

MIL-F-7417(USAF)  
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## MILITARY SPECIFICATION

### FIXED GUN AND ROCKET INSTALLATIONS, ENGINEERING TESTS OF

#### 1. SCOPE

1.1 This specification covers the requirements for the fabrication of a firing test stand and the engineering tests of fixed gun and rocket installations of new model military aircraft and succeeding models thereof in which the installation has been re-designed, and any alternate installations thereof.

#### 2. APPLICABLE PUBLICATIONS

2.1 The following publication shall form a part of this specification to the extent specified herein:

##### 2.1.1 Specifications:

###### U. S. Air Force:

R-1800	Aircraft, General Specification for
C-1803-9	Stress Analysis Criteria

##### 2.1.2 Publications:

###### U. S. Air Force, Air Materiel Command:

Manual No. 80-1	Handbook of Instructions for Air-
	craft Designers

#### 3. REQUIREMENTS

3.1 Fixed Gun Installation and Alternate Fixed Gun Installation.- Tests as outlined in this specification shall be required of the contractor on all new model military aircraft and succeeding models thereof in which the fixed gun installation has been re-designed. Tests as outlined in this specification shall also be required of the contractor on any alternate fixed gun installation required by the model specification.

3.1.1 Gun Installation Firing Test Stand.- The contractor shall provide, prior to the completion of the first airplane equipped for gunnery, a gun firing test stand which represents as closely as possible, the fixed gun installation to be installed in the airplane as required by the airplane model specification. The gun firing test stand and tests thereof shall be completed as early as possible in the aircraft development program in order to incorporate into the aircraft design any changes found necessary during ground firing tests.

3.1.2 Materials.- The test stand shall be constructed of the same materials and in the same manner as used in the flying prototype gun installation.

3.1.3 Construction.- The test stand installation shall be constructed in duplication of that section of the aircraft in which the guns are located. In wing installations this shall include an actual section of the wing mounted in a suitable framework to support it in firing position. In fuselage installations this shall include that part of the fuselage in which the guns are located and all of the fuselage forward of the guns and shall be mounted in a suitable framework to support it in firing position. The framework shall be mounted on skids to permit readily sliding the test stand about on concrete ramps or aprons.

3.1.4 Provisions for Accessories.- The test stand shall have in it all gun mounts, feed and ejection chutes, ammunition boxes, blast tubes, guns, gun charging equipment, gun cameras, and gun heaters plus any other equipment, including sighting, radar, radio, oxygen, lighting, hydraulic, instrument panel, et cetera, which will be carried in this section of the fuselage or wing and which might be adversely affected in operation due to blast or vibration resulting from gun firing. Further, there shall be included all necessary wiring, switches, and plumbing for the operation of the guns, gun chargers, gun camera, gun heaters, and any other equipment included in the test stand. Means shall be made for operation of the gun gas scavenging system, if provided. The stand shall also include leveling lugs and plumb bob attaching points which will serve to align the test stand in the same attitudes as the airplane assumed during specified aerial gunnery conditions.

3.1.5 Power Connections.- No integral power source shall be furnished by the contractor but suitable standard electrical, hydraulic, or pneumatic couplings as required shall be installed in the test stand to receive leads from the power sources. These electrical,

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hydraulic, or pneumatic couplings shall be furnished for the armament. Other equipment located in the test stand or sections thereof which in the opinion of the Procuring Agency is considered particularly vulnerable to damage due to gun firing, shock, and vibration shall be connected to these couplings and shall be operated as closely as possible to duplicate conditions in an actual airplane.

3.1.6 Function.- It shall be required to readily demonstrate the following functions with the gun installation firing test stand.

- (1) Firing of all guns without malfunction due to the installation, including operation of gun gas scavenging system, if provided
- (2) Ammunition feeding in short and long bursts as required of the specific type gun installed
- (3) Case and link ejection of retention
- (4) Operation of ammunition containers
- (5) Operation of the gun charging system
- (6) Operation of the gun firing system
- (7) Effect of gun blast and vibration on the airplane structure, armament equipment, and equipment other than armament equipment, located in or near the airplane gun bays
- (8) Ease of loading and servicing guns, gun camera and ammunition containers
- (9) Ease of removing and reinstalling the sight, radar, guns, gun camera and ammunition containers
- (10) Operation of all access doors and fastening devices
- (11) Ability to boresight guns and gun camera through required ranges of adjustment
- (12) Durability of blast tubes and fairings through expected firing life of the airplane
- (13) Operation of gun heaters which attach to the guns
- (14) Operation of harmonization of the complete sighting system, if included in the installation firing test stand

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- (15) Operation of ammunition box heaters if feasible and applicable
- (16) Operation of gun compartment heaters if feasible and applicable

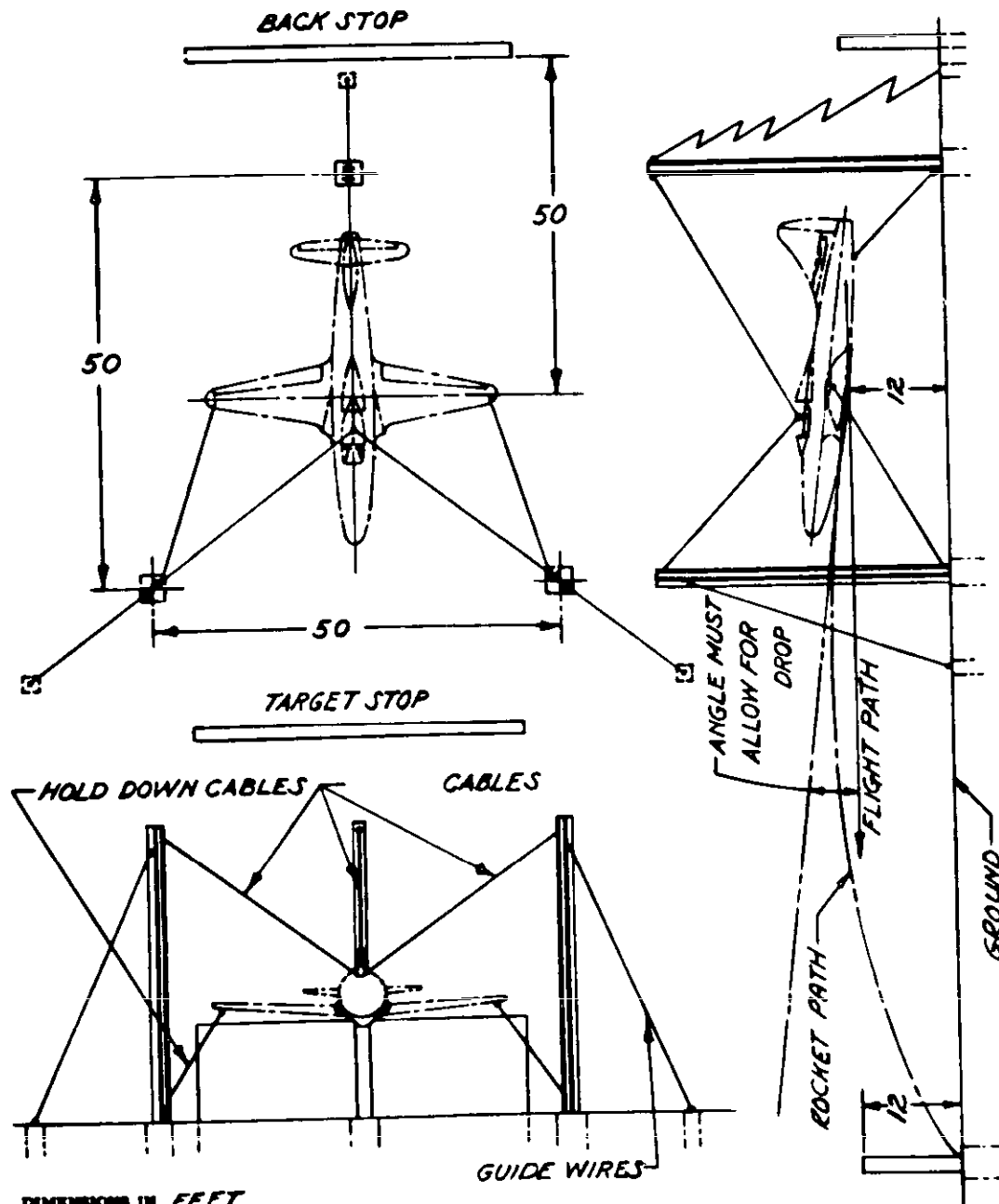
**3.2 Rocket Installation.-** Engineering tests as outlined in this specification shall be required of the contractor on all new model military aircraft and succeeding models thereof in which the rocket installation has been redesigned. The contractor shall provide qualified engineering personnel, a rocket firing test crew, and airplane maintenance personnel. The Procuring Agency shall provide a pilot, a crew for handling and preparing the rockets to the point of delivering them to the immediate vicinity of the airplane, and an official observer(s). Due to the difficulty of firing rockets in inhabited areas, the rocket firing test shall be accomplished at a designated government reservation.

