
Marine Corps Artillery Safety Standing Operating Procedures



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UNITED STATES MARINE CORPS
10th Marine Regiment, 2d Marine Division
PSC Box 20105
Camp Lejeune, NC 28542-0105
and
11th Marine Regiment, 1st Marine Division
PSC Box 555504
Camp Pendleton, CA 92055-5504
and
12th Marine Regiment, 3d Marine Division
FPO AP CA 96602-8658
and
14th Marine Regiment, 4th Marine Division
NAS JRB FT.W, 4210 Hercules Rd
Fort Worth, TX 76127
and
Marine Corps Artillery Detachment, Field Artillery School
759 McNair Ave.
Fort Sill, OK 73503-5600

JtRegtO P3570.1C
10th Mar
11th Mar
12th Mar
14th Mar
MCAD

JOINT REGIMENTAL ORDER P3570.1C

From: Commanding Officer, 10th Marine Regiment
Commanding Officer, 11th Marine Regiment
Commanding Officer, 12th Marine Regiment
Commanding Officer, 14th Marine Regiment
Commanding Officer, Marine Corps Artillery Detachment,
Fort Sill, OK

To: Distribution List

**Subj: MARINE CORPS ARTILLERY SAFETY STANDING OPERATING
PROCEDURES (SHORT TITLE: MCASS)**

MARINE CORPS ARTILLERY SAFETY SOP

JRegtO P3570.1C

**Subj: MARINE CORPS ARTILLERY SAFETY STANDING OPERATING
PROCEDURES (SHORT TITLE: MCASS)**

Ref: (a) SECNAVINST 5100.14
(b) SPAWARINST 5100.12
(c) NAVORD OP 2239
(d) NAVMEDCOMINST 6470.2
(e) JtDivO P5100.20
(f) MCO P3570.1
(g) MCO 8020.1
(h) MCO 8025.1

Encl: (1) LOCATOR SHEET

1. Purpose. To establish uniform procedures for safety when firing artillery ammunition.

2. Cancellation. JtRegtO P3570.1B

3. Applicability. All Marine Artillery units will comply with this order when engaging in live fire. Appropriate waivers can be requested for certain requirements of this SOP. If a conflict exists between the policies of this order and the local range regulations of other installations, follow the more stringent requirements. Justifiable waivers to this Order may be requested and will be considered on a case by case basis by the Regimental Commanders.

4. Reserve Applicability. This order is applicable to the Marine Corps Reserve.

5. Action

a. Battalion Commanding Officers will ensure that:

(1) All personnel who are assigned safety duties when firing artillery read and understand the provisions of this order.

(2) All units comply with the contents of this Order, and all required personnel are safety qualified.

(3) Amplifying instructions are issued when necessary.

b. Regimental S-3 is responsible for supervising the safety certification program.

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6. Recommendations. Marine Detachment, Fort Sill, is the coordinating command for this SOP. Recommendations for revising this SOP are invited and should be submitted to the Commanding Officer, Marine Detachment (Attn: Doctrine Officer), 759 McNair Ave. Fort Sill OK 73503-5600, via the appropriate chain of command. Recommendations for changes to this SOP will be routed to 10th, 11th, 12th, and 14th Marines (Attn: S-3) for comment prior to incorporation.

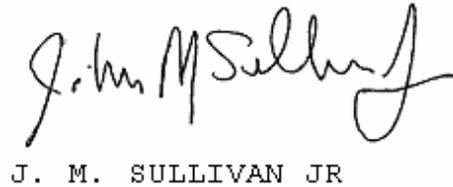
7. Certification. Reviewed and approved this date.



T. L. CARIKER



S. T. CAMPBELL



J. M. SULLIVAN JR



J. E. FONDAW



J. A. PACE

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LOCATOR SHEET

Subj: MARINE CORPS ARTILLERY SAFETY STANDING OPERATING
PROCEDURES (SHORT TITLE: MCASS)

Location:

(Indicate location(s) of copy(ies) of this Manual)

ENCLOSURE (1)

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CHAPTER 1

GENERAL

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CHAPTER 1

GENERAL

1000. POLICY

1. This order establishes artillery safety policies and procedures during the live firing of cannon artillery. Commander's may establish more restrictive measures as necessary based on unit capabilities and state of training. This order will be used in conjunction with applicable orders, field manuals, technical publications, and the range regulations of the facility where firing is conducted.

2. Safety is the result of proper application of artillery procedures and adherence to requirements and procedures set forth in this order. Artillery procedures are inherently safe. Safety and speed of execution are not mutually exclusive. Responsiveness means timely and accurate fires. This is accomplished by following prescribed procedures. However, safety will never be sacrificed for speed.

3. Firing exercises will not be conducted unless all participating personnel have been thoroughly briefed on the provisions of this order, and all personnel assigned safety duties have been certified in accordance with the requirements herein.

4. Officers and enlisted personnel in command or supervisory billets, or specifically detailed to perform safety related duties, will be thoroughly familiar with this order.

5. The Regimental S-3 is designated the cognizant staff officer for this order.

1001. APPLICATION. This order is applicable to all units organic to or under operational control of this command. Units of this command operating independently or under the control of another headquarters shall adhere to the provisions of this order unless otherwise directed. Should the contents of this order conflict with directives of higher headquarters the Commanding Officer, MARDET, should be notified via the appropriate chain-of command.

1002. AUTHORITY FOR USE OF FIRING RANGES/IMPACT AREAS. Specific regulations that govern assignment of available local ranges are

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contained in current editions of local range regulations. If other ranges are used, the Regimental S-3 will provide appropriate range regulations and supplementary instructions. All requests for ranges/impact areas will be submitted via Regimental Headquarters. Approval of requests will normally be confirmed by publication of weekly firing notices/bulletins or by message.

1003. BATTERIES DEPLOYING WITHOUT PARENT BATTALION

1. A battery conducting an independent exercise must possess a copy of all applicable range regulations, field manuals, and technical manuals.
2. The Battery Commander assumes all responsibilities as OIC of Firing (this includes authority to approve and sign range safety cards and surface danger zone diagrams).
3. All personnel listed in paragraph 2002 who deploy with the battery will be safety certified.
4. Batteries attached to BLTs should comply with the regulations of the local range where they are operating.
5. Batteries attached to and deployed with BLTs will submit a courtesy copy of the surface danger zone diagram (SDZD) to the BLT S-3, when required according to paragraph 4001.

1004. SPLIT BATTERY OPERATIONS. Batteries may fire from two positions simultaneously during displacements or from offset positions providing all of the requirements of this order are met. Safety personnel required to be present for live fire must be physically present in both positions (there is not a requirement to have an OIC in each position. The Position Commander at each location will serve in this capacity).

1005. MLRS UNITS. MLRS units that are attached (either TACON OPCON or ADCON) to USMC units will compute their respective safety parameters/computations. The MLRS Commanding Officer is overall responsible for all safety matters pertaining to his unit to include all artillery rocket live firing.

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CHAPTER 2

COMMAND SAFETY CERTIFICATION PROGRAM

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CHAPTER 2

COMMAND SAFETY CERTIFICATION PROGRAM

2000. PURPOSE. This chapter contains instructions, procedures and policies required to administer the regimental command safety certification program.

2001. GENERAL

1. Safety certification is the commander's means of designating individuals qualified to perform in certain artillery safety billets. This determination is made with the help of practical and written command safety certification examinations. All personnel requiring certification must successfully pass the prescribed examinations for their billet and be certified in writing by their Regimental or Battalion Commander.

2. Certification is effective for one year from signature date on the command safety certification card/letter. Only the written examination covering local range regulations is required for recertification of Marines transferring from one regiment to another.

3. Marines assigned to a non-artillery TAD/FAP billets in excess of 180 days must be recertified prior to participating in livefire training or within 45 days of return, whichever occurs first.

4. Marines returning from MEU commitments are required to be recertified prior to conducting live fire exercises, but no later than 45 days after returning. Past experiences have shown that artillery skills tend to rapidly decline in those units that are deployed for extended periods of time with landing force units. Every effort must be made to ensure Marines are thoroughly familiar with all safety practices.

5. Marines returning from unit deployment program (UDP) rotations do not require safety recertification, so long as they are within the one year recertification window contained in paragraph 2001.2.

6. Marines returning from the 31st MEU do not require safety recertification, so long as they are within the one year recertification window contained in paragraph 2001.2.

7. New personnel arriving at a command must be certified prior

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to participating in live fire training or within 45 days of joining the unit, whichever occurs first.

8. Safety certification of new join personnel, transferred within the regiment, remains valid for one year from the issue date of their current Safety Card so long as they provide documentation supporting their safety certification from their transferring unit.

2002. BILLETS REQUIRING CERTIFICATION

1. The following personnel will be command safety certified.
 - a. **All** 0802 Majors and below.
 - b. Majors and Captains performing duties as the Regimental/Battalion S3. One time safety certification prior to assuming billet duties. Yearly recertification is not required while in this billet.
 - c. Regimental/Battalion Operations Chiefs. One time safety certification prior to assuming billet duties. Yearly recertification is not required.
 - d. Regimental/Battalion Field Artillery Chiefs. One time safety certification prior to assuming billet duties. Yearly recertification is not required.
 - e. All 0848 and 0844 Marines serving as operations chiefs and assistant operations chiefs.
 - f. Battery Gunnery Sergeants.
 - g. Section Chiefs.
 - h. Naval Gunfire Liaison Officers may be directed by the Battalion Commander to become safety certified in order to serve in the capacity of RSO.
 - i. 0803s serving in 0802 unrestricted officer billets will be command certified based on the T/O billet in which he is serving.
2. The following personnel will be laser safety certified.
 - a. Laser Range Safety Officers

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b. Laser Operators.

NOTE: The examinations for the certification of the Laser Range Safety Officers and the Laser Operators are initially administered during the appropriate course of instruction. Recertification is conducted annually by obtaining at least an 80% on the appropriate exam administered by the Regimental LSSO. Recertification can also be accomplished by re-attending the appropriate course of instruction.

2003. COMMAND SAFETY CERTIFICATION FORMATS. The command safety certification examination process consists of two types of examinations: written and practical. The written examination is divided into several parts, with the appropriate parts taken by every individual requiring certification. Personnel whose billet requires a detailed knowledge of the procedures tested take the practical examination in addition to the written examination. Examination descriptions follow.

1. Written Examinations

a. Part I: General Knowledge

- (1) Number of questions: 25-50.
- (2) Type of questions: Multiple choice, matching, fill-in the blank and true/false.
- (3) Source of questions: This Order, weapons technical manuals, TM 43-0001-28, FM 6-40/MCWP 3-16.4, FM 6-50/MCWP 3-16.3, and ST 6-40-31.
- (4) Minimum passing score: 100%.
- (5) References are authorized for use in completing this portion of the examination.
- (6) Specific exams are given based on MOS (0802, 0811 and 0848).

b. Part IA: General Knowledge -Local Regulations

- (1) Number of questions: 10
- (2) Type of questions: Multiple Choice, fill-in the blank

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- (3) Source of questions: Local range regulations
- (4) Minimum passing score: 100%
- (5) References are authorized for use in completing this portion of the examination.

c. Part II: Safety T's

- (1) Number of Questions: 20
- (2) Type of questions: Fill in the blank (Determine whether the fire command is safe or unsafe)
- (3) Source of questions: This Order and FM 6-50/MCWP 3-16.3.
- (4) Minimum passing score: 100%
- (5) No references are authorized for use in completing this portion of the examination.

d. Part III: Executive Officer's Minimum Quadrant Elevation (Min QE)

- (1) Number of questions: 5
- (2) Type of questions: Computation of XO's Min QE using both the manual method and rapid fire tables.
- (3) Source of questions: This Order, FM 6-40/MCWP 3-16.4 or FM 6-50/MCWP 3-16.3.
- (4) Minimum passing score: 100% (Min QE accuracy: 0 mil error allowance)
- (5) References are authorized for use in completing this portion of the examination.

e. Part IV: Safety Computations

- (1) Number of questions: 4
- (2) Type of questions: Manual computation of low and high angle safety for shell Smoke (M825), Illum, WP, and HE before and after occupation. Automated computations of HE before and after occupation.

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(3) Source of questions: This Order, FM 6-50/MCWP3-16.3, FM 6-40/MCWP 3-16.4, and ST 6-40-31.

(4) Minimum passing score: 100% (A 3 mil error allowance for minor interpolation differences on manual problems, a 0 mil error allowance on the computer problems).

(5) References are authorized for use in completing this portion of the examination.

f. Part V: Aiming Circle

(1) Number of questions: 8

(2) Type of questions: Fill in the blank, computations, and practical application.

(3) Source of questions: This order, FM 6-50/MCWP 3-16.3 and XO's Handbook.

(4) Minimum passing score: 100%

(5) The XO's Handbook (ST 6-50-20) is the only authorized reference for use in completing this portion of the examination.

(6) Tolerances: Orienting Angle +/- 1 mil
 Grid Azimuth +/- 10 mils

2. Practical Examination

a. The howitzer practical examination portion of the command safety certification program will consist of one or more of the following seventeen tasks, depending on the billet held. The weapon's operators manual is the only authorized reference for completing this portion of the examination. The task, condition and performance standards contained in MCO 3501.26__ will be used for certifying knowledge.

(1) Lay the howitzer.

(2) Verify emplacement of aiming posts and recording of deflection.

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- (3) Determine site to crest.
 - (4) Perform Gunner's Quadrant Micrometer Test.
 - (5) Perform Gunner's Quadrant End-for-End Test, and Vertical Shoe Test.
 - (6) Set/lay for quadrant with gunner's quadrant/on carriage fire control equipment.
 - (7) Measure the quadrant with the gunner's quadrant.
 - (8) Boresight using a distant aiming point (DAP).
 - (9) Boresight using the aiming circle method listed in FM 6-50/MCWP 3-16.3.
 - (10) Boresight using the collimator method listed in FM 6-50/MCWP 3-16.3.
 - (11) Perform reciprocal lay of the M198 howitzer.
 - (12) Verify boresight on the M198, 155mm howitzer using the M139 alignment device.
 - (13) Measure cant on appropriate weapon system.
 - (14) Prepare and verify projectiles, propellants and fuzes for firing.
 - (15) Complete the gunner's reference card.
 - (16) Shift from primary to alternate aiming points.
 - (17) Perform fire control alignment tests. (May be performed in a group effort as a period of instruction, use of weapon's TM is authorized for all tasks except gunner's quadrant test).
- b. Minimum passing score: Receive a "GO" on each task.
- c. References authorized for task (17) only.

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2004. EXAMINATION REQUIREMENTS

1. Initial and annual examinations which must be fulfilled to certify an individual by rank and/or billet under the provisions of this order.

<u>BILLET</u>	<u>WRITTEN EXAM(S)</u>	<u>PRACTICAL TASKS</u>
0802 (Majors and Captains in S-3 Billet)	I and IA Upon assumption of billet duties	CO's Discretion
0802 (Majors)	I and IA	CO's Discretion
0802 (Captain and Below)	I-V	1-17
NGLO (when directed)	IA	
0803 (when directed)	Based on T/O billet	Based on T/O billet
Regimental/Battalion Field Artillery Chiefs	Upon assumption of billet duties	
Battery Gunnery Sergeants	I-III, V	1-17
Regimental/Battalion Operations Chiefs	I-IV Upon assumption of duties	No requirement.
Battery Operations Chiefs and Assistant Operations Chiefs	I-IV	No requirement.
Section Chiefs	I-II	1-17

2005. EXAMINATION MATERIALS

1. Written Examination Materials

a. MARDET, USAFAS, Fort Sill, OK will provide each regiment with original copies of all safety computations, answer sheets, and answer keys to Part IV. CO, MARDET, maintains proponency for computational procedures, periodic update, and development of new versions of safety exams. Development and maintenance of Part IA is the responsibility of each individual regiment.

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- b. Regimental FACs are responsible for developing a standardized 0811 safety exam within their respective regiments. Battalion FACs are authorized to administer these exams.
- c. Regiments will provide each battalion with reproducible copies of all safety examinations, answer sheets, and answer keys.
- d. Battalions are responsible for reproducing additional copies of the safety examinations and answer sheets as required. Battalions will serialize and control reproduced copies of safety examinations, as well as maintain records of all Marines taking the safety examination.
- e. All examinations will be administered at the appropriate battalion/battery, by the individual(s) appointed in writing by the Battalion Commander.

2006. EXAMINATION RESULTS, CONTROL, AND DESTRUCTION RESPONSIBILITIES

1. General

- a. Marines not achieving 100% for safety certification will be individually debriefed on their test results and afforded an opportunity to re-test in the specific areas in which they did not achieve 100% mastery. An individual who fails two times may have his name forwarded to the Battalion Commander for administrative action. If the Battalion Commander determines that the individual deserves another chance the second re-test will be given by the RASO.
- b. Re-testing will be conducted as soon as possible.
- c. Examination materials will be graded, recorded and maintained for a period of time based on the commander's discretion.
- d. The Battalion Artillery Safety Officer (BASO) and Laser Systems Safety Officer will maintain a current copy of the Command Safety Certification letter on hand at all times.
- e. Battalions are required to issue Command Safety Certification Cards, provided by the regimental S-3, to all personnel who are Command Safety Certified. In the case of

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1st Battalion, 12th Marines, 12th Marines regimental headquarters will assume this responsibility. **These cards are to be carried at all times when performing safety related duties.**

2. Battalion Practical Examinations

a. The Battalion Artillery Safety Officer will coordinate, schedule, and oversee administration of practical examinations. He will consolidate the personnel within his battalion which require practical safety examination.

b. Battalion Commanders will assign, in writing, test administrators, Staff Sergeant or above to:

(1) Administer and grade the practical examination. The test administrators will not evaluate members of their own battery. Additionally, the Battalion Field Artillery Chief, if not the test administrator, will monitor the administration of the practical examination when it is administered by a member of a firing battery.

(2) Provide test results to the BASO.

(3) In 14th Marines, Battalion I-I's (with concurrence from the Battalion CO) will assign in writing, a test administrator, either the Battery Gunnery Sergeant, the Operations Chief or both, at each battery location.

3. Battalion Written Examinations

a. The Battalion Artillery Safety Officer is responsible for the control of written examinations held within the battalion. He will coordinate and schedule written tests with the provisions of this chapter.

b. Battalion Commanders will assign, in writing, a test administrator from the Battalion Headquarters, Staff Sergeant or above who will:

(1) Sign for and pick up written examinations from the Battalion Artillery Safety Officer.

(2) Administer and grade written examinations.

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(3) Provide the test results to the Battalion Artillery Safety Officer.

c. In 14th Marines, Battalion I-I's (with concurrence from the Battalion CO) will assign in writing, a test administrator, the Operations Chief, Battery Gunnery Sergeant or both, at each battery location. He will perform the same duties as outlined in 2006.3.b. above.

2007. COMMAND SAFETY CERTIFICATION INSPECTION PROGRAM

1. General. The command safety certification inspection program is designed to evaluate the provisions of this Order.

2. Battalion Administration Inspection. The Regimental Artillery Safety Officer will conduct an administrative inspection of all battalions annually. The Artillery Safety Inspection Checklist in Appendix A will be used for these inspections.

3. Battery Safety Assistance Visits. The Regimental Artillery Safety Officer will periodically evaluate individual firing batteries during live fire exercises. Firing battery procedures, as well as unit safety practices will be evaluated. These visits will be announced in advance. The checklists in Appendixes B and C will be used for these assistance visits. The RASO will notify the Battalion Commander or the next senior ranking officer within the battalion of his intended visit.

4. Inspection And Safety Assistance Visit Results. Written results of inspections and safety assistance visits will be given to the Battery Commander with information copies sent to the Regimental Commander and the Battalion Commander.

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CHAPTER 3

DUTIES OF SAFETY PERSONNEL

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CHAPTER 3

DUTIES OF SAFETY PERSONNEL

3000. PURPOSE. To designate the safety billets and duties at the regimental, battalion and battery levels.

3001. GENERAL. This section identifies personnel charged with specific responsibilities when firing live ammunition.

1. Command Safety Certification Program. This program is established by Regimental and separate Battalion Commanders, to train and qualify individual unit members in the safety procedures for their specific areas of responsibility. This program will fall under the cognizance of the unit S-3.

2. Billets requiring command safety certified personnel will include, but are not limited to, the firing battery Commanding Officer, Executive Officer, Assistant Executive Officer, Battery Gunnery Sergeant, Fire Direction Officer, Operations Chief, Assistant Operations Chief and Section Chief. If one of these positions is not filled by a command certified individual, another individual, command safety certified and qualified to fill that position, will perform the safety duties required by this SOP during live-fire operations.

3. Artillery Safety Officer. An officer at the regimental, battalion, and battery level assigned, in writing, having the responsibility of monitoring the Command Safety Certification Program. Artillery safety officers will also follow other duties as directed in this SOP.

3002. RESPONSIBILITIES

1. The Regimental S-3

a. Monitors training to ensure safety training is scheduled and conducted at the battalion and firing battery levels.

b. Assigns a Major or Captain (MOS 0802) as the Regimental Artillery Safety Officer.

c. Is authorized to approve safety as directed by the Regimental Commander.

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2. The Regimental Artillery Safety Officer (RASO)

- a. Maintains this SOP and recommends modifications as required by changes in doctrine and artillery safety practices.
- b. Develops, prepares, and updates Part IA of the written command safety certification examination for artillery, as well as the laser safety examination to be used by the battalions.
- c. Administers the command safety certification written and practical examinations to Regimental Headquarters Battery personnel.
- d. Monitors and evaluates the artillery practices of subordinate units. He will not compute or verify any safety data to be used in any exercise other than during investigations.
- e. Conducts artillery safety command inspections of battalions and batteries annually, when requested by the unit, or when directed by the Regimental Commander.
- f. Conducts Battery Safety Assistance Visits periodically, or when requested by the unit or directed by the Regimental Commander. Visits will be conducted using Appendixes B and C.
- g. Maintains an updated list of all command safety certified personnel in the Regimental Headquarters Battery.

3. The Battalion Commander

- a. Implements and administers the policies, procedures, and instructions contained in this SOP.
- b. Ensures adequate and timely artillery safety training is scheduled and conducted.
- c. Ensures applicable personnel are safety certified prior to assuming their duties.
- d. Assigns a Major or Captain (MOS 0802) the additional duty of Battalion Artillery Safety Officer (BASO). This officer may be the Battalion S-3.

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e. Assigns, in writing, personnel to administer the command safety certification written or practical examinations.

f. Ensures all safety is computed per Chapter 4 of this order.

4. The Battalion Artillery Safety Officer (BASO)

a. Ensures adequate safety training is scheduled and conducted.

b. Coordinates and schedules the command safety certification written and practical examinations.

c. Ensures safety certification examinations are administered by a Staff Sergeant or above who has been assigned in writing by the Battalion Commander.

d. Maintains an updated list of all command safety certified personnel in the battalion.

e. Verifies surface danger diagrams and/or range safety cards are received from Range Control or constructed within the battalion.

f. Monitors artillery safety procedures during live fire exercises.

g. Performs other duties as directed.

5. The Officer in Charge (OIC) of Firing

a. General. The OIC of Firing is "the officer in command of troops conducting firing on, or utilizing, a specific range facility;" i.e., the Battery Commander of a firing battery; unless otherwise specified in writing by his Battalion Commander.

b. The OIC of Firing is responsible for all aspects of safety in the firing unit. He is assisted in his duties by all other safety certified Marines. He ensures all safety personnel follow the regulations of this SOP and local range regulations.

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c. Duties Prior to the Start of Live Firing. The OIC of Firing will:

(1) Be familiar with the current editions of reference (f), FM 6-50/MCWP 3-16.3, local range regulations, and this order.

(2) Ensure all required personnel in the battery are command safety certified and/or laser certified annually or more frequently as required by this order.

(3) Ensure a command safety certified Marine computes safety data, and a safety certified officer verifies, ***through independent computations***, the safety data. Data verification using independent computations is mandatory and therefore remains the responsibility of the OIC to ensure rigid adherence to this specific safety requirement.

NOTE: Independent Computations Defined. The requirement for independent computations of safety data minimizes the possibility of error in computations and is consistent with the artillery principle of a second check. Independent computations are defined as data determined by a second safety certified person by independent means.

Examples of Independent Computations. This includes using completely separate means; e.g. Manual vs BUCS. It also includes two separate systems; e.g. 2 separate AFATDS, 2 separate BUCS, or 2 sets of manual computations. Not recommended, but acceptable, is two separately constructed databases on the same system. (This prevents comparison for discrepancies).

Examples of Non-independent Computations. Independent verification is not independent computations. For example, a second person, who reviews the manual computations of the first, is not performing independent computations. The same applies to automated systems. Transferring a database from one AFATDS or BUCS to another in order to compute safety is not a form of independent computations.

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(4) Ensure all Safety T's and safety data are approved by affixing his signature to the original document following the words "Approved by". The OIC of Firing will always approve and sign the initial safety data and Safety T's for each position. In the absence of the OIC of Firing, the Position Commander is authorized to approve and sign subsequent safety data and safety T's.

