

8. Zuni 5 Inch Rocket Test Report. I loved doing this test and I had a great crew at Stewart helping me get it done. The firing procedure was to approach the target at tree top level, pop up to 500 feet, roll the aircraft on it's back, establish the dive angle, roll the aircraft back upright on the target, trim, fire and hang a hard left (or right) back down to tree top level. The time available from pop-up to firing was 10 to 12 seconds.

Note. Prior to this test we had been firing single 5' rockets on our training missions. No one had ever fired four 5 in" rockets at the same time from an OV-1. A decision was made to test this procedure and to document the test in case something went wrong. We loaded the aircraft with 4 packs of 4 rockets each and Maj. Clifford Johnson loaded a Grumman photographer into a chase OV-1. We established a long approach at about a 20 degree glide angle to the target. I gave the photographer a countdown in the firing sequence and he took the picture. The result is shown in the small photo copy included.

3/1965

HEADQUARTERS
226TH AERIAL SURVEILLANCE & ESCORT BATTALION
11TH AIR ASSAULT DIVISION
Fort Benning, Georgia 31905

ZUNI 5 INCH ROCKET TEST REPORT

1. GENERAL: During the period 8-15 January 1965 the 226th Aerial Surveillance and Escort Battalion, 11th Air Assault Division conducted a firing test of the 5 inch Zuni rocket at Ramagen Range, Fort Stewart, Georgia. The test was conducted in two phases.

2. TEST OBJECTIVES:

- a. Determine accuracy of the 5 inch Zuni rocket when fired from a JOV-1 (Mohawk) aircraft utilizing the standard low level gunnery pattern.
- b. Determine procedures and techniques which will best produce direct hits on a point target such as a tank.
- c. Determine the minimum number of firing runs required to obtain a very high assurance of a direct hit.
- d. Determine aircraft exposure time.

3. PHASE I TEST: (8-11 Jan 65)

a. Purpose:

- (1) To determine sight (mil) setting.
- (2) To determine optimum slant range.
- (3) To determine most effective no. of rounds to fire each firing run (closely related to firing options discussed later)

b. Flight data:

- (1) Pilot - Capt Nathan C. Green
- (2) Aircraft JOV-1 63-13126
- (3) Run in heading to target - 132 degrees
- (4) Roll-in altitude - 500 feet absolute.
- (5) Firing altitudes - 150 to 300 feet absolute depending on slant range.
- (6) Angle of glide-eight to ten degrees.
- (7) Indicated airspeed - 220 knots.

(8) Rocket load - Sixteen; four LAU-10 launchers loaded with four zunis each.

c. Firing Options

(1) Single fire: Firing one rocket from one pack on each firing run. This method had been attempted prior to the test and was found ineffective against a point target.

(2) Rapid fire: Firing from one to four rockets at a time and firing more than once on each firing run. Firing four rockets at a time (one from each pack) it is possible to expend all sixteen rounds on one firing run. This method provides excellent area coverage but is not as effective as desired against a point target. Major problem areas encountered using the rapid fire method are:

(a) The sight moves through the target at one point during the firing run. This is the only point at which accurate fire can be delivered at a point target.

(b) With a glide angle of eight to ten degrees in the low level pattern the aircraft is moving at an approximate speed of 360 feet per second. It takes approximately three seconds to fire the sixteen rockets if they are fired four at a time. During those three seconds the slant range is constantly changing causing the dispersion pattern on the ground to be approximately four hundred feet long and 20 to 40 feet wide.

(3) Four round salvo: Firing one round from each Zuni pack simultaneously and firing once on each firing run. No major problems encountered using this method of fire.

d. Discussion: It was necessary to bore sight the launchers to obtain hits consistently. This was accomplished to the degree permitted by adjusting the sway braces laterally and in elevation by adjustment of the hook up lugs on the LAU-10 launcher. Final adjustment for bore sighting was arrived at by trial and error until the most effective hit pattern was obtained. The aircraft was placed on jacks and a bore sight template made at 1000 inches using the armament datum line as the reference. (See annex III for bore sighting template.) Accuracy was best at shortest slant ranges. In the interest of safety 1000 feet was established as the minimum slant range. It is felt that under combat conditions engagement range could be reduced to 700 feet, thereby, providing increased accuracy. It was difficult to locate and track targets (painted OD) at slant ranges greater than 1500 feet. The target tended to blend with the terrain.

e. Results

(1) Sight angle - 50 mils.