**3.2.1 Air to Ground Rocketry Installation.-** The contractor shall supply an airplane hoisting sling to suspend the entire airplane in a flight position for ground test purposes when all components are in place including tanks, bombs, and other installations which rocket blast might effect. The Procuring Agency will supply suitable equipment mobile or otherwise for hoisting the airplane as described during ground tests, and an official observer(s).

**3.2.1.1 Construction.-** The ground firing test shall be accomplished by suspending or elevating the entire airplane a minimum height of twelve feet from the ground or at a distance at which ground blast reflections will have no effect on the aircraft. The airplane hoisting sling, furnished by the airplane contractor, is normally suspended from one or more GFE motorized cranes of suitable capacity or by a test stand similar to that shown in Figure 1. The sling is to be designed so as to fix the airplane in such a position that the rockets in flight will clear all obstacles during the entire burning time of the rocket motor. A specific target will not be required but a suitable back stop is necessary or sufficient clear area must be available beyond the burning point to allow spent rocket to come to rest. Adequate space will also be provided to the rear of the test stand to dissipate rocket blast during firing. The airplane must be moored sufficiently to prevent any change in position as a result of rocket firing. Landing gear shall be retracted during rocket firing tests. In the event the gross weight of the aircraft exceeds the capacity of the hoisting equipment, the fuel, engines, and other easily removed equipment and furnishings not vital to the success of the ground rocket firing acceptance tests shall be removed from the test aircraft. When such measures do not decrease the weight of the aircraft to within the capacity of the hoisting equipment, ground rocket firing tests and contractor equipment, if any, shall be as specified by the Procuring Agency.

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DIMENSIONS IN **FEET**  
UNLESS OTHERWISE SPECIFIED.  
TOLERANCE ON:

- ANGLES -  
- DECIMALS -  
- FRACTIONS -

# STAND-ROCKET GROUND TEST

**FIGURE 1**

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**3.2.1.2 Functions.-** It shall be required to demonstrate the following operations with the airplane mounted on the rocket firing test rig:

- (1) Firing of all rockets without malfunction
- (2) Rocket feeding on automatic type launchers, if applicable
- (3) Operation of the rocket firing electrical system
- (4) Operation of the jettisoning system, electrical and/or mechanical
- (5) Ability of entire airplane structure including airplane equipment other than armament equipment to withstand the effects of rocket blast and vibration

**3.2.2 Air to Air Rocketry Installation.-** Prior to the completion of the first production airplane equipped for rocket firing, the contractor shall build two test structures. One shall be a test stand for ground firing and the other shall be an actual article for aerial tests.

**3.2.2.1 Construction.-** The ground test stand shall consist of that component of the aircraft which contains the rocket installation and a rigid support therefor. The aircraft mock-up structure shall be made in the same manner and of the same materials as the production article insofar as possible. It shall consist of items necessary for firing rockets and, in addition, as many other items as possible which might be adversely affected by the blast, recoil load, vibration, and corrosion resulting from rocket firing. There shall be included all necessary wiring, switches, and plumbing for the operation of the rocket installation and other equipment installed in the test structure. If necessary for the operation of rocket installation or other items contained in the ground test stand, suitable couplings shall be provided for external pick-up. For firing tests, the centerline of rocket tubes on ground test stand shall be between 7-1/2 and 15 degrees nose up from ground horizontal. This stand shall have a working surface with the same elevation and attitude relative to the rocket section as the airplane in normal ground servicing attitude. Moreover, the stand shall be adjustable so that the working surface is level for the servicing time tests.

**3.2.2.2 Functions.-** The test structures shall be sufficiently complete to demonstrate readily the following functions:

- (1) Firing of all rockets without malfunction
- (2) Effectiveness of rocket firing sequence and timing
- (3) Operation of mechanical features

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- (4) Operation of exit doors and opening devices
- (5) Operation of rocket tube heaters or rocket temperature sensing equipment in flight only
- (6) Operation of rocket package extension and retraction gear when applicable, and operation of rocket launcher poppet valves and plenum chamber doors
- (7) Operation of rocket package or pod jettison gear, if applicable
- (8) Effect of blast, recoil load, vibration, and corrosion on the airplane structure, rocket tubes, mounts, and airplane components other than armament equipment located in test section
- (9) Ease of loading rockets and servicing rocket tubes and gun camera
- (10) Safety features for loading rockets
- (11) Squib check after round is in place
- (12) Ease of replacing rocket tubes and gun camera
- (13) Ease of cleaning rocket tubes
- (14) Ease of unloading rocket
- (15) Ease of replacing rocket package or pod

#### 4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Inspection.-- The gun, and if applicable, the rocket firing test rig and/or installation in the airplane and/or alternate installation shall be subject to inspection by authorized Government inspectors. Tests shall be conducted by the contractor under the supervision of the representatives of Procuring Agency expressly assigned for this purpose, and any reports referred to herein shall be furnished to the representative, unless otherwise designated.

4.2 Previous Acceptance.-- Previous acceptance or approval of material or the release of any design by the Procuring Agency shall in no case be construed as a guarantee of the acceptance of the finished product.

4.3 Test Report.-- Contractors shall furnish a test report giving the results of test required to determine compliance with the requirements

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and tests specified herein. Contractors not having laboratory facilities satisfactory to the Procuring Agency shall engage the services of a commercial testing laboratory acceptable to the Procuring Agency and capable of conducting tests to determine compliance with all the requirements and tests contained in the specification.

4.4 Purpose of Ground Firing Tests.- Ground firing tests shall be conducted by the contractor to prove as conclusively as possible to the Procuring Agency that the installation will function properly during aerial tests, to determine the dispersion of fire, vibrations and blast effect on associated equipment, and to determine the cyclic rate.

4.5 Servicing Weapons.- Guns, rocket equipment and weapon accessories shall be serviced and maintained during the following tests in accordance with the approved methods for this type of equipment as outlined in pertinent Technical Orders, Technical Manuals and other like data.

4.6 Number of Rounds to be Fired.-

4.6.1 Gun Installations.- The minimum number of rounds to be fired from each gun position shall be determined from the following table.

TYPE OF AIRCRAFT	MINIMUM ROUNDS PER GUN POSITION	
	GROUND TESTS (TEST STAND)	AERIAL TESTS
Interceptor	10,000	10,000
Air Superiority	10,000	10,000
Fighter-Bomber	30,000	30,000
Night Intruder	30,000	30,000
Photo Recon Fighter	10,000	10,000
Escort Fighter	10,000	10,000

4.6.2 Rocketry Installations.- The minimum number of rounds to be fired shall be as hereinafter stated.

4.7 Gun Ground Mount Test.- A ground mount shall be constructed to determine the cyclic rate of fire and the "Critical Gun Pull" of each endurance gun used in the following tests. The mount shall be capable of withstanding trunnion loads for the particular gun specified in the model specification and shall have approximately 25000 pounds per inch deflection. The ground mount shall be designed so that it may be adapted to



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both conventional or contractor's gun mountings in the event that the contractor designed mounting differs radically from the conventional. Provisions shall be made for mounting a rigid sheet metal feed chute, having link relief similar to that provided in the airplane feed chute, which will allow gun feeding from either the right or left. The length of the chute should be sufficient to contain 75 rounds of caliber .50 linked ammunition or 30 rounds of 20mm linked ammunition or sufficient to assure that weights will not touch ground. (See 4.7.3). This feed chute shall be rigidly attached to the gun feedway or feeder entrance so that the chute lies horizontal in the plane of the feed chute normal to the gun axis. In the case of the sprocket type feed mechanism, the chute shall be mounted horizontal and tangent to the sprocket. A ball bearing pulley shall be incorporated at the end of the chute farthest from the gun. A cable to which calibrated weights can be attached and which may be joined to the ammunition belt shall be provided. The cable must be of sufficient length to prevent the weights from contacting the pulley.

4.7.1 Gun Adjustment.- Install new guns on the ground mount and make required adjustments in accordance with the approved methods for the weapon being used.

4.7.2 Cyclic Rate Determination.- Determine the cyclic rate of each gun and record data, see sample form Appendix A. A 20 round burst shall be used. A minimum of three runs shall be made and the results averaged. Care should be exercised to maintain approximately the same barrel temperature during these tests. (See 4.7.3.3). In the event that a contractor designed gun mounting of radical departure from the conventional is being used in the type airplane under test, comparative cyclic rate tests between the conventional gun mounting and the contractor type gun mounting shall be conducted. The contractor shall provide adequate recording equipment.