(5) Ensure the following references are maintained in each firing position and all personnel performing safety duties are familiar with their contents:

(a) This SOP.

(b) Applicable range regulations.

(c) MCO P3570.1 (reference (f)).

(d) FM 6-50/MCWP 3-16.3.

(e) Operators manual of the weapon to be fired
M198 - TM 08198A-10/1

(f) FM 6-40/MCWP 3-16.4.

(g) TB-11-7025-354-10-1, AFATDS GDU JA; and ST 6-40-31, BUCS JA.

(6) Ensure each section has no less than a section chief and six 0811s.

(7) Ensure the unit is in the proper firing position for which the surface danger diagram or range safety card was prepared.

(8) Ensure all personnel assigned safety duties are briefed concerning artillery safety and range requirements. All personnel participating in the firing exercise must understand their responsibility to command "CHECK FIRING" upon observing any unsafe condition. Firing will be stopped promptly when any unsafe act is observed or reported.

(9) Ensure coordination has been conducted with Range Control for any other unit which may be endangered by artillery fires.

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(10) Ensure that positions located by hasty survey techniques are verified by a safety certified officer. Remember fifth order survey is required whenever conducting overhead fire. Local range regulations may be more restrictive.

(11) Ensure a check round is fired in accordance with Appendix P of this order.

d. Duties During Firing. During firing, the OIC of Firing will:

(1) Ensure either himself or the Position Commander is present during firing.

(2) Ensure personnel wear a helmet, flak jacket, and ear plugs within 50 meters of a howitzer engaged in an active fire mission.

(3) Ensure smoking is prohibited within 50 feet of ammunition or powder pits.

(4) Ensure safety computations are performed by a safety certified Marine and verified, **through independent computations**, by a command safety certified officer, at the appropriate times mentioned in paragraph 4004.

(5) Follow procedures in Chapter 8 of this order for incidents involving ammunition accident/malfunctions or rounds impacting outside authorized impact area (Artillery Incidents).

(6) If an Air MEDEVAC is required for a serious injury adhere to the following:

(a) Cease firing.

(b) Contact the base Range Control or higher headquarters by the most expeditious means available.

(c) Submit the request for MEDEVAC using the format in Figure 8-2 in the absence of any other specified formats.

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(7) Ensure all night missions are observed using a night observation device, unmanned aerial vehicle, aerial observer, counter battery/mortar radar, or under coordinated illumination. Local range regulations and local command SOPs must be consulted before a radar may be used as the only means of observation (i.e. when the RSO cannot observe the impact area or the rounds). Particular care must be taken to ensure the target area is sufficiently controlled to prevent unauthorized access by personnel. Communications must be maintained between the RSO on the OP, the radar providing assistance, Range Control and the unit(s) firing. The radar section NCOIC will be familiar with the duties of the RSO as outlined herein.

(8) Ensure proper out of traverse procedures are followed, per Appendix D.

(9) Comply with Chapter 8 for procedures used in handling accidents, incidents and investigations.

e. Duties After Firing. After firing, the OIC of Firing will:

(1) Ensure procedures are in place for maintenance of all designated records per this order.

(2) Ensure a thorough police of the firing area. Neither trash nor ordnance will be buried.

6. The Position Commander

a. General. The Position Commander is normally the Battery Executive Officer. However, any command safety certified **officer** may be assigned to act as the Position Commander by the OIC of Firing. The Position Commander is responsible for the safe practices of the firing battery. When the OIC of Firing is absent, the Position Commander assumes the responsibilities listed in paragraph 3002.5. If he is required to leave the position, he will designate another safety certified officer as Position Commander to ensure positive control.

b. Duties Prior to the Start of Live Firing. The Position Commander will:

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- (1) Ensure all aiming circles are properly declinated by personnel safety certified in that task (as per chapter 2, ST 6-50-20).
- (2) Ensure combat safety checks outlined in Appendix F are performed.
- (3) Maintain a copy of the range/position safety card (when used) and a current Safety T in the firing position and be familiar with their contents.
- (4) Verify at least one section chief and six cannoneers are present on each 155mm towed howitzer. (In 14th Marines, two 0800's in the OJT cycle, vice two 0811's, can be used in the section. However, no more than two 0800's for each 155mm crew will be used.)
- (5) Verify that a corpsman with first aid equipment including a stretcher and an emergency vehicle suitable for medical evacuations are in the firing position.
- (6) Ensure a suitable LZ is identified at each firing position for possible medical evacuation.
- (7) Ensure that an air sentry is briefed and posted, who will give immediate warning to the Position Commander if an aircraft flies near the gun-target line.
- (8) Ensure road guards are briefed and posted when required for safe firing. Road guards are required whenever firing over a road closer to the firing position than 725 meters for 155mm howitzers or when specified in local range regulations.
- (9) Supervise lay of the battery for direction.
- (10) Compute XO's Min QE for each charge and ensure all information contained in the XO's Report is correct and that XO's Min QE is verified by a second command safety certified Marine.
- (11) Ensure that only ammunition which is authorized for firing is issued. If overhead firing will be

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conducted, the ammunition must be cleared for overhead firing.

(12) Ensure ammunition fired is within prescribed temperature limits.

(13) Ensure all ammunition is inspected for serviceability and accountability, and supervise its storage and handling.

(14) Ensure all firing precautions have been taken, all weapons are serviceable, and pre-fire checks have been completed.

(15) Ensure lay of the battery is verified by a safety certified individual. This individual cannot be the same safety certified individual who laid the battery. Lay is verified using the following procedures:

(a) Set up the safety circle at least 10 meters from the aiming circle used to lay the weapons.

(b) Orient the safety circle by a method other than that used to orient the lay circle; e.g. grid azimuth, or hasty survey method. If a different method cannot be used, the safety circle will be oriented using the orienting angle method using a second OS established by separate survey.

(c) Refer the lay circle to the safety circle: the readings must be within +/- 10 mils. Remember to use the "see red, read red" rule when comparing deflections between the two instruments.

(d) Set the referred reading from the lay circle on the safety circle using the upper (recording) motion. Sight the safety circle back on the lay circle using the lower (nonrecording) motion.

(e) Command the howitzers to refer to the safety circle after primary aimpoints have been emplaced and boresight verified. The referred deflection from each howitzer must be within +/- 2 mils of the reading on the safety circle.

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(f) Announce SAFE or UNSAFE as appropriate. If a howitzer is unsafe, the Marine operating the safety circle WILL NOT state the number of mils the referred deflection varies from that of the safety circle.

(g) Ensure all unsafe (i.e., deflection varies greater than +/- 2 mils) howitzers are re-laid by the lay circle and reverified by the safety circle.

(16) Ensure each Howitzer Section Chief verifies the boresight of his weapon (alignment of the M137 via the M139) or if required correct for boresight. The following methods are authorized to boresight the weapon; Distant Aiming Point (DAP) method in accordance with the weapon TM is primary. Emergency boresighting procedures (Collimator and Aiming Circle) methods in accordance with the FM 6-50/MCWP 3-16.3 are secondary.

(17) Ensure that the unit is in the position for which the surface danger diagram was prepared.

(18) Ensure that the range/position safety card and/or firing limitations apply to the unit, exercise, date, and time.

(20) Ensure the following personnel have a current Safety T: Position Commander, FDO, Assistant XO, Battery Gunnery Sergeant, Operations Chief, and all Section Chiefs.

(21) In the absence of the OIC of Firing, approve and sign updated safety data and safety T's after the OIC of Firing has approved the initial data.

(22) Verify the FDO has properly calculated a Min QE for each shell family and charge to clear any intermediate crest(s).

(23) Verify location of the firing unit through an independent check other than survey.

c. Duties During Firing. During firing, the Position Commander will:

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- (1) Require personnel to wear a helmet, flak jacket, and earplugs in the firing position within 50 meters of a howitzer engaged in a fire mission.
- (2) Prohibit smoking within 50 feet of ammunition or powder pits.
- (3) Ensure sections chiefs follow the procedures outlined in paragraph 3002.10, to include verifying that the correct charge is prepared and loaded.
- (4) Collect all outdated safety T's prior to the distribution of new safety T's.
- (5) When placed in "Check Firing status, all actions on the howitzer ceases. The weapon will not be touched in any manner to include the removal of the primer or propellant until commanded by the OIC of firing.
- (6) Ensure weapon tubes are not moved until a subsequent fire command or "END OF MISSION" is received. This does not apply when firing sweep/zone fire.
- (7) Inform the OIC of Firing if ammunition fails to function properly.
- (8) Report all accidents or injuries to the OIC of Firing.
- (9) Ensure the following is accomplished if "CHECK FIRING, TO THE REAR OF THE PIECE, FALL IN.", is received:
 - (a) All weapon crews immediately fall in to the rear of their weapons.
 - (b) All weapons, ammunition and excess powder charges (bags) are undisturbed and weapons reflect data corresponding to when the check firing was received.
 - (c) The battery fire direction officer(s) immediately verifies firing data and checks for errors, without changing any information or data.

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(d) Notify the OIC of Firing.

(e) No weapon is placed in action or moved until permission is given by the OIC of Firing.

(f) See paragraph 6, Appendix G for specific actions that can be performed by the OIC of Firing.

(10) Suspend firing when any unsafe condition is observed. Examples of unsafe conditions include, but are not limited to:

(a) Safety features of a weapon not operable.

(b) Propellant increments exposed to flames.

(c) Personnel smoking within 50 feet of ammunition or the nearest powder pit.

(d) Improper handling and/or storage of ammunition.

(e) Time fuzes previously set and not reset to safe.

(f) Personnel not wearing proper uniform (see Para 3002.5.d.(2)).

(g) Chambers not being swabbed and/or tubes inspected after firing.

(h) One man ram.

(11) Comply with Chapter 8 for procedures used in handling accidents, incidents and investigations.

(12) Maintain observation for individuals suffering from blast overpressure. Individuals displaying shortness of breath, chest discomfort, bleeding from the mouth, nose, or ears, or excessive shakiness (tremors) directly associated with weapon firings may be suffering from blast overpressure. Paragraph 11-3.a of reference (f) applies. Refer to specific weapon TM for designated firing procedures.

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d. Duties After Firing. After firing, the Position Commander will:

- (1) Ensure excess powder is properly burned according to FM 6-50/MCWP 3-16.3 and local range regulations.
- (2) Ensure proper packing of unused ammunition for return to a secure storage facility is completed.
- (3) Ensure police of the firing position is complete.
- (4) Ensure range and gun position check out procedures are conducted with range control.
- (5) Ensure air lines are connected to all howitzers and trailers prior to towing. Unserviceable air brakes constitute a safety deadlined vehicle.
- (6) Ensure Records of Missions Fired (ROMF) are maintained for a period of at least one month. Records may be maintained longer at the discretion of the commander.

7. The Fire Direction Officer (FDO)

a. General. The Fire Direction Officer is a command safety certified officer designated by the OIC of Firing. He is responsible for the accurate computation of all firing data. The Fire Direction Officer has the **primary responsibility** for computing safety data and safety T's as described in this SOP, the FM 6-40/ MCWP 3-16.4, and the ST 6-40-31. He ensures all firing data is within prescribed safety limits before it is transmitted to the weapons. The FDO or Operations Chief must be present in the FDC during live fire exercises.

b. Duties Prior to the Start of Live Firing. Prior to live firing, the Fire Direction Officer will:

- (1) Construct or obtain the appropriate range safety card.
- (2) Construct a surface danger diagram(s), if required.

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(3) Prepare or verify safety computations, diagrams and safety T's.

(4) Ensure the FDO verifies, **through independent computations**, the accuracy of the safety diagrams, safety computations, and safety T's and initials the safety diagrams and safety T's. The tolerances listed in paragraph 3002.7.C.(3) must be satisfied when verifying safety computations.

(5) Provide the Position Commander with the required number of safety T's signed by the OIC of Firing.

(6) Plot the limits of the target area, all NFA's and all RFA's in red on all firing charts and FDC situation maps.

(7) Calculate the Min QE to clear any intermediate crests between the firing position and the impact area that are not accounted for by the XO's Min QE.

(8) Compare the XO's Min QE with the Min QE for the Min Range Line, and select the largest of these values as the Min QE on the safety T.

NOTE: The FDO is responsible for ensuring his fires clear all intervening crests between the firing position and Min Range Line (see chapter 15, FM 6-40/MCWP 3-16.4 for correct procedures). If the Min QE to clear an intervening crest is larger than the value determined in step (8) above then the FDO MUST adjust the safety T to reflect this Min QE within the deflection limits of the intervening crest.

(9) Ensure communications with the Range Safety Officer are established and confirm that the impact area and surface danger areas are clear of unauthorized personnel.

(10) Ensure that clearance to fire has been granted by Range Control or the controlling headquarters.

(11) Ensure FDO or Ops Chief verifies all lay information and piece locations are properly entered into AFATDS/BUCS with no errors.

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(12) Ensure the following formats are reviewed by the FDO or Ops Chief prior to being executed and converted:

- (a) MAP MOD and DATUM
- (b) UNIT DATA; WEAPONS
- (c) INITIATE FM
- (c) CALCULATE MVV
- (d) UNIT DATA; MV
- (e) VIEW MET;CM
- (f) UNIT DATA; REGISTRATION
- (g) UNIT DATA; MUNITIONS, FUZES, PROPELLANTS

c. Duties During Firing. During firing, the Fire Direction Officer will:

(1) Assess the battery's ability to fire accurately based on what elements of the five requirements for accurate predicted fire are accounted for in the firing solution, and which are missing: specifically, fifth order survey, current Met message, current MVV's, propellant temperature, and square weights.

(2) After the check round is fired in the center of the target area, determine whether to accept missions or improve firing data according to Chapter 11 of FM 6-40/MCWP 3-16.4 by performing a subsequent MET technique or the five steps to improve firing data.

(3) Ensure the following safety procedures are performed during the conduct of fire missions:

(a) FDO/OPs chief verifies that target location is within the target area.

(b) FDO/OPs chief verifies that fire commands are safe prior to transmission to gunline.

(4) Ensure all Fire Mission data is determined by two

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means of computations. The data must agree within the tolerances listed below:

(a) **Primary-AFATDS, Backup-manual.** This is the primary method of operation for all Battery FDC's and will be utilized unless deemed not feasible by the Battery Commander. If adjusting, use the adjusting piece or use the base piece for fires in effect data. Ranges must check within 30 meters and deflections must check within 15 mils.

(b) **Primary-AFATDS, Backup-AFATDS.** Since both databases should be identical, ranges must check within 0 meters, and deflections must check within 0 mils (additionally, both databases must be constructed independently).

(c) **Primary-AFATDS, Backup-BUCS.** Using a ghost howitzer in BUCS to represent the COB, ranges must check within 30 meters and deflections must check within 10 mils.

(d) **Primary BUCS, Backup-BUCS.** Since both databases should be identical, ranges must check within 0 meters, and deflections must check within 0 mils (additionally, both databases must be constructed independently).

(e) **Primary-BUCS, Backup-manual.** If adjusting, use the adjusting piece or use the piece located closest to the center of battery for fires in effect data (this position is the chart location of the battery). Ranges must check within 30 meters and deflections must check within 15 mils.

(f) **Linear and irregular sheafs using AFATDS/BUCS, Backup-manual.** Use the piece closest to center gun-target line. Ranges should check within 30 meters and deflections within 15 mils. But as each method of computation uses a different aimpoint, FDO's must use judgment in determining whether or not data is accurate.

(g) **Primary-manual, Backup-manual.** Ranges must check within 30 meters and deflections must check within 3 mils.

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(4) Ensure safety computations are performed at the appropriate times listed in para 4004.

(5) Ensure radio checks are conducted in accordance with local range regulations or established SOPS on the designated Net. If communications are lost with the RSO or the controlling headquarters (i.e. Range Control), command "CEASE FIRING" immediately until communications are reestablished.

(6) Ensure all firing data is safe before transmitting it to the howitzer sections.

(7) Comply with Chapter 8 for procedures used in handling accidents, incidents and investigations.

d. Duties After Firing. After firing, the Fire Direction Officer will:

(1) Notify Range Control that his unit has completed firing for the day.

(2) Ensure all computer printouts, records of fire and safety diagrams are attached to the original range safety card and maintained for a period of at least one month. Records may be maintained longer at the discretion of the commander.

8. The Operations Chief

a. General. The Operations Chief is command safety certified and assists the Fire Direction Officer in the execution of duties. He may compute safety data. The Operations Chief is in charge of the FDC during the absence of the FDO. A qualified Assistant Operations Chief may perform the duties of Operations Chief providing he is command safety certified.

b. Responsibilities. The Operations Chief has the same responsibilities as the Fire Direction Officer. In the absence of the FDO he maintains the same authority as the FDO. In addition he will:

(1) Ensure designated communication nets are operating and all Range Control requirements are satisfied.

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- (2) Printout and verify the BUCS/AFATDS database. These data base printouts should be retained in the journal and kept on file a minimum of one month.
- (3) Ensure the limits of the target area are plotted in red on all firing charts and FDC situation maps.
- (4) Ensure registration corrections (whether received or determined) are verified and correctly applied to subsequent missions.
- (5) Ensure concurrent and subsequent MET techniques are correctly performed.
- (6) Ensure recorders are using DA form 4504 or Mission Data Record (computer ROF) to record all firing data.
- (7) Ensure all firing data is safe before transmitting it to the howitzer sections.

9. The Battery Gunnery Sergeant. Battery Gunnery Sergeants are command safety certified senior cannoneers. They assist the OIC of Firing and the Position Commander in the execution of their duties.

10. The Section Chief

a. General. The Section Chief is a command safety certified cannoneer in charge of a howitzer section appointed by the Commander. He is responsible for all practices that take place on or near his weapon. The Section Chief has **FINAL** responsibility for the safe firing of his weapon.

b. Duties Prior to Firing. Prior to firing, the Section Chief will:

- (1) Read and apply the procedures in this SOP and the TM for his weapon and supervises/ensures the verification of all actions performed on the weapon.
- (2) Maintain current weapon's technical manual(s) and this SOP.
- (3) Measure and report the angle of site to crest.
- (4) Obtain and maintain the following information:

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- (a) Applicable safety T's.
- (b) Ammunition types authorized for firing.
- (c) Special instructions.

(5) Refer to the safety circle when commanded. Follow these steps.

- (a) Ensure the azimuth counter (M-100 series sight) is used during the safety check
- (b) Set off the deflection to the primary aiming point.
- (c) Correct for displacement by traversing the tube until proper sight picture is obtained.
- (d) Refer to the safety circle and announce the deflection.

(6) Ensure ammunition is authorized for firing. Handle the ammunition in accordance with FM 6-50/MCWP 3-16.3 and the appropriate weapon operators manual.

(7) Verify boresight in accordance with the weapon TM prior to firing from a new position, at least once every 24 hours, and whenever the sight has been subjected to shock other than firing. If the boresight cannot be verified the howitzer is out of action until corrective maintenance is performed.

(8) Ensure no more than eight rounds are routinely prepared for firing. If participating in a schedule of fires requiring additional rounds, Battalion Commanders may authorize the preparation of more than eight projectiles and propellants. This authority may be delegated to Battery Commanders when independently deployed, away from their parent battalions. The complete charge will remain in the powder canister until the powder is cut to the proper charge. Powder will only be cut after charge (or a subsequent fire command; fuze, deflection or quadrant) is announced in the fire command. Time fuzes will not be preset.

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(9) Prepare powder pits as specified below. Precautions will be taken to keep unused increments dry to ensure safe and subsequent burning.

(a) Mission powder pit:

1 The mission powder pit is co-located at the ammunition pit, which contains all components i.e. (Projectiles, Propellants, Fuzes.) and is located to the rear of the right spade.

2 Excess powder charges will not be moved from the mission powder pit to the end of mission powder pit until the command "END OF MISSION" is given.

(b) End of mission powder pit:

1 The pit is approximately 15 meters or roughly eight paces from the mission powder pit.

* Note unit SOP will determine the exact placement of the ammunition pit.

(10) Complete the Section Chief's report and forward it to the BOC or XO's pit.

(11) Ensure the gunner's reference card is completed.

(12) When pre-fire checks have been completed, advise the Position Commander.

(13) Ensure projectiles, propellants and fuzes are properly segregated.

(14) Issue safety brief.

NOTE: It is the responsibility of individual commanders to develop a safety brief applicable to their training objectives.

c. Duties During Firing. When using the Gun Display Unit (GDU), the section chief announces the data from the section chief's assembly (SCA). If the GDU is not being used, then the recorder announces the data from the FDC or an additional communication asset may be used. The section chief places himself between the trails to best supervise the section. Upon announcement of "Fire

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Mission", the section chief supervises and performs the following actions:

- (1) Cannoneer #1 inspects cannon tube and announces, "Bore Clear".
- (2) The section chief verifies that the data is safe IAW the current safety T if Safety T(s) have been issued and are in effect. Command "CHECK FIRING, UNSAFE DATA" and immediately notify the Position Commander and Fire Direction Officer if unsafe fire commands are received.
- (3) The section chief applies the announced quadrant plus any corrections to the Gunner's quadrant for the first round fired from his howitzer after each occupation and then as directed by special instruction contained in the fire command. SEE NOTE #1.
 - a. The recorder writes down the data on the recorder's sheet (DA 4513). After the commands are given, the recorder cycles through the data on the SCA to ensure that the data on the recorder's sheet is correct.
- (4) Cannoneer #4 repeats announced projectile, selects and prepares projectile.
- (5) Cannoneer #3 repeats the announced charge, selects and prepares charge.
- (6) Cannoneer #2 repeats the announced fuze and fuze setting, selects and prepares fuze.
- (7) When quadrant is announced or displayed on the Gun Assembly (GA), the assistant gunner rotates the elevation control knob until announced quadrant appears in the elevation counter and reads back quadrant from the elevation counter to the section chief. Announces, "Set" when bubbles are CENTER.
- (8) When deflection is announced or displayed on the Gun Assembly (GA), the gunner turns azimuth knob until deflection appears in the deflection counter and reads back deflection from the deflection counter to section chief. Announces

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"Ready" when mount is level and proper sight picture is obtained.

- (9) When the prepared projectile is brought forward, no one will announce the shell/fuze combination or time. The section chief will verify the ammunition being loaded is in accordance with the fire command. The section chief performs the following actions:

- a. Announce shell/fuze combination to the recorder who verifies the shell/fuze combination from the recorder sheet and announces , "Shell ____, Fuze ____ Verified".
- b. Reads the time setting on the fuze to the recorder who verifies the time setting from the recorder sheet and announces, "Time ____ Verified".
- c. If the shell/fuze or time setting announced by the section chief is incorrect, the recorder will announce, "Correction, and announce the correct Shell/fuze or time setting from the DA4513.
- d. Verifies that the fuze is wrench tight.
- e. Observe and ensure that a two-man ram is used and proper commands and procedures are used while loading the projectile.

- (10) The section chief will verify the proper quadrant is applied to the howitzer according to the fire commands. The section chief performs the following actions:

- a. The section chief will check the data on the quadrant GA if GDU is utilized.
- b. The section chief applies the announced quadrant plus any corrections to the Gunner's Quadrant for the first round fired from his howitzer after each occupation and then as directed by special instruction contained in the fire command: "Use Gunner's Quadrant".
- c. The section chief checks the bubbles on the M18 to ensure that they are level. This step will never be omitted when conduction section chief verification.
- d. The section chief reads the QE set on the elevation counter to the recorder who verifies

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- the QE from the recorder sheet and announces, "Quadrant ___ verified".
- e. If the QE announced by the section chief is incorrect, the recorder will announce, "Correction, and announce the correct QE from the DA4513.
- (11) The section chief will personally sight and verify the correct charge is prepared according to the fire commands.
- a. The section chief announces the charge to the recorder who verifies the charge from the recorder sheet and announces, "Charge ___ __bag verified".
- b. If the charge announced by the section chief is incorrect, the recorder will announce, "Correction, and announce the correct charge from the DA4513.
- c. Section chief will then visually check and count the unused increments prior to allowing #1 cannoneer to load the charge
- d. The section chief observes Cannoneer #1 loading the propellant and priming the howitzer using proper procedures, to include announcing "Charge ___ ___ bag, I see red" and "Primed".
- (12) The section chief will check the data on deflection GA if GDU is utilized.
- a. The section chief ensures the bubbles are level on the M171 telescope mount.
- b. The section chief looks through the eyepiece of the M137 to ensure that the howitzer is properly aligned with the collimator, aiming posts or DAP.
- c. The section chief looks at the deflection scale on the M137 and reads the deflection from the deflection counter to the recorder who verifies the deflection from the recorder sheet and announces, "deflection _____, verified".
- d. If the deflection announced by the section chief is incorrect, the recorder will announce, "Correction, and announce the correct deflection from the DA4513.

