
	5. Verify clocks synchronized.	TC, Q-34	_____
02 00	6. Rainfield "UP" and "GO".	T-72	_____
	7. Verify hazard area clear.	S-1, S-2	_____
	8. T-41 cleared to load gun.	TC	_____
60	9. Announce count.	TC	_____
	10. Gun loaded.	T-41	_____
30	11. Wind velocity "GO".	T-41	_____
05	12. Initiate 05 second countdown to fire.	T-41	_____
00 00 00	13. Fire.	T-74	_____
	14. Record round number and fire time.	TC	_____
	15. Verify gun safe.	T-41	_____
	16. Verify fuze functioned and give location (Target or Rainfield).	T-74	_____
	17. Repeat Steps 6 through 16, as required, to complete testing.	TC	_____
	18. In the event a fuze fails to function, notify Track Control and determine if EOD is required.	T-41	_____

NOTE: Targets will be repaired/replaced as required after Item #16.

FIRING LOG TO BE MAINTAINED BY TRACK CONTROL

Round Number	Fire Time	Fuze Functioned	
		<u>In Rain</u>	<u>On Target</u>

NOTE:

Under round number for gun sighting rounds put in "SIGHT-IN"; for test rounds, number each one sequentially beginning with Number 1.

DYNALLECTRON CORPORATION land-air division		TOP NO 0-7-7				HIGH SPEED TRACK OPTICAL PLAN			
Oplan Series 603R-A		Letter of request for I.O.P. M.E. BUSH				Date I.O.P. Due: 7 AUG. '80			
Project Title: M-577 MISSILE FUZE TEST		Prepared By: BAGWELL				Date of scheduled run: 12 AUG. '80			
J.O.N. 921CSY45		Checked By: H.D. Sevenson				Date 7-31-80			
Test Manager MR. D. SEVERSON		Approved By: Billy D. Adams				Date 8-1-80			

Station	T.S. Location	Camera Type	Lens Size	FPS	Film Type	Length	Program		Coverage Segment		Image Size		Assignment
							On	Off	Horiz	Vert	Horiz	Vert	
F-2814	DS 1250	K-38	24	DIS FRAM	2424	125'	MANUAL	810'	405'	0223	0222	F-2814 (DS 1250) VIEW FROM SEGMENT DS 750 THRU SEGMENT DS 1550	
	1080 Smm		INCH	PER ROUND	IR					IN/FT	IN/FT	(CAMERA WILL BE ANGLED TO THE EAST SLIGHTLY SO THAT THE GUN LOCATION WILL BE IN THE RIGHT SIDE OF THE FORMAT AND STILL HAVE OVERLAPPING COVERAGE WITH CAMERA COVERAGE FROM F-2815)	
												(WILL BE USED TO VIEW THE GUN AT FIRE AND FIZES THRU RAINFIELD TO EVALUATE SENSITIVITY OF FIZES THRU THE RAINFIELD AREA)	
												CLOCK TUNING REQD	

(1) D.S. MEANS DISPENSING STATION MEASURED FROM THE START OF THE RAIN TEST COMPLEX IN THE HAY DRAW AREA. (2) TEST MANAGER WILL GIVE A 3 SEC. COUNTDOWN PRIOR TO EACH ROUND FIRED. (3) SYNCHRONIZE CAMERA CLOCKS WITH TRACK CONTROL.
 (4) BURNERS REQ'D AT EACH CAMERA SITE FOR PROTECTION OF PERSONNEL. (5) CAMERA OPERATORS REQUESTED TO KEEP A LOG OF EVENTS (E.G., FRAME NUMBER VS. ROUND NUMBER.) (6) DAYLIGHT ORIENTATION SHOT REQ'D FROM EACH CAMERA.
 (7) PROTECTIVE APPROX. 12" LONG & 4" IN DIA.
 (8) USE NOTE 'A' ON POR.