#### 4.7.3 Critical Gun Pull Tests.-

4.7.3.1 Belt Length.- For each gun position determine a convenient length of belted ammunition for the critical gun pull tests. Convenient length shall mean a sufficient number of rounds of belted ammunition threaded through the feed chutes of the actual gun installation to allow ten rounds to be fired without the end of the belt entering the ammunition box end of the feed chute. Belt lengths selected shall normally vary directly with each gun position as the feed chutes vary in length.

4.7.3.2 Belt Pull.- From gun data, estimate the number of pounds weight, to be added to the cable attached to the belt required to determine critical gun pull. The term "Critical Gun Pull" is used to indicate the point in pounds load on the ammunition belt at which gun fails to feed or the belt separates. Several trials will usually be

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necessary before the exact critical gun pull figure is determined. The belt pull of the Caliber .50 M-3 and 20mm guns are rated at 35 and 70 pounds, respectively.

4.7.3.3 Warm Up.- For the caliber .50 gun or others having an internal shuttle type feed where barrel recoil may effect belt feed pull, the following procedure shall be applied. Warm up each gun by firing a total of 60 rounds immediately prior to the initial addition of weight to the belt and the firing of the required ten rounds automatic fire for the critical gun pull test. If the critical gun pull testing and cyclic rate testing on each gun is not completed once begun and the weapon is allowed to cool, an additional 60 rounds warm-up shall be required. Every effort shall be made to obtain and maintain the same gun bore temperature in all guns tested for critical gun pull. The 20mm gun with separate feeder does not require such procedures.

4.7.3.4 Type Links.- New belt links shall be used in each ammunition belt when determining critical gun pull since some permanent deformation occurs during each test.

4.7.3.5 Number of Rounds to be Fired.- One dummy round shall be inserted after the first 10 in the ammunition belts used in critical gun pull tests to provide a positive means of stopping the gun. All additional rounds shall be live ammunition.

4.7.3.6 Records.- Data on critical gun pull performance shall be recorded, see sample form Appendix B.

4.7.4 Dispersion Tests.- New guns shall be mounted on the single gun ground mount and required adjustments made in accordance with the approved methods. Each gun shall be boresighted on a target at 1,000 inches and the dispersion measured and photographed as found in the applicable subparagraphs related to single gun dispersion. These guns shall be designated as "Dispersion Guns" hereafter. A sufficient number of guns shall be tested to obtain the required number of guns for the particular model airplane under test, each of which have a dispersion equal to or less than that specified for the gun. For the Caliber .50 M-3 gun the requirement is that all rounds of a ten round burst fired automatically at a target at 100 foot range can be enclosed in an eight inch diameter circle. The 20mm gun will be considered to have the same requirement. Data obtained shall be recorded by gun number and installation firing stand gun position assigned on forms provided, see sample form Appendix A, for the guns selected for use in the subsequent dispersion tests. No data on dispersion need be recorded for those guns not used as "Dispersion Guns". In the event that a contractor designed gun mounting of radical departure from the conventional is being used in the type airplane under test, comparative dispersion tests between each gun mounted conventionally and then on the contractor type gun mounting shall be conducted.

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#### 4.8 Installation Firing Stand Test.-

4.8.1 Gun Camera Tests.- The gun camera shall be operated during all ground firing tests from the installation firing test stand in order to determine the general operation of the gun camera system, and to determine the effects of firing-incurred vibration on the resultant image. The target used for ground testing may be the one used as the gun target. It shall not be necessary to hit the targets in these tests but only to include the target in the field of the camera. The guns shall be fired in bursts of not less than two seconds duration (unless otherwise specified) and the camera shall be set so as to provide three seconds of overrun. The shutter speed shall be set in accordance with the requirements for reducing vibration effects upon the photographic image, and the lens aperture adjusted accordingly. Film obtained when developed shall be forwarded to the Procuring Agency, with complete information as to the lens aperture, shutter speed, overrun period, and frames-per-second settings used, as part of the required reports.

#### 4.8.2 Installation Dispersion Tests.

4.8.2.1 Set-up of Installation Firing Stand.- The firing test stand shall be set up in level flight position. The dispersion guns, in order to obtain data on gun mount accuracy, shall be installed and marked as to their location in the installation. The guns shall then be boresighted at 1,000-inch range using a boresight target.

4.8.2.2 Targets.- Firing targets shall be installed and crosses placed on the targets to correspond with the boresighting of each gun using Government furnished boresighting equipment which is known to be accurate through prior inspection.

#### 4.8.2.3 Firing Schedule.

4.8.2.3.1 One round shall be fired from each "Dispersion Gun", one gun at a time. This shot shall be marked and results photographed.

4.8.2.3.2 Twenty rounds shall be fired from each gun, automatic fire, one gun at a time and results photographed.

4.8.2.3.3 A check shall be made of the installation for tightness of all guns, accessories, and mounts.

4.8.2.3.4 New targets shall be installed as specified above, and the guns reboredsighted.

4.8.2.3.5 One round shall be fired from each gun, in salvo. Mark these shots and photograph results. Each round from each gun shall be identified by the application of lithographic ink of different colors to aid in gun pattern identification.

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4.8.2.3.6 Twenty rounds shall be fired in salvo, and results photographed. Each gun shall be identified by the application of lithographic ink to the projectiles of the belted ammunition to aid in gun pattern identification.

4.8.2.3.7 Remove targets.

4.8.2.4 Target Analysis.-- The following simplified rectangular system for dispersion pattern analysis has been adopted as standard among testing agencies. The steps for analysis of a 20 round target pattern are as follows:

4.8.2.4.1 Through the center of the extreme left shot of the best 80 percent group (80 percent groups will be used throughout) draw a vertical coordinate Y.

4.8.2.4.2 Through the center of the extreme lowest shot of the best 80 percent group draw the horizontal coordinate X.

4.8.2.4.3 Through the center of the extreme right hand shot of the best 80 percent group draw a vertical line intersecting the horizontal coordinate at point A as illustrated in Figure 2.

4.8.2.4.4 Through the center of the uppermost shot of the best 80 percent group draw a horizontal line which intersects with the vertical coordinate Y at point A and complete the rectangular inclosure of the pattern group as shown in Figure 2.

4.8.2.4.5 Through the use of two measurements given as the width XA of the rectangle and the height YA, the area covered by the group is indicated as well as the dispersion of the group both vertically and horizontally.

4.8.2.4.6 Both of these two measurements shall always be given as plus quantities.

4.8.2.4.7 Having determined the confines of the rectangle inclosing the desired best percentage of the target group, next draw the two diagonals. The intersection of the diagonals shall represent the Center of Impact Area and shall be used in the following steps to indicate the bias of the group from the boresight point which is defined as the deviation of the gun.

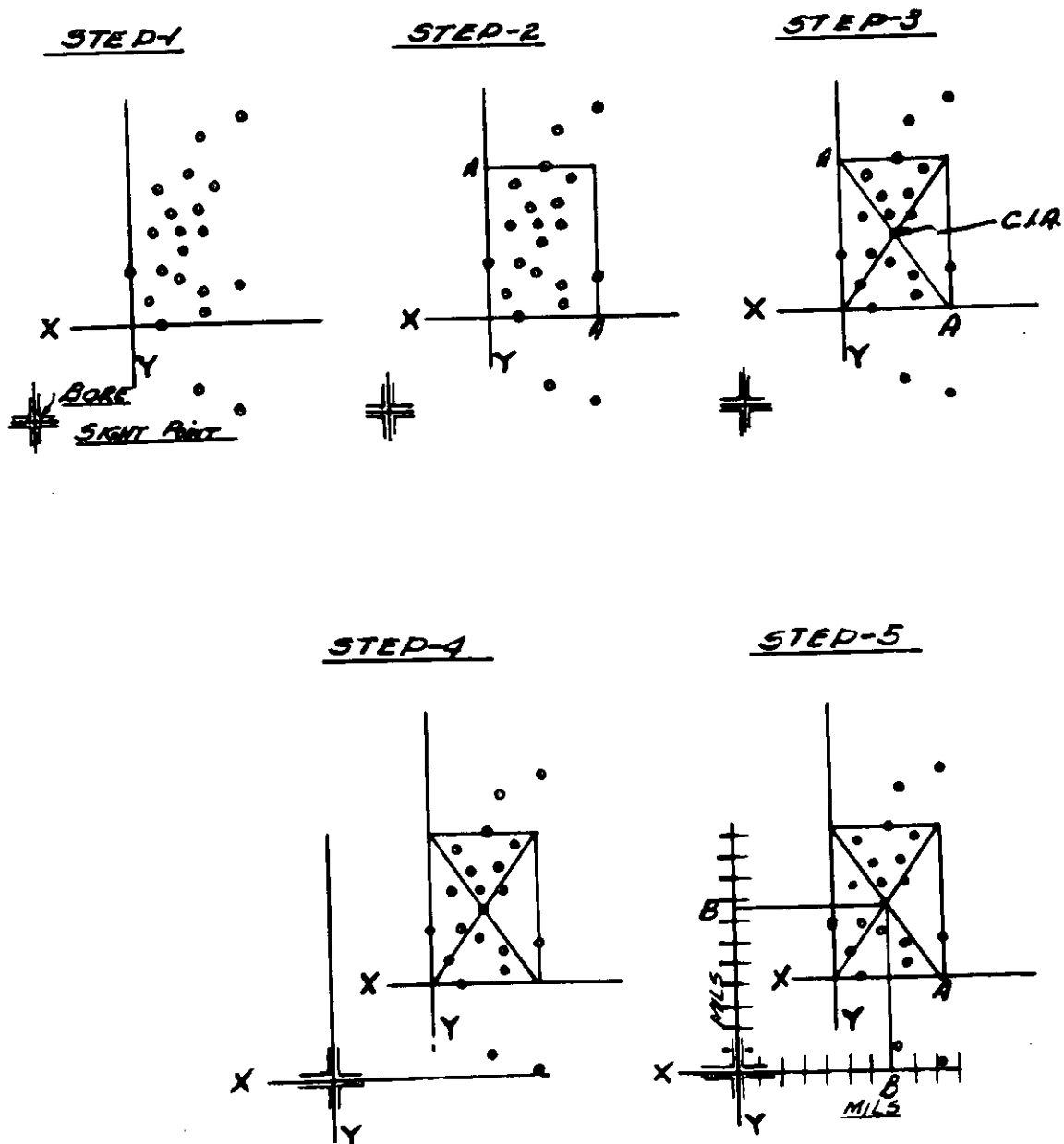
4.8.2.4.8 Draw the X and Y coordinates through the boresight point.