(2) Bore sight template - see annex III

(10) Firing option - four round salvo

(11) Light (mil) setting - 50 mils

c. Results:

(1) Number of flights - 8 (see annex II page 9 thru 16)

(2) Firing runs on the target - 32

(3) Rounds fired - 126

(4) Direct hits - 23

(5) Firing runs that obtained hits - 15 (47%)

(6) Exposure time - 8-10 seconds

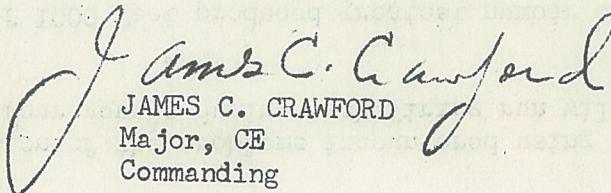
d. Conclusions:

(1) Single round hit probability was .125 (12.5% of rounds fired hit the target).

(2) Two firing runs, firing one salvo of four rounds on each run gives a high assurance of a direct hit (94% assurance).

(3) If sway braces and hook-up lugs permitted complete convergence of a four round salvo at 1000 feet it is proposed that a greater degree of accuracy could be achieved.

(4) Due to single round low hit probability the four round salvo attack will be the standard method for point target engagement.


JAMES C. CRAWFORD
Major, CE
Commanding

ANNEX I 1 page - Range diagram

ANNEX II 16 pages - Individual flight and firing run records

ANNEX III 1 page - Bore sighting template

HEADQUARTERS
226TH AERIAL SURVEILLANCE & ESCORT BATTALION
11TH AIR ASSAULT DIVISION
Fort Benning, Georgia 31905

AJVAV-SA-C

2 February 1965

SUBJECT: Zuni 5 Inch Rocket Test Report

TO: See Distribution

1. The attached Zuni 5 Inch Rocket Test Report is published for information of all concerned.


2. During the period 5 thru 15 Jan 65 this Battalion conducted a firing test of the Zuni Rocket from the JOV-1 (Mohawk) at a point target. Detailed report of test attached as Incl 1.

3. Firing one salvo of four Zunis per firing run proved to be the most effective method of fire. Using this method 15 out of 32 firing runs obtained direct hits (47%). Average exposure time was 10 seconds.

4. This battalion has adopted the four round salvo method of firing as standard. A firing run made by a flight of two aircraft will give a 94% assurance of a kill.

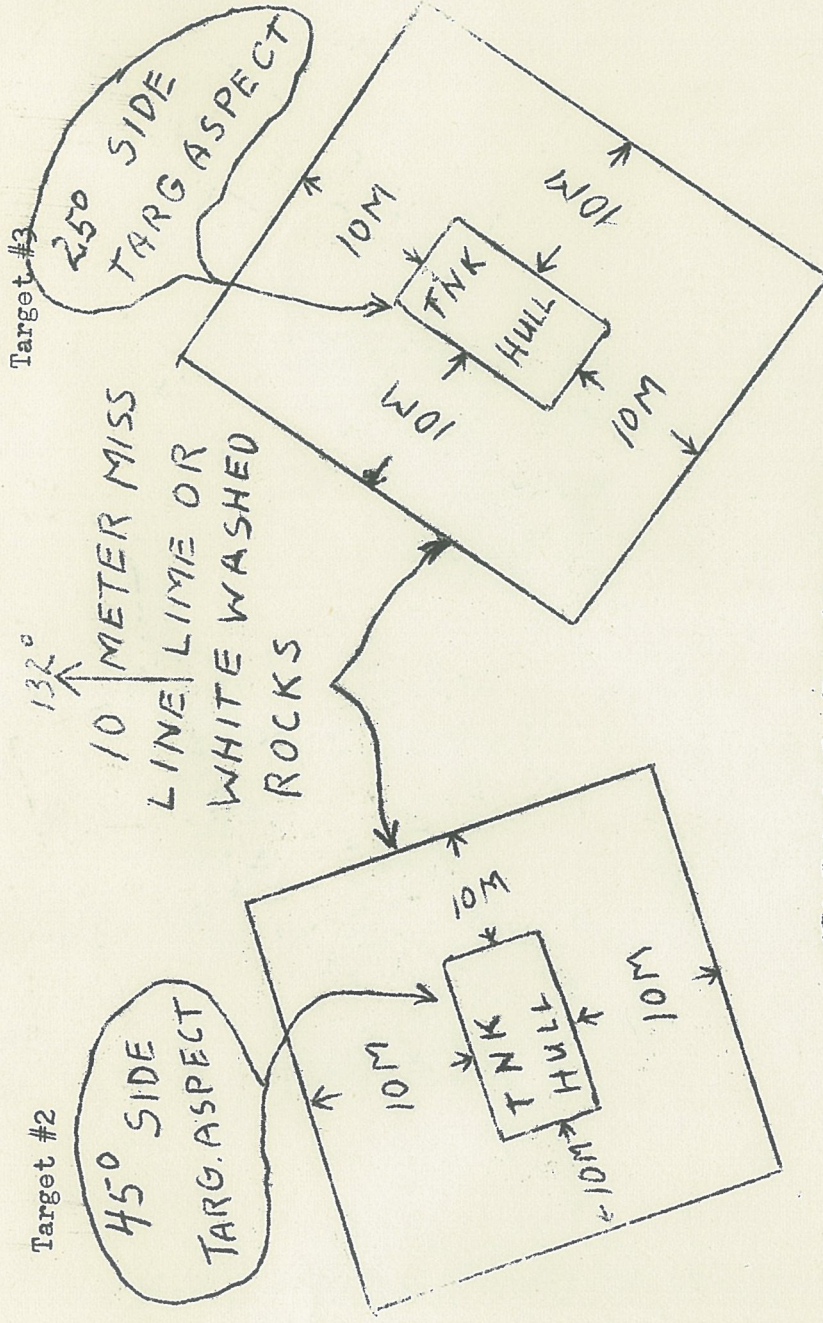
FOR THE COMMANDER:

1 Incl
as


ROGER D. SIMPSON
Captain, SigC
Adjutant

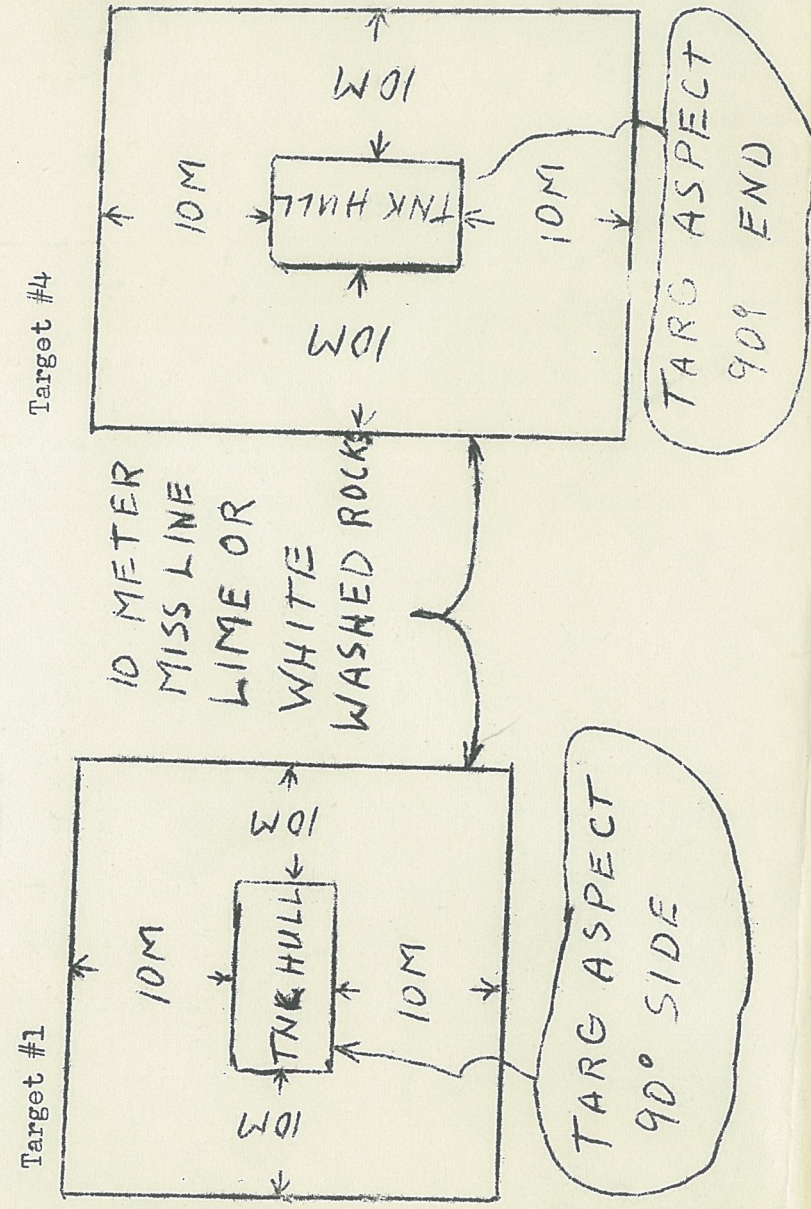
DISTRIBUTION:

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3 ea - CO 11th Avn Gp
3 ea - XO 2nd Bde
3 ea - G3 Div



TARGET DIMENSIONS
(ALL SAME)

LENGTH 20'9 1/2"
HEIGHT 8'10"
WIDTH 7'3 1/2"



COVER SHEET ANNEX II

1. Refer to range diagram Annex I for target numbers and dimensions.
2. Scoring of hits and misses accomplished by an officer in a helicopter.
3. Diagram info on individual flights not to scale.
4. Legend for diagrams

- a. **X** - rocket estimated within 10 feet of target
 - b. **(X)** - rocket estimated one hundred feet or more from the target
 - c. **[X]** - target
5. Run in heading - 132° = bottom of page

FLIGHT NUMBER ONE

DATE _____ 8 Jan 65
 TIME _____ 1530 hours
 WINDS _____ South-West 7K
 Slant Range _____ 1000 Feet
 Rounds fired _____ 14
 Firing Runs _____ 4
 Hits on Target _____ 2

REMARKS - Firing method used four round salvo. Station number two malfunctioned on the first firing run and fired a second rocket (suspect the interometer was set on tube number one when armed and stepped to tube number two after number one fired). This malfunction caused the second firing run to have three rounds available. Two rockets refused to fire on the fourth run and were returned to the base airfield for dearming. Rocket dispersion on the ground was 50 to 100 feet horizontally and vertically. Target utilized, number one.