HIGH SPEED TRACK OPTICAL PLAN

Opcon Series	63 R-A	Project Title:	W577 MTSQ FUSE TEST	Test Manager	DON SEVERSON
J.O.N.	921CSY 45	Prepared By:	BAGWELL	Checked By:	<i>[Signature]</i>
		Date	7-31-80	Date	8-1-80
		L/A No.	0205		

Still Photography	Motion Picture	Not Req'd ()	Not Req'd ()
☒ 2 1/2 x 2 1/2 Pre-Post Run ☒	() 16mm Pre-Post Run (Color)	() 35mm Pre-Post Color Slides	
() 4x5 Pre-Post Run (B&W) (Color)	() Tracking Cameras Required (See TD-Below)	() Blast-Off Shot (Color Only)	
() Peloreid (B&W) (Color)	() Helicopter Tracking (See HT-Below)	☐ Oncoming View ☐ Rear	() Other

[illegible]

Notes:

* 02 2 1/4 x 2 1/4 Roll Film As Req'd By Test Manager.

DYNALLECTRON CORPORATION land-air division

OPTICS INSTRUMENTATION PLAN

OPLAN SERIES: 63R-A TOP N^o 0-7-7		DATE: 7-31-80	GENERATOR REQ'D: ONE
TS _____		DS 850	DS 800
TS _____		TS _____	

PLAN VIEW

SIDE VIEW OF CAMERA & TGT. BOARD.

FX-1

5000 fps
450' B&W

16mm f.f. NOVA
25mm LENS

DS 850

STATION **FX-1**

LOCATION **DS 850 54' SOUTH OF TARGET BOARD**

TURN-ON **T-3.0 SEC**

TURN-OFF **OUT OF FILM**

MANUAL **(COUNTDOWN FROM T/M)**

ALIGN CAMERA(S) AS FOLLOWS: **FX-1 1 TO TGT. BOARD & 54' SOUTH, POSITION & HOR. & VERT. OPTICS IN CENTER OF GRID BOARD. CAMERA HEIGHT APPROX 5' TO BE LEVEL WITH & OF BOARD.**

STATION **FX-1**

TURN-ON **T-3.0 SEC**

TURN-OFF **OUT OF FILM**

MANUAL **(COUNTDOWN FROM T/M)**

SPECIAL INSTRUCTIONS

ALIGN CAMERA(S) AS FOLLOWS: **FX-1 1 TO TGT. BOARD & 54' SOUTH, POSITION & HOR. & VERT. OPTICS IN CENTER OF GRID BOARD. CAMERA HEIGHT APPROX 5' TO BE LEVEL WITH & OF BOARD.**

STATION **FX-1**

TURN-ON **T-3.0 SEC**

TURN-OFF **OUT OF FILM**

MANUAL **(COUNTDOWN FROM T/M)**

TIMING REQ'D ☒ DIODE ☐ NEON **1000~**

EVENT: **FX-1 WILL RECORD 5 ROUNDS DURING DAYLIGHT HOURS PRECEDING NIGHT MISSION, FOR PURPOSES OF DETERMINING PROJECTILE VELOCITY. (ONE 450' BALL OF FILM PER ROUND FIRED) CAMERA & GENERATOR TO REMAIN OUT OF FIELD OF VIEW OF K-38 PRIOR TO NIGHT MISSION.**

- (1) NO RAW WILL BE REQ'D FOR THIS AFTERNOON FIRING.
- (2) IMAGE SKEW WILL BE .0034 INCH WHICH IS LESS THAN THAT OBTAINED ON SSR-MISSION.
- (3) TEST MANAGER WILL GIVE A 5 SEC. COUNTDOWN PRIOR TO EACH SHOT. CAMERA MUST BE RELOADED AFTER EACH SHOT.

INSTRUMENTATION SECTION

OPTICAL PLAN

land-air division

[illegible]

Notes: All Timing Amplifiers to be Diode unless otherwise specified.

Track Final Clear Time T. _____ Hour(s) _____ Min.

Timing-Programming Amplifier Ready Time 1. ____ Hour(s) ____ Min.

Camera Turn On Time T-____Hour(s)____Min.



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 6585TH TEST GROUP (AFSC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO 88330

7

EPLV TO

9 SEP 1980

ATTN OF: TKO (Mr Severson, AV 349-2162)

SUBJECT: Preliminary Data, 577 MTSQ Fuze Tests

TO: Commander, ARRADCOM
DRDAR-LCN-T
Bldg 61
ATTN: Mr Tom Perkins
Dover NJ 07801

1. Attached are three copies of the following data:
 - a. Muzzle velocity
 - b. I.R. film data
 - c. Volumetric rainfield calibrations
 - d. Wind velocity, temperature, and barometric pressure

You were previously given copies of the Operations Plan, Countdown, and Optical Instrumentation Plan.