4.8.2.4.9 Through the Center of Impact Area draw a vertical line which intersects the horizontal or X coordinate passing through the boresight

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PROCEDURE - DISPERSION  
TARGET MARKING



NOTE:  
THE MARKING AS APPEARS IN  
STEP 5 SHALL APPEAR  
IN PHOTOGRAPH.

FIGURE 2

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point at point B thus indicating by term XB the distance of the Center of Impact Area laterally from the boresight point.

4.8.2.4.10 In like manner, draw a horizontal line through the Center of Impact Area which intersects the vertical or Y coordinate through the boresight point at point B thus indicating by the term YB the distance of the Center of Impact Area vertically from the boresight point.

4.8.2.4.11 All four terms shall be presented as shown in Figure 2.

4.8.2.4.12 In addition, it shall be necessary to indicate the relative location of the boresight point from the pattern group or Center of Impact Area by prefixing a plus or minus sign to the terms XB and YB when necessary. When the boresight point is to the left of and below the target group both of the terms XB and YB shall be positive. When the boresight point is to the right of the target group and above both terms shall be preceded by minus signs.

4.8.2.5 Target Photographs.- In photographing targets, the rectangular system scale calibrated in mils in accordance with directions given in Figure 2 and paragraph 4.8.2.4 shall be placed on the target to appear in the photographed results. Bullet dispersions shall be recorded, see sample form Appendix A. At 1,000-inch range, the horizontal measurement in inches shall be considered as the mil dispersion in azimuth. Likewise, the vertical measurement in inches shall be considered the mil dispersion in elevation.

4.8.2.6 Rejections.- Measurements obtained shall show no increase in dispersion due to gun mounts or all tests shall be suspended and the cause determined and corrected and the above dispersion test repeated.

4.8.3 Frictional Loss in Feed Chutes of Installation.- Loss due to friction in the ammunition feed chutes shall be determined as follows:

4.8.3.1 Guns to be Used.- Mount guns which were previously critical gun pull calibrated (endurance guns) on the ground mount in the test stand, and record their location in the installation.

4.8.3.2 Cable Rigging.- In the plane of the ammunition box end of the feed chute provide a means of attaching weights to the length of belt previously selected as convenient during the ground mount critical gun pull tests. It will normally be necessary to attach a cable to end of the belt after feeding the belt through the feed chute and then provide a hole in the ammunition box through which the cable will be threaded. The cable will then pass over a pulley placed at sufficient height that the weights can be attached to the end of the cable.

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4.8.3.3 Critical Gun Pull - Installation.- Determine the critical gun pull of each weapon in the installation when using the feed chuting and proper warm-up of the guns as given in 4.7.3.3.

4.8.3.4 Record of Results.- Record the critical gun pull and calculate and record the friction loss for each gun on the form. (See sample form Appendix B).

4.8.3.5 Positive "G" Calculation.- Using the longest length of belted ammunition it is possible to encounter for each gun position, determine the length of belted ammunition in rounds upon which positive "G" forces will act without an equal and opposite reaction in other portions of the belted ammunition due to these same "G" forces. Multiply the positive limit load figure for the airplane under consideration by the weight of this length(s) of belted ammunition. Compare this figure with the critical gun pull determined in 4.8.3.3 above. Calculate the difference assigning a sign + or - with respect to the critical gun pull figure (greater than or less than the CGP) determined in 4.8.3.3 and record on the form, see sample form Appendix B.

4.8.3.6 Negative "G" Calculation.- Determine and record in the same manner as the positive "G" calculation, 4.8.3.5 above.

4.8.3.7 Rejections.- In the event that the positive and/or negative "G" calculations are greater than the critical gun pull in any gun position in the installation, the contractor shall reduce these figures below the critical gun pull figures through redesign to reduce friction loss due to feed chuting, etc., or by the use of assist feed devices. The contractor shall repeat such portions of the critical gun pull testing as to demonstrate this reduction after redesign.

#### 4.8.4 Installation Cyclic Rate Tests:

4.8.4.1 Cyclic Rate Determination.- Using three 20-round bursts, determine the cyclic rate of each gun mounted in the test stand and record data as indicated in the sample form Appendix A. Care shall be taken to maintain approximately the same barrel temperature as found in previous cyclic rate tests. (See 4.7.2).

4.8.4.2 Rejections.- The cyclic rates of each gun, whether fired from the gun ground mount or the test stand, shall not vary more than  $\pm 5$  percent as compared to the same gun mounted conventionally on the ground mount by reason of feed or ejection, blast tubes, et cetera, exceptio where gun boosters are installed in the installation. When boosters form a part of the installation, the cyclic rate of each gun must not vary more than  $\pm 5$  percent as compared to the same gun mounted conventionally on the ground mount without boosters. In the event that the cyclic rates

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exceed the tolerances above, the test shall be suspended, the cause determined and corrected and a new series of cyclic rate tests begun.

#### 4.8.5 Endurance Firing of Installation Stand.

4.8.5.1 Number of Rounds to be Fired.- A minimum number of rounds as noted in 4.6 shall be fired for bursts of three to four seconds followed by cooling periods of at least three minutes duration. The installation should be checked periodically for tightness. Any malfunction or stoppage shall be recorded and photographs taken when possible. Except where specifically noted otherwise, guns shall be fired in salvo during these tests. Rounds fired for dispersion, critical pull, and cyclic rate will be counted in the total rounds to be fired.

4.8.5.2 Number of Stoppages.- There shall be no gun stoppages or stoppages chargeable to the installation under the conditions given above in less than 5% of the total number of rounds required in 4.6.

4.8.5.3 Records.- For the purpose of tabulation, each separate loading of the ammunition boxes shall be considered as a separate test. These tests shall be recorded as indicated in sample form Appendix A.

4.8.6 Intermediate Dispersion.- Intermediate ground dispersion tests shall be performed after approximately 50% of the total number of rounds required have been fired. These tests shall be in accordance with applicable paragraphs above using the respective "Dispersion Guns" for each gun position.

4.8.8 Maintenance Time Study.- During the tests, the following operations will be timed using two men reasonably familiar with the installation and equipment:

- (1) Time required to completely load the test stand with the full load of ammunition
- (2) Time required to remove and replace all guns
- (3) Total time required to prepare the installation of the test stand for another mission. That is, total time to open doors, remove guns, load ammunition boxes, replace guns, and ready for firing and close gun bay doors
- (4) Time taken to adjust gun alignment

4.8.9 Rejections.- In the case of structural failure, or the cracking, warping, chipping, et cetera, of any components of the fixed gun installation during firing of the test stand, the test shall be discontinued. The



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test stand shall be repaired in a manner which will closely approximate a design change in volume production of aircraft and a new test begun. However, if other than structural failure occurs during the final 50% of the rounds to be fired in a test on new model aircraft or succeeding models thereof in which the fixed gun installation has been redesigned or any alternate installations, the test may be completed with or without temporary repairs provided the first model airplane equipped for gunnery incorporates permanent changes of design as a result of study of these failures. The first model airplane equipped for gunnery in any case shall satisfactorily complete the aerial firing test specified herein.