Run #1

⊗
 X X
 X [] X

Run #2

X [] X
 X X

Run #3

X [] X
 X X X

Run #4

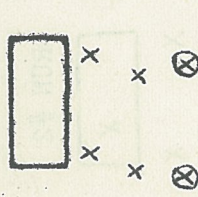
X [] *
 X

FLIGHT NUMBER TWO

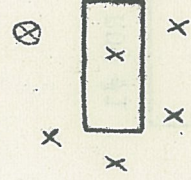
DATE _____ 9 Jan 65
 TIME _____ 1345 hours
 WINDS _____ South 10K
 Slant range _____ 1200 to 1000 ft
 Rounds fired _____ 16
 Firing runs _____ 4
 Hits on target _____ 2

REMARKS - Firing method used, six rockets fired on the first run in rapid fire. Two of the rounds landed about three hundred feet from the target and all rounds were short. The second firing run was fired the same way, however, one hit was scored. The remaining four rockets were fired two at a time on two runs. Using the rapid fire method about one-half second must be allowed between shots to permit the intervalometer to operate in the pack. This causes a change in slant range between shots and necessitates retrimming the aircraft to keep the sights on the target. About one second must be allowed after each trim change for neutralization of the control surfaces. Dispersion pattern on the last three runs had rounds short, over, and on both sides of the tank. Target utilized, number one.

RUN #1



RUN #2



RUN #3




RUN #4





FLIGHT NUMBER THREE

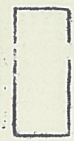
DATE 10 Jan 65
 TIME 1000 hours
 WINDS South 15K
 Slant range 1250 ft
 Rounds fired 12
 Firing runs 4
 Hits on target 1

REMARKS - A change of aircraft was necessary and 61-2726 was used for this flight. The Zuni packs were loaded the same as on 63-13126. Pack number five refused to fire. The rapid fire method was again tried firing four rockets on each run (fired in pairs). One hit scored on firing run number two. Target utilized, number one.

RUN #1

 X X
 ⊗ ⊗

RUN #2

 X X X

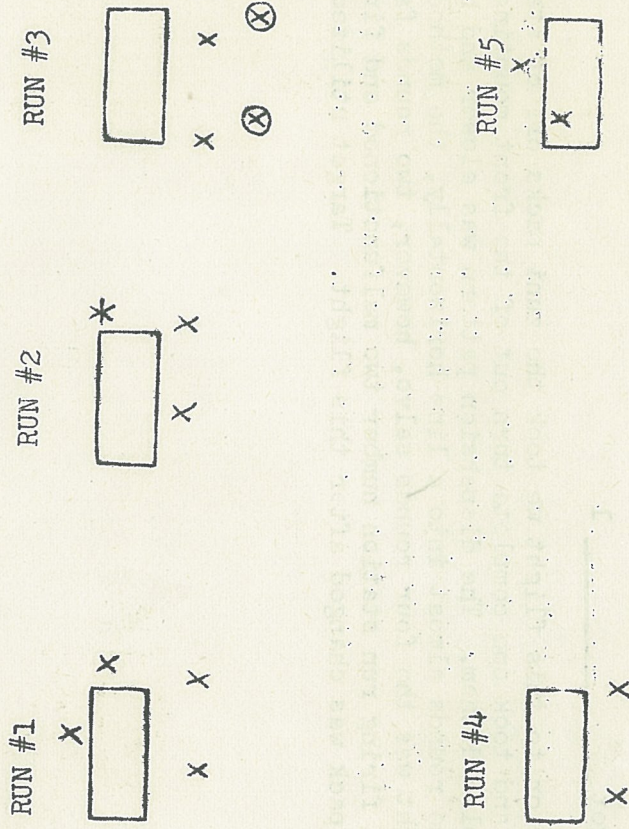
RUN #3

 X X

RUN #4

 X X

FLIGHT NUMBER FOUR

DATE _____ 11 Jan 65
 TIME _____ 0800 hours
 WINDS _____ North 8K
 Slant Range _____ 1500 ft
 Rounds fired _____ 15
 Firing runs _____ 5
 Hits on target _____ 1

REMARKS - Salvo method used on runs number one and two. One round failed to fire and the rapid fire method was used on the remaining runs. Aircraft number 63-13126 was again used. Prior to this flight and the next two flights we changed the position of the zuni packs on the racks in an attempt to tighten the dispersion of the rockets. We found that we could move the front of the pack toward the nose of the aircraft and by tightening the sway braces in sequence hold it in that position. The dispersion pattern is improving. Target utilized, number one.