2. A Test Summary Report containing all of the above information will be published in the future and forwarded to you.

FOR THE COMMANDER

Donald M. Severson

DONALD M SEVERSON
Test Manager
6585th Test Group/TKO

1 Atch
Data

63R MUZZLE VELOCITY ROUNDS

12 August 1980

<u>ROUND NO</u>	<u>MUZZLE VELOCITY (FPS)</u>
1	No data (lanyard hung)
2	2758
3	2807
4	2758
5	2827

HH20

M577 MTSQ FUZE TEST
RESULTS
FROM I.R. FILM DATA

DATE	ROUND NO.	FIRE TIME	FUZE - S/N	FUZE FUNCTION LOCATION
12 Aug 80	1	2243:42	557	No Indication
	2	2245:06	577 - 80	" "
	3	2245:46	577 - 81	" "
	4	2246:16	577 - 82	" "
	5	2246:50	577 - 83	" "
	6	2247:17	577 - 84	" "
	7	2247:50	557	" "
	8	2248:23	577 - 85	" "
	9	2249:01	577 - 86	" "
	10	2249:44	577 - 87	" "
13 Aug 80	11	2201:38	557	Target
	12	2202:17	577 - 88	" "
	13	2202:53	577 - 89	" "
	14	2203:33	577 - 90	" "
	15	2204:09	577 - 91	" "
	16	2204:45	577 - 92	" "
	17	2205:18	557	" "
	18	2025:15	557	" "
14 Aug 80	19	2025:49	577 - 93	" "
	20	2026:17	577 - 94	No Indication
	21	2026:43	577 - 95	" "
	22	2027:08	577 - 96	Target
	23	2027:38	577 - 97	" "
	24	2028:09	557	" "
	25	2028:45	577 - 98	" "
	26	2029:12	577 - 99	" "
	27	2029:38	577 -100	" "
	28	2030:02	577 -101	" "
	29	2030:39	577 -102	" "
	30	2030:54	557	" "
	31	2110:09	557	" "
	32	2111:50	577 -103	No Indication
	33	2112:14	577 -104	Target
	34	2112:46	577 -105	" "
	35	2113:29	577 -106	" "
	36	2114:30	577 -107	" "
	37	2114:58	557	Rainfield
	38	2115:20	577 -108	Target
	39	2115:52	577 -109	" "
	40	2116:16	577 -110	" "
	41	2116:43	577 -111	" "
	42	2117:05	577 -112	No Indication
	43	2117:31	557	Target
	44	2118:02	577 -113	" "
	45	2118:19	577 -114	Target*

<u>DATE</u>	<u>ROUND NO.</u>	<u>FIRE TIME</u>	<u>FUZE - S/N</u>	<u>FUZE FUNCTION LOCATION</u>
14 Aug 80	46	2118:47	577 -115	No Indication*
	47	2119:11	577 -116	Target*
	48	2119:33	577 -117	" "
	49	2119:53	557	Rainfield
	50	2216:15	557	"
	51	2216:40	577 -118	Target
	52	2217:01	577 -119	"
	53	2217:26	577 -120	"
	54	2217:51	577 -121	"
	55	2218:14	577 -122	"
	56	2218:39	557	Rainfield
	57	2218:58	577 -123	Target
	58	2219:17	577 -124	"
	59	2219:42	577 -125	"
	60	2220:02	577 -126	"
	61	2220:24	577 -127	"
	62	2220:46	557	Rainfield
	63	2221:07	577 -128	Target
	64	2221:25	577 -129	"
	65	2221:49	577 -130P	"
	66	2222:11	577 -131P	"
	67	2222:32	577 -132P	No Indication
	68	2222:58	557	Rainfield
	69	2223:18	577 -133P	No Indication
	70	2223:39	577 -134P	" "
	71	2223:59	577 -135P	" "
	72	2224:23	577 -136P	Target
	73	2224:45	577 -137P	"

*THESE ROUNDS HIT THE GROUND AT THE END OF THE RAINFIELD, JUST IN FRONT OF THE TARGET.