4.8.10 Report on Installation Firing Tests.- A complete report covering the entire ground test shall be prepared and submitted to the Procuring Agency, prior to aerial test of the airplane. The reports shall show the total stoppages for each gun position of each type encountered during the test as well as failures and cause thereof and corrections of installation components. During the course of the tests partial reports shall be submitted when tests are one-quarter, one-half, and three-quarters complete. A separate report showing an accurate record of parts failed or replaced will be submitted to the Procuring Agency within 30 days of completion of the ground firing tests. This report will be used for provisioning purposes for the subsequent aerial tests and for production aircraft.

4.8.11 Sample Forms.- Sample forms to be used for recording data, see Appendix, shall be completed to include all information obtained during the ground firing tests. New or additional forms may be provided by the contractor if desired providing all presently requested information is included.

4.8.12 Disposition of Installation Test Section.- Upon completion of the ground test, instructions as to disposition of the test stand will be obtained by communicating with the Procuring Agency.

#### 4.9 Aerial Gunnery Tests.

4.9.1 Preliminary Steps.- Aerial tests shall be conducted in the following manner using the airplane designated by the Procuring Agency. This will normally be the first airplane equipped for gunnery.

4.9.1.1 Airplane Selection.- The contractor shall be required to assure that the test airplane designated is complete with respect to the armament installation, and includes all changes determined necessary from firing the test stand. In addition, any airplane produced after that which is used for aerial firing tests shall have an armament installation of the same conformation as that which has successfully completed aerial test firing. All aircraft equipment, such as instruments, radio, et

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cetera, shall be in operation during all gun firing in order to determine effect of gun vibration, etc., on this equipment.

**4.9.1.2 Requirements.-** The general requirements for the aerial firing tests are as follows:

**4.9.1.3 Guns.-** The guns selected for the aerial tests shall be those which have at least the minimum belt pull established by the Ordnance Department, to be determined by conducting critical gun pull tests on a ground mount as in 4.7.

**4.9.1.4 Loading.-** In firing the guns in flight, each gun shall be loaded with a full load of ammunition prior to each flight. If stoppages occur, the firing will continue with the balance of the guns until it is no longer possible to fire.

**4.9.1.5 Dispersion Tests.-** Install "Dispersion Test Guns" previously calibrated on a ground mount in the airplane, place the airplane in flight attitude as noted on the harmonization target prepared for model airplane, and conduct dispersion tests as noted in pertinent paragraphs above.

**4.9.1.6 Functional Check.-** At least one load shall be fired on the ground prior to aerial flight in order to check general functioning and security of all components.

**4.9.2 Number of Flights.-** A sufficient number of flights will be made to prove the gun installation in various attitudes of flight. It is usually possible to fire the guns during approximately six maneuvers per flight, firing one three-second burst per maneuver and cooling the guns for three minutes between bursts. The contractor shall limit the aerial test firing to one flight for each condition. In the event of a malfunction the flight shall be repeated.

**4.9.3 Number of Rounds.-** After satisfactory completion of the aerial tests as outlined below, the airplane shall be flown and fired or ground fired at the discretion of the procuring agency a sufficient number of rounds to equal the required minimum as set forth in 4.6.

**4.9.4 Aircraft Speed and Altitude.-** At least 80 percent of the aerial gun firing shall be flown at or above 80 percent V maximum. Subject to such considerations as safe maneuvering altitudes, gun firing range restrictions, fuel consumption, etc., the aircraft shall be flown and fired at altitudes where the maximum "Q" effects are obtained, where  $Q = \frac{1}{2} \rho V^2$ ,  $\rho$  = density and V = aircraft velocity.

**4.9.5 Gun Chargers.-** Electrical control circuits for automatic gun chargers will be rendered inoperable and other type chargers will not be used during flight in order that gun stoppages can be properly analyzed during ground inspection following the mission. The charger system shall be complete, however, with chargers attached to gun and compressor running

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and/or storage tanks filled. During ground loading operations, the charger should be used in order to simulate actual operating conditions.

4.9.6 Mild Maneuvers.-- The guns shall be fired at a medium altitude of 1,000 to 10,000 feet during the following maneuvers;

- (1) Steep climb
- (2) Steep dive
- (3) From level flight to right turn
- (4) From level flight to left turn
- (5) Repeat the above maneuvers until ammunition is expended

4.9.7 Medium Maneuvers.-- One flight shall be flown as follows:

- (1) Diving turn to right
- (2) Diving turn to left
- (3) Right vertical turn to level
- (4) Level to right vertical turn
- (5) Level to left vertical turn
- (6) Repeat the above maneuvers until ammunition expended

4.9.8 Severe Maneuvers.

4.9.8.1 Positive "G" Maneuvers.-- One flight shall be flown with gun heaters used if desired. A full complement shall be fired wherein all or a part of each burst occurs within 1/2 "G" of the maximum "G" loading of the aircraft and during the following maneuvers.

- (1) Right turn
- (2) Left turn
- (3) Straight pullouts

4.9.8.2 Negative "G" Maneuvers.-- One flight shall be flown as follows: Gun heaters shall be used as desired. Full complement to be fired out in one second bursts during pushovers which subject the airplane to negative one (-1.0) "G" loads.

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4.9.9 Combat Maneuvers.-- One flight shall be flown as follows: Gun heaters shall be used as desired. Maneuvers for which any type aircraft was not designed shall not be required.

- (1) Left spiral
- (2) Right spiral
- (3) Severe slip to right
- (4) 360 degree roll
- (5) Chandele to left
- (6) Chandele to right
- (7) Immelman
- (8) Severe slip to left
- (9) Loop

4.9.10 Night Flights.-- At least one gunnery and rocket firing mission shall be flown at night. A report on the amount and adverse effects of gun flash and rocket blast and flash on the pilot's ability to maintain night adaptability shall be made.

#### 4.9.11 High Altitude Flights.

4.9.11.1 Gun Heater Flights.-- One flight shall be made with gun heaters on throughout tests as desired. Prior to firing the guns, the installation shall be prepared by flying the aircraft for thirty minutes at an altitude that will give a temperature of  $-17.8^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) or lower in the surrounding air. The airplane will then be flown in a rapid descent to an altitude where the temperature is at least  $+10^{\circ}\text{C}$  ( $+50^{\circ}\text{F}$ ) and be flown at this altitude and temperature for 30 minutes. The aircraft shall then be returned to an altitude where the ambient temperature is at least  $-17.8^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) and flown for thirty minutes. The aircraft shall be flown to as near its service ceiling as practicable during this final thirty minutes and upon completion of the required time the guns shall be fired during medium maneuvers as described in 4.9.7. If flight time requirements cannot be met, landing and refueling will be permissible after the first portion of flight, thus eliminating the low altitude portion of the flight. If gun stoppages occur due to low temperatures, the cause will be determined, correction made, and the flight repeated.

4.9.11.2 Gun Charger Flights.-- One flight shall be made with gun heaters on throughout as desired. The gun charging system shall be in operation.

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Guns shall be ready for firing but round will not be in chamber. Ammunition belt shall be loaded with a dummy round after every 50 rounds of live ammunition. At a safe altitude after take-off, chargers will be operated to load guns. Prior to firing guns, the airplane shall be flown, first at high altitude, then low altitude or landed, then flown at high altitude, all as described in paragraph above. If difficulty occurs in charging guns, the cause shall be determined, the condition corrected and the flight repeated.