FLIGHT NUMBER FIVE

DATE _____ 11 Jan 65
 TIME _____ 1000 hours
 WINDS _____ North 10K
 Slant Range _____ 1500 ft
 Rounds fired _____ 14
 Firing runs _____ 4
 Hits on target _____ 1

REMARKS - Prior to this flight we took the zuni packs off of station number one and six and took one complete turn out of the front mounting lug on each pack and replaced them. The dispersion pattern was closer and brought the strike of the rounds almost into a line horizontally, the method of fire used on this flight was the four rounds salvo, however, two rounds failed to fire. On the first firing run station number two malfunctioned and fired a second rocket, the pack was changed after this flight. Target utilized, number one.

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X X X

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FLIGHT NUMBER SIX

DATE _____ 11 Jan 65
 TIME _____ 1300 hours
 WINDS _____ North 15K
 Slant Range _____ 1500 ft
 Rounds fired _____ 15
 Firing ruhs _____ 4
 Hits on target _____ 0

REMARKS - Salvo of four rockets per run utilized. Pattern was again basically linear and one rocket failed to fire. The crosswind was difficult to compensate for and the air was turbulent. Target utilized, number one.

RUN #1



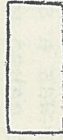
X X X X

RUN #2



X X X X

RUN #3



X X X X

RUN #4

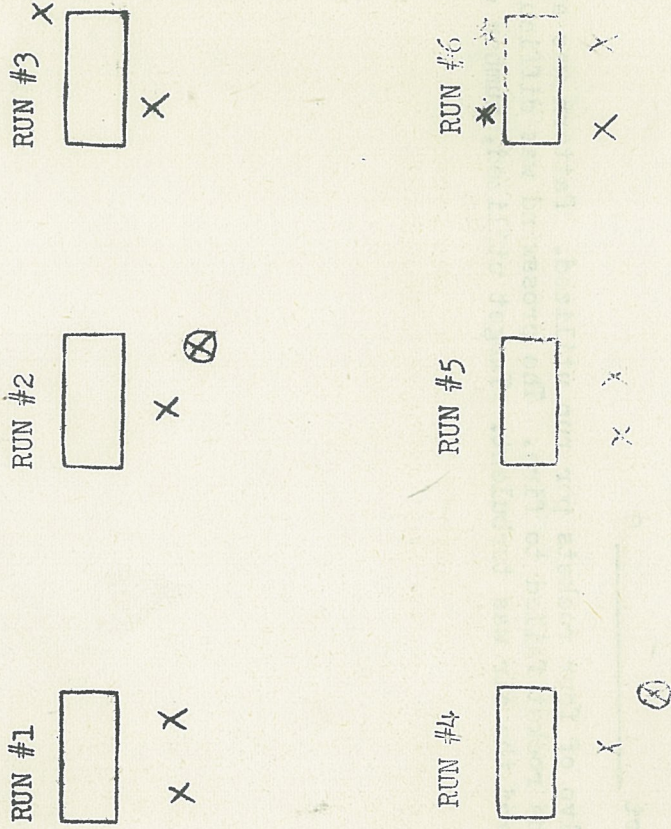


X X X X

FLIGHT NUMBER SEVEN

DATE _____ 11 Jan 65
 TIME _____ 1545 hours
 WINDS _____ North-east 15K
 Slant Range _____ 1800 ft
 Rounds fired _____ 14
 Firing runs _____ 6
 Hits on target _____ 0

REMARKS - Method used, salvo of two rockets on the first five firing runs. The last run was a salvo of four. The dispersion pattern was again extended, the probable cause was the increased slant range, not having the wings of the aircraft perfectly level and the longer time of flight of the rockets. Rocket motor burnout was observed prior to the rocket striking the ground. Target utilized, number one.



FLIGHT NUMBER EIGHT

DATE 12 Jan 65

TIME 0800 hours

WINDS North 3-5K

Slant Range 1000 ft

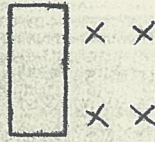
Rounds fired 16

Firing runs 4

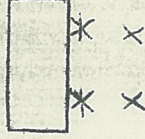
Hits on target 1 (two rounds)

REMARKS - Firing method used, four round salvo on each firing run. Prior to this flight the zuni packs on stations one and six were removed and the front mounting lugs were tightened one-half turn. The rocket dispersion on this flight formed a box pattern with the rounds striking the ground approximately 15 to 25 feet apart. The aircraft (63-13126) was grounded after this flight for the purpose of recording bore sighting information. Target utilized, number one.