NOTE: ROUNDS 1-10 MISSED THE TARGET AND HIT THE BUNKER TO THE RIGHT SIDE OF THE TARGET. THE OTHER ROUNDS WHICH DID NOT INDICATE A FUZE FUNCTION MOST PROBABLY WERE BURIED IN THE BUNKER, SHIELDING THE FLASH FROM THE CAMERAS.



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 6585TH TEST GROUP (AFSC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO 88330

TO: TKS (Mr Monfette, 5-2203)

SUB: 63R-A Ballistic Rainfield Calibration Results

TO: TKO (Mr Severson)

1. The following data are the Ballistic Rainfield Calibration results for the 63R-A 90MM Fuze tests conducted from 12 Aug - 15 Aug 80.

PRE-TEST RESULTS

<u>Winds</u>	<u>Location</u>	<u>Nozzle Pressure</u>	<u>Avg Accumulation Rate</u>
2k Down, 2 Cross	100-110 ft	3 PSIG	18.8 in/hr
2 Down, 1 Cross	110-120 ft	3 PSIG	25.7 in/hr
2 Down, .5 Cross	120-130 ft	3 PSIG	28.5 in/hr

POST DATE

1K Down, .5k Cross	110-120 ft	3 PSIG	22.38 in/hr
1k Down, .5k Cross	120-130 ft	3 PSIG	24.3 in/hr

Phillip C Monfette
PHILLIP C. MONFETTE
Mechanical Eng/Rainfield System



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 6585TH TEST GROUP (AFSC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO 88330

PLV TO
FM OF: WE (Shipe, 2580)

27 August 1980

SUBJECT: Environmental Data, M577 MTSQ Fuze Tests, 12-14 Aug 80

TO: TKO (Mr Severson)

1. Paragraph 4 and the Attachment give the environmental data taken during the M577 MTSQ Fuze Tests along the ballistic rainfield 12-14 Aug 80. This was the first test series where more than one anemometer was set up and available for real-time input to GO/NO GO decisions.

2. Temperature and pressure data were taken at the bunker next to the howitzer, except 14 Aug temperature and humidity data was estimated from the Holloman Base Weather Station. Cross-rainfield and along-the-rainfield wind component data were taken with Gill "UV" anemometers set approximately ten feet from the north edge of the rainfield at the following locations:

- a. Station C: 200 feet west of the east end of the rainfield
- b. Station B: 700 feet west of the east end of the rainfield
- c. Station A: 75 feet east of the west end of the rainfield

A cross-rainfield wind component from the north was defined as positive, south negative. An along-the-rainfield wind component from the east is negative, west positive.

3. Due to time and other constraints, we were unable to a) get the Station B cross-rainfield wind component or Station A wind recorder working and b) perform a post-test anemometer calibration. As a result of this and a loss of power on the 14th, some of the wind data is missing. We estimate wind data accuracy at about $\pm .4$ knot.

4. Temperature, humidity, and pressure data are as follows:

- a. Shells 1-10: $72^{\circ} \text{ F} \pm 3^{\circ} \text{ F}$, $75\% \pm 5\%$, $875.8\text{mb} \pm .2\text{mb}$
- b. Shells 11-17: $73^{\circ} \text{ F} \pm 1^{\circ} \text{ F}$, $81\% \pm 2\%$, $872.2\text{mb} \pm .2\text{mb}$
- c. Shells 18-73: $73^{\circ} \text{ F} \pm 3^{\circ} \text{ F}$, $88\% \pm 5\%$, $871.4\text{mb} \pm .3\text{mb}$

John A. Shipe
JOHN A SHIPE, Major, USAF
Staff Meteorologist

1 Atch
Wind Components Data

WIND COMPONENTS FOR EACH HOWITZER SHELL
(Given in knots)