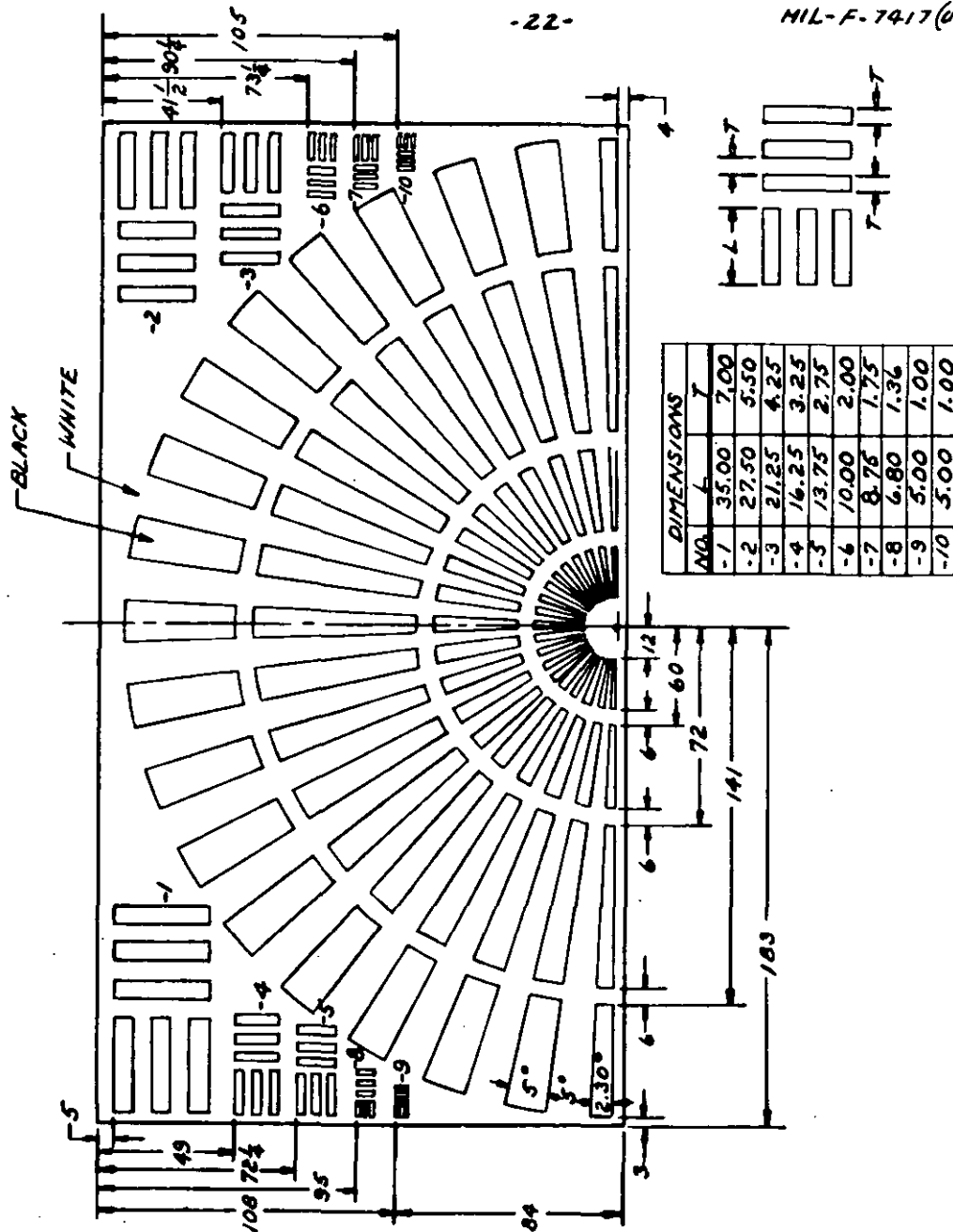
4.9.12 Camera Flights.- When practicable at some time during aerial tests, three passes shall be made at ground or water targets to record general functioning and possible vibration of the gun sight aiming point camera installation while firing the guns in bursts of not less than a two second duration and with the camera set so as to provide three seconds of overrun. The shutter speed shall be set in accordance with the requirements for reducing vibration effects on the photographic image and the lens aperture adjusted accordingly. Unless an approved target is available, the target shall be fabricated as shown in Figure 3 and shall be mounted on a suitable frame and/or raft provided by the contractor. It shall not be necessary to hit the target during these runs but only to include the target in the field of the camera. Film obtained when developed shall be forwarded to the Procuring Agency with information as to the number of frames per second and aperture used as a part of the required reports.

#### 4.9.13 Other Flight Test Observations and Investigations.

4.9.13.1 Observations.- During the flight firing test, the following applicable points shall be reported upon:

- (1) Handling qualities of airplane for gun aiming
- (2) Vision over nose, searching, sighting, et cetera
- (3) Effect of firing on airplane control
- (4) Vibration of sighting system
- (5) Operation of sighting system
- (6) Position of sight head and comfort of sighting position
- (7) Operation of sun screen (if supplied) and sight controls
- (8) Fumes in cockpit or compartments, and carbon monoxide contamination
- (9) Visibility during night firing and effect of flash

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RESOLUTION TARGET

**DIMENSIONS IN INCHES.**

**FIGURE 3**

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- (10) Security of all armament installation items and amount of wear
- (11) Damage to airplane by case and link ejection
- (12) Vibrations of instruments
- (13) Effect of firing on other airplane components, radio compass, radio, attitude gyro, et cetera

4.9.13.2 Temperature Survey.- As soon as possible during the course of the aerial firing tests, unless otherwise specified, a comprehensive temperature survey shall be made of those areas of the aircraft other than the cockpit in which sight and radar equipment are located. These data shall be the subject of a separate report to the Procuring Agency.

4.9.14 Final Dispersion Tests.- After completion of the aerial tests, a final dispersion test shall be accomplished using "dispersion" guns as specified in the pertinent paragraphs above.

4.9.15 Rejections.- Any structural failure occurring in less than 60% of the total number of rounds to be fired shall be cause for rejection of the installation and shall require that all aerial tests specified herein be repeated, or at the discretion of the Procuring Agency, all tests be repeated after satisfactory redesign. Items subject to wear such as gun mounts and electrical components of the armament system shall not have to be replaced in less than 50% of the total number of rounds to be fired.

4.9.16 Report of Aerial Gunnery Test.- A complete report covering the aerial gunnery test shall be prepared for transmittal to Procuring Agency. The report shall show the total stoppages for each gun position of each type encountered during the test. In addition to those places where specifically noted above, photographs shall be taken of all phases of the ground and air firing tests, where practicable, showing malfunctions, stoppages, breakages, et cetera, of all features of the armament installation. Partial reports shall be submitted when the tests are one-quarter, one-half, and three-quarters complete. A separate report showing an accurate record of parts failed or replaced will be submitted to the Procuring Agency within 30 days of the completion of tests to provide provisioning data for production aircraft.

4.9.17 Aircraft Disposition.- The aircraft will be referred to the Procuring Agency for further testing.

4.10 Rocket Firing Tests - Ground.- Ground firing tests shall be conducted by the contractor to prove as conclusively as possible to representatives of the Procuring Agency that the installation will function properly during tests, to determine the effect of blast and the cyclic rate of rocket firing.

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#### 4.10.1 Air-to-Ground Rocketry Installation.

##### 4.10.1.1 Preliminary Steps.

4.10.1.1.1 Inspection.- The rocket launching installation shall be inspected prior to mounting the aircraft on the test rig as follows;

- (1) All circuits checked simultaneously with standard circuit testers, Type B-1 or B-2
- (2) The operation of each arming solenoid checked
- (3) The sequence of operation of the intervalometer for rocket firing checked, to insure that the proper sequence is obtained
- (4) Launchers for fin stabilized rockets inspected, to insure the centerlines of the rockets are parallel to the velocity vector of the airplane for rocket firing as described in the airplane model specification within one degree
- (5) Any initial mal-alignment of mounts recorded in addition, the distance between the front and rear mount at each station shall be recorded. This distance shall be measured parallel to the rocket centerline, between surfaces on front and rear mounts which limit rearward movement of the lugband and fin

4.10.1.1.2 Rocket Arming and Maintenance Time Study.- The following operations shall be timed using two operators reasonably familiar with the installation and equipment;

- (1) Time required to load all rocket firing facilities with a full load of ammunition
- (2) Time required to remove and to replace all quickly removable type launchers, if applicable
- (3) Total time required to prepare the airplane for a complete rocket mission using a pre-established checking and loading procedure

4.10.1.1.3 Taxi Tests.- Taxiing test shall be made over rough, sodded terrain with a full load of rockets to determine the effect of repeated shock loading in the vertical (and fore and aft) direction on the mounting structure and rocket retaining shear wires. The test shall be made with full weight dummy rounds. If an alternate design exists which results in a more extreme loading condition, both the normal and alternate conditions shall be tested. Taxiing shall be conducted at a minimum speed of 25 mph



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for a total of 15 minutes. The rockets, rocket installation and all components which might be effected by the rocket installation shall be inspected for distortion or failure at the end of 5, 10 and 15 minute taxiing periods. In case of necessary redesign, the entire test shall be repeated. Measurement shall be made during taxiing of the maximum increase and decrease of the distance between front and rear mounts, where applicable. Also, measurement shall be made during extreme loaded condition, at those mounts, deemed most likely to give maximum deflection, and shall give linear displacement between front and rear rocket attachment points. Adjustment of the rocket lug bands in this, and succeeding deflection tests, shall be such as to not restrict the relative movement of the front and rear mounts.