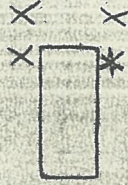
Run #1



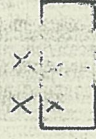
Run #2



Run #3



Run #4

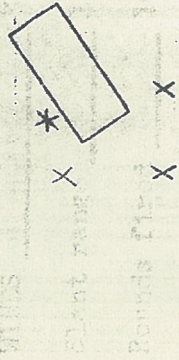


FLIGHT NUMBER NINE

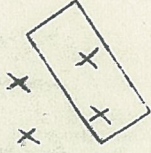
DATE _____ 12 Jan 65
 TIME _____ 1100 hours
 WINDS _____ North 5k
 Slant range _____ 1000 ft
 Rounds fired _____ 16
 Firing runs _____ 4
 Hits on target _____ 1 (two rounds)

REMARKS - Firing method used, four round salvo. Aircraft number 63-13119 was loaded with zuni packs with the same adjustments as the packs on aircraft number 63-13126. The dispersion pattern was basically unchanged. Target destroyed, number two.

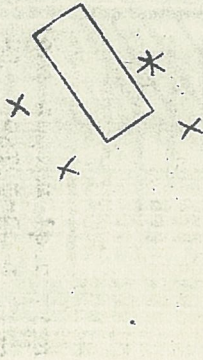
Run #1



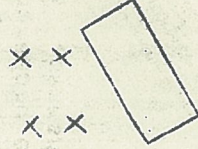
Run #2



Run #3



Run #4



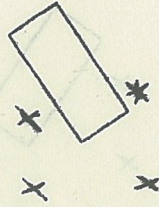
FLIGHT NUMBER TEN

DATE _____ 12 Jan 65
 TIME _____ 1400 hours
 WINDS _____ North-East 5k
 Slant Range _____ 1000 feet
 Rounds fired _____ 16
 Firing runs _____ 4
 Hits on target _____ 2 (4 rockets)

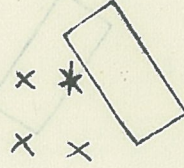
REMARKS - Firing method used, four round salvo. On firing runs when no hits were scored close misses (within ten feet of the target) were observed. No shot utilized, number two.



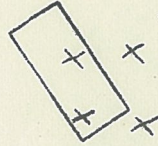
Run #1



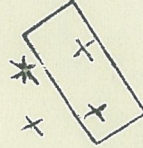
Run #2



Run #3



Run #4

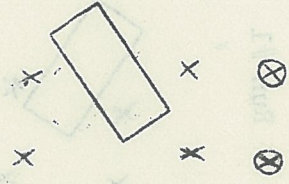


FLIGHT NUMBER ELEVEN

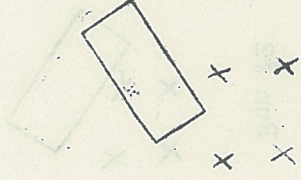
DATE _____ 14 Jan 65
 TIME _____ 1000 hours
 WINDS _____ North-west 5k
 Slant Range _____ 1300 to 1000 feet
 Rounds fired _____ 14
 Diving runs _____ 4
 Hits on target _____ 1

REMARKS - Rapid fire method utilized and on the first two firing runs the rounds were fired as rapidly as possible (two rounds were fired each time the firing switch was activated). Target utilized, number two.

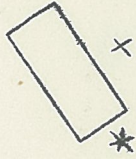
Run #1



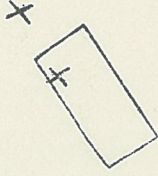
Run #2



Run #3



Run #4

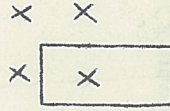


FLIGHT NUMBER TWELVE

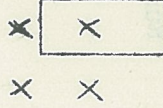
DATE _____ 14 Jan 65
 TIME _____ 1400 hours
 WINDS _____ West 12K
 Slant Range _____ 1000 feet
 Rounds fired _____ 16
 Firing runs _____ 4
 Hits on target _____ 4 (5 rockets)

REMARKS - The four round salvo method of fire was utilized. Dispersion pattern was excellent, the sun was in position for good visibility in the target area, and the wind presented no problem. Target utilized, number four.