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- (13) Once the howitzer is loaded, the section chief takes appropriate actions to fire the weapon in accordance with the fire command.
- (14) After the round is fired, the section chief ensures that Cannoneer #1 swabs and inspects the chamber between each and every round, inspects the bore and announces "Bore clear".
- (15) Ensure fire commands and ammunition expenditures are properly recorded on DA Form 4513.

Note 1: If the Gunner's quadrant (with corrections applied) is placed on the quadrant seats of the M172 mount and it disagrees with the M18 by more than +/- 1 mil, the howitzer may be called out of action for corrective maintenance or the M17 may be used to lay for quadrant elevation if it's within tolerance (+/- 1 mil) with the Gunner's Quadrant. If the M17 and M18 are both beyond tolerance, the howitzer should be called out of action, unloaded and a Fire Control Alignment test and measurement should be conducted. In a combat emergency the Gunner's quadrant may be used to lay for QE however, at the first possible opportunity the howitzer must be called out of action for corrective maintenance.

Note 2: If the section receives a high angle mission, the projectile, propellant and primer will be loaded at the loading elevation, all other procedures remain the same

Note 3: This procedure is written for the conduct of indirect fire.

(16) Notify the Position Commander or OIC of Firing of unsafe conditions which are beyond the Section Chief's capability to correct. Examples of such conditions are, but not limited to:

- (a) Safety feature of weapon not operative.
 - (b) Misfires, hangfires, cookoffs, and sticker rounds.
 - (c) Personnel in front of the gun line.
 - (d) Insufficient personnel to fire his weapon.
- (17) Supervise all misfires, hangfires, cookoffs, and

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sticker rounds on his weapon in accordance with Appendix O of this order.

(18) Ensure the last deflection/quadrant fired and the fire control equipment are not changed until a subsequent fire command or "END OF MISSION" is received.

(19) Correct all observed unsafe conditions or improper service of the piece. Examples include but are not limited to:

(a) Powder bags exposed to fire.

(b) Personnel smoking within 50 feet of howitzers or ammunition.

(c) Improper handling or storage of ammunition.

(d) Fuzes, propellants, and projectiles not segregated.

(e) Time fuzes previously set and not reset to safe/shipping.

(20) During each fire mission ensure that:

(a) Ammunition is not loaded until quadrant is announced.

(b) Powder chamber and bore are inspected after each round.

(c) The chamber is swabbed after firing each round of separate loading ammunition.

(d) Lanyard is attached or grasped only at the command of the section chief (per reference of the appropriate weapon's TM).

d. Duties After Firing. After firing, the Section Chief will:

(1) Notify the Battery Gunnery Sergeant of any unserviceable or unexpended ordnance.

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- (2) Turn-in all excess powder increments to the Position Commander or Battery Gunnery Sergeant.
- (3) Verify the weapon is clear.
- (4) Verify howitzer air brakes are in service prior to towing. Unserviceable air brakes constitute a safety deadline.
- (5) Verify the tube light is attached and operational.
- (6) Verify cotter pin on vehicle pintle is properly installed.

11. Range Safety Officer

a. General

(1) The Range Safety Officer (RSO) is responsible for maintaining surveillance of and safety within the entire surface danger area, and the airspace above and immediately adjacent to the surface danger area.

During firing, the RSO will maintain continuous surveillance. At night, Night Vision Goggles (NVG's) may be used to satisfy this requirement if approved by the OIC of Firing. An RSO will be assigned to each impact area. If two or more units are firing into the same impact area, only one RSO is required.

(2) Where visual surveillance of the impact area is not feasible by the RSO, the OIC of Firing may authorize surveillance by Q-36 Radar (unless local range regulations or established SOPs restrict the use of radar as the only method of observation) or Aerial Observer. In these situations, the OIC of Firing will ensure that continuous communication is maintained with the agency responsible for observing the impact area and the agency responsible for controlling the unit(s) firing into the impact area.

(3) The RSO will be an 0802, 0803, 0848, 0861 (rank is dictated by local range regulations) or a Naval Gunfire Officer designated by the OIC of Firing.

b. Duties Prior to the Start of Live Firing. Prior to beginning firing operations, the Range Safety Officer will:

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- (1) Review the local range regulation(s).
- (2) Establish and maintain radio communications with the local base Range Control or controlling higher headquarters.
- (3) Ensure a copy of this SOP, the local base range regulations, and any special written instructions issued by the OIC of Firing, Range Control or higher authority are present.
- (4) Ensure the limits of the target area are plotted on all maps used by forward observers in the vicinity of the OPS.
- (5) Ensure all personnel on or near the observation post are wearing a helmet and flak jacket, and that they are briefed on applicable safety regulations.
- (6) Brief all forward observers of their duty to command "CHECK FIRING, TO THE REAR OF THE PIECE, FALL-IN." if they observe a round impacting out of the designated impact area.
- (7) Develop a terrain sketch which includes the visible portions of the target, impact and secondary danger areas.
- (8) Maintain an OF fan properly oriented on the range map to assist in determining the location of impacting rounds.
- (9) Conduct a visual sweep of the target, impact and secondary danger area. When satisfied that these areas are clear of personnel, request clearance to commence firing from Range Control. Upon receiving clearance to fire, contact the firing units and authorize the unit to commence firing.

c. Duties During Firing. During firing, the Range Safety Officer will:

- (1) Maintain surveillance of surface and air danger area, command "CHECK FIRING" if aircraft, vehicles or personnel approach or enter the danger area, and report such incidents to the OIC of Firing.

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(2) Command "CHECK FIRING" whenever visibility of the impact area is obscured by fog, dense smoke, etc. unless radar has been approved as the only method of observation.

(3) During live fire, maintain radio communications with Range Control or the appropriate controlling headquarters as required by range regulations/current OPORD using the designated safety net. If communications are lost, check firing on the range until communications are reestablished.

(4) Accomplish the following if a round impacts outside the designated impact area:

(a) Ensure "CHECK FIRING, TO THE REAR OF THE PIECE, FALL-IN." is immediately passed to the firing unit.

(b) Notify the appropriate level commander or his designated command safety certified representative (i.e. battery commander during battery level exercises, battalion commander during battalion level exercises or their designated representatives).

(c) Measure the azimuth to the location of the round(s) and note any terrain features that should aid in crater location.

(d) Resume firing only after authorization has been obtained from the OIC of Firing.

(5) Maintain a listing of possible dud ammunition and the general location of impact. Provide this information to range control at the completion of the exercise.

(6) Comply with Chapter 8 for procedures used in handling accidents, incidents and investigations.

d. Duties After Firing. After firing, the Range Safety Officer will:

(1) Supervise the police of the OPs.

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(2) Obtain authorization from the OIC of Firing to secure the range.

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CHAPTER 4

COMPUTATION OF SAFETY

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4000. GENERAL. The surface danger diagram includes all elements of the surface danger zone safety areas as defined in reference (f). For howitzers, there are two types of diagrams depending on the mode of firing, either direct or indirect. The range safety cards and the safety computations discussed below cannot be determined until the appropriate surface danger diagram has been constructed.

1. Definitions

- a. Target Area - The point or location to which the weapon is to be fired (ref (f)).
- b. Impact Area - The primary danger area for indirect fire weapons that is established for the impact of all rounds. When applied to direct fire weapons, it is the area located between established range limits. The impact area is within the approved surface danger zone (ref (f)).

NOTE: By definition, the impact area of a surface danger diagram consists only of the target area and its associated probable errors. When referring to base training areas, "impact areas" marked on base maps include both the impact area and secondary danger areas (areas A, B, and C).

2. Direct Fire

- a. The minimum target engagement distance for 155mm direct fire, when unprotected troops are located in the firing position, is 750 meters.
- b. When constructing the direct fire surface danger diagram, distance X (as defined in Ch 11 of ref (f)) will not be less than the range corresponding to an elevation of 267 mils for the charge fired. This does not apply to indirect fire.
- c. Area D will not be occupied during direct fire.
- d. See local range regulations for specific restrictions on direct fire.

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4001. SURFACE DANGER DIAGRAMS

1. A surface danger diagram is not required to be constructed by the firing unit if the installation commander who controls the range has previously constructed and approved a surface danger diagram or target area for the specific firing position or impact area. The OIC of Firing must check local range regulations to determine the requirements for preparing surface danger diagrams. The limits of the danger areas must be plotted on a map prior to firing to ensure they fit within the base designated impact area, regardless of who constructed the surface danger diagram.

2. When firing on a range without a previously approved target area, a surface danger diagram will be prepared for each firing position and verified by the OIC of Firing or Battalion Safety Officer. When preparing a diagram, the following information must be reflected:

- a. The impact area (including the target area) and all danger areas, (A, B, C, D, E, as described in chapter 11, of reference (f)).
- b. Battery center and observation posts.
- c. Marginal information: Map reference, firing unit, data and time of firing, and signature of approving authority.

4002. RANGE SAFETY CARDS

1. The range safety card describes the limits of authorized fire for a particular weapon, ammunition, type of trajectory, and special instructions pertaining to firing. The information on the card is valid only for the unit, date, and times indicated. In addition, range safety cards will be distributed as follows:

- (a) Battalion S-3
- (b) OIC of Firing or Position Commander
- (c) Battery Fire Direction Officer

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2. Range safety cards will be approved by the Battalion Commander. Regimental Commanders may authorize Battalion Commanders to delegate approval and verification authority to Battalion S-3s. "Special instructions" are used to provide information and specify firing limitations not listed in other sections. Examples are restriction on illumination, "doglegs", night firing restrictions, min range differences for MT, MTSQ and/or VT fuzes and charges authorized for high angle if different from the basic charges authorized.

3. When batteries are conducting independent operations Regimental Commanders may authorize Battalion Commanders to delegate approval and verification authority to the Battery Commander to approve range safety cards. In 14th Marines, when battery's are conducting independent operations, Battalion CO/I-I's may authorize Battery I-I's to approve range safety cards.

4. The number of doglegs will be at the discretion of the Battalion Commander.

5. Changes to the range safety card are not authorized unless approved by the Battalion Commander or approving authority.

4003. AUTOMATED RANGE SAFETY SYSTEM (ARSS). The ARSS is only approved for constructing Range Safety Cards ***(it is not approved for computations of safety data, surface danger zone diagrams, or construction of Safety Ts)***. ARSS 4.0 is the only validated ARSS program. Battalions will be guided in its use by the current ARSS Users Manual and this order. The Battalion S-3s are responsible for the installation and maintenance of the ARSS program.

1. Target Area Input

a. Definitions. The following apply only to ARSS.

(1) Impact Area - The ARSS program uses the term "impact area" in reference to a base impact area. It not only includes the target area and probable errors for dispersion, but also secondary danger areas A, B, and C.

(2) Target Area - The ARSS program refers to the target area as the remaining area of a base impact area, that has been buffered for probable errors and secondary danger areas. It is the area from which a range safety fan is computed, and must be defined by the user.

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NOTE: ARSS is not capable of computing probable errors, secondary danger areas A, B, C, or Danger Area E. Instead it recommends a worst case solution for buffering in from the edge of the impact area. The grids entered in ARSS represent the target area (by its definition) and the user must account for probable errors and secondary danger areas when defining a target area. The target area must be described to compute ARSS safety.

b. Target Area Description

(1) Determine the dimensions described in reference (f) for Danger Areas A, B, and C. Determine the range to the center of the proposed target area and extract the PER and PEDF from the appropriate TFT for the given charge. Measure inward from the impact area boundary 8 PEDF + area A laterally, 8 PER + area B on the far side of the proposed target area, and 12 PER + area C on the short side of the proposed target area. The remaining area is the target area for this charge.

NOTE: Areas A and B are smaller for illumination projectiles. Installations with small impact areas may consider computing separate range safety cards for illumination.

(2) Determine grid coordinates that describe this target area. ARSS allows the maximum input of 20 grids. The last grid must be the same as the first so ARSS can "close the box."

(3) A command safety certified officer will verify these coordinates. The diagram and list of coordinates must be labeled "Verified" followed by the officer's printed name, signature and date of verification.

(4) The document will then be submitted to the Battalion Commander for approval. Regimental Commanders may authorize Battalion Commanders to delegate approval authority to Battalion S-3s.

c. Input the target area grids into the ARSS program with map-spotted altitudes.

d. Some installations may have target area grids predetermined. These can be input directly into the ARSS program, and will sometimes define a much larger buffer area than one determined using the steps above. This precludes the operator

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from having to manually plot all the PEs and secondary danger areas, but reduces the target area. In some situations, when shooting low charges with high probable errors, the buffer area may be insufficient. In those instances, you MUST ensure the buffer area is adequate.

2. Computation of a Range Safety Card

- a. Select "Range Card Data Only."
- b. Enter unit ID.
- c. Enter FIRING POINT grid and altitude.
- d. Enter the correct target area from the target area directory.

NOTE: If the target area grids have not been entered (Step 1b), you cannot proceed.

- e. Enter Low or High angle.
- f. Enter weapon system.
- g. Enter number of doglegs, or describe target area using azimuths and ranges.
- h. Charges listed include any charge capable of ranging a portion of the target area. The most appropriate charge based on Probable errors or angle of fall should be chosen when using a standard buffer. If using a buffer based on probable errors of a specific charge, that is the only charge associated with the safety card.
- i. Print the Range Safety Card for verification and approval.

(1) Verification means a Command Safety Certified Officer must plot the range safety card before signing and dating the document.

(2) Approval means the Battalion Commander must sign and date the document. Regimental Commanders may authorize Battalion Commanders to delegate approval authority to Battalion S-3s.

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j. Area E is not computed by ARSS. Ensure area E is accounted for and any requirement for Road Guards is entered on safety card if any roads lie within Area E.

3. Range Safety Card for an Open Training Area

a. This is more commonly referred to as "training area safety". This procedure allows units to occupy positions that do not have published Range Safety cards, or areas that have not been designated as firing points by Range Control. Using ARSS, the procedure is the same as paragraph 4003.2. above, with exceptions listed below. Safety Computations must be computed by means listed in para 4005-4007.

b. OIC's **MUST** consult local range regulations and Range Control for additional guidance for this type of fire.

c. Some range regulations require a surveyed grid from which to compute safety. In these cases, use OS grid as the firing point grid. Otherwise, enter center of battery grid and altitude in place of firing point grid. Ensure that all guns are within the prescribed radius of the center of battery. If outside the radius, then separate safety must be computed, unique to that gun.

d. If survey must be replaced in a training area firing position where a position safety card has already been computed and approved based on the OS or COB grid, the range safety card will remain valid **if** the new OS/COB grid is within 50 meters of the OS/COB grid on the original range safety card.

4. ARSS Documentation

a. Below are the documents required for the ARSS Safety Package to be given and retained by the firing battery for a minimum of one month after completion of firing.

(1) Range/Position Safety Card (Verified and Approved).

(2) Range Safety Fan (Verified and Approved).

(3) Survey Card.

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4004. SAFETY COMPUTATION REQUIREMENTS

1. Preoccupation Safety. If local range regulations permit, units may fire with Safety T's computed prior to occupation under

the following stipulations: the COB is located within local range regulations of the firing point grid, safety is concurrently recomputed with initial occupation data (see paragraphs 2-7 below), and targets fired on until updated safety is complete are located in the center of the target area.

2. Upon initial occupation of a position, safety will be computed using all available information and nonstandard conditions. A completely accurate solution depends on the following:

a. Accurate survey (5th Order). Survey of a lesser degree does not preclude firing or computation of safety, but does require recomputing safety upon update.

b. Accurate weapon and ammunition information. This includes the following nonstandard conditions:

(1) Propellant temperature

(2) Projectile square weight

NOTE: Worst case application of projectile square weight; e.g., 8 [] WP; is considered accurate for safety computations unless the FDO desires to update safety when actual square weight is determined.

(3) Muzzle velocity variation (battery average).

NOTE: The predicted battery average MVV (average shooting strength + propellant efficiency) should be used in initial computations if no other information is available, but is not considered accurate until compared to calibrated data.

c. Accurate Meteorological information. The validity of the MET message is based on the conditions listed in FM 6-40/MCWP 3-16.4, and the FDOs assessment of the current situation (pertaining to changes in weather).

d. Applicable Registration Corrections. The application of previous registration corrections (in the form of position

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constants, AFATDS Registration Corrections, or BUCS residuals) is based on the principles discussed in FM 6-40/MCWP 3-16.4.

3. If all of these nonstandard conditions are known and accounted for in initial computations, then safety is only updated as nonstandard conditions change. If any of these nonstandard conditions are not initially compensated for, then safety must be recomputed as the unknown elements are identified and compensated for.

4. After applying new data (MET message, completed registration corrections, calibration or change in MVVs, change in prop temp, survey update), perform a verification mission by computing firing data to one point of the target area.

a. Low Angle - the upper right hand corner (max right Df at max range) of the target area.

b. High Angle - the lower right hand corner (max right Df at min range) of the target area.

5. If the new data corresponds to **deflection** corrections greater than 100 meters new safety data will be computed and new safety T's issued.

6. If the new data corresponds to **range** corrections of 100 meters or 4PERs, whichever is greater, new safety data will be computed and new safety T's issued.

Example 1): HE, Low Angle, Chg 7, Max Rg 8000 M

Old Data Max QE 304 mils
R Df 3002 mils

New Data Max QE 308 mils
R Df 2996 mils

a. **Rg Corr = $\Delta E1$ x Col 5, Table F \approx 10 Meter accuracy**

Rg Corr \approx +4 mils $\rightarrow \Delta E1 = 4 \times 22$ (Col 5, Table F) = 88 \approx 90 M

1) **4 PER = 4 x Col 3, Table G 1 10 Meter Accuracy**
4 PER = 4 X 21 (Col 3, Table G) = 84 M \approx 80 M

2) **Compare 100 M to 4 PER and select largest value**

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100 M > 80 M → 100 M > 4 PER therefore **100 M** is used for comparison.

90 M < 100 M therefore Rg Corr does **not** require safety to be updated.

b. **Df Corr = ΔDf x Rg in 1000s ≈ 10 Meter accuracy**

Df Corr ≈ -6 mils → ΔDf = 6 x 8 (mil relation formula, W=R x m → W=6x8) = 48 M ≈ 50 M.

50 M < 100 M therefore Df Corr does **not** require safety to be updated.

Example 2): HE, Low Angle, Chg 7, Max Rg 13000 M

Old Data Max QE 535 mils
R Df 2990 mils

New Data Max QE 545 mils
R Df 3000 mils

a. **Rg Corr = ΔE1 x Col 5, Table F ≈ 10 Meter accuracy**

Rg Corr ≈ +10 mils → ΔE1 = 10 x 12 (Col 5, Table F) = 120M

1) **4 PER = 4 x Col 3, Table G ≈ 10 Meter Accuracy**

4 PER = 4 X 32 (Col 3, Table G) = 128 M ≈ 130 M

2) **Compare 100 M to 4 PER and select largest value**

100 M < 130 M → 100 M < 4 PER therefore **130 M** is used for comparison.

120 M < 130 M therefore Rg Corr does **not** require safety to be updated.

b. **Df Corr = ΔDf x Rg in 1000s ≈ 10 Meter accuracy**

Df Corr ≈ +10 mils → ΔDf = 10 x 13 (mil relation formula, W=R x m → W=10x13) = 130 M.

130 M > 100 M therefore Df Corr **does** require all safety to be updated.

7. If the receipt of new data requires re-computation of safety, the battery may continue to fire using the old safety T's while safety is being updated, providing the FDO ensures that he fires

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only on targets located near the center of the target area.

8. All old safety T's will be collected prior to new safety T's being issued.

9. Computations for projectiles with nonstandard weights. When firing projectiles other than standard weight, the principle of the worst case scenario is applied to determine the safest data possible for the minimum or maximum range. For unknown nonstandard [] weights this means 2[] (M116) to 8[] (M110). If known, the actual nonstandard [] weight is used. Data will be computed as it affects the following:

a. Low angle, charges below 7W: Compute heaviest [] weight data to min range. Compute lightest [] weight data to max range.

b. Low angle, charge 7W and above: Refer to table F, columns 18 and 19 of the appropriate TFT; e.g. AN-2 for M825. For ranges below the range change over point, compute data as in paragraph a. If the range is beyond the range change over point (where an increase in [] weight has a negative correction value), compute heaviest [] weight data to the max range. Heaviest [] weight data is still computed to the min range if it is below the range change over point. Lightest [] weight data is computed to the min range line if it is beyond the range change over point.

c. High angle, charge 4W and below: same as paragraph a.

d. High angle charge 5G/5W and above: Refer to table F, columns 18 and 19 of the appropriate TFT; e.g. AN-2 for M825. For ranges below the range change over point, compute data as in paragraph a. When the maximum range is beyond the range change over point (an increase in [] weight has a negative correction value), compute heaviest [] weight data to the max range. When the minimum range is beyond the range change over point, the FDO only has to compute lightest [] weight data to the minimum range.

10. High Angle Safety. Minimum fuze settings are not computed for high angle safety T's. The FDO must verify that the fuze setting determined corresponds with the appropriate target range.

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NOTE: Verification missions and Range K transfers are determined from the lower right hand corner of the target area for high angle.

4005. MANUAL COMPUTATION OF SAFETY

1. Manual safety is the primary means of safety computations and the only means of computing safety for all base ejecting projectiles and Copperhead. Manual computation of safety will be accomplished in accordance with Change 1 of the 1996 edition of the FM 6-40/MCWP 3-16.4 and this order. No changes to the matrices or computational procedures (other than those promulgated by the proponent agency, MARDET, USAFAS, FT. SILL) are authorized.

2. COMPUTATIONS. There are two matrices for manual computation of safety for all projectiles. Figure 4-1 is the low angle matrix and Figure 4-2 is the high angle matrix. Burster type projectiles such as HE and WP simply use graze burst data determined to the Min and Max Range lines. Graze Burst data for base ejecting projectiles is determined using Table C, Ballistic Data for Safety Computations, in the appropriate TFT or FT addendum.

3. PREOCCUPATION SAFETY. Preoccupation safety assumes that with few exceptions, nonstandard conditions are not known and cannot be accounted for. One exception to this is [] weight for projectiles, such as WP (M110). If more than one nonstandard condition can be accounted for prior to occupation, use post-occupation computation procedures.

a. Safety Diagrams. Drift is applied to both high and low angle matrices.

b. Matrices. The Range K factor is not determined for preoccupation computations. If no nonstandard conditions are accounted for, the Diagram, Total, and Entry Ranges are all the same. If a correction for a nonstandard condition from Table F, such as [] weight for WP, is applied, then Total and Entry Ranges are the same.

4. POST-OCCUPATION SAFETY. Post-occupation procedures account for multiple nonstandard conditions. This includes anytime safety is updated due to a change in nonstandard conditions, as per para 4004. The basis of post-occupation safety is determining Rg K and a GFT DF Correction for each projectile

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family. Requirements vary depending on whether an FDC is automated or manual.

a. Safety Diagrams. In addition to drift, a GFT deflection (DF) correction is applied to determine Max Right and Max Left DF's. This can be determined manually or using an automated system. A GFT DF Correction is determined for each projectile family and applied to every max DF on the range safety diagram.

b. Matrices. Multiple nonstandard conditions are accounted for by applying a Range K transfer to Total Range. If the Rg K factor accounts for all nonstandard conditions, then the Range Correction will be zero (0.0). A Rg K factor is determined for each projectile family; e.g. an HE Rg K factor is applied to WP and illumination projectiles. A second Rg K is determined for DPICM family projectiles.

(1) WP (M110). Typically, all nonstandard conditions are accounted for in a Rg K factor. However, an HE Rg K factor applied to a WP projectile does not account for the difference in projectile [] weight. In this case, the Range Correction for [] weight should still be accounted for in column (b) and The Rg K factor still applied to Total Range. This is applicable for any nonstandard condition not incorporated into the Rg K factor, such as a second lot of projectiles with a different [] weight.

Fig 4-1. Low Angle Safety Matrix

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
DIAGRAM	RG	TOT	RG	ENTRY						M564/	M582			M728/	
	RG + CORR	= RG	x K	= RG	CHG	VI	SI	+ EL	= QE	M565	M577	TOF	+ 5.5	= M732	DRIFT

(a) This is the minimum or maximum range from the range safety diagram.