4.10.1.2 Ground Firing.-- To assure, insofar as is possible, trouble free aerial tests, the following ground tests shall be conducted with the aircraft mounted in the test rig:

- (1) Number of Rounds.-- A minimum of five rounds fired from each launching position except when installed in such a location that blast effect might injure an important structure or control surface. In such cases, a minimum of 10 rounds shall be fired. When "Double Shot" rounds are carried a minimum of five rounds shall be fired from the lower position in addition to the five or ten rounds, as the case may be, fired from the upper position. Firing tests shall commence with the intervalometer in the "Single" position and conclude with two full complements of rockets with the intervalometer in the "Auto" position.
- (2) Cyclic Rate.-- The cyclic rate of fire checked and recorded on automatic (package) type launchers if applicable. A minimum of 20 rounds shall be used to determine this accurately.
- (3) Inspection for Damage.-- For wing mounted rocket installations the landing gear and flaps operated through three complete cycles upon completion of the firing on the test stand smooth operation without any binding chargeable to rocket firing shall be obtained.
- (3)b Deflection of Mounts.-- Where design of the external mounts is such that multiple rockets are supported by one framework which in turn is attached to aircraft structure, measure the maximum increase and decrease of the distance between front and rear supports of a rocket adjacent to one being fired. Measurement shall be made at the position deemed most likely to give maximum deflection, and shall give linear displacement between front and rear mount rocket attachment points.

4.10.1.3 Rejections.-- In the case of structural failure, warping, cracking, or the extreme chipping and corrosion of finish of any components of

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the rocket installation or of the airplane during firing on the test stand, the test shall be discontinued. Corrective measures shall be taken which will closely approximate a design change in volume production of aircraft and the ground firing tests repeated. Photographs of all defects shall be taken and the remedial action described in detail.

4.10.2 Air-to-Air Rocketry Installation.- Ground tests shall consist of firing from the test stand, and firing from the actual article prior to aerial tests. The test procedure shall be as follows:

- (1) Number of Rounds.- Fire one full load in the arrangement and cyclic rate anticipated for flight tests. In addition, with rockets at +120°F, fire one full load at maximum rate. Load dummy rounds in all tubes not under test in order to simulate the remainder of the load and to allow a check for possible jamming by debris from rockets already fired. Fire a total of 20 rounds in the most critical tube and in any other tube(s) deemed advisable for structural, functional, safety, or other considerations. The quantity of 20 rockets may include all the applicable rockets fired in the above preliminary tests.
- (2) Cyclic Rate.- During full load ripple firings, mark rounds in each salvo distinctively and determine tentative cyclic rate.
- (3) Ballistics.- A series of 20 rockets is to be fired from one tube on a range instrumented for acceleration and velocity tests. This test is required for any novel tube configuration for which data are not available.
- (4) Servicing Tests.- Using dummy rockets and with the working surface in a horizontal position, determine the time for following:
  - a. Load rockets
  - b. Unload rockets
  - c. Replace one rocket
  - d. Replace one rocket tube
  - e. Replace one launcher firing mechanism
  - f. Clean all rocket tubes
  - g. Replace gun sight aiming point camera (when used)
  - h. Reload gun sight aiming point camera (when used)
  - i. Boresight gun sight aiming point camera (when used)
  - j. Reload by replacing rocket package or pod with loaded rocket package or pod
  - k. Check rocket firing circuit

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4.10.2.1 Aircraft Ground Test Procedure.- Secure the aircraft against recoil loads and elevate the centerline of the tubes to a minimum of 5 degrees nose up. Start with the maximum safe number of rockets and gradually increase the number loaded and fired until it is assured that a complete load may be safely fired. Fire two such full loads in the arrangement anticipated for combat. Fire one full load of rockets at an operating temperature of 120°F. Load dummy rounds in all tubes not under test in order to simulate the remainder of the load and to allow a check for possible jamming by debris from rockets already fired. Fire a total of 20 rounds in the most critical tube and in any tube(s) deemed advisable for structural, functional, safety, or other considerations. The quantity of 20 rockets may include all the applicable rockets fired above.

#### 4.11 Aerial Rocket Firing Tests.

##### 4.11.1 Air-to-Ground Rocketry Installation.

4.11.1.1 Preliminary Steps.- Prior to aerial rocket firing, a flight test shall be conducted with full load under combat maneuvers. These maneuvers shall impose on the airplane 50 percent of the ultimate vertical and horizontal load factors, including such combinations of vertical and side loads and of air and inertia loads as shall impose maximum loads on the rocket installation. In addition, rocket installation shall be subjected to quick reversal loads by a rapid series of a minimum of five yaw and five pitch maneuvers. As described in paragraph 4.10.1.3 above, in the event of failure, the test shall be repeated following corrective action.

##### 4.11.1.2 Aerial Firing.- The following aerial tests shall be conducted:

- (1) Number of Rounds.- At least ten rounds fired from each launcher. In the event of "double shot" installations, five rounds shall be fired from the lower position in addition to the 10 rounds from the upper position.
- (2) Maneuvers.- Two full complements fired singly during level flight with the balance fired in ripples during dives of 0 degrees to 35 degrees. In the event of malfunction, not due to faulty rockets, the cause shall be determined and corrected and the installation retested until three additional full complements, one fired singly, have been fired.
- (3) Firing Guns with Rockets.- In aircraft where applicable to assure no interferences in rocket fire due to machine gun operation, at least one full complement of ammunition fired from each gun in the air while dummy rockets are installed.

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The rockets and the launching installation shall be inspected upon completion of the gun firing test and the result recorded.

4.11.1.3 After Firing Measurements.- In order to determine if permanent set has taken place due to firing and/or maneuvers of external type launchers, the following measurements shall be made:

- (1) Rocket Mount Deflections.- Record difference between the maximum and the minimum front-to-rear mount distances as recorded in paragraph 4.10.1.1.1.
- (2) Comparison with Pre-Firing Measurements.- Determine largest of the values of increases of distances between front and rear mounts, as recorded above 4.10.1.1.1, 4.10.1.1.3 and 4.11.1.3. The largest decrease values of distance shall also be determined.
- (3) Limits.- The arithmetic sum of the three values recorded in accordance with 4.11.1.3(1) and 4.11.1.3(2) shall be less than  $1/4$  inch, in order to insure proper retention of the rocket in the mounts.
- (4) Rejections.- If the sum of the three values given above is  $1/4$  inch or greater, the mounts must be redesigned. Reconsideration of mounts exceeding this permissible value only slightly, may be gained by the contractor submitting to the Procuring Agency a test report giving full particulars of the extent of excess variation, and conducting such additional tests as deemed necessary by the Procuring Agency.

4.11.1.4 Rocket Jettison Tests.- All jettison devices shall be checked in flight as follows:

- (1) Rockets jettisoned in level flight by the normal cockpit controls at cruising speed.
- (2) Rockets jettisoned while airplane is in a minimum pullout of 2 g. Double rounds shall be tested where applicable.
- (3) Full weight dummy rounds on jettison tests, unless live rounds can be safely dropped and subsequently recovered.
- (4) A full load of rockets for each test described above.

4.11.1.5 Rocket Flight Tests Observations.- During the aerial firing tests, the following applicable points shall be reported upon:

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- (1) Flight characteristics of airplane with launchers and rockets installed and with launchers only
- (2) Effect of "Single" and "Auto" firing on airplane control
- (3) Handling of aircraft if an unsymmetrical rocket loading is obtained through a normal firing when applicable
- (4) Security of all rocket installation items and amount of wear, failure, or distortion during test
- (5) Ease of loading and servicing rocket launchers
- (6) Ease of removing and reinstalling rockets and launchers
- (7) Operation of all access doors and fastening devices
- (8) Durability of blast tubes and fairing through expected firing life of the airplane

4.11.1.6 Rejections of Rocket Installation.- After satisfactory completion of rocket firing tests as specified above, a complete inspection shall be made. Major structural failure or excessive malfunction due to the installation shall be cause for rejection of the installation and shall require that all aerial rocket firing tests specified herein be repeated, or at the discretion of the Procuring Agency all tests be repeated after satisfactory redesign.

4.11.1.7 Report of Rocket Tests.- A complete report covering the entire rocket firing tests shall be prepared for transmittal to the Procuring Agency. The report shall cover malfunctions, taxiing results, flight maneuvers executed and results, design changes required as a result of firing and any other data pertinent to the installation obtained during the tests. In addition to those instances specifically noted above, photographs shall be taken of all phases of the rocket firing tests showing in particular, blast effect on all airplane surfaces.

#### 4.11.2 Air-to-Air Rocketry Installation:

4.11.2.1 Preliminary Maneuvers.- With full loads of dummy rounds perform the following maneuvers: (Inspect the structure and installation at the completion of the tests.)

- (1) Aerial Tests (Mild)
  - a. Level flight to right turn
  - b. Level flight to left turn

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## (2) Aerial Tests (Medium)

- a. Diving turn to right
- b. Diving turn to left
- c. Right vertical turn to level
- d. Level to right vertical turn
- e. Level to left vertical turn

(3) Aerial Tests (Severe Position "g"):

- a. Pull out within  $1/2$  g of maximum positive limit g loading established for airplane

(4) Aerial Tests (Severe Negative g):

- a. Pushover as close as possible to the design negative g for the airplane

(5) Aerial Tests (Severe Combat Maneuvers):

- a. Left spiral
- b. Right Spiral
- c. Severe slip to right
- d. 360 degree roll
- e. Chandelle to right
- f. Chandelle to left
- g. Immelman
- h. Severe slip to left
- i. Loop
- j. Rough taxiing tests with full load of dummy rockets installed

(6) Aerial Tests With Package Extended (When Applicable). - Repeat the above maneuvers with the pocket extended. In addition, at 30,000 feet altitude and 100 percent V max., extend the rocket package through six cycles.