Run #1



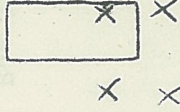
Run #2



Run #3



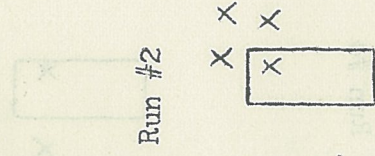
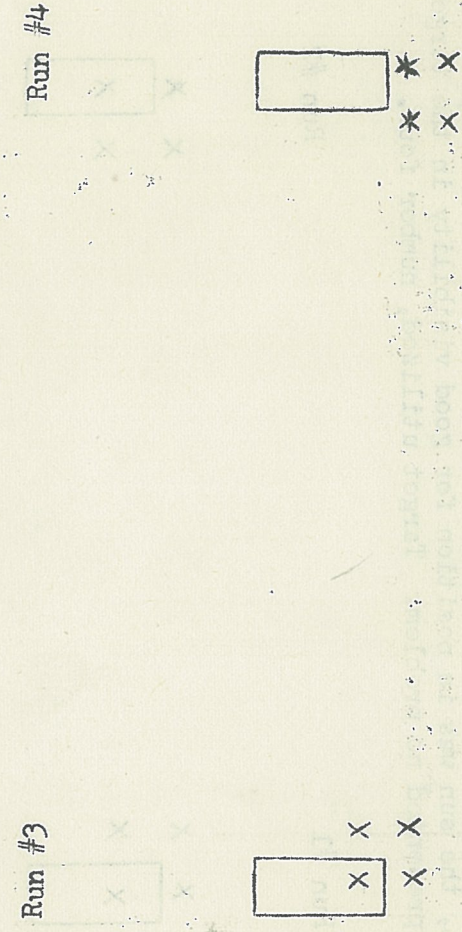
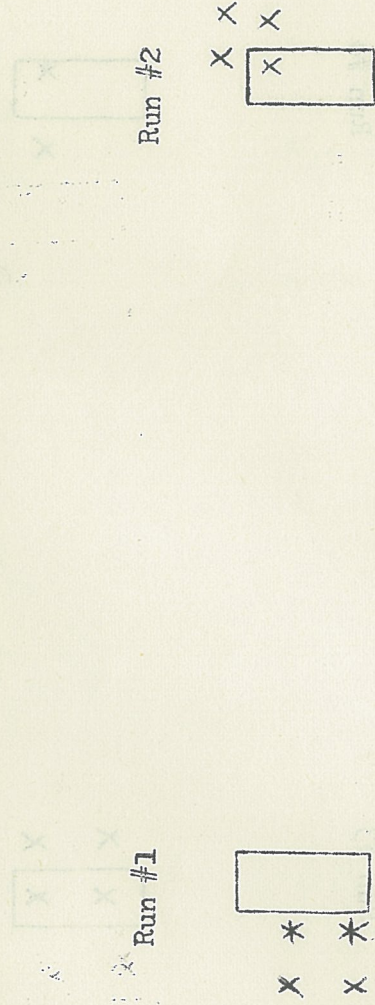
Run #4



FLIGHT NUMBER THIRTEEN

DATE 15 Jan 65
 TIME 0830 hours
 WINDS East-south-east 5k
 Slant range 1000 feet
 Rounds fired 16
 Firing runs 4
 Hits on target 2 (4 rockets)

REMARKS - Firing method used, four round salvo. On the firing runs when no hits were scored, close misses (within 10 feet) were observed. Target utilized, number four.

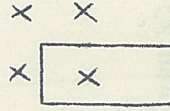


FLIGHT NUMBER TWELVE

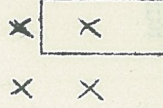
DATE _____ 14 Jan 65
 TIME _____ 1400 hours
 WINDS _____ West 12K
 Slant Range _____ 1000 feet
 Rounds fired _____ 16
 Firing runs _____ 4
 Hits on target _____ 4 (5 rockets)

REMARKS - The four round salvo method of fire was utilized. Dispersion pattern was excellent, the sun was in position for good visibility in the target area, and the wind presented no problem. Target utilized, number four.

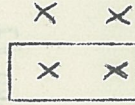
Run #1



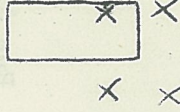
Run #2



Run #3



Run #4

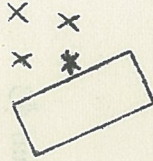


FLIGHT NUMBER FOURTEEN

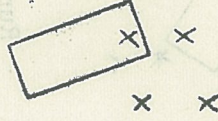
DATE 15 Jan 65
 TIME 1100 hours
 WINDS South-east 8k
 Slant Range 1000 feet
 Rounds fired 16
 Firing runs 4
 Hits on target 2 (4 rounds)

REMARKS: Firing method used, four round salvo. Firing on targets at different angles to the run in heading presented no problem. Average number of hits on the target was not reduced when firing at the targets presenting the smallest area to the run in heaving. Target utilized, number three.