(b) This is the range correction for nonstandard conditions from Table F, if required. This is typically for preoccupation safety or corrections for nonstandard conditions not included in the Range K factor in column (d), such as WP [] weight. Examples of nonstandard conditions accounted for in (b) include, but are not limited to, difference in projectile square weight, difference in muzzle velocity, or any nonstandard condition accounted for prior to determining a Range K factor. If there is no change from standard, or all nonstandard conditions are accounted for in the Range K factor, this

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value is zero (0). To determine a range correction from Table F, use the following formula:

$$\text{RANGE CHG} \quad \text{NONSTANDARD CONDITION} \quad - \quad \text{STANDARD CONDITION} \quad = \quad \text{CHANGE IN STANDARD} \quad \times \quad \text{RG CORR FACTOR} \quad = \quad \text{RANGE CORRECTION}$$

- (c) This is the sum of the Diagram Range and the Range Correction. If there is no range correction, then the Total Range will be the same as the Diagram Range.
- (d) This is the Range K factor determined by using technique 2 in the FM 6-40/ MCWP 3-16.4. This is for post occupation safety. It represents total corrections for a registration, MET + VE, or other subsequent MET technique. It represents all nonstandard conditions (unless a separate nonstandard condition such as change in square weight for WP is listed separately in column (b)). It is multiplied times the Total Range to determine Entry Range.
- (e) This is the sum of the Total Range times the Range K factor. It is expressed to the nearest 10 meters. If there is no Range K factor, then the Entry Range will be the same as the Total Range. Entry Range is the range to which Elevation is determined.
- (f) This is the charge from the range safety card for this set of safety computations.
- (g) This is the Vertical Interval from the range safety diagram.
- (h) This is the site determined to the Diagram Range by using the GST or TFT from the head of the projectile family; e.g., site for the M110 WP projectile is determined with the AM-2, M825 site is computed using the AN-2. Site is computed to the Diagram Range, as that is where the Vertical Intervals are determined.
- (i) This is the elevation from Table C (base ejecting), or GFT/TFT (bursting). (GFT settings are not used to determine data since a Range K factor is applied.)
- (j) This is the sum of Elevation and Site. It is the minimum or maximum Quadrant Elevation at the minimum or maximum Range.

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- (k) This is the Minimum Fuze Setting for the M564/565 fuze from Table C (base ejecting), or GFT/TFT (bursting), corresponding to the Entry Range. *
- (l) This is the Minimum Fuze Setting for the M582/M577 fuze from Table C (base ejecting), or GFT/TFT (bursting), corresponding to the Entry range. * (Note, this also applies to the M762, M767, and MOFA fuzes.)
- (m) This is the Time Of Flight from Table C (base ejecting), or GFT/TFT (bursting), corresponding to the Entry Range. *
- (n) This is the safety factor applied to the Time of Flight to determine VT fuze data. *
- (o) This is the sum of TOF + 5.5. It is the Minimum Fuze Setting for M728/M732 VT fuzes. *
- (p) This is the Drift corresponding to the Entry Range from Table C (base ejecting), or GFT/TFT (bursting). Drift is applied to the range safety diagram by using the "Least, Left; Most, Right" rule. The "least" or lowest drift is applied to all left deflection limits, and the "Most" or greatest drift is applied to all right deflection limits.

* - Computed only for minimum Entry Ranges, and only if applicable to the ammunition and the range safety card.

Fig 4-2. High Angle Safety Matrix

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(I)	(j)	(k)	(l)	(m)
DIAGRAM	RANGE	TOTAL	RANGE	ENTRY								
	RANGE + CORR	= RANGE	x K	= RANGE	CHG	VI	<SI/10	X 10mil	Si	Fac = SI + EL	= QE	DRIFT

- (a) This is the minimum or maximum range from the range safety diagram.
- (b) This is the range correction for nonstandard conditions from Table F, if required. This is typically for preoccupation safety or corrections for nonstandard conditions not included in the Range K factor in column (d), such as WP [] weight. Examples of nonstandard conditions accounted for in (b) include, but are not limited to, difference in projectile square weight, difference in muzzle velocity, or any nonstandard condition accounted for prior to determining a Range K factor. If there is no change from standard, or all nonstandard conditions are accounted for in the Range K factor, this

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value is zero (0). To determine a range correction from Table F, use the following formula:

$$\text{RANGE CHG} \quad \text{NONSTANDARD CONDITION} \quad - \quad \text{STANDARD CONDITION} \quad = \quad \text{CHANGE IN STANDARD} \quad \times \quad \text{RG CORR FACTOR} \quad = \quad \text{RANGE CORRECTION}$$

- (c) This is the sum of the Diagram Range and the Range Correction. If there is no range correction, then the Total Range will be the same as the Diagram Range.
- (d) This is the Range K factor determined by using technique 2 in the FM 6-40/ MCWP 3-16.4. This is for post occupation safety. It represents total corrections for a registration, MET + VE, or other subsequent MET technique. It represents all nonstandard conditions (unless a separate nonstandard condition such as change in square weight for WP is listed separately in column (b)). It is multiplied times the Total Range to determine Entry Range.
- (e) This is the sum of the Total Range times the Range K factor. It is expressed to the nearest 10 meters. If there is no Range K factor, then the Entry Range will be the same as the Total Range. Entry Range is the range to which Elevation is determined.
- (f) This is the charge from the range safety card for this set of safety computations.
- (g) This is the Vertical Interval from the range safety diagram.
- (h) This is the Angle of Site divided by 10, determined by dividing Vertical Interval by Entry Range in Thousands.
- (i) This is the 10 mil Site Factor, determined from the GFT or TFT from the head of the projectile family (e.g., 10 mil Site Factor for the M110 WP projectile would be determined with the AM-2, and M825 10 mil Site Factor would be computed using the AN-2)
- (j) This is Site, the product of <Site/10 X 10 Mil Site Factor (Note: Site is determined for the Diagram Range).
- (k) This is the elevation to impact from Table C (base ejecting), or GFT/TFT (bursting) corresponding to Entry Range.

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- (l) This is the sum of Elevation and Site. It is the minimum or maximum Quadrant Elevation at the minimum or maximum Range.
- (m) This is the Drift corresponding to the Entry Range from Table C (base ejecting), or GFT/TFT (bursting). Drift is applied to the range safety diagram by using the "Least, Left; Most, Right" rule. The "least" or lowest drift is applied to all left deflection limits, and the "Most" or greatest drift is applied to all right deflection limits.

5. MANUAL FDC. In a completely manual environment, the Total Corrections applied as a GFT setting are used to perform the Range K transfer and apply a GFT DF correction to the safety diagram. In other words, Rg K is determined to the same point the GFT setting is determined. The verification mission to the corner of the target area is still performed, however, there is no requirement to determine a different set of Total Corrections to the upper or lower right hand corner of the target area.

6. AUTOMATED FDC. An automated FDC may utilize its AFATDS/BUCS to determine the data necessary to perform a Rg K transfer and GFT DF correction. In an automated FDC, Rg K is determined to the same right hand corner of the target area where the verification mission required in para 4004 is performed. The data necessary to determine the Rg K/GFT DF Correction is determined during the verification mission.

a. Safety Diagram. To determine the GFT DF Correction, use the following formula and apply LARS:

1. Select a gun to act as the "base piece" or basis for correction. This will be the howitzer closest to your center of battery.
2. Create a false observer in your JMUL. Establish this false observer in your current situation using the grid and altitude from the howitzer closet to your center of battery.
3. Process a polar mission using the false observer to the center range of the impact area using the following:

Direction = the AOL
Altitude = gun altitude minus 20 meters

4. Determine firing data for using fuze time.

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5. QE = Adjusted elevation for GFT setting. (polar mission was conducted using gun altitude therefore site = 0.)

6. FS = Adjusted time

7. Total Deflection Correction:

TOTAL DF CORR = Gun Deflection - Common deflection

8. GFT Deflection Correction:

GFT DF CORR = Total DF CORR - drift corresponding to adj el
(apply to all DF limits on the safety diagram)

b. Matrix. To determine a Range K factor using the AFATDS or BUCS, use the following formula:

New AFATDS QE (from data to upper/lower right hand corner)
- Site (corresponding to right hand corner (see matrix))

=ADJ EL

Rg~ (ADJ EL) (Rg corresponding to ADJ EL from GFT/TFT/ADD)
(divided by)

DIAGRAM Rg (Rg corresponding to right hand corner (see matrix))

=Rg K factor (expressed to 0.0001)

c. Example: HE, Low angle, Charge 7 max range 10,000 M:

New Data max QE	312 mils
Right Df	2996 mils

d. Once it is determined that safety must be recomputed as per para 4004, the max DF is compared to the Diagram DF of 3000. The Total DF Correction is R4 (use LARS). Subtracting Drift corresponding to Adj EL of L9, the GFT DF Correction is R13. This is applied to every max DF on the safety diagram. Drift corresponding to the appropriate range is also applied.

e. The Max QE must be corrected for site (since the verification mission incorporated the altitude to the max range line). If site determined on the safety matrix was +3, the actual ADJ EL was 309. The range corresponding to elevation 309 on the AM-2 GFT is 9800. This is divided by

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the Diagram Range, or max range line, which is 10,000. The resulting Rg K factor is 0.9800, which is expressed to the nearest 0.0001. This is now multiplied by the Total Ranges on all HE family projectile matrices to determine the Entry Range used to compute new safety data.

4006. BACK-UP COMPUTER SYSTEM (BUCS) REV 1 SAFETY COMPUTATIONS

1. BUCS is only authorized for computing safety for the following projectiles: HE and M110 WP. BUCS REV1 safety computations will be conducted in accordance with the ST 6-40-31.

2. BUCS REV1 must be recomputed as nonstandard conditions become known. The following are the nonstandard conditions which must be programmed into the BUCS in order to achieve a complete solution:

a. Survey Information

- (1) Weapon Location/Firing Point

NOTE: The BUCS REV1 solution is based on the safety fan constructed from the location of the howitzer selected for computations. The location of this howitzer must represent the location of the point from which the Range Safety Card defines the target area; e.g. the firing point.

b. Muzzle Velocity Information.

- (1) Propellant Temperature
(2) Projectile Square Weight

NOTE: Follow the same rules for nonstandard square weights as per paragraph 4004.

- (3) Muzzle velocities

NOTE: The battery average Muzzle Velocity should be used.

c. Computer or Ballistic MET

d. Registration Corrections (when applicable)

NOTE: BUCS residuals represent position constants, which are only a part of Total Corrections. While represented as a

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percentage of standard, they are not equivalent to the Rg K factor used to compute safety.

3. BUCS Rev1 safety is recomputed as specified in paragraph 4004. The appropriate changes in the database are applied prior to executing.

4007. ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEM (AFATDS)

1. Currently, the AFATDS 99 Version 6.3.X.X software is only authorized for computing safety for the HE M107 family of projectiles (except M485 Illumination), and Rocket Assisted Projectile family (RAP). AFATDS IS NOT AUTHORIZED TO COMPUTE SAFETY FOR THE DPICM FAMILY OF PROJECTILES (TO INCLUDE M825, IMPROVED SMOKE), THE BASEBURN FAMILY OF PROJECTILES, THE M485, SERIES ILLUMINATION PROJECTILE, OR COPPERHEAD.

2. The procedure consists of processing polar mission information to the corners of the target area. The following are the nonstandard conditions which must be programmed into the AFATDS in order to achieve a complete solution:

a. Accurate Survey Information

(1) Weapon Location

NOTE: The AFATDS solution is based on computations from the location of a false howitzer, The location of this false howitzer is initially represented as the location of the point from which the Range Safety Card defines the target area; e.g. the firing point. Upon occupation, the false howitzer represents the Center of Battery.

(2) False Observer

NOTE: The AFATDS solution is also based on the safety fan constructed from the location of a false observer. The location of this false observer must represent the location of the point from which the Range Safety Card defines the target area; e.g. the firing point; and does not change.

b. Muzzle Velocity Information

(1) Propellant Temperature

(2) Projectile Square Weight

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NOTE: Follow the same rules for nonstandard square weights as per paragraph 4004.

(3) Muzzle velocities

NOTE: The false howitzer's MVV should be the battery average Muzzle Velocity.

c. Computer MET.

d. Registration Corrections (when applicable).

3. AFATDS safety is recomputed as specified in paragraph 4004. The appropriate changes in the database are applied prior to executing.

4. The following matrices are to be used when performing safety with AFATDS 99 Ver 6.3.X.X (Standard mission processing procedures are located in the AFATDS GDU Job Aids):

LOW ANGLE

LLHC DIR DIST VI LOT CHG LEFT DF MIN QE MIN TI TF+5.5 = MINVT
(If a separate Min Ti Rg is specified on the range safety card MIN TI will not be determined with this matrix)

LLHC DIR DIST VI LOT CHG MIN TI (This Matrix used only if a separate Min TI Rg is specified on the range safety card)

URHC DIR DIST VI LOT CHG RIGHT DF MAX QE

Legend: LLHC Lower Left Hand Corner (of target area)

 URHC Upper Right Hand Corner (of target area)

 DIR Direction from false observer to corner (Az from the Basic Safety Diagram)

 DIST Distance from false observer to corner (Rg from the Basic Safety Diagram)

 VI Vertical interval from false observer to corner. VI is applied to the polar missions as a vertical shift.

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NOTE: Minimum safe time is computed including a Down 20 in the computation of VI.

NOTE: If min time range is different from min PD range use the VI from the min PD range plus an additional vertical shift of Down 20.

LOT	Ammunition lot used in computations
CHG	Charge used in computations
LEFT DF	Deflection corresponding to left azimuth of target area
MIN QE	Quadrant Elevation corresponding to minimum range of target area
MIN TI	Minimum safe time corresponding to the minimum range , or Min TI range, of the target area (See Note above)
TF+5.5=	Time of Flight corresponding to minimum MIN VT range plus 5.5 seconds to determine minimum safe VT time setting
RIGHT DF	Deflection corresponding to the right azimuth of target area
MAX QE	Quadrant Elevation corresponding to maximum range of target area

a. The target area is defined from the point described on the range safety card. In order to compute safety, a false observer must be recorded in the data base at that location and all data computed based on polar missions to the corners indicated in the matrices from that location. The howitzer location should be the battery center location (if preoccupation safety is being computed, place the howitzer firing the data in the same location as the observer. Upon occupation, update the data by changing the howitzer location to battery center, but leaving the false observer in the same location).

NOTE: The actual target area is defined from the location listed on the range safety card, which is the false observer's location.

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b. If the safety diagram contains doglegs, then each dogleg will be computed as either a LLHC or URHC using the matrices. If the dogleg is a minimum range dogleg, use the LLHC matrices. If the dogleg is a maximum range dogleg, use the URHC matrix. An easy rule to ensure that computations are performed for the correct corner of the target area is "Low angle, shoot every other corner proceeding from the lower left hand corner moving in a clockwise direction". (This rule applies to **low angle** only)

c. The matrices are first recorded with all known information (LLHC/URHC, DIR, DIST, VI, LOT and CHG). The other values are determined through computations of polar missions from the false observer (located at the firing point grid listed on the range safety card for both preoccupation and post occupation safety) for the recorded howitzer (located on the same grid as the false observer for preoccupation safety and at battery center for post occupation safety) and recorded in the matrix. Safety "T"s are generated after the computations are verified by another safety certified individual performing independent computations.

HIGH ANGLE

LRHC DIR DIST VI LOT CHG RIGHT DF MAX QE

ULHC DIR DIST VI LOT CHG LEFT DF MIN QE

Legend: LRHC Lower Right Hand Corner (of target area)

 ULHC Upper Left Hand Corner (of target area)

 DIR Direction from false observer to corner (Az from the Basic Safety Diagram)

 DIST Distance from false observer to corner (Rg from the Basic Safety Diagram)

 VI Vertical interval from false observer To corner

 LOT Ammunition lot used in computations

 CHG Charge used in computations

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RIGHT DF	Deflection corresponding to right azimuth of target area
MAX QE	Quadrant Elevation corresponding to minimum range of target area
LEFT DF	Deflection corresponding to the left azimuth of target area
MIN QE	Quadrant Elevation corresponding to maximum range of target area

d. The target area is defined from the point described on the range safety card. In order to compute safety, a false observer must be recorded in the data base at that location and all data computed based on polar missions to the corners indicated in the matrices from that location. The howitzer location should be the battery center location (if preoccupation safety is being computed, place the howitzer firing the data in the same location as the observer. Upon occupation, update the data by changing the howitzer location to battery center, but leaving the false observer in the same location).

NOTE: The actual target area is defined from the location listed on the range safety card, which is the false observer's location.

e. If the safety diagram contains doglegs, then each dogleg will be computed as either a LRHC or ULHC using the matrices. If the dogleg is a minimum range dogleg, use the LRHC matrices. If the dogleg is a maximum range dogleg, use the ULHC matrix. An easy rule to ensure that computations are performed for the correct corner of the target area is, "High angle, shoot every other corner from the lower right hand corner moving in a counter clockwise direction." (This rule applies to **high angle** only)

f. The matrices are first recorded with all known information (LLHC/URHC, DIR, DIST, VI, LOT and CHG). The other values are determined through computations of polar missions from the false observer (located at the grid listed on the range safety card for both preoccupation and post occupation safety) for the recorded howitzer (located on the same grid as the false observer for preoccupation safety and at battery center for post occupation safety) and recorded in the matrix. Safety "T"s are generated after

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the computations are verified by another safety certified individual performing independent computations.

5. Safety data is determined by processing polar missions with the false observer to the appropriate corners of the safety diagram. Entries into fields affected by the AFATDS automatic selection routine, such as charge, should be forced entries by the operator to ensure data is determined under the correct parameters.

6. Preoccupation Safety

a. Ensure the following are applied to the database.

(1) Enter a false howitzer located at the firing point grid. If no firing point, use OS grid.

(2) Enter for the false howitzer's MVV the average battery MVV for the given projectile family/propellant type/charge group combination.

(3) Create a false observer in the JMUL. Establish this observer in your current situation. (enter grid and altitude used in step (1) (either firing point grid or OS grid and altitude)).

b. Ensure the following are incorporated into the mission processing.

(1) The polar target locations should incorporate direction and distance to the appropriate corner, and VI to the appropriate range line.

(2) Ensure the appropriate shell, fuze, lot and charge are used in computations.

(3) Process separate missions to min range line to compute min time, even if there is not a separate min range line for time.

7. Post-Occupation Safety

a. In addition to the normal changes in the database, ensure the following are applied.

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- (1) Verify the Azimuth of Lay and update ORSTA with the correct OS grid.
- (2) Delete the false howitzer in order to obtain the correct COB.
- (3) After COB is determined, reenter the false howitzer at the COB grid.
- (4) Do **not** change the false observers location in the database. He remains at the firing point grid.
- (5) Re-compute safety as per paragraph 4004.

b. Safety Update Upon Change in database.

- (1) Enter database change into AFATDS.
- (2) Re-compute safety as per paragraph 4004.
- (3) Updates from registration corrections only affect same angle of fire, projectile family, and propellant type computations.

4008. SPECIAL MUNITIONS

1. ROCKET ASSISTED PROJECTILE (RAP). Computations for RAP are the same as for HE except for the addition of buffer areas to the minimum or maximum range. The newest version of RAP FTs, AO-1, indicate 155 mm RAP can be fired in rocket-on or rocket-off mode. When firing QE 950 mils and below in the rocket-on mode, a 6000 meter buffer short of the minimum range line must be applied in case of rocket motor failure. When firing QE 950 mils and below in the rocket-off mode, a 6000 meter buffer beyond the maximum range line must be applied in case of rocket motor ignition. When firing above QE 950 mils the respective buffers are 8000 meters utilizing the same principle listed above.

2. COPPERHEAD

a. Ensure the Range Safety Diagram is constructed as per figures 11-6 and/or 11-7 of ref (f). The mission essential area for the glide mode must start at least 1.5 km from the target point. No personnel are allowed in the surface danger zone when firing ballistic mode.

b. Safety computations are performed using manual procedures discussed in para 4005.4 with the following

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exceptions. Range K is determined to either the target or the center of the target area rather than the right hand corner (this is already the case for a manual FDC).

c. When firing AFATDS data, FDOs must verify which mode they are firing (ballistic or glide), by comparing the first digit of the fuze setting with the following data from FT AS-1:

<u>1ST DIGIT</u>	<u>FIRING MODE</u>
1-2	BALLISTIC
3-9	GLIDE

(1) AFATDS provides only one solution for Copperhead missions. If this data is unsafe to fire, then manual computations provide the only means to determine firing data using a different mode or charge.

(2) FDOs able to select the charge they will compute safety for should first attempt a dry fire mission approximating range, visibility, and cloud height to obtain the which mode and charge the AFATDS is likely to recommend as a firing solution.

3. DPICM. Apply the following additional considerations: Areas A & B are 650 meters for M483. The appropriate submissile drift factor in ref (f) must be applied. Access to area D and firing over friendly troops is not permitted. Uprange and lateral ricochets of up to 500 meters may occur from projectiles that fail to function.

4. Base-Burn DPICM. The considerations applied to both RAP and DPICM are applied to M864 BBDPICM. The actual buffer area short of the target area for M864 is 5,000 meters, and the same submissile drift factors as DPICM are applied.

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CHAPTER 5

LASER SAFETY

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CHAPTER 5

LASER SAFETY

5000. GENERAL

1. This chapter provides information applicable to the AN/PAQ-3 Modular Universal Laser Equipment (MULE) and the AN/GVS-5 Laser Rangefinder (LRF) and outlines requirements for a sound laser safety program. Reference (b) provides a checklist for meeting requirements of the laser safety program.

2. The MULE employs a high power Neodymium Yag laser. While the MULE does not generate sufficient energy to injure the skin, it does present a serious hazard to the eye. The hazard is due to the fact that the laser energy cannot be detected by the retina; hence, there is no self-protective mechanism (e.g. blinking or turning away) when the beam strikes the eye. Exposure is not realized until the damage is done. Serious impairment of vision or blindness will result depending on the amount of energy absorbed.

3. The AN/GVS-5 Rangefinder also employs a 1.064 micron Neodymium YAG laser. Like the MULE, severe permanent damage can result if the eye absorbs laser energy.

5001. REGIMENTAL LASER SYSTEMS SAFETY OFFICER

1. The Regimental Laser System Safety Officer (LSSO) will be assigned in writing and is responsible for implementing the policies and procedures contained in this chapter. He will be thoroughly familiar with references (a), (b), (d), (f) and applicable Division Order(s).

2. The Regimental LSSO will be formally trained as a CAT II LSSO in accordance with reference (b).

3. Specific duties include:

a. Monitoring required formal classroom refresher training of laser operators and laser range safety officers.

b. Coordinating formal training of battalion LSSOs.

c. Monitoring the use of laser systems in the field.

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- d. Maintaining records on all laser command safety certified personnel. Identifying personnel who have laser injuries to the RAS for medical follow-up.
- e. Coordinating and forwarding the Exempt Laser Inventory Report (Figure 5-1) and the Laser Inventory Report (Figure 5-2) to the Division LSSO by July 15 annually.
- f. Complying with the Laser Safety Inspection Checklist (Figure 5-3).
- g. Forwarding Laser Incident Reports (Figure 5-4) to the Division LSSO as required.

5002. REGIMENTAL MEDICAL OFFICER

- 1. Establish a Laser Medical Surveillance Program (if necessary), in accordance with reference (b) and the Laser Program Checklist developed by the Navy Occupational Safety and Health Manual.
- 2. Coordinate medical treatment for personnel who have sustained or who are suspected of having sustained laser eye injury.

5003. BATTALION COMMANDERS

- 1. Appoint, in writing, an officer or staff noncommissioned officer as the Battalion Laser Systems Safety Officer.
- 2. Appoint in writing on the Range/Position Safety Card an officer or SNCO as the Laser Range Safety Officer (LRSO). An LRSO must be present at each observation point/post from which lasers are operated. He is responsible for ensuring that lasers are operated in accordance with this chapter and other applicable regulations.
- 3. Ensure all personnel operating lasers possess a valid laser operator safety card.

5004. BATTALION LASER SYSTEMS SAFETY OFFICER

- 1. The Battalion LSSO is responsible for implementing the requirements in this chapter and other applicable regulations. He will be thoroughly familiar with references (b), (f), applicable Division Order(s), and be formally trained CAT II LSSO in accordance with reference (b).

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2. Specific duties include:

- a. Ensure annual formal classroom refresher training is conducted for laser operators and Laser Range Safety Officers.
- b. Monitor field usage of laser systems to ensure safe operation of lasers at approved OPs.
- c. Maintain files on all personnel that are command certified personnel, and forward revised roster to the Battalion Ordnance Officer and maintain an updated copy on file at all times.
- d. Provide a Laser Range Firing Log (Figure 5-5) to laser operators as required.
- e. Maintain Laser Range Firing Logs for a period of five years.
- f. Submit the Exempt Laser Inventory Report (Figure 5-1) annually to the Regimental LSSO by July 1.
- g. Submit the Laser Inventory Report (Figure 5-2) annually to the Regimental LSSO by July 1.
- h. Submit Laser Incident Reports (Figure 5-4) to the Regimental LSSO within 2 days, as required.
- i. Comply with the Laser Safety Inspection Checklist (Figure 5-3).