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4.11.2.2 Aerial Firing.-- The following aerial tests shall be conducted:

4.11.2.2.1 Dispersion Tests:

- (1) Structural and Aerodynamic Dispersion.-- Determine the dispersion caused by structural and aerodynamic effects of this installation. This test is to be performed over a suitably instrumented range at combat altitude. Twenty pairs of rockets shall be fired from each pair of tubes which are deemed to affect the rocket trajectory differently. The tubes tested for each pair of rockets fired are to be located symmetrically about a vertical and/or horizontal centerline, contingent on the configuration of the installation.
- (2) Overall Dispersion.-- Determine the overall dispersion by firing one full load of rockets in combat pattern at combat altitude over an instrumented range. In the event that unsatisfactory dispersion results, such conditions as the installation permits are to be varied. For verification, fire two full loads without changing the variables after a satisfactory dispersion has been demonstrated.

4.11.2.2.2 Firing in Maneuvers:

- (1) Fire one full load in a steep dive and one full load in a steep climb
- (2) Record as much ballistic data as possible during this series of tests by ground camera and gun sight aiming point coverage

4.11.2.2.3 Night Firing Test.-- Fire one full load of rockets at night to determine affects of rocket blast on pilot's ability to maintain night adaptability.

4.11.2.3 Defects.-- In the event of structural or functional defects during any part of the above tests, repairs which duplicate production changes must be made. The number of rounds previously fired may not be counted in life test.

4.11.2.4 Reports.-- A complete report covering the entire test shall be forwarded to the Procuring Agency. The report shall show total rounds fired per tube, number and type of malfunctions, firing pattern, dispersion tests, flight maneuvers executed and results obtained, design changes required as a result of firing and any other data pertinent to the installation obtained during the tests. All reasonable photographic coverage will be arranged.

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5. PREPARATION FOR DELIVERY. - Not applicable

6. NOTES

6.1 The following information may be used by contractors and inspectors in testing armament equipment in aircraft.

6.2 The requirements given herein describe the manner in which compliance with paragraphs F-9 and F-13a(2)(c) of Specification R-1800E, paragraphs F-2c and F-2d of Specification R-1803-9A, paragraph D-4 of Specification C-1803-E, and Sections 21 and 25 of Manual 80-1 "Handbook of Instructions for Aircraft Designers" can be demonstrated.

6.3 Major structural failure or excessive stoppages due to design or equipment installation during any portion of these tests shall be cause for rejection of the installation and may require that all aerial tests of this specification be repeated at the discretion of the Procuring Agency. As required by the Procuring Agency, any or all of the tests are subject to be repeated after satisfactory redesign.

6.4 Minor breakages or malfunctions should not exceed, in the opinion of the Procuring Agency, average breakage or stoppage encountered in previous test model aircraft of the general type presently being tested. Unsatisfactory operation may be cause for repetition of aerial tests of this specification after satisfactory redesign.

6.5 Other Armament Tests.- Engineering tests shall be conducted in addition to armament tests on production quantities or aircraft as specified in other publications and shall not be conducted concurrently with armament tests on production quantities of aircraft.

**PATENT NOTICE:** When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

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## APPENDIX "A"

## TEST HISTORY RECORD

AIRPLANE TYPE AND NO. (if applicable)

Mission No.	Date	Gun Position and Number												Type Mission Configuration	Alt. Feet	Free Air OoP	Heater on or OFF	Type Ammo & Lot #
		R-1				R-2				R-3								
		3199282																
		Rds. Load- ed	Rds. Fired	Total Gun Posi- tion	Rds. Load- ed	Rds. Fired	Total Gun Posi- tion	Rds. Load- ed	Rds. Fired	Total Gun Posi- tion	Rds. Load- ed	Rds. Fired	Total Gun Posi- tion					
		page	page	page	page	page	page	page	page	page	page	page	page					
1	12/2	400	250	250	400	--	400	400	--	400	400	400	Note "A"	--	-	-	Cal..50 #1954	
18	2/28	400	-	6845	400	202	7100	400	10	6541	400	400	400	35000	-20°	On	Cal..50 #702	

A. Expand as required.

B. Gun position shall be numbered commencing at the airplane centerline, as R1, R2, L1, L2, etc., when viewed from the cockpit forward. When guns are positioned one above the other the uppermost position inboard shall be designated the number 1 gun right or left with the balance numbered in order downward and thence outboard if applicable.

C. Malfunction Code and explanation: See following page.

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Appendix "A" (Cont)MALFUNCTION CODE

<u>Types</u>	<u>Function</u>
"A"	Guns or Ammunition
"B"	Feeding equipment
"C"	Ejection equipment
"D"	Charging mechanism
"E"	Solenoids, etc. equipment
"F"	Handling of equipment
"G"	Mounting or Structure
"H"	Miscellaneous or undetermined
"OK"	Denotes fired out

Number malfunctions numerically in each group as encountered.

Examples: OK - Fired out  
 B2 - Booster motor burned out  
 D10 - Charger cable fouled bolt recoil

Following analysis and the assignment of a number, additional malfunctions encountered which are analyzed as due to exactly the same cause shall carry that same number, regardless of gun position, that is, No. B-2 may appear several times throughout the record when several burned out booster motors are encountered. A separate "Test Legend" shall be attached to the test history record to explain the coded malfunctions and shall show the conditions which were found in the installation during the analysis which led to the conclusion that the malfunction was due to a certain cause.

## Examples:

- F-1 Gun was not charged before take off due to oversight. Three hundred rounds (full load) remained in ammunition container.
- A-1 Failure to extract from belt. Round next to cartridge stops and in position for extraction. Bolt in battery. Link showed no evidence of a stripper jam. Cause unknown.
- A-3 Blown primer cup during cook off. Next round had light strike due to primer cup brass in firing pin port.

When guns are removed and cleaned, gun component parts changed, gun mounts tightened, cracks are found in the installation, et cetera, these shall be indicated by a series of "Notes" in numerical order as encountered and shall also be attached to the test history record. When identical work is performed on the installation this fact shall be indicated by the same note number.

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Appendix "A" (Cont'd)

Examples:

Notes

1. Feeder replaced - was incorrectly assembled.
5. Guns removed, cleaned, recoiled and reinstalled - no parts replaced

Upon completion of the ground or aerial portions of the acceptance tests, the total number of malfunctions of each type shall be determined and forwarded as a summary as a portion of the required reports.

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## APPENDIX "A"

DISPERSION TESTDispersion in Mils  
Best 80% of Beaten Zone

1 mil = 1 inch at 1,000 inches

Test # and Date	Type Test - Mounting	Gun Position		L1	L2	L3	R1	R2	(etc.) (As Required)
		Gun Number	Gun Number						
(1)  (11-30-49)	(Single Gun)	80% Pattern	YA 80 Azimuth	(3.5)	(2.4)				
			YA 80 Elevation	(4.2)		(3.0)			
	(Ground Mount)	Center Impact Shift *	YB 80 Azimuth	(+2.8)		(-4.5)			
			YB 80 Elevation	(-3.4)		(-2.2)			
(7)  (1-4-48)	(Salvo)	80% Pattern	YA 80 Azimuth						
			YA 80 Elevation						
	(Air- plane)	Center Impact Shift	YB 80 Azimuth						
			YB 80 Elevation						

(As required)

\* NOTE: Indicate + or - sign, reference paragraph 4.8.1.4.

NOTE: Gun positions shall be numbered commencing at the airplane centerline as R-1, R-2, L-1 or L-2, etc., when viewed from the cockpit forward. When guns are positioned one above the other, the uppermost position inboard shall be designated the #1 gun, right or left with the balance numbered downward and thence outboard if applicable.

APPENDIX "A"

MIL-F-7117 (USAF)

CYCLIC RATE TEST

Airplane:

Type of Timing Device:

Gun Post- tion	Gun Num- ber	Gun Config- uration - Ground Mount	No. of Rounds	Rounds Per Minute			
				Ground Mount	Test Stand of Airplane	Difference	
						Rounds	Percent
		(See Note below)					

NOTE: Indicate use or non-use of barrel sleeves, chargers and other accessories normally used on the weapon in the airplane installation.

NOTE: Gun positions shall be numbered commencing at the airplane center line as R-1, R-2, L-1, or L-2, etc., when viewed from the cockpit forward. When guns are positioned one above the other, the uppermost position inboard shall be designated the #1 gun, right or left with the balance numbered downward and thence outboard if applicable.