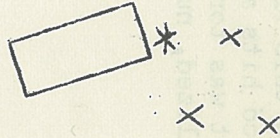
Run #1



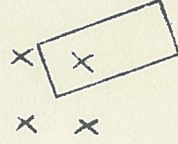
Run #2



Run #3



Run #4



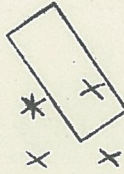
FLIGHT NUMBER FIFTEEN

DATE _____ 15 Jan 65
 TIME _____ 1430 hours
 WINDS _____ South-east 10k
 Slant Range _____ 1000 feet
 Rounds fired _____ 16
 Firing runs _____ 4

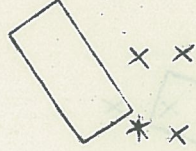
Hits on target _____ 2 (four rounds)

REMARKS - Firing method used, four round salvo. Brig General Knowles accompanies me on this flight and commented favorably on the results. Two of the runs scored hits and the other two runs had very close misses. The top of the target was torn off by the effect of the hits on the last firing run. Target utilized, number two.

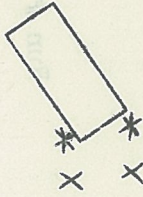
Run #1



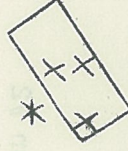
Run #2



Run #3



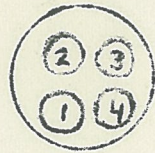
Run #4



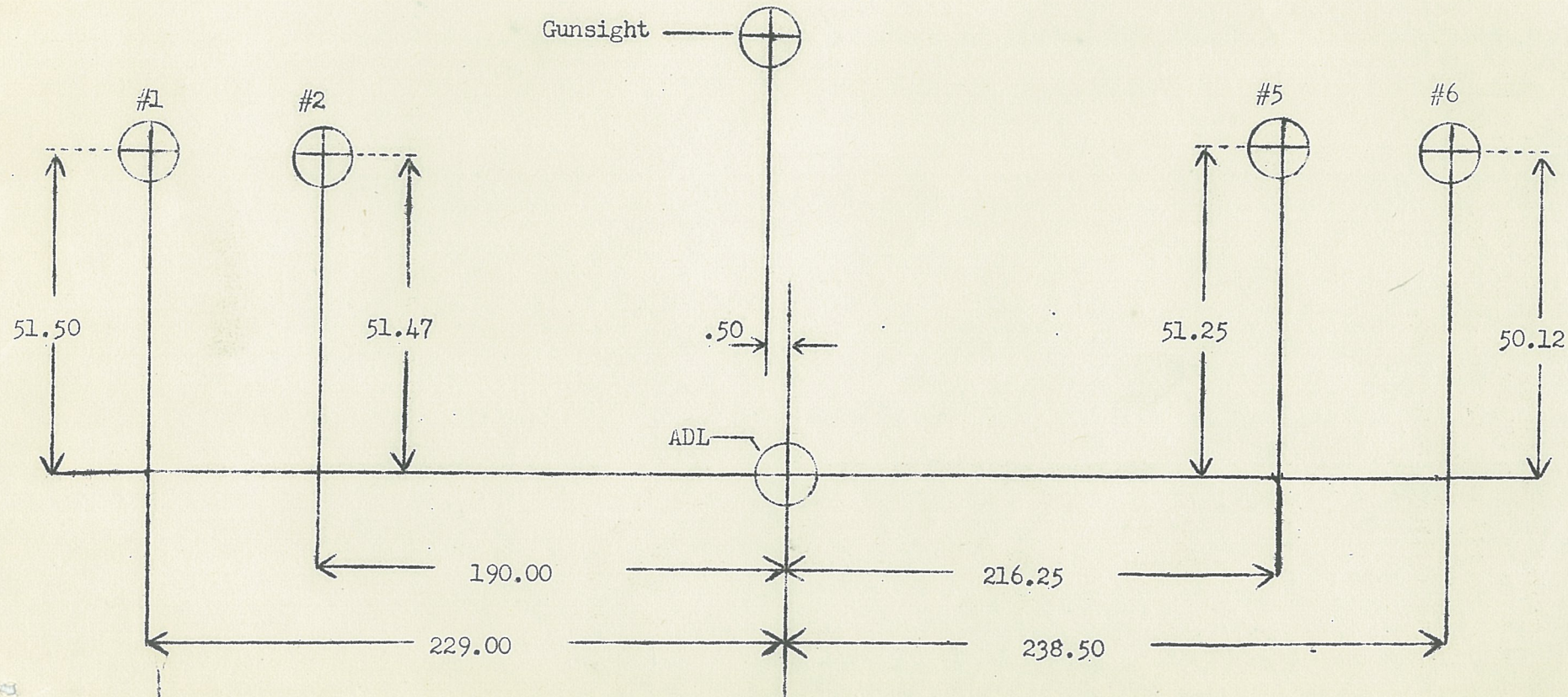
ANNEX 3 TO ZUNI FIRE TEST REPORT

ZUNI BORESIGHTING

Alignment diagram for boresighting
982" boresight target from nose
wheel axle. Provides for 1000 ft
fire convergence and 0° angle of
attack.



View looking aft to front.
To boresight stations 1 & 2, set
boresight tools in tube #4.
To boresight stations 5 & 6, set
boresight tools in tube #1.



Annex 3