5005. LASER RANGE SAFETY OFFICER (LRSO)

1. One LRSO is required for each observation point/post from which lasers will be operated.

2. LRSO Range Safety Procedures

- a. Generally, local regulations will limit lasers to be operated only from specified OPs and into designated areas or to designated targets. In this case, the LRSO will ensure that he obtains the correct laser safety fan data and plots this on his map. Where the local regulations permit a unit to create its own Laser Surface Danger Zone (LSDZ), the LRSO will construct this IAW the procedures in Chapter 19 of

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reference (f). The LSDZ must be reviewed and approved by the unit LSSO prior to laser operations.

b. Prior to laser operations the LRSO will:

- (1) Review the LRSO checklist (Figure 5-6) and ensure compliance.
- (2) Arrange for or confirm with Range Control that the range has been swept for specular reflective material.
- (3) Confirm that the correct OP(s) is/are occupied.
- (4) Establish communications with range control and receive clearance to operate the lasers.
- (5) Post warning signs and barricades as required by local regulations.
- (6) Ensure that the range, including the buffer zone, is clear of all personnel.
- (7) Ensure that all personnel who may be exposed to either the direct beam or reflected beam are wearing laser protective eyewear. Regular sunglasses do not protect against laser energy.
- (8) Brief all operators on the left, right, minimum and maximum vertical limits of the laser target area. Instruct operators not to commence lasing until cleared by the LRSO, and to cease lasing immediately upon command of the LRSO or upon observing any unsafe condition.

c. During lasing operations the LRSO will ensure:

- (1) He carries his Laser Certification Card at all times when performing duties as LRSO.
- (2) Each laser firing is approved and recorded on the Laser Range Firing Log (Figure 5-5).
- (3) Operators announce "LASING, LASING, LASING" prior to each firing.
- (4) Constant surveillance of the laser range area, and

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command "CEASE LASING" if personnel enter the range area or any other unsafe condition is observed.

(5) Operators do not exceed the left, right or vertical limits of the range.

(6) Operators do not lase any target with a highly reflective surface (mirrors, chromeplating, etc.)

(7) Operators do not attempt to lase through glass, plastic, plexiglass, etc.

(8) If communications with range control are lost, lasing operations are ceased.

(9) Operators turn the laser power off after each mission until the next mission is approved by the LRSO.

d. After lasing, the LRSO will ensure:

(1) The laser power source is removed prior to moving the laser from the OPS or at the completion of each day's use.

(2) Range control is notified when lasing ceases.

(3) Any personnel suspected of receiving an eye injury or over exposure to laser energy receive immediate medical treatment, and a Laser Incident Report is filed.

(4) The Laser Range Firing Logs are turned over to the unit LSSO.

5006. LASER OPERATORS

1. Marines designated as operators will attend the course prescribed by the Division LSSO and administered by Division Schools or the unit LSSO prior to operating any laser. If there is no Division LSSO, the Regimental LSSO will provide guidance.

2. While using a laser, operators will ensure:

a. They carry Laser Certification Card at all times when operating a laser.

b. They understand the range limits.

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- c. They announce "LASING, LASING, LASING" prior to each firing.
- d. The laser is not fired on any target until approval is granted by the LRSO.
- e. No highly reflective targets are lased.
- f. No targets are lased at a range of less than 1000 meters.
- g. Lasing ceases immediately if anyone enters his field of view.
- h. The laser power is turned off between missions.
- i. The laser power source is removed at the end of the day's missions or prior to moving the laser.

5007. TRAINING REQUIREMENTS

- 1. Regimental LSSO/Battalion LSSO/LRSO/Laser Operators must successfully complete training given by NAVSEA, or Div LSSO in the following areas:
 - a. Laser fundamentals.
 - b. Biological effects of laser energy.
 - c. Specular and diffuse reflection hazards.
 - d. Other hazards (e.g. electrical, chemical, etc.).
 - e. Laser system classification.
 - f. Responsibilities.
 - g. Control measures.
 - h. Medical surveillance requirements.
 - i. Range safety limits and the operational use of the laser systems.
 - j. Safety requirements contained in this SOP as applicable.

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5008. COMMAND LASER CERTIFICATION REQUIREMENTS

1. LRSO's are initially qualified upon successfully completing the LSSO class given by the Division LSSO or NAVSEA. They must be recertified annually by passing the LSSO test administered by the unit LSSO, or by re-attending and passing the Division LSSO course.
2. Operators are initially certified by successfully completing the training given by the Division LSSO. They must be recertified annually by either passing the laser operations test given by the unit LSSO or re-attending and passing the laser operations course.

5009. PROTECTIVE EYEWEAR

1. Protective eyewear reduces the hazard of laser light to the human eye. Laser protective goggle lenses and sunglass type eyewear are available through normal supply channels.
2. Protective eyewear is not required for routine training unless personnel are viewing a range not swept for specular reflections or are located within the LSDZ. All personnel down range who may be endangered by laser operations, such as aircraft crews, or vehicle operators must also wear protective eyewear.
3. All protective eyewear must be clearly marked with the optical density and wavelength of laser device it is designed to protect against. Chapter 19 of reference (f) defines the optical characteristics of protective eyewear.
4. Do not use any type of regular sun glasses in lieu of protective eyewear specifically designed and labeled as laser protective. Do not use any laser protective eyewear which is cracked, severely scratched or otherwise unserviceable.

5010. ACCIDENT INVESTIGATION/REPORTING PROCEDURES

1. When an individual is exposed to laser radiation or an injury is suspected or observed, a complete medical examination shall be performed as soon as possible. The Regimental or Battalion Commanding Officers will direct respective LSSOs to conduct an accident investigation IAW the requirements of reference (d).
2. A letter report shall be submitted to the commander NAVMEDCOM (MEDCOM-21) via Division CG (Attn: Div LSSO) within 15 days of

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the incident. At a minimum, the report shall include the exposure received and a copy of the medical examination.

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SOP FOR ARTILLERY SAFETY

From:

To: Commander, Space and Naval Warfare Systems Command
(SPAWAR-OOF)

Subj: EXEMPT LASER INVENTORY REPORT FOR FY ____

Laser Type _____

Manufacturer _____

Contract Number _____

National Stock Number
(if available) _____

Serial Number _____

Exemption Qualification: (Check applicable boxes)

Combat _____ Training _____ Classified _____

Status

Number of Lasers: _____

In Use _____ In Storage _____ Awaiting Disposition _____

Transferred within DOD to _____

Serial Number(s) _____

ASD Approval Date _____ Transfer Date _____

Disposed outside of DOD to _____

Serial number(s) _____

ASD Approval Date _____ Transfer Date _____

_____ Signature

Figure 5-1.--Sample Exempt Laser System Inventory.

MARINE CORPS ARTILLERY SAFETY SOP

From:

To: Commander, Space and Naval Warfare Systems Command
(SPAWAR-OOF)

Subj: CLASS 3b AND CLASS 4 LASER INVENTORY REPORT FOR FY ____

Laser Type ** _____

Manufacturer _____

National Stock Number
(if available) _____

Contract Number _____

Plant Account Number(s) Disposition

a. Program/User/Custodian(s) _____

b. Location(s) _____

c. Use(s) _____

NOTE: Description shall include laser medium, emitted wavelengths, maximum output of laser radiation, pulse duration (when appropriate), and laser class.

Signature

Figure 5-2.--Sample Laser Inventory Report.

MARINE CORPS ARTILLERY SAFETY SOP

LASER SAFETY INSPECTION CHECKLIST

	YES	NO
Does the command have Class III or IV lasers or exempt lasers?		/
If yes, continue with the following:		
1. Has a laser hazard control program been established? (SPAWARINST 5100.12A, Encl 7)		/
COMMENTS:		
2. Has a Laser Systems Safety Officer (LSSO) been designated in writing and does he have direct access to the CO? (SPAWARINST 5100.12A, Encl 7)		/
COMMENTS:		
3. Does the LSSO have sufficient technical competence and authority to approve or disapprove the local use of lasers? (SPAWARINST 5100.12A, Encl 7)		/
COMMENTS:		
4. Has the LSSO received a minimum of 20 hours of formal classroom training in laser radiation? (Laser Safety School or equivalent) (SPAWARINST 5100.12A, Encl 8)		/
COMMENTS:		
5. Has a local Laser Safety Organization or Committee been established to assist the LSSO in discharging his responsibilities? (If warranted by the magnitude of the potential hazard in local operations) (SPAWARINST 5100.12A, Encl 7) /		/
COMMENTS:		
6. Does the LSSO maintain a list of all lasers and their locations? (SPAWARINST 5100.12A, Encl 7)		/
COMMENTS:		

Figure 5-3.--Sample Laser Safety Inspection Checklist.

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YES NO

7. Have local laser safety regulations been established /
including standing operating procedures for indoor
maintenance and outdoor operational laser operations?
(SPAWARINST 5100.12A, Encl 7)

COMMENTS:

8. Are safety responsibilities written for laser or /
Laser System Operations which include normal operational
procedures,
emergency and documentation of all laser
firing? (SPAWARINST 5100.12A, Encl 7)

COMMENTS:

9. Are local Laser Ranges surveyed at least annually /
for safety? (SPAWARINST 5100.12A, Encl 7)

COMMENTS:

10. Are warning systems and signs placed in appropriate /
locations to protect all personnel from laser radiation?
(SPAWARINST 5100.12A, Encl 7)

COMMENTS:

11. Has a protective goggles program been established? /
Are they properly labeled and periodically inspected and
evaluated? (SPAWARINST 5100.12A, Encl 7)

COMMENTS:

12. Have all unit personnel designated as operators /
attended the MULE/AN/GVS-5 operators course?
(SPAWARINST 5100.12A, Encl 7)

COMMENTS:

13. Have all personnel in areas with lasers been /
informed by formal classroom training about the
potential hazards associated with accidental exposure
to lasers? (SPAWARINST 5100.12A, Encl 7)

COMMENTS:

MARINE CORPS ARTILLERY SAFETY SOP

**Figure 5-3.--Sample Laser Safety Inspection Checklist--
Continued.**

14. Are local laser radiation accidents and incidents / YES NO
investigated with appropriate recommendations and
corrective actions initiated? (SPAWARINST 5100.12A, Encl 7)

COMMENTS:

15. Is medical evaluation performed and an incident /
report submitted via the chain of command to COMNAVMEDCOM
(MEDCOM-21) within 30 days of the incident with a copy to
SPAWAR (OOF)? (NAVMEDCOMINST 6470.5.d & e)

COMMENTS:

MEDICAL SURVEILLANCE

16. Has the LSSO determined and designated incidental /
and laser personnel? (NAVMEDCOMINST 6470.5b)

NOTE: Laser personnel - those individuals routinely working
with class 3 or 4 lasers. These people usually work in
research and development, laser repair, and maintenance, or
work with engineering/construction lasers.

NOTE: Incidental personnel - those individuals whose work
makes it possible, but unlikely, that they will exceed the
applicable MPE. These people include the operators of
fielded military laser systems, when these systems are
operated on certified laser ranges and follow prescribed
laser safety procedures.

COMMENTS:

17. Has the LSSO submitted records of personnel exposed /
to laser emissions to the medical officer for medical
surveillance? (SPAWARINST 5100.12A, Encl 7)

COMMENTS:

18. Are all personnel designated either as incidental or /
laser enrolled in the appropriate medical surveillance
program? (NAVMEDCOMINST 6470.5b)

COMMENTS:

**Figure 5-3.--Sample Laser Safety Inspection Checklist--
Continued.**

MARINE CORPS ARTILLERY SAFETY SOP

YES NO

19. Are the required examinations performed prior to participation in and upon termination of laser work and following any suspected laser injury? /
(NAVMEDCOMINST 6470.5b)

COMMENTS:

20. Have incidental personnel received eye examinations for visual acuity? (NAVMEDCOMINST 6470.E2.2) /

COMMENTS:

21. Do laser personnel receive visual acuity determinations and eye examinations based on the wavelength of laser radiation? Is medical history taken? /
(NAVMEDCOMINST 6470.E2.2.2)

COMMENTS:

22. Is an inventory and record of the status of all exempted laser products maintained? (SECNAVINST 5100.14A, Pg 5,7) /

COMMENTS:

23. Is a report on military exempt lasers provided to SPAWAR? (SECNAVINST 5100.14A, Pg 5,7) /

COMMENTS:

24. Is approval received from the Deputy Assistant Secretary of Defense for Equal Opportunity and Safety Policy, via SPAWAR, prior to the transfer or disposal of any military exempt laser? (SECNAVINST 5100.14A, Pg 5,7) /

COMMENTS:

25. Is the required caution label affixed to all military exempt lasers? (SPAWARINST 5100.12A, Encl 10) /

COMMENTS:

**Figure 5-3.--Sample Laser Safety Inspection Checklist--
Continued.**

MARINE CORPS ARTILLERY SAFETY SOP

SOP FOR ARTILLERY SAFETY

LASER INCIDENT REPORT

Date: _____

1. Reported By: (Unit) _____

To: Division LSSO (VIA Regimental S-3)

2. Incident Location: _____ Date: _____

3. Persons Involved: _____

4. Type of Laser & Use: _____

5. Laser Serial #: _____

Manufacturer: _____

Address: _____

6. Exposure Conditions: _____

7. Bio-Effects: _____

8. Prognosis: _____

9. Action: _____

Figure 5-4.--Sample Laser Incident Report.

MARINE CORPS ARTILLERY SAFETY SOP

SOP FOR ARTILLERY SAFETY

LASER RANGE FIRING LOGS

Command _____

Range _____

Date _____

System _____

User _____

Mission _____

Commander _____

Firing # Time Target Location Firing Position/Heading

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

LASER SAFETY SUPERVISOR

Figure 5-5.--Sample Laser Range Firing Log Form.

MARINE CORPS ARTILLERY SAFETY SOP

SOP FOR ARTILLERY SAFETY

LRSO CHECKLIST

1. **Prior to Departure for Range:**

- a. Is the LRSO qualified?
- b. Does the LRSO take a copy of After Arrival Checklist to the range?
- c. Have laser operators attended the required laser safety course and applicable operator course?
- d. If laser safety eyewear is being used, has the eyewear been inspected by the cognizant LSSO?
- e. Is the range certified as laser safe?
- f. Is the LRSO familiar with MCO 3750.1A, Chap 19, and the Division Laser Safety SOP?
- g. Does the LRSO take a Laser Firing Log to the range?

2. **Before Firing Checklist:**

- a. Is a firing log maintained?
- b. Is applicable Range Fan plotted on map?
- c. Has the range been visually checked for specular reflectors on the day of firing?
- d. Is a corpsman present?
- e. Are laser warning signs posted as required by the range regulations?
- f. Are road guards/air sentinels posted and 2-way communications with the LRSO established? Are they briefed?
- g. Are communications established with Range Control?
- h. Are communications established between LRSO, FAC and involved aircraft?

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Figure 5-6.--Sample LRSO Checklist.

- i. Have lasers been correctly boresighted for night use?
 - j. Have operators received the range safety brief? Are all operators briefed on the left, right, upper and lower limits of the target area?
 - k. Are lasers in the correct firing position?
 - l. Are communications established with all down range personnel; do they have protective eyewear ready for use?
3. Prior to departure from the range, is a copy of firing log forwarded to Range Control Officer?
4. After departure from range, is a copy of firing log forwarded to the Battalion/Regimental/Division LSSO?

Figure 5-6.--Sample LRSO Checklist--Continued.

MARINE CORPS ARTILLERY SAFETY SOP

CHAPTER 6

AMMUNITION

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CHAPTER 6

AMMUNITION

6000. GENERAL. This chapter highlights significant safety precautions involving ammunition. These instructions are not all inclusive. All safety personnel, including sections handling ammunition, must be familiar with FM 6-50/MCWP 3-16.3, TM 43-0001-28 and TM 43-0001-28-7. If there is a conflict in any published field manual or technical manual, the TM 43-0001-28-7 will take precedence.

6001. CARE AND HANDLING OF AMMUNITION. Ammunition must be handled carefully to ensure proper functioning and to avoid accidents. Since accuracy of fire is affected by damaged ammunition, the care and handling of ammunition must be carefully supervised. Ammunition components must be kept as clean as possible. Some basic principles for handling and using ammunition by firing battery personnel are:

1. Do not tumble, drag, or throw projectiles, propellants, fuzes, or primers.
2. Do not place ammunition components on bare ground. Tarpaulins, dunnage, etc. will be placed under all ammunition to ensure sand/grit does not get on the ammunition and in to the howitzer. There will be a minimum of 6 inches of clearance between ammunition and the ground and 18 inches of overhead clearance between ammunition and the tarp.
3. Inspect the complete round according to FM 6-50/MCWP 3-16.3 before loading into the weapon. A clean cloth will be kept nearby for wiping off foreign matter.
4. Transport and store white phosphorus (WP M110) and chemical projectiles separate from other types of projectiles. WP and chemical projectiles will be stacked (stored and or transported) in a vertical position, with the base of the projectile down.
5. Secure all ammunition during transportation.
6. Do not make unauthorized alterations to ammunition.
7. Know how to assemble, handle, and prepare ammunition for firing.

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8. Store ammunition in a dry place, protected from direct rays of the sun. Tarps should be oriented to provide the best protection from the sun and rain. Ammunition will be uniformly conditioned prior to firing.
9. Do not attempt to remove the supplementary charge from the projectile by any means other than the lifting loop.
10. Designate projectiles extracted by ramming as "Grade 3" and return to the ammo dump.
11. Use the proper tools to cut banding material. For example, do not use an axe to cut the bands on ammunition pallets.
12. Use non-sparking tools when handling ammunition.

6002. GENERAL INSTRUCTIONS FOR FUZES

1. **WARNINGS: NEVER ATTEMPT TO FIRE AN ARTILLERY ROUND OF ANY CALIBER WITHOUT USING THE FUZE AUTHORIZED FOR THAT PARTICULAR ROUND. THE FIRING OF A ROUND WITHOUT A FUZE OR WITH AN UNAUTHORIZED FUZE COULD RESULT IN AN IN-BORE EXPLOSION OR OTHER HAZARDOUS CONDITION THAT COULD CAUSE DEATH OR SERIOUS INJURY TO PERSONNEL OR DAMAGE TO MATERIAL.**

2. Artillery In-Bore Detonations Involving Fuzes

a. In-bore detonations of fuzes can result in fatalities to personnel and loss of weapons. Malfunctions generally occur when the fuze is not fully seated in the projectile. The importance of fully seating the fuze in an artillery projectile cannot be overemphasized. Prior to setting, the fuze must first be tightened with the appropriate fuze wrench until the fuze shoulder is seated flush with the nose of the projectile and no gap exists.

WARNING: DO NOT FIRE ANY ROUND UNLESS THE FUZE IS FULLY SEATED. IF A GAP EXISTS BETWEEN THE SHOULDER OF A FUZE AND THE PROJECTILE, EITHER REPLACE THE FUZE WITH ONE THAT WILL FULLY SEAT, OR TURN THE ROUND IN AS A GRADE THREE IF THE PROBLEM EXISTS WITH THE FUZE WELL THREADS. WHEN THE FUZE IS NOT TIGHTLY SEATED, PREMATURE DETONATION MAY OCCUR THROUGH SUDDEN SEATING FROM ROTATION OF THE PROJECTILE IN THE BORE.

b. Fuzes are sensitive to shock.

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CAUTION: WHEN TIGHTENING A FUZE TO THE PROJECTILE, DO NOT HAMMER OR USE AN EXTENSION HANDLE ON THE FUZE WRENCH.

- c. Commanders will ensure that all personnel, especially howitzer sections, understand these procedures, precautions, and warnings.

6003. SPECIAL INSTRUCTIONS FOR VARIABLE TIME (VT), ELECTRONIC TIME (ET), AND MECHANICAL TIME (MTSQ) FUZES

1. Variable time fuzes(VT)

- a. To set for point detonating, the M732 and M732A2 will be set index mark aligned over PD.
- b. VT fuzes will not be fired in proximity action within 750m of friendly troops.
- c. The M732 Fuze can be utilized on standard high explosive projectiles and the M549A1 HERA projectile in rocket off mode only.
- d. The M732A2 Fuze can be utilized on standard high explosive projectiles and the M549A1 HERA projectile in rocket on and off modes.
- e. Fuzes, particularly VT, must be seated properly to prevent premature detonation. No gap should exist between fuzes and projectiles when seated. If a gap exists, DO NOT FIRE THE ROUND.
- f. There is no charge restriction for the M732 series fuzes.
- g. DO NOT ATTEMPT TO SET M732A2 ON ODD NUMBERED SECONDS

2. Electronic time fuzes (ET)

- a. If electronic time fuzes, M762 and M767 fails in the time mode or impacts before a time setting expires, there is no true point detonating back up; however, the round may or may not function on ground impact.
- b. Upon activating an electronic time fuze, M762 and M767 the liquid crystal display should read 888.8, to return the fuze to shipping and storage setting, a time setting of <88.8 should be applied to the fuze.

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- c. The battery life of the M762 and M767 is 15 days.
- d. There is no charge restriction for the M762 series fuzes.

3. Mechanical time fuzes (MT/MTSQ)

- a. The M564, M577, and the M582 can be set as many times as necessary.
- b. When using the M564 (MTSQ) for impact action, set it to 90.0 seconds (regardless of its date of manufacture) to preclude premature detonation.
- c. When setting the M564 fuze, the last direction of rotation should always be in the direction of increasing numbers (clockwise).
- d. The M577 and the M582 fuzes are set to the desired time by rotating the fuze setter in a counterclockwise direction. To return the fuze setting to the shipping and storage setting, the fuze setter must be rotated in a clockwise direction.
- e. When using the M577 or M582 fuzes for impact action, set them to <98.0. The shipping/storage setting for these fuzes is <93.5 to <95.5. A dud will result if a round is fired with the shipping/storage setting still on these fuzes. (The M577 fuze is used on base ejecting projectiles. Impact action for the M577 fuze should only be used with the M483A1 and M864 projectiles in the self registration mode with the spotting charge threaded to the fuze).

6004. CONTROL OF PROPELLANTS

- 1. 155mm. The complete propellant charge will remain in its packing container/canister until the powder is cut to the proper charge. Powder will only be cut when the charge is announced in the fire command. When the powder is removed from the canister the following precautions will be taken;
 - a. Remove the complete propellant charge from the canister and examine it to ensure that all increments are present and serviceable.

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- b. Remove excess increments and retie the remaining charges.
- c. Section chief must visually verify the prepared (cut) charge and the excess powder increments.
- d. Carry the excess powder to the mission pit after the Section Chief's inspection.

2. The procedures in paragraph 6004.1 above will be accomplished under the direct supervision of the Section Chief and serve as the final check prior to declaring the weapon safe to fire. (See paragraph 3002.10.c(6) for procedures).

6005. ROCKET ASSISTED PROJECTILES (RAP)

1. M549 AND M549A1 RAP can be fired in rocket-on and rocket-off mode. Removal of the base cap prepares the ammunition to fire in the rocket-on mode. Leaving it securely in place prepares it for rocket-off mode. The cap is reverse threaded; i.e. left-hand; and has arrows, which plainly show the correct direction for removal. Failure to remove this cap will prevent ignition of the rocket motor and cause the round to fall short.

2. The 155mm RAP, M549/M549A1 projectile cannot be fired if the obturating band is missing or broken or if the howitzer tube wear exceeds 0.093 inches.

3. The M198 howitzer can fire the M549/M549A1 projectile using charge 7 M4A2 (WB), charge 8 M119A1 (WB), or charge 7 M119A2 (RB). Use of charge 8 M119 (WB) propelling charge is prohibited due to the possible failure of the rocket motor to ignite.

4. The M198 howitzer is authorized to fire the M549A1 projectile using the M203 charge. Use of the M203 propelling charge to fire the M549 RAP round is not authorized.

6006. SPECIAL AMMUNITION

1. DPICM FAMILY. All DPICM family projectiles (M483A1, M825, etc.) should be inspected to ensure the obturating band is present and in good condition prior to firing.

2. M825A1. There are no USMC stocks of M825A1 projectiles. However, if USMC units encounter M825A1 during training with Army units, they should be aware that it has NONE of the restrictions affecting M825 (see not below). The M825A1 has a

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different FCI than M825, hence a different BCS mnemonic and different firing tables (the AN-2 GFT or FT ADD Q-0 (REV) Ch 2 has M825A1 data).

NOTE: The only M825A1 that is authorized for all propellants currently in the USMC inventory are the ones featuring Alband manufactured smoke canisters. A 360 degree red band located on the ogive of the projectile can easily identify these rounds. The M825 projectile is restricted to firing below 950 mils elevation with the M203 series charge. Firing this combination at elevations exceeding 950 mils may result in short rounds.

6007. OVERHEAD FIRE When firing overhead of troops, only ammunition lots specifically cleared for overhead fire may be used. Lots not cleared for overhead fire will be identified and segregated (or not distributed). Improved Conventional Munitions (ICM) projectiles will not be fired over the heads of troops during training exercises. RAP lots that are cleared for overhead fire may be fired overhead of troops during training exercises ONLY WHEN APPROVED BY THE COMMANDING GENERAL.

6008. TRANSPORTATION OF AMMUNITION. Supervisory personnel must be familiar with references (C), (G) and applicable Division Order(s). Transportation of ammunition will be conducted in accordance with Appendix E of the SOP.

6009. AMMUNITION TEMPERATURE LIMITS. Artillery ammunition will function safely with the temperature limits prescribed in TM 43-0001-28. When firing at extreme temperatures, below -30 degrees F or above 125 degrees F, check the applicable TM for restrictions.