Shell #	Station A		Station B		Station C	
	Cross-Rainfield	Along-Rainfield	Cross-Rainfield	Cross-Rainfield	Along-Rainfield	Along-Rainfield
1	-1.0	-1.5	-.8	-1.8	-2.7	
2	-1.0	-2.0	-1.0	-1.0	-2.5	
3	-.7	-1.5	-.8	-1.0	-3.0	
4	-.5	-1.7	-.7	-1.2	-3.1	
5	-.6	-1.8	-.4	-1.2	-3.3	
6	-1.0	-2.0	-.7	-1.1	-3.0	
7	-1.0	-2.0	-.7	-1.5	-3.3	
8	-1.0	-2.0	-1.0	-1.4	-3.3	
9	-.8	-1.5	-.8	-1.2	-2.9	
10	-.7	-1.7	-.8	-1.0	-3.0	
11	-2.5	.5	-2.5	-2.0	.5	
12	-2.2	.7	-2.5	-2.4	.5	
13	-2.5	.7	-3.0	-2.0	.8	
14	-2.8	.5	-2.5	-2.0	.6	
15	-3.0	.5	-2.3	-2.4	.6	
16	-2.8	.5	-2.7	-2.0	.4	
17	-2.8	.5	-2.7	-2.3	.4	
18	.7	0	.4	.5	0	
19	.5	0	.7	.4	0	
20	.5	0	.6	.2	0	
21	.4	--	.6	0	--	
22	.5	--	.6	--	--	
23	.5	--	.6	--	--	
24	.6	--	.7	.3	--	
25	.6	--	.7	.5	--	
26	.7	--	.7	.4	--	
27	.6	--	.7	.4	--	
28	.6	--	.7	.2	--	
29	.6	--	.7	.1	--	
30	.6	--	.2	--	--	
31	--	-1.5	.3	--	--	
32	--	-1.5	.4	-.2	0	

WIND COMPONENTS FOR EACH HOWITZER SHELL (CONTD)
(Given in knots)

Shell #	Station A		Station B		Station C	
	Cross-Rainfield	Along-Rainfield	Cross-Rainfield	Cross-Rainfield	Along-Rainfield	Along-Rainfield
33	.1	-1.6	.8	-.2		0
34	--	-2.0	1.0	-.3		-2.0
35	.4	-1.5	1.3	-.2		-2.3
36	.8	-1.0	1.1	.5		-3.3
37	.5	.8	1.0	-.7		-2.4
38	1.4	--	1.5	.9		-2.5
39	1.5	--	1.0	1.0		-1.7
40	--	--	1.0	1.2		-1.0
41	1.2	--	1.0	1.2		-1.0
42	--	--	1.0	2.0		-1.0
43	--	--	1.3	1.1		-.9
44	--	--	1.8	1.1		-.8
45	--	--	1.7	.9		-.5
46	--	--	1.6	1.3		-1.2
47	--	--	.0	1.5		-1.5
48	--	--	.9	1.4		-1.5
49	--	--	4.0	2.7		-1.3
50	--	--	3.3	2.5		-1.5
51	--	--	2.7	2.2		-1.5
52	--	--	3.6	2.9		-1.4
53	--	--	3.2	2.0		-1.0
54	--	--	3.7	2.0		-1.0
55	--	--	4.7	1.7		-.9
56	--	--	3.9	2.5		-.5
57	--	--	4.0	2.5		-.8
58	--	--	2.8	3.0		-1.3
59	--	--	3.0	2.2		-1.2
60	--	--	3.0	2.7		-1.0
61	--	--	2.5	3.5		-.9
62	--	--	3.5	3.0		-1.0
63	--	--	2.5	3.7		-1.1
64	--	--	3.0	2.0		-1.0

WIND COMPONENTS FOR EACH HOWITZER SHELL (CONTD)
(Given in knots)

Shell #	Station A		Station B		Station C	
	Cross-Rainfield	Along-Rainfield	Cross-Rainfield	Cross-Rainfield	Along-Rainfield	Along-Rainfield
65	—	—	2.5	3.0	—	-.6
66	—	—	3.0	1.1	—	-.5
67	—	—	2.7	2.3	—	-.5
68	—	—	3.2	1.8	—	-.2
69	—	—	3.4	3.3	—	0
70	—	—	3.2	2.9	—	-.5
71	—	—	2.6	1.5	—	-.3
72	—	—	1.6	2.4	—	.0
73	—	—	2.3	1.5	—	-.3