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CHAPTER 7

RADIOLOGICAL HAZARDS

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SOP FOR ARTILLERY SAFETY

CHAPTER 7

RADIOLOGICAL HAZARDS

7000. HANDLING OF FIRE CONTROL DEVICES CONTAINING RADIOACTIVE TRITIUM. Radioactive tritium is present in relatively small quantities in several optical devices in the field artillery. It serves as night-lighting for various sighting instruments and requires neither maintenance nor electrical power. While the danger of serious harm from this material is remote, certain precautions are appropriate. This chapter highlights special handling requirements for artillery fire control instruments containing tritium.

1. Responsibilities

a. Commanding Officers. Commanding Officers are responsible for duties designated in reference (e), paragraph 1002.1.

b. Command Radiation Safety Officer (RSO). The Command's RSO is responsible for duties specified in reference (e), paragraph 1002.2.

c. Users. Individuals working near radiation sources are responsible for:

(1) Knowing the procedures, rules, and special instructions set forth in this SOP, the applicable TM's, TM-5104-15/12 and reference (e).

(2) Reporting (immediately) any incidents, personal injury (however slight), suspected exposure, or ingestion of a radiation source.

2. Major Items Affected. The following items contain tritium and must be handled per this section.

a. Collimator, infinity, aiming reference (radioactive), M1A1.

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b. Howitzer, medium, towed, 155mm, M198:

- (1) Telescope, Elbow, 138.
- (2) Telescope, Panoramic, M137.
- (3) Mount, Telescope, and Quadrant, M171.
- (4) Quadrant, Fire Control, M17.
- (5) Quadrant, Fire Control, M18.
- (6) Alignment Device, M139.

c. Quadrant, Fire Control (Gunnery) (Radioactive), M1A2.

3. Instructions for the Radiological Safety Program. Reference (e) is amplified as follows.

a. Radiation Health Protection Program

(1) All personnel exposed to tritium gas will be referred to the local medical officer to determine the need for a radiochemical urinalysis.

(2) If required by the medical officer, a radiochemical urinalysis will be performed. The procedure for performing a radiochemical urinalysis is contained in NAVMED P5055, Chapter 3.

(3) Provisions of reference (e), paragraph 6001.1 apply.

b. Emergency Procedures. See reference (e), paragraph 6000.2.

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c. Contamination Control. The following material is recommended for implementing contamination control procedures in reference (e), paragraph 6000.3. Each battery should maintain these items while conducting training.

<u>Description</u>	<u>NSN</u>
Bag, Plastic	8105-00-837-7753
Bag, Plastic, 20X25 in.	8105-00-269-4662
Gloves, Plastic	8415-00-248-3228
Tape, Pressure Sensitive	7510-00-059-9062

d. Personnel Decontamination. Personnel decontamination (exposed skin) will be conducted per reference (e), paragraph 6001.1.

e. Radiological Incident Reporting

(1) All incidents will be reported to the unit RSO immediately. A radiological incident is any unplanned event which results in loss of radioactive material. Contamination of personnel and property could be the result. Examples of radiological incidents include:

(a) The release of gas from a sealed source during accidental breakage, explosion, or fire.

(b) Lost or stolen tritium devices.

(2) The unit RSO will submit (via the Regimental Safety Officer, Division (G-3), and Base Radiation Safety Officer), a report to the Commander, ARRCOM (DRSAR-SF), Rock Island Arsenal, Rock Island, Marine Corps (Code LMA) and the Division Ordinance Officer, within five working days. Submit reports per format in reference (e), paragraph 5001.3.

4. Personnel Training Requirements. All personnel that operate, handle, and/or maintain radioactive devices will be familiar with minimum safety requirements specified in reference (e), Appendix D.

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CHAPTER 8

ACCIDENTS/INVESTIGATIONS

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CHAPTER 8

ACCIDENTS/INVESTIGATIONS

8000. GENERAL. This chapter provides policy and procedures for handling accidents, incidents, and investigations. A review of recent accidents reveals that firing accidents fall into two main categories:

1. Failure on the gunline to independently verify elements of a fire command prior to firing a round, especially charge and fuze setting. Section Chiefs and gunline supervisors too often are overwhelmed by a sense of competition and mission urgency. While both competition and speed of execution can be healthy motivators, it is unacceptable to sacrifice any aspect of gunline safety procedures to get a round down range faster. Unsupervised speed kills. Battery commanders and Battery Gunnery Sergeants must supervise the gunline to ensure that safe firing practices and procedures are being followed.

2. Failure within the FDC to maintain an accurate data base, or loss of situational awareness, particularly the location of lead elements. Within the FDC there will always be multiple distractions to FDOs and Ops Chiefs. It is very easy to neglect verification or accurately update activities, and in our haste to complete the mission, errors are made. Again, unsupervised speed kills!

3. This order establishes procedures designed to eliminate these types of accidents. **In all recent cases where a conclusive cause of a firing incident was reached, it was the result of failure to adhere to published safety procedures!**

8001. DUDS

1. Artillery, naval gunfire, and aerial duds will be immediately reported to Base Range Control upon discovery.

2. When possible, artillery and naval gunfire duds will be marked as shown below:

(DUD)

(TAPE)



(STAKE)

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3. Aviation duds will not be marked. If the impact area is accessible, a sentry will be positioned 150 meters from the dud along normal ground approaches.

4. Use Figure 8-1 to report duds.

5. Under no circumstances will duds be handled, removed, or destroyed by other than explosive ordnance disposal (EOD) personnel.

8002. DEFECTIVE AMMUNITION

1. In the event of an accident or upon receipt of defective ammunition, the OIC of Firing will:

a. Comply with the applicable provisions in this order.

b. Notify Regimental Headquarters (S-3) via respective battalion (S-3).

c. Submit appropriate reports using the following formats:

(1) Medical Evacuation Request - Figure 8-2.

(2) Dud Report - Figure 8-1.

(3) Defective Ammunition Report (Preliminary) - Figure 8-3.

d. Submit a follow-up ammunition report (within 24 hours) to the Regimental S-4 per TM 9-1300-206.

e. Cease firing all ammunition lot(s) suspected of being defective.

2. The Regimental S-3 will immediately notify the Regimental Commander and inform the Regimental S-4 of the accident/malfunction.

3. The Regimental S-4 will send an initial report to the Division Ordnance Officer and ensure subsequent detailed reports are submitted per TM 9-1300-206 and MCO P8205.1.

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8003. INVESTIGATIONS

1. Investigations into artillery incidents must be immediately and properly conducted. This section outlines principal requirements for investigations. Appendix G will be used as a guide.
2. The appropriate level commander (i.e. the battalion commander if the firing incident involves one firing unit or the regimental commander if the incident involves an entire battalion) will assign, in writing, an artillery investigating officer specifically for each firing exercise or may designate one as a standing assignment. This assigned officer will be a command safety certified officer. When a battery is deployed, the battery commander shall request an investigating officer be appointed by higher headquarters (MEU, etc.). This should be a command safety certified officer from outside the battery, e.g. the MEU Fire Support Officer, Target Intelligence Officer, etc.

8004. FIRING INCIDENT PROCEDURES

1. When an incident occurs, the OIC of Firing will immediately command "CHECK-FIRING, TO THE REAR OF THE PIECE, FALL IN", and provide the following information to his battalion S-3:
 - a. When the battery was cleared hot, and when they last fired.
 - b. For batteries having fired within 15 minutes prior to check firing:
 - (1) Grid location of battery.
 - (2) Grid location of target(s) last fired on.
 - (3) Chart range to target.
 - (4) Azimuth of lay.
 - (5) Charge fired/propellant type.
 - (6) Quadrant elevation's fired.
 - (7) Deflection's fired.
 - (8) Shell/fuze fired.

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(9) Time set, if applicable.

2. The Battalion's will notify the Regimental S-3 of the incident as soon as possible. The report should include the following information:

- a. Time
- b. Location
- c. # and type of rounds
- d. Casualties
- e. Other significant information

3. Any Marine can command "CHECK-FIRING" when he observes a round detonate or impact outside the impact area. Upon observing an out of safe round, immediately:

- a. Command "CHECK-FIRING".
- b. Inform the RSO of what was observed to ensure the round was indeed outside the impact area and that the RSO is aware of the situation.
- c. Notify Range Control.
- d. Determine (as possible) the azimuth, grid location, and/or height of burst to the detonation or impact.

4. **All firing will immediately cease upon check firing.** Firing will not resume until cleared by Range Control and Battalion Commander. If deployed, the OIC of Firing will make the decision.

5. Duties of the Regiment. For each firing incident:

- a. S-3. During normal working hours:
 - (1) Notify the Regimental Commanding Officer and Executive Officer.
 - (2) Notify the Division G-3 and the G-4.
 - (3) Notify the Investigating Officer.

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(4) Send a crater analysis team to the impact location as appropriate.

b. Regimental Artillery Safety Officer (RASO)

(1) Assume the duties of the Regimental S-3 in his absence.

(2) Ensure an investigating officer is appointed from a battalion other than the battalion involved. When this requirement can not be met a disinterested third party from within the battalion may be appointed to conduct the investigation.

(3) Receive initial information from the battalion(s).

(4) If possible, proceed to the location of the firing unit and observe attitude and adherence to good firing battery procedures.

(5) Receive the investigation results from the investigating officer.

c. Regimental Command Duty Officer. After normal working hours:

(1) Notify the Regimental S-3 and RASO.

(2) Notify the Commanding Officer and Executive Officer.

(3) Notify the Division Staff Duty Officer of the incident and the actions being taken.

d. Regimental Field Artillery Chief. Follow instructions as may be issued by the RASO.

6. Duties of the Battalion

a. Notify the Regimental Commander, Regimental S-3, or Regimental Command Duty Officer (as appropriate) immediately.

b. Ensure information in paragraph 8004.1.b is passed to the Investigating Officer as soon as possible.

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7. Duties of the Range Safety Officer (RSO)

- a. Place all units in "CHECK-FIRING".
- b. Notify the OIC of Firing (first) and Range Control (subsequently) and provide the following:
 - (1) Time of impact.
 - (2) Approximate location of impact.
 - (3) Number of rounds.
 - (4) Type of rounds (e.g., HE, WP, HC, etc.).
 - (5) Casualties (if known).

8. Duties of the Firing Unit

- a. The OIC of Firing will:
 - (1) Ensure the command "CHECK-FIRING, TO THE REAR OF THEPIECE, FALL IN" is given.
 - (2) Assemble all howitzer section personnel to the rear of the piece without verifying the last data fired, without leveling bubbles, and without performing any actions requiring traversing or elevating of the tube. Ammunition, Gun Display Units, Recorder Sheets, etc. will remain untouched by the gun crews.
 - (3) The OIC of Firing may perform the procedures necessary to obtain the information required in paragraphs 6 and 7 of Appendix G.
 - (4) Authorize the resumption of firing **ONLY** upon approval of the Battalion Commander and Range Control.
- b. The Position Commander will:
 - (1) Immediately dispatch all available command safety certified personnel above the section chief level to cover as many of the firing pieces as possible.

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(2) When the command safety certified personnel identified above are in position direct: "CHECK-FIRING, TO THE REAR OF THE PIECE, FALL IN."

(3) Ensure when "TO THE REAR OF THE PIECE FALL IN" is received at the howitzer section, the section chief immediately assembles his crew to the rear of the piece without verifying the last data fired, without leveling bubbles, and without performing any actions requiring traversing or elevating of the tube. Ammo, GDUs, Recorder Sheets, etc. will remain untouched.

(4) Ensure proper conduct of personnel on the gunline.

(5) Verify the data set on the on-carriage fire control equipment, the data sent by the FDC, and the data recorded at the howitzer sections. DO NOT change any data or traverse or elevate any tube without approval of the OIC or investigating officer.

(6) Verify the charge fired by sighting the number of unused increments in the mission and end of mission powder pits.

(7) Resume firing when authorized by the OIC of Firing.

c. The Fire Direction Officer will:

(1) Notify the Position Commander of the incident without alerting the gun crews or giving any commands to change the lay of the weapons.

(2) Ensure no changes to the AFATDS/BUCS, firing charts or records of fire occur.

(3) Verify the last firing data.

(4) Plot and compute the data to the actual point of impact.

(5) Remove and safeguard the Record of Fire; the BUCS/AFATDS printout (if appropriate) containing the mission data and database, all computer and ballistic MET messages, all concurrent and subsequent MET worksheets, the most recent registration data and current safety computations.

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d. The Battery Gunnery Sergeant. Ensure the cannoneers are formed to the rear of the gun line and assist the Position Commander as directed.

9. Duties of the Investigating Officer

a. Collect the information listed in paragraph 8004.1.b for all units currently in the field.

b. Determine suspected units and proceed to their locations.

c. Follow the checklist provided in Appendix G.

d. Recommend to the Regimental S-3 those units which may be taken out of a check-firing status.

e. Submit preliminary findings to Regimental S-3 as soon as possible.

f. Submit completed investigation to Regimental Commander within 10 days of the incident.

g. Ensure the RASO receives a copy of the completed investigation.

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DUD REPORT

ALPHA: DTG _____

BRAVO: LOCATION OF DUD (GRID COORDINATES)

CHARLIE: TYPE OF WEAPON _____

DELTA: TYPE OF ROUND _____

ECHO: NUMBER OF DUDS _____

FOXTROT: HOW MARKED? _____

GOLF: PERSON SUBMITTING REPORT _____ RANK _____

HOTEL: PERSON WHO KNOWS LOCATION(S) OF DUD _____

RANK _____ TELEPHONE _____ UNIT _____

Figure 8-1.--Format for Dud Report.

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MEDICAL EVACUATION REQUEST FORM

- A. Number and type of Each Category
 - 1. Emergency - Critical life or death
 - 2. Priority - Serious injury, life not immediately threatened
 - 3. Routine - Minor injuries or death
- B. Requesting Unit (Radio Call Sign)
- C. Pickup Coordinates
- D. Number of WIA/KIA/SICK Requiring Evacuation
- E. Airborne Medical Assistance Required/Not Required. (If required, MEDEVAC may be delayed).
- F. Landing Zone Secure/Not Secure
- G. Best Approach Direction
- H. Landing Zone Marked (describe)
- I. Landing Zone Frequency (if different from MEDEVAC common net) and Call Sign.

EXAMPLE:

CANNONBALL THIS IS CANNONBALL ALPHA. I HAVE MEDEVAC REQUEST.
CAN YOU COPY? TEXT FOLLOWS.

ALPHA ONE EMERGENCY THREE PRIORITY
BRAVO CANNONBALL ALPHA
CHARLIE 349786
DELTA FOUR WIA
ECHO NOT REQUIRED
FOXTROT LZ SECURE
GOLF PILOTS DISCRETION
HOTEL SMOKE
INDIA BUTTON COMMON - ALPHA ONE FOUR

Figure 8-2.--Format for Medical Evacuation Form.

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DEFECTIVE AMMUNITION REPORT (PRELIMINARY)

1. This report will be sent as soon as possible after the incident:
 - a. Nomenclature and lot number of item or complete round.
 - b. Fuze lot.
 - c. Appearance of item prior to use.
 - d. Brief description of malfunction.
 - e. Extent of injury to personnel or damage to property.
 - f. Number of rounds of defective lot fired prior to malfunction.
 - g. Number of rounds of defective lot remaining on hand.
 - h. Action taken regarding withdrawal of ammunition from use.

Figure 8-3.--Format for Accident/Defective Ammunition Report (Preliminary).

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MARINE CORPS ARTILLERY SAFETY SOP

APPENDIX A

ARTILLERY SAFETY INSPECTION CHECKLIST

1. General. This appendix provides the checklist used by the Regimental Artillery Safety Officer when conducting annual artillery safety inspections of battalions and batteries. It is not all-inclusive.

2. Battalion Checklist

a. **Publications.** Are the following publications (with current changes) available for use by the S-3/S-4 sections.

<u>PUBLICATION</u>	<u>YES</u>	<u>NO</u>
(1) MCO P3570.1	___	___
(2) MCO 8020.1	___	___
(3) MCO 8025.1	___	___
(4) MCRP 3-16.2A TECHNIQUES AND PROCEDURES MAN.	___	___
(5) TM 4700-15/1	___	___
(6) TM 43-0001-28	___	___
(7) TM 43-0001-28-7	___	___
(8) TM 9-1000-202-14	___	___
(9) TM 08198A-10/1	___	___
(10) TM 9-1290-200-14/P	___	___
(11) TM 9-1290-359-12/P	___	___
(12) TM 9-1300-206	___	___
(13) TM 9-1300-251-20	___	___
(14) TM 11-7025-317-10-1&2	___	___
(15) TM 11-7440-283-12-2	___	___
(16) FM 6-40/MCWP 3-16.4	___	___
(17) ST 6-40-31	___	___
(18) FM 6-50/MCWP 3-16.3	___	___
(19) Division SOP for Class V(W)	___	___
(20) Division SOP for Motor Transport	___	___

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- (21) JtRegtO P3570.1 _____
- (22) NAVSEA SW020-AF-ABK-010 _____
- (23) Local Range Regulations _____
- (24) ARSS Users Manual (Version 4.0) _____
- (25) Division Laser Safety Order _____
- (26) SPAWAR INST 5100.1 _____
- (27) Applicable TFTs _____
- (28) TB-11-7025-354-10-4 Air Operations Job Aides _____
- (29) TB-11-7025-354-10-5 Fire Planning Job Aides _____

3. Surface Danger Diagram/Range Safety Card/Target Area Overlays

a. Files verification

<u>UNIT</u>	<u>FIRING DATA</u>	<u>GP</u>	<u>SURFACE DANGER DIAGRAM ON FILE</u>	<u>POSITION/ RANGE SAFETY CARD ON FILE</u>	<u>TARGET AREA OVERLAY</u>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

b. Verification of Data on Surface Danger Diagram (select for verification with Target Area Overlay)

Unit _____ Firing Data _____ GP _____

	<u>DATA</u>	<u>CHECK DATA</u>
Center Range	_____	_____
Maximum/ Minimum	_____	_____
PE Range	_____	_____
x 8	_____	_____
x 12	_____	_____
	<u>DATA</u>	<u>CHECK DATA</u>
Center Range	_____	_____
PE Defl	_____	_____
x 8	_____	_____

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Ammunition _____
Area A Dim. _____
Area B Dim. _____
Area C Dim. _____
Area E Dim. _____
Road Guard _____

c. Verification of Data on Range Safety Card

Unit _____ Firing Data _____ GP _____

Were the following safety personnel assigned?

OIC _____

RSO _____

Laser Range Safety Officer _____

Special Instructions:

VT Range _____

Road Guards _____

Ammo Restrictions _____

PSO _____

4. Command Safety Certification

a. Has the battalion scheduled and conducted safety training?

b. Is the Battalion Artillery Safety Officer (BASO) assigned in writing?

c. Is he a 0802 Major or Captain?

d. Are practical exam administrators assigned in writing by the Battalion Commander?

e. Is the BASO monitoring battery training?

f. Is/are exam administrator(s) a Staff Sergeant or above?

g. Are exams safeguarded against compromise?

5. Lasers

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- a. Is the Bn LSSO an officer or SNCO?
- b. Is he at least a category II course graduate?
- c. Does the LSSO maintain records of safety test dates and safety certifications, of all operators or supervisors who operate laser systems?
- d. Does the LSSO administer the laser safety tests to all operators and supervisors?
- e. Have all laser operators passed the annual laser certification test?
- f. Have all laser operators attended an approved block of instructions?
- g. Does the LSSO maintain all laser firing logs that have been received via the LRSO for a period of five years?

6. <u>Files</u>	<u>YES/NO, COMMENTS</u>
a. Test Results	_____
b. Certification Ltrs	_____
c. Appointment Ltr	_____
d. Laser Firing Logs	_____
e. Attendance Rosters for Laser Safety Classes	_____

7. Battery Checklist

a. **Publications.** Are the following publications (with current changes) available for use by the firing battery?

<u>PUBLICATION</u>	<u>YES</u>	<u>NO</u>
(1) MCO P3570.1A	___	___
(2) MCO 8020.1_	___	___
(3) MCO 8025.1_	___	___
(4) MCRP 3-16.2A TECHNIQUES AND PROCEDURES MAN.	___	___
(4) TM 43-0001-28	___	___
(5) TM 43-0001-28-7	___	___
(6) TM 9-1300-206	___	___
(7) TM 9-1300-251-20	___	___

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- ____ (8) FM 6-40/MCWP 3-16.4 _____
- ____ (9) ST 6-40-31 _____
- (10) FM 6-50/MCWP 3-16.3 _____
- (11) Division SOP for Class V(W) _____
- ____ (12) JtRegtO P3570.1A _____
- (13) NAV ORD OPS 2239 _____
- (14) Local Range Regulations _____
- (15) TM 11-7025-297-10 AFATDS Operator's Manual _____
- (16) TB 11-7025-297-10 AFATDS Operators Notebook _____
- (17) TB-11-7025-354-10-1 AFATDS GDU,
Tech FD, Job Aides _____

b. Basic Safety Diagram Data Verification

- (1) Firing Date _____ GP _____
- (2) Ammunition Authorized _____
- (3) Before Registration Data
 - HE _____
 - WP _____
 - ILLUM _____
 - Other _____
- (4) After Registration Data
 - HE _____
 - WP _____
 - ILLUM _____
 - Other _____

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APPENDIX B

GUNLINE INSPECTION CHECKLIST

BTRY _____ **GUN POSITION** _____ **DATE** _____

COMMANDING OFFICER _____ **RANK** _____ **UNIT** _____

SECTION CHIEF _____ **RANK** _____ **GUN #** _____

BEFORE FIRING

YES NO REMARKS

TM, LO, SOP CURRENT _____

SAFETY LIMITS FOR DEFLECTION/QUADRANT
PRESENT AND PROPERLY EMPLACED_ (in accordance with local range
regulations) _____

GUNNERS REFERENCE CARD COMPLETED _____

PREFIRE CHECKS VERIFIED _____

COLLIMATOR PROPERLY EMPLACED _____

SITE TO CREST MEASURED _____

PIECE TO CREST RANGE MEASURED CORRECTLY _____

BORESIGHT VERIFIED _____

SECTION CHIEF REPORT COMPLETED _____

NO MORE THAN 90 MILS CANT _____

ALTERNATE AIMING POINT EMPLACED AND RECORDED _____

MISSION/END OF MISSION PITS 15M APART _____

MISSION/END OF MISSION PITS LARGE ENOUGH _____

NO MORE THAN 8 PROJECTILES PREPARED _____

FUZES ARE NOT PRESET _____

NO MORE THAN 8 PROPELLANTS (8 M4A2 CANISTERS OR 4 M3A1 CANISTERS)
NONE PRECUT _____

USE NON-SPARKING TOOLS WHILE HANDLING AMMUNITION _____

AMMUNITION 6 INCHES OFF THE GROUND _____

18 INCHES OF OVERHEAD COVER ON AMMUNITION _____

MARINE CORPS ARTILLERY SAFETY SOP

AMMUNITION SEPARATED BY LOT AND TYPE _____

SPADE KEYS AND BASEPLATE RETAINING PINS EMPLACED _____

HOWITZER RANGE CARD COMPLETED _____

ALL PERSONNEL BRIEFED ON THEIR DUTIES _____

TIME ALLOTTED FOR PRACTICAL APPLICATION _____

POWDER TEMPERATURE GAUGE IN USE _____

DURING FIRING

YES NO REMARKS

HELMET AND FLAK JACKET WORN _____

HEARING PROTECTION USED _____

MINIMUM NUMBER OF 0811'S ON HOWITZER _____

SAFETY T'S CURRENT AND UTILIZED _____

YES NO REMARKS

LANYARD ATTACHED OR GRASPED WHEN COMMANDED BY THE SECTION CHIEF
(per reference appropriate weapon's TM) _____

SWAB CHAMBER AFTER EVERY ROUND _____

AMMUNITION AND CHARGES VERIFIED _____

QUADRANT VERIFIED WITH M18 MOUNT _____

ALL DATA VERIFIED ON HOWITZER _____

UNUSED POWDER INCREMENTS DISPLAYED _____

GDU SETUP PROPERLY _____

NOTES

INSPECTION PERFORMED BY: NAME _____ RANK _____

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0811 SKILL TEST

YES

NO

REMARKS

SECTION CHIEF

MISFIRE PROCEDURES _____

COMPUTE ZONE/SWEEP DATA _____

DIRECT FIRE COMMANDS _____

MICROMETER KNOB TEST _____

END FOR END TEST _____

VERTICAL SHOE TEST _____

MEASURE FOR QUADRANT W/GUNNERS QUAD _____

LAY FOR QUADRANT W/GUNNERS QUAD _____

GUNNER/A GUNNER

VERIFY BORESIGHT _____

RECIPROCAL LAY PROCEDURES _____

OUT OF TRAVERSE PROCEDURES _____

TAKE UP DISPLACEMENT ON AIMING POINTS _____

REFERRING _____

LAY ON ALTERNATE AIMING POINT _____

MEASURE CANT ON WEAPON _____

LAY FOR QUADRANT W/RANGE QUAD _____

MICROMETER KNOB TEST _____

END FOR END TEST _____

VERTICAL SHOE TEST _____

ATC/#1 CANNONEER

AMMUNITION KNOWLEDGE _____

STORAGE PROCEDURES _____

LOADING/UNLOADING PROCEDURES _____

MARINE CORPS ARTILLERY SAFETY SOP

POSITION SAFETY INSPECTION

	<u>YES</u>	<u>NO</u>	<u>REMARKS</u>
RANGE FLAG IN PLACE	_____	_____	_____
CORPSMAN IN POSITION	_____	_____	_____
AIR SENTRY W/BINOS POSITIONED	_____	_____	_____
AIMING CIRCLE DECLINATED WITHIN 30 DAYS	_____	_____	_____
AREA E ROAD GUARDS POSTED	_____	_____	_____
SAFETY BRIEF HELD BY OIC	_____	_____	_____
SAFETY T'S CURRENT	_____	_____	_____
SAFETY T'S IN POSSESSION OF MINIMUM PERSONNEL	_____	_____	_____
POSITION COMMANDER/OIC PRESENT DURING FIRING	_____	_____	_____
XO'S MIN QE COMPUTED CORRECTLY	_____	_____	_____
AIMING CIRCLE CORRECTLY ORIENTED	_____	_____	_____
SAFETY CIRCLE CORRECTLY ORIENTED	_____	_____	_____
VERIFIED LAY OF HOWITZERS	_____	_____	_____
VERIFY SUBTENSE	_____	_____	_____
VERIFY VERTICAL ANGLE	_____	_____	_____
FIRE DETAIL ORGANIZED	_____	_____	_____
OUT OF DATE SAFETY T'S COLLECTED	_____	_____	_____
ON HAND ITEMS:			
1. SOP for Artillery Safety	_____	_____	_____
2. WEAPON TM	_____	_____	_____
3. FM 6-50/MCWP 3-16.3	_____	_____	_____
4. POSITION SAFETY CARD	_____	_____	_____
5. LOCAL RANGE REGULATIONS	_____	_____	_____
6. COMMAND SAFETY CERTIFICATION CARDS	_____	_____	_____

MARINE CORPS ARTILLERY SAFETY SOP

BILLETS

	NAME	TIME IN BILLET	TRAINING
CO	_____	_____	_____
XO	_____	_____	_____
AXO	_____	_____	_____
BTRY GYSGT	_____	_____	_____
LOCAL SEC.	_____	_____	_____
#1	_____	_____	_____
#2	_____	_____	_____
#3	_____	_____	_____
#4	_____	_____	_____
#5	_____	_____	_____
#6	_____	_____	_____

REMARKS: _____

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AMMUNITION TRUCK DRIVER

	<u>YES</u>	<u>NO</u>	<u>REMARKS</u>
FIRE EXTINGUISHER PRESENT/CURRENT INSPECTION	_____	_____	_____
3 BI-DIRECTIONAL REFLECTORS PRESENT	_____	_____	_____
CHOCK BLOCKS PRESENT AND UTILIZED	_____	_____	_____
LOADED VEHICLES PROVIDED SECURITY	_____	_____	_____
AMMUNITION COVERED AND VENTILATED	_____	_____	_____
PROJECTILES UPRIGHT AND SECURED	_____	_____	_____
AMMUNITION HAS PROPER DUNNAGE ON VEHICLE	_____	_____	_____
FUZES STORED PROPERLY	_____	_____	_____
NO LOOSE DUNNAGE MIXED W/LIVE AMMO OR PERSONAL GEAR	_____	_____	_____

DRIVERS HAVE:

	<u>YES</u>	<u>NO</u>
1. VEHICLE/EQUIPMENT OPERATION RECORDS (TRIP TICKET)	_____	_____
2. SF91A, OPERATORS REPORT OF MOTOR VEHICLE ACCIDENT	_____	_____
3. DD626, INSPECTION REPORT	_____	_____
4. NAVSEA SW020-AF-ABK-010 EXPLOSIVES HANDBOOK	_____	_____
5. SF46, OPERATORS PERMIT W/EXPLOSIVE DRIVER ANNOTATED	_____	_____
6. MEDICAL EXAMINERS CERTIFICATE	_____	_____
7. DD 836 SPECIAL INSTRUCTIONS FOR MOTOR VEHICLE DRIVERS	_____	_____

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MARINE CORPS ARTILLERY SAFETY SOP

APPENDIX C

FDC INSPECTION CHECKLIST

BTRY _____ **GUN POSITION** _____ **DATE** _____

Fire Direction Officer: Name _____ **Rank** _____

How long billet held: _____ **Have you attended ATS** _____

Operations Chief: Name _____ **Rank** _____

How long billet held: _____ **Have you attended** _____
Ops Chiefs Course?

<u>ITEM</u>	<u>YES</u>	<u>NO</u>	<u>REMARKS</u>
1. SAFETY SOP ON HAND	_____	_____	_____ _____ _____
2. FM 6-50/MCWP 3-16.3 ON HAND	_____	_____	_____ _____ _____
3. FM 6-40/MCWP 3-16.4 ON HAND	_____	_____	_____ _____ _____
4. AFATDS/BUCS JOB AIDS ON HAND	_____	_____	_____ _____ _____
5. APPROPRIATE TFTs ON HAND	_____	_____	_____ _____ _____
6. AFATDS IS PRIMARY FD MEANS	_____	_____	_____ _____ _____
7. GDUs UTILIZED FOR FIRE CMDS	_____	_____	_____ _____ _____
8. SAFETY T AND COMPUTATIONS ____SIGNED AND DATED	_____	_____	_____ _____ _____
9. SAFETY COMPUTED USING AUTHORIZED PROCEDURES	_____	_____	_____ _____ _____

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<u>ITEM</u>	<u>YES</u>	<u>NO</u>	<u>REMARKS</u>
10. SAFETY DIAGRAM DRAWN ON MAP AND FIRING CHART	_____	_____	_____ _____ _____
11. MOST RECENT MET IN USE	_____	_____	_____ _____ _____
12. MVV'S FOR GB AND WB AVAILABLE AND IN USE FOR ALL HOWITZERS	_____	_____	_____ _____ _____
13. MET PLUS VE WITH CHECK RDS OR REGISTRATION CONDUCTED AFTER POSITION OCCUPATION	_____	_____	_____ _____ _____
14. FIRE COMMAND STANDARDS AND FIRE ORDER STANDARDS POSTED	_____	_____	_____ _____ _____
15. AMMUNITION COUNT POSTED AND MONITORED IN THE FDC	_____	_____	_____ _____ _____
16. CHART CLEAN, NEAT, AND PROPERLY CONSTRUCTED	_____	_____	_____ _____ _____
17. DATA BASE RECORD ON HAND AND PROPERLY LABELED	_____	_____	_____ _____ _____
18. SAFETY COMPUTATIONS ORGANIZED LABELED AND READILY AVAILABLE	_____	_____	_____ _____ _____
19. SAFETY CERTIFICATION LETTER IN BATTERY POSITION	_____	_____	_____ _____ _____

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<u>ITEM</u>	<u>YES</u>	<u>NO</u>	<u>REMARKS</u>
20. AFATDS AND BUCS HAVE MATCHING DATA BASES. BUCS RESIDUALS HAVE BEEN DETERMINED BY BRINGING BUCS "ON LINE"	_____	_____	_____ _____ _____
21. COPY OF XO'S REPORT ON HAND	_____	_____	_____ _____ _____
22. POSITION SAFETY CARD ON HAND	_____	_____	_____ _____ _____
23. MIN QE VERIFIED	_____	_____	_____ _____ _____
24. VERIFIED FIRING DATA SAFE PRIOR TO SENDING TO HOWITZERS	_____	_____	_____ _____ _____
25. REG CORRECTIONS APPLIED, NEW SAFETY "T"S PREPARED, SIGNED, AND VERIFIED	_____	_____	_____ _____ _____

NOTES

Inspection performed by: _____ Rank _____

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APPENDIX D

TRAVERSING BEYOND CARRIAGE LIMITS

1. M198

- a. The howitzer aiming point will shift to either aiming posts (primary) or DAP (secondary).
- b. The gunner will rotate the head of the sight until 3200 is set on the deflection counter.
- c. The gunner will release the deflection clutch.
- d. The gunner will rotate the sight until the deflection corresponding to the aiming point is set on the azimuth counter.
- e. The gunner will engage the deflection clutch.
- f. The gunner will place the announced deflection on the deflection counter.
- g. The gunner announces "speed shift, muzzle right (or left)".
- h. Ensure that the top carriage locking pin is inserted prior to speed shift.
- i. The speed shift lever will be moved to the down position.
- j. The assistant gunner will ensure the cannon tube is at approximately 800 mils QE.
- k. The spade retaining pins and spade keys will be removed if necessary.
- l. The speed shift assembly will be lowered, at least two cannoneers will hold down each trail.
- m. The speed shift assembly will be lowered until clearance is obtained under the baseplate.
- n. At the command "Trails up" the section will lift and shift trails in the direction indicated by the gunner.
- o. The gunner will align the vertical hairline on his aiming point and order "TRAILS DOWN".
- p. The spade retaining pins and spade keys will be reinstalled.
- q. The speed shift lever will be placed in the UP position and the howitzer lowered to the ground.

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- r. The gunner will level his sight and take up a correct sight picture by traversing the howitzer.
- s. The spades will be properly emplaced.
- t. The speed shift assembly will be raised and the speed lever placed in the OFF position.
- u. The section chief will report the howitzer laid on the new deflection.

2. SAFETY CONSTRAINTS FOR TRAVERSING BEYOND CARRIAGE LIMITS. The following guidelines will be followed when speed shifting:

a. M198

- (1) Do not use the baseplate and detent assembly as a speed shift assembly.
- (2) Ensure the weapon is free of all ammunition and the wheel lever is in the OFF position.
- (3) Ensure the top carriage locking pin is inserted prior to speed shifting.
- (4) Ensure the plunger handles are inserted into the trails so that the spades can hang loose and pivot during the speed shift. This is dependent on the terrain and amount of cant of the weapon.
- (5) Always elevate or depress the cannon tube to approximately 800 mils before speed shifting as this is the balance point for the howitzer.
- (6) When speed shifting on soft sand (mud, sod, etc.) place logs, ammunition packing material or similar support under the speed shift assembly for additional stabilization.
- (7) NEVER fire the howitzer while the speed shift assembly is supporting the weapon.
- (8) A safety certified Marine will ensure each section chief has followed the correct procedures and is using the correct aiming point.
- (9) When sending a speed shift mission to the gunline, the special instruction, "DO NOT LOAD" will always be part of the fire command.

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APPENDIX E

TRANSPORTATION OF ARTILLERY AMMUNITION

1. EXPLOSIVES DRIVERS. The Regimental Motor Transport Officer will ensure that explosive drivers are trained, qualified, tested and licensed in accordance with the applicable Division Order(s).

2. METHODS OF TRANSPORTATION

a. General. All tactical cargo-type vehicles and all tactical trailers are authorized to transport ammunition or explosives aboard Marine Corps Installations provided the ammunition or explosives are packed or contained in their original containers. If the ammunition carried is not in proper wooden containers, wooden dunnage must be used to protect the ammunition from the ferrous metal bed of the vehicle in accordance with reference (g). Dunnage must also be used when transporting containers with metal ends to ensure that the ends do not contact metal truck beds. Transporting HE, when lying on its side on proper dunnage, is authorized for short hauls from the ammunition dump to the firing position. However, care must be taken in warm weather to ensure rounds are not exposed to sunlight when in this position.

b. Trailers. Trucks and trailers are considered separate vehicles for compatibility purposes. When two or more vehicles in tandem are transporting hazardous material each will display placards according to its contents (i.e. both trucks and trailers). NAVSEA OPS 2165 Vol 1, para. 4-7.6.7 thru 4-7.6.11 provides detailed instructions regarding as to size, shape, color, and proper location of placards affixed to motor vehicles when transporting hazardous material.

c. Combat Loads. Howitzer prime movers are not authorized to transport ammunition with gun crews unless a waiver request has been approved (see paragraph 6).

d. Loose Projectile Restraint System (LPRS). Five-ton cargo trucks are authorized to transport loose M107 HE projectiles using (LPRS) provided the following conditions are met:

(1) No fuzed projectiles will be carried in the LPRS.

(2) Only properly tested and inspected tie down straps are used; NSN 5340-00-980-9277 and NSN 5340-01-084-4997.

(3) The LPRS must have a wooden base with at least 2 inches of clearance. The LPRS may be ordered under NSN 2590-01-223-2949 for the 15 round divider rack,

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NSN 2590-01-223-2945 for the short panel and NSN 2590-01-223-2944 for the long panel.

3. VEHICLE REQUIREMENTS FOR TRANSPORTING OF AMMUNITION AND EXPLOSIVES

a. Vehicle Markings

(1) All government vehicles transporting Class A (i.e., ammunition for cannons with explosive projectiles, gas projectiles, incendiary projectiles, illuminating projectiles, supplementary charges, fuzes, etc.), Class B (i.e., propellant charges, igniters, etc.) and Class C (i.e., primers) will have reflector signs as required by the Department of Transportation (i.e., "EXPLOSIVE A, EXPLOSIVE B", etc.) secured to the front, rear and sides of the vehicles. The explosive signs are available at Self-Service as Standard Form 432. When a vehicle contains more than one type of Class V (W) (e.g., explosives Class A and B), the vehicle will display the greater hazard sign (Class A).

(2) Vehicles will display the sign (Standard Form 432) only when transporting Class V (W) material. Remove the signs when ammunition is not being carried.

(3) Use reference (c) to determine which sign to display.

(4) The unit transporting the Class V (W) will provide the signs.

(5) Ammunition handling is never administrative. Signs must be displayed at all times, even in tactical situations (i.e. combat load).

b. Requirements. The following requirements are mandatory when transporting Class V (W) material except when modified by higher authority:

(1) All tactical vehicles and trailers will be covered with fire resistant and water proof tarpaulin (not required while aboard military installations) which will be securely fastened to the vehicle to fully protect the load from sparks, fire and moisture. Tarpaulin front and end curtains must be used on all cargo-type motor vehicles when off station. Additionally, adequate ventilation must be provided in loaded vehicles. Loaded vehicles will be aired periodically by removing tarpaulins. A tarpaulin is not required when the Class V (W) material is packed in wooden containers that have been tested in accordance with Navy standards and have been proven to be fire resistant and waterproof (i.e., manufacturers

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packing).

(2) All electrical wiring and battery cables will be enclosed or located to prevent contact with the load.

(3) Tires must be in good condition and properly inflated in accordance with the vehicle operator's manual. Required spare tires will not be carried in cargo spaces or in the body of the vehicle, except when the vehicle's design provides for such storage.

(4) Each vehicle transporting Class V (W) will carry a minimum of one 10 pound dry chemical purple K powder (PKP) extinguisher or 15 pound carbon dioxide (CO2) type, properly filled, readily accessible, and displaying a current certification tag.

(5) Red lights will not be used on the front or top of any explosive carrying vehicle, with the exception of Explosive Ordnance Disposal (EOD) vehicles.

(6) Running lights or reflectors, headlights, tail lights, and brakelights will be clean, adjusted and in operating condition.

(7) A minimum of three bi-directional emergency reflective triangles will be available to the driver in each vehicle. These items will be used in the event a vehicle holding ammo breaks down. Reflectors will be placed 100 ft in front and behind the vehicle.

(8) The commander must authorize the refueling of vehicles loaded with explosives or ammunition. Extreme caution will be taken anytime this action occurs (i.e. fuel hose will be grounded, engine shut off, and personnel will stand by with a fire extinguisher).

(9) Each vehicle will have a spark/flame arrestor device (i.e., a standard muffler) in serviceable condition.

(10) All vehicles will be equipped with chocking blocks. During loading and unloading of vehicles, the brakes must be set and wheels chocked.

(11) No smoking will be allowed when transporting Class V (W) material or within 50 feet of the vehicle.

(12) At no time will a loaded vehicle be left unattended, unless the vehicle is in an authorized "holding area" with proper security.

(13) Whenever possible, vehicles loaded with

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ammunition will not be routed through, stopped or staged within cities, towns or camp areas where civilians, troops, or facilities are located (this does not apply to firing battery positions).

(14) Tie down straps are required to hold all ammo firmly in place.

c. Forms. Drivers transporting Class V (W) material will possess the following:

(1) DD110, Vehicle and Equipment Operation Records.

(2) SF91A, Operator's Report of Motor Vehicle Accident.

(3) DD626, Inspection Report.

(4) DD836, Special Instructions for Driver (FOR OFF BASE USE ONLY).

(5) NAVORD OPS 2239 (current edition), Motor Vehicle Driver's Handbook on Ammunition, Explosives and Hazardous Materials.

(6) SF46, Motor Vehicle Operator's Permit on which is annotated "Explosives Driver," renewed annually.

(7) Medical Examiner's Certificate, renewed annually.

4. VEHICLE AND DRIVER SAFETY

a. General. References (c) and (g) establish regulations for ammunition drivers.

b. Additional Regulations. In addition to the regulations established in reference (c) and (g), the following requirements must be met:

(1) Before ammunition is loaded or unloaded, all vehicles must have the engine shut off and be parked with gears in neutral, parking brake set and wheels chocked.

(2) No leaking or damaged Class V (W) containers will be accepted for transportation.

(3) Separate-loading projectiles and component parts may be transported off their shipping pallet provided there is proper dunnage (minimum height of two inches). Furthermore, the load must be properly braced to prevent shifting during movement. Additionally, each projectile must have its grommet in place to protect the rotating band.

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(4) Vehicles loaded with Class V (W) material will not be allowed to stand overnight unless in an authorized "holding area" with proper security. An authorized "holding area" may be established by firing units at the firing location by following the applicable Division Order(s) for Class V (W) material.

(5) No vehicle will be loaded with more ammunition than its gross weight capacity. Consideration must be given to road conditions when determining vehicle loads. Additionally, the weight must be distributed evenly over the entire bed of the vehicle.

(6) Parent units will instruct (brief) personnel who will draw and/or transport artillery ordnance on ordnance hazards prior to drawing them.

(7) Ammunition convoys of two to five vehicles will be supervised by a qualified noncommissioned officer (NCO) or above. Convoys of five to ten vehicles will be supervised by a Staff NCO (SNCO) or above. Convoys of ten or more vehicles will be supervised by an officer. If supervisors of the appropriate ranks are not available, the OIC of Firing can designate a qualified Marine to lead an ammunition convoy. All convoy commanders will be properly briefed on the route of march, ordnance hazards, emergency procedures, and will be familiar with references (c) and (g), and the applicable Division Motor Transport Order(s).

5. STORAGE OF AMMUNITION ON VEHICLES. When storing ammunition on vehicles within the battery position, comply with the following procedures:

- a. Keep ammunition on pallets with a minimum of two inches clearance between the stack and the bed of the truck.
- b. Open drain plugs on all trailers when the vehicle is parked. Reinstall the plugs prior to moving to a new position or conducting fording operations.
- c. Distribute (evenly) the weight of the ammunition load.
- d. Ventilate loads by periodically raising tarpaulins.
- e. Prohibit smoking or open flame within 50 feet of the storage area (i.e., from ammunition vehicles or the gun line).
- f. Keep explosive signs on all ammunition vehicles while loaded.
- g. Provide security for ammunition on a 24 hour basis.

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6. COMBAT LOADING Combat loading of ammunition on prime movers while operating aboard Marine Corps bases must be approved by the Base Commander. Units desiring to exercise combat loading procedures will send their request via the Commanding Officer, **th Marines (Attn: S-4). When operating aboard other bases or installations, units will comply with local base regulations.

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APPENDIX F

SAFETY CHECKS AND DATABASE VERIFICATION

1. ACCURATE AND SAFE DATA. The procedures described in this appendix summarize standard safety checks and fire direction computer database verification procedures applicable in combat or peacetime. **Accurate and safe firing data is a function of procedure, training, discipline, and chain of command. If all factors are performed correctly, the result is accurate and safe firing data and accomplishment of the missions assigned artillery units.**

2. INDEPENDENT CHECKS

a. The checks/verifications described within can directly effect firing data. These checks must be accomplished by someone other than the person who performed the initial action. In other words, a person cannot check himself; he must have independent verification. **This system of independent checks must be a continuous process, a discipline lived by all artillerymen rather than a simple set of rules.**

b. Independent checks are proactive, meaning that a majority of the checks occur prior to receiving a fire mission. This ensures the requested fires are timely as well as accurate.

c. When a forward observer requests fire on a specific target location, someone (other than the requester) checks the target plot as it relates to the location of friendly units and positively clears the fires. The Fire Support Coordinator (FSC) is doctrinally responsible for this check, although the Battalion and Battery FDOs provide an additional check by verifying the plot against the restrictive fire support coordination measures on the situation map.

d. A verification of database information for the firing position means someone, normally the Battery XO, performs an independent verification of the firing position information prior to providing the data to the FDC.

e. As described earlier in this SOP, independent checks are performed on each howitzer by the section chief to verify lay of the howitzer, emplaced retaining pins, prefire checks, cut charges, fuze settings, and set deflection and quadrant, as well as ensuring the announced firing data is applied as announced.

f. Independent checks are also performed in the Fire Direction Center (FDC) where the database must be verified, either as the information is input or as a total review once the entire database has been constructed. The checks

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are continuous since the FDC must verify any additions, changes, or deletions to the database as they occur.

3. PROCEDURES PRIOR TO FIRING

a. Advance party

- (1) Verify ORSTA location.
- (2) Verify azimuth of lay.
- (3) Verify piece location information (polar from ORSTA, polar from gun, or grid).

b. Howitzer Section Chief

- (1) Verify proper emplacement of howitzer.
- (2) Verify reference points (collimator, DAP, aiming posts).
- (3) Verify prefire checks.
- (4) Verify site to crest.
- (5) Verify boresight.

c. Battery Executive Officer/Gunnery Sergeant

- (1) Confirm that basic periodic tests and services, and borescope were performed correctly and within the specified time interval as required by the appropriate technical manual for the weapon system.
- (2) Compute XO's MIN QE.
- (3) Ensure that advance party and howitzer section checks are performed and verified.
- (4) Verify that the FDC receives the correct ORSTA, azimuth of lay, and piece location information.
- (5) Check azimuth of lay with M-2 compass.

4. FDC PROCEDURES FOR AFATDS OPERATIONS. The procedures described in this section are database verification procedures for units who use AFATDS as the primary means of technical fire direction. The technical manuals do not address these checks.

a. Verify database construction/restoration and initialization.

- (1) Independently establish data bases.

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(2) Verify MAP MOD information (MAP MOD in AFATDS, MAP MOD file in BUCS).

(3) Verify weapon system, sight system, and referred deflection (UNIT DATA in AFATDS, WPN LOC in BUCS).

(4) Verify azimuth of lay (UNIT DATA in AFATDS, WPN LOC in BUCS).

(5) Verify ORSTA and piece locations. ORSTA location must be identical in AFATDS and BUCS. Tolerances for piece locations between AFATDS and BUCS are 1 meter EASTING, 1 meter NORTHING, and 1 meter ALTITUDE. Verify piece location grids and center of battery grid with map spot (UNIT DATA and WEAPONS in AFATDS, WPN LOC in BUCS).

(6) Verify projectile lot designators and projectile weights (UNIT DATA; MUNITIONS in AFATDS, AMMO file in BUCS).

(7) Verify Muzzle Velocity Variation (MVV) files (CALCULATE MVV in AFATDS, MVV FILE in BUCS).

(8) Verify MET files (VIEW MET; CM for AFATDS, BALLISTIC MET file in BUCS).

(9) Verify Known Target/Known Point files for LOCATION and ALTITUDE

(10) Verify SUPPORTED UNIT DATA (Observers) for LOCATION and ALTITUDE

(11) Verify updates, changes, and any additions or deletions in the database between AFATDS and BUCS.

b. FDC Prefire Checks

(1) If the secondary means of computation is manual, construct a GFT setting and TGPC's using the procedures in AFATDS GDU Job aids.

(2) Compute a "dry FFE mission" to a known point specifying a converged sheaf and compare to the secondary means of computing data. This procedure is designed to detect gross ammunition, fire unit, and MET related errors and to ensure that the data base was constructed correctly.

(3) Verifying AFATDS registration corrections. The registering unit is responsible for verifying the

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registration corrections (UNIT DATA; REG)/residuals computed at the conclusion of the registration prior to transferring the registration corrections to another firing unit. Use the procedures listed in the AFATDS GDU Job Aids to validate the registration.

5. SAFETY CHECKLIST

a. Figure F-1 is a quick reference for personnel to use as a guide in preparing for and conducting live fire exercises. This list is not totally inclusive and should not be considered the only requirements.

SAFETY CHECKLIST

- _____ Road Guards (Area E)
- _____ Range Flags Posted
- _____ Air Panels Emplaced
- _____ Ammunition Storage/Handling
- _____ Safe Smoking Distance From Ammo
- _____ Unit In Proper Firing Position
- _____ Database Verified
- _____ Safety Data Printout
- _____ Data Base Printout
- _____ Safety Data Verified Through Independent Computations
- _____ Air Sentry Posted
- _____ Corpsman Present
- _____ Ammo Cleared For Overhead Fire
- _____ Range Control Notified When Hot/Cold
- _____ Boresight Howitzers
- _____ Boresight Verified
- _____ Site to Crest for each Howitzer/XOs Min QE
- _____ Lay of Battery Verified
- _____ Protective Equipment on Gunline (Helmet/Ear Plugs)
- _____ Current Safety 'T'
- _____ Misfire Procedures
- _____ Comm Established/Maintained with Range Control
- _____ Safety Tapes/Stakes
- _____ Prefire Checks
- _____ Powder Pit Procedures
- _____ Check Firing Procedures
- _____ Suspended Firing-Breeches Cracked/Powder Removed
- _____ Powder Burning Procedures followed
- _____ Personnel on gunline wearing helmet, ear plugs, etc.

Figure F-1.--Safety Checklist.

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APPENDIX G

INVESTIGATION CHECKLIST

NOTE: This checklist is for use by personnel conducting firing incident investigations and will be submitted with the completed investigation.

1. INVESTIGATING OFFICER: NAME _____ RANK _____
SSN _____ BILLET _____

2. DESCRIPTION OF INCIDENT:

FIRING BATTERY

3. IF OBSERVED FROM BATTERY POSITION:

AZIMUTH OF BURST: _____ HEIGHT OF BURST: _____

ESTIMATED LOCATION OF BURST: _____

TIME OF FLIGHT: _____

NUMBERS OF HOWITZERS FIRING: _____ DAMAGE IN POSITION: YES NO

NATURE OF DAMAGE IN POSITION: _____

4. Record date/time group (DTG) the command "CHECK FIRING" was announced and who announced "CHECK FIRING". _____

5. Immediately obtain and secure the following:

- a. All safety Ts marked with user's identification.
- b. All Records of Fire, DA Form 4504.
- c. All Records of Missions Fired, DA Form 4513.
- d. All Firing Charts, AFATDS/BUCS printouts, and journals as appropriate.

6. The OIC of Firing or the investigating officer will accomplish the following. He may require the assistance of the Position Commander.

- a. Turn Pantels to lay circle, record DF for each howitzer and determine the azimuth of the tube.
- b. Check lay circle and record all computations.
- c. Take deflections readings from lay circle to the pantel of each piece.

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- d. Check safety circle and record all computations.
- e. Do reciprocal check between lay and safety circles.

- (1) Lay circle DF _____
- (2) Safety circle DF _____

7. WITHOUT MOVING ANY EQUIPMENT, RECORD THE FOLLOWING FOR EACH HOWITZER:

a. Quadrant Data:

WPN	QE on DA FORM 4504	QE on DA Form 4513	QE on WEAPON	BUBBLES LEVEL	SPECIAL CORRECTION	QE USING GUNNERS QUAD
1						
2						
3						
4						
5						
6						

b. Deflection Data:

WPN	DF on DA FORM 4504	AZ COUNTER READING	DF on DA FORM 4513	SPECIAL CORRECTIONS	SIGHT PICTURE CORRECT?
1					
2					
3					
4					
5					
6					

c. Record Data on Gunners Reference Card.

WPN	AZ of LAY	DF to AC	DF to SAFETY CIRCLE	DF to COLLIMATER	DF to AP
1					
2					
3					
4					
5					
6					

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d. Shell/Fuze Data:

WPN	FZ on DA FORM 4504	FZ on DA FORM 4513	TI on DA FORM 4504	TI on DA FORM 4513	SHELL on DA FORM 4504	SHELL on DA FORM 4513
1						
2						
3						
4						
5						
6						

_____ e. Charge Data:

WPN	CHARGE ON DA FORM 4504	CHARGE on DA FORM 4513
1		
2		
3		
4		
5		
6		

8. COUNT AND RECORD THE NUMBER OF EXCESS POWDER INCREMENTS IN THE MISSION AND END-OF-MISSION PITS.

MISSION PITS

WPN	GREEN BAG		WHITE BAG			
	4	5	4	5	6	7
1						
2						
3						
4						
5						
6						

END OF MISSION PITS

WPN	GREEN BAG		WHITE BAG			
	4	5	4	5	6	7
1						
2						
3						
4						
5						
6						

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9. COMPARE SAFETY "T" DATA WITH DATA ON:
 - a. FDC RECORD OF FIRE, IS THE DATA SAFE?
 - b. SECTION CHIEF RECORD OF MISSIONS FIRED, IS THE DATA SAFE?
10. COMPARE FDC RECORD OF FIRE WITH SECTION CHIEF RECORD OF MISSIONS FIRED.
11. WAS CORRECT SAFETY "T" USED FOR THE CHARGE FIRED?
12. IF A TIME FUZE WAS FIRED, DETERMINE:
 - a. TIME SET _____
 - b. WHO VERIFIED IT _____
13. HAVE THE MARINE WHO ACTUALLY SET THE FUZE DEMONSTRATE IT TO YOU.
14. HAVE THE SECTION CHIEF DEMONSTRATE HOW HE VERIFIED THE FUZE SETTING.
15. DID THE UNIT:
 - a. VERIFY LAY?
 - b. VERIFY BORESIGHT?
16. DID THE SECTION CHIEF:
 - a. VERIFY THE CHARGE FIRED?
 - b. PERFORM AN END-FOR-END TEST WITH HIS GUNNERS QUADRANT?
 - c. CHECK SHELL/FUZE/TIME?
 - d. CHECK DF/QE ON LAST ROUND FIRED?
17. IF INCIDENT APPEARS TO BE A RANGE ERROR, PERFORM AN END-FOR-END TEST.

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18. COUNT AND RECORD ALL PROJECTILES, PROPELLANT CANISTERS AND FUZES REMAINING ON EACH SECTION.

	TYPE	GUN 1	GUN 2	GUN 3	GUN 4	GUN 5	GUN 6	LOT
SHELL								
SHELL								
SHELL								
SHELL								
SHELL								
PROP								
PROP								
PROP								
PROP								
PROP								
FUZE								
FUZE								
FUZE								
FUZE								
FUZE								

19. WERE ANY FUZES PRESET? YES NO TYPE_____ SETTING_____

20. WAS ALL AMMUNITION CLEARED FOR OVERHEAD FIRE? YES NO

21. WAS AMMUNITION PROPERLY SEGREGATED? YES NO
EXPLAIN_____

22. BORESIGHT WEAPONS - VERIFY THE BORESIGHT OF EACH GUN.

#1	YES/NO	#4	YES/NO
#2	YES/NO	#5	YES/NO
#3	YES/NO	#6	YES/NO

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FDC

23. WERE ALL PERSONNEL OUT OF THE FDC WHEN YOU ARRIVED?
24. DID THE FDO VERIFY HIS CHECK ROUNDS?
25. COULD THE FDO SPECIFY WHICH ELEMENTS OF THE 5 REQUIREMENTS FOR ACCURATE PREDICTED FIRE HE WAS OR WAS NOT MEETING?

TARGET LOCATION (HOW WERE TARGETS LOCATED)

SURVEY (5TH ORDER, HASTY?)

WEAPON/AMMO ([] WT, PROP TEMP, MVVs)

MET (HOW OLD, IN USE OR NOT)

PROCEDURES

26. COLLECT RECORDS OF FIRE FOR THE:
- a. MISSION INVOLVING THE INCIDENT.
 - b. LAST COMPLETE MISSION.
 - c. REGISTRATION.
 - d. CURRENT MET.
 - e. AFATDS/BUCS DATA BASE WITH VERIFICATION PRINTOUTS.
 - f. MUZZLE VELOCITY RECORDS.
27. WAS ALL DATA ON ROF FILLED IN? IF "NO" EXPLAIN: _____
-

28. CHECK SAFETY COMPUTATIONS.

29. WERE THEY DONE? _____ MIN QE _____ MIN TI _____
MIN VT _____ UPDATED AFTER REG _____ AFTER MET _____

30. WAS A COPY OF THE XO'S REPORT ON HAND? MIN QE _____
MIN VT _____ MIN TI _____

31. WAS A COPY OF THE POSITION/RANGE SAFETY CARD IN THE FDC? _____
a. WAS IT SIGNED BY THE BATTALION COMMANDER? _____

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b. WAS A PSO ASSIGNED? _____

32. DID THE SAFETY CARD AUTHORIZE THE SHELL, CHARGE AND FUZE JUST FIRED? _____

33. IF DATA WAS COMPUTED MANUALLY, DETERMINE FROM THE CHART:

a. DID THE GRID LINES MATCH MAP? _____

b. BATTERY POSITION PLOTTED CORRECTLY? YES NO

GRID _____ ALT _____

c. LAST ROUND (PIN) LOCATION. GRID _____ ALT _____

d. TARGET FIRED UPON CORRECTLY? _____

PREVIOUS PIN LOCATION _____

e. TARGET GRID ORIENTED PROPERLY? _____

f. DF INDICES SET PROPERLY? _____

g. CHART LAID ON PROPER AZIMUTH OF FIRE? _____ AZ _____

h. VI AND SI PROPERLY DETERMINED. VI _____ SI _____

i. VERIFY RG AND DF TO LAST ROUND. RG _____ DF _____

j. IF OBSERVERS POSITION IS PLOTTED, WERE AZIMUTH INDICES CONSTRUCTED CORRECTLY? _____

k. WAS FDC USING A GFT SETTING?

(1) AFATDS/BUCS MANUALLY DERIVED? _____

(2) GFT SETTING:

GFT _____, CHG _____, LOT ___ / ___ RG _____, EL _____, TI _____,
GFT DF CORR _____, TOT DF CORR _____

(3) DOES AFATDS/BUCS DATA MATCH GFT DATA +/-3 MILS? _____

l. MUZZLE VELOCITY VARIATION OF BATTERY CENTER SOLUTION _____

m. SPECIAL CORRECTIONS? YES/NO RECORD CORRECTION BELOW

#1 L/R _____ +/- _____ #4 L/R _____ +/- _____

#2 L/R _____ +/- _____ #5 L/R _____ +/- _____

#3 L/R _____ +/- _____ #6 L/R _____ +/- _____

34. WAS THE MISSION FIRED USING AFATDS/BUCS/MANUAL?

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35. WHAT MEANS WAS USED TO BACKUP OR CHECK THE PRIMARY MISSION DATA? _____

36. WHAT WAS DIFFERENCE IN "CHART" RANGE AND DEFLECTION BETWEEN THE PRIMARY AND BACKUP MISSION DATA? _____

37. PRINTOUT AVAILABLE: YES NO

38. IF NO, WHY NOT? _____

39. VERIFY FOLLOWING DATA FROM PRINTOUT OR BY ENTERING BUCS FILES:

- a. MV'S GUNS 1 THRU 6
- b. WHEN MV'S OBTAINED?
CORRECTLY ENTERED: YES/NO
- c. CURRENT MET: YES/NO
CORRECTLY ENTERED: YES/NO
- d. CURRENT PROP TEMP: YES/NO
CORRECTLY ENTERED: YES/NO
- e. CURRENT RESIDUALS: YES/NO
CORRECTLY COMPUTED: YES/NO
- f. CORRECT TGT GRID: YES/NO
- g. PIN PLOTTED ON CHART OR MAP: YES/NO
WITHIN SAFETY DIAGRAM: YES/NO
- h. ALTITUDE CORRECTLY DETERMINED: YES/NO
- i. INTERVENING CRESTS: YES/NO
- j. VERIFY ALL INITIALIZATION FORMATS.
VALID? _____ (IF NO, EXPLAIN).

40. IF AFATDS DATA, CHECK THE FOLLOWING:

- a. VIEW CM MET: VERIFY THE FOLLOWING FIELDS.
 - (1) CURRENT MET
- b. UNIT DATA, AMMUNITION, MUNITIONS: VERIFY THE FOLLOWING:
 - (1) PROJECTILE SQUARE WEIGHT
- c. UNIT DATA, DETAIL, DETAILED DATA: VERIFY THE FOLLOWING:
 - (1) WEAPON MODEL

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- (2) AZIMUTH OF LAY
- d. UNIT DATA, DETAIL, WEAPON: VERIFY THE FOLLOWING:
 - (1) WPN NUMBER
 - (2) GROUP
 - (3) LOCATION
- e. UNIT DATA, DETAIL, CALC WEAPON LOC: VERIFY THE FOLLOWING:
 - (1) CENTER OF BATTERY LOCATION
 - (2) ORINETING STATION A LOC, IF APPLICABLE
 - (3) ORIENTING STATION B LOC, IF APPLICABLE
- f. INITIATE FIRE MISSION: IF END OF MISSION HAS NOT BEEN GIVEN, VERIFY THE FOLLOWING:
 - (1) TGT NUMBER, IF APPLICABLE
 - (2) KNPT, IF APPLICABLE
 - (3) LOCATION, IF APPLICABLE
 - (4) GRID ZONE
 - (5) DIR, IF APPLICABLE
 - (6) DIST, IF APPLICABLE
 - (7) SHIFT, IF APPLICABLE
 - (8) SHELL
 - (9) FUZE
 - (10) CHARGE
 - (11) FIRE UNITS/ADJUSTING UNITS
 - (12) OBSERVER, IF APPLICABLE
- g. ADJUST WINDOW: IF APPLICABLE, VERIFY THE FOLLOWING:
 - (1) TARGET NUMBER
 - (2) OBSERVER
 - (3) AZIMUTH, IF APPLICABLE
 - (4) DEVIATION CORRECTION, IF APPLICABLE

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- (5) RANGE CORRECTION, IF APPLICABLE
- (6) HOB CORRECTION, IF APPLICABLE
- (6) SHELL
- (7) FUZE
- (8) CHARGE
- (9) TARGET LOCATION
- (10) ALT

h. AFATDS FIRING ORDERS

- (1) WPN
- (2) CAP
- (3) MOC
- (4) # ROUNDS
- (5) SHELL CATEGORY
- (6) SHELL MODEL
- (5) SHELL LOT
- (6) PROP COLOR
- (7) PROP LOT
- (8) PROP CHARGE
- (9) FUZE CATEGORY
- (10) FUZE MODEL
- (11) FUZE LOT
- (12) FUZE TIME
- (13) DF
- (14) QE

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41. WHAT WERE THE FIRE COMMANDS RECORDED BY THE:

FDC: _____
GUN #1 _____
GUN #2 _____
GUN #3 _____
GUN #4 _____
GUN #5 _____
GUN #6 _____

42. WERE THERE ANY ABNORMAL SOUND, FLASHES OR ANY UNUSUAL CHARACTERISTICS UPON FIRING? _____

43. WERE THE WEAPONS FULLY OPERATIONAL AND PROPERLY MAINTAINED?

44. RECORD NAMES OF:

OIC OF FIRING _____
POSITION COMMANDER _____
FDO _____
PSO _____
1ST HOWITZER SECTION CHIEF _____
2ND HOWITZER SECTION CHIEF _____
3RD HOWITZER SECTION CHIEF _____
4TH HOWITZER SECTION CHIEF _____
5TH HOWITZER SECTION CHIEF _____
6TH HOWITZER SECTION CHIEF _____

45. NARRATIVE SEQUENCE OF EVENTS.

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APPENDIX H CAMP LEJEUNE RANGE SAFETY

1. INFORMATION. The Commanding General, Marine Corps Base, Camp Lejeune is the controlling authority for training areas and live fire aboard Camp Lejeune. The current edition of BO P3570.1 (Marine Corps Base Range Control SOP) promulgates training regulations for Camp Lejeune.

2. GENERAL RULES

- a. Only ammunition cleared for overhead fire will be used aboard Camp Lejeune.
- b. During indirect fire no quadrant below 267 will be fired.
- c. During firing, all personnel in the firing position will wear a helmet, flak jacket and hearing protection when the howitzers are engaged in an active fire mission. Unless waived by the CG, 2d MarDiv, this is the field uniform for firing exercises aboard Camp Lejeune. **The OIC of Firing will enforce this requirement.**
- d. Section Chiefs must be Corporals or above.
- e. The OIC of Firing will ensure that 10th Marines personnel slated to perform in safety certified billets attend the next scheduled appropriate Artillery Training School (ATS) course of instruction. Failure to attend the next scheduled course will result in the Marine being denied the opportunity to serve in that billet until he completes appropriate course. This requirement is not applicable to 14th Marines personnel.
- f. The AFATDS/BUCS computed center of battery must be within 200 meters of the grid used in the construction of the range safety card.
- g. The RSO and controlling FDC will maintain continuous communications with range control on frequency 38.60 MHz.
- h. Regimental LSSO's/Battalion LSSO's/LRSO's must be formally trained Cat II LSSO's (rank is at the discretion of the commander).
- i. All Officers, SNCOs and NCOs performing safety duties will carry an "Ammunitions Malfunction Data Collection Guide" (8025), NAVMC 10155 (Rev 10-17).
- j. When in fire condition IV or V, a fire fighting detail consisting of one officer, one NCO, and 20 Marines will be organized for use in the position in the event of fires.
- k. A red range flag will be placed at the firing position

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- entrance. During daylight hours, air panels (red or orange) will be displayed in the shape of an arrow, positioned approximately 25 meters in front of the gunline. The arrow will point in the direction of fire. At night, the firing position will be marked with a red flashing light placed approximately 25 meters in front of the gunline.
1. Prior to firing after speed shifting, all howitzers will be relaid and safed using existing safety procedures outlined in this SOP.
 - m. All indirect artillery fire aboard Camp Lejeune requires 5th order survey.
 - n. Initial firing of howitzers obtained from MPF replacement or with replaced or serviced, recoil, breech, or tube will be fired with charge 4 or lower and a 50' lanyard (2 x 25).
3. MEDEVAC. If an AIREVAC is required aboard Camp Lejeune:
- a. Contact Range Control Duty Officer by radio call sign BLACKBURN 38.60 (VHF), 325.0 (UHF), by field phone, or base telephone, ext. 3064 or 3065.
 - b. Give exact location by coordinates, range designator, gun position, or training area.
 - c. Provide nature of incident/extent of injury.
 - d. In the event BLACKBURN can not be reached, contact Base Command Duty Officer, ext. 2526/2527.
 - e. Further information is provided in the current edition of BO P11102.1, (SOP for Training Facilities and Services).
4. TACTICAL VEHICLE ROAD CROSSING
- a. When vehicles cross or turn on a hard surface roads (highways) during tactical exercises or administrative road marches, road guards will be positioned on both sides of the crossing site at a distance sufficient to stop oncoming traffic (a minimum of 100 yards on 55 MPH roads and 50 yards on 35 MPH roads). No vehicle will begin crossing the highway until the road guards are in position and control of traffic has been established.
 - b. Road guards will remain in position while the vehicles are crossing the highway and until all debris (i.e. dirt, mud) has been cleaned from the highway, shoulders, and crossing pads, if applicable.
 - c. During the hours of darkness or restricted visibility, road guards will be equipped with reflective guard vests,

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flashlights, and reflective triangles. They will position themselves so all traffic is stopped before any vehicle enters the highway. Triangles will be placed at least twenty (20) yards in front of the road guard so oncoming traffic can have an unobstructed view of both the triangles and the road guard.

d. During night training exercises in the Camp Lejeune area, vehicles will have headlights on whenever crossing hard surface roads. In addition, the crossing point will be illuminated with HMMWV or truck headlights, if possible. The Base Provost Marshal will provide traffic control, if requested.

5. SAFETY DATA FOR DIRECT FIRE RANGE

a. To allow firing batteries to engage targets on the inland side of the Intercoastal Waterway special data has been computed. This was done in 1988 by physically "firing in" the data to verify QE's. When firing in this portion of the G-7 range, all that must be done is to extract the appropriate data from the paragraphs below to complete the position safety card. No surface danger diagram is required to engage targets on the inland side. Safety supervisors will ensure tape or stakes are emplaced using the third berm (range 920 meters).

b. All safety limits were established relative to battery center, grid 959343, directly across the observers berm from the range house. No howitzers will be emplaced forward of a line 20 meters in front of and parallel to the observers berm.

c. Authorized Direct Fire Minimum and Maximum Quadrant Limits:

M198 - charge 7 white bag

(1) Max QE: 11

(2) Min QE: 5

d. Azimuth boundaries for G-7 range

(1) Left: 2422

(2) Right: 2618

e. The initial azimuth to orient the howitzers is 2520. The section chief will mark the limits on the howitzer with tape or stakes as appropriate and record the deflection limits on a safety "T". The Position Commander will verify these limits prior to live firing.

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- f. Howitzers may be rough laid using the grid azimuth method. A safety circle is not required.
- g. If a displacement of three feet or more is observed during direct fire the Position Commander will reverify the azimuth limits on the piece.
- h. When firing on the far side of the Intercoastal Waterway, battalions will compute safety using the indirect fire techniques for battery center and azimuth limits in 2 and 4 above.
- i. All other position and range safety orders and regulations remain in effect.

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APPENDIX I

CAMP PENDLETON RANGE SAFETY

1. INFORMATION. The Commanding General, Marine Corps Base, Camp Pendleton is the controlling authority for training areas and live fire aboard Camp Pendleton. The current edition of BO P3500.1__ (Training Facilities Regulations) promulgates training regulations aboard Camp Pendleton.

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APPENDIX J

TWENTYNINE PALMS RANGE SAFETY

1. INFORMATION. The Commanding General, MCAGCC, Twentynine Palms is the controlling authority for training areas and live fire aboard Twentynine Palms. The current edition of MCAGCC/CCO P3500.4__ promulgates training regulations aboard Twentynine Palms.

2. GENERAL

a. Emergency MEDEVAC will be coordinated by BEARMAT (Freq 49.85 primary, 38.90 secondary). See page 3-5, paragraph 3003 of CCO P3500.4 for specific MEDEVAC procedures. Remember to notify BEARMAT on the primary net and coordinate on the secondary.

b. MCAGCC safety regulations require that a Position Safety Officer be located at each firing position during live exercises involving firing over the heads of maneuvering troops. A waiver may be granted to this requirement if formally requested.

c. During CAX events (when MSLs are used), the MSLs will be entered in the AFATDS as a FLOT. Since the AFATDS can only have one FLOT on file, each MSL is entered as it changes. This will provide the FDC with an alert that the target plots short of the current MSL.

d. All NFAs/RFAs, and other fire support coordination measures, must be plotted on the firing chart/situation map in the FDC. No fires or their effects will enter a NFA/RFA or airspace coordination area (ACA) without specific approval by the TTECG controller. See CCO P3500.4 for a list of permanent NFAs.

e. Weapons firing from a position located by hasty survey may fire with data settings obtained by MET plus VE method if the Battery Commander has absolute confidence in his location. Before commencing general firing, two observed check rounds must be fired by the firing unit if overhead fire is to be conducted. If the Battery Commander lacks confidence in his location after firing, he will conduct a registration.

3. SPECIAL INSTRUCTIONS FOR FIRING EXERCISES WITH MANEUVER FORCES (FOR NON-CAX EVENTS WITH NO TTECG INVOLVEMENT)

a. Reference (f) requires the use of Minimum Safe Line (MSLs) for firing exercises with maneuver forces. If the forces do not plan on maneuvering into the impact area, only one MSL is required. In all other cases, MSLs must be constructed to facilitate the maneuver plan.

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- b. A Minimum Range Line (MRL) corresponding to each MSL will be used to determine the near edge of the target area. The MRL must be at least 1000 meters beyond the MSL.
 - c. After determining the MRLs, the artillery FDC must compute safety data and construct Safety Ts for each position and each MSL prior to the start of the exercise. Safety Ts must be updated in accordance with Chapter 4 of this SOP.
 - d. The senior fire support coordinator (FSC), in conjunction with the maneuver commander, will establish the MSL to be used and authorize changes to current MSLs. Positive confirmation is required on all MSL changes. When accomplished by radio, the entire transmission must be read back. A simple "Roger" will not suffice. The senior FSC must prohibit execution of all maneuver and unit moves across MSLs until all firing units acknowledge the new MSL and confirm the posting of new safety data. Only the senior FSC, in conjunction with the maneuver commander, can authorize movement across the old MSL.
 - e. During planning for the exercise, the senior FSC must brief the maneuver commander and his staff on the purpose and procedures relating to the use and crossing of MSLs.
 - f. Artillery headquarters and firing units must log in all transmissions relating to MSLs including the initiating and receiving units, the MSL number and the effective time.
 - g. Subordinate units must confirm current MSLs every thirty minutes if no changes have been received.
 - h. FDOs will not compute firing data for targets falling short of the current MRL. If a change to the MSL causes a previously received target to fall short of the new MRL, the FDO will end the mission, notify the effected unit and annotate the record of fire or automated printout to reflect the unsafe circumstances.
3. WAIVERS DURING MCAGCC COMBINED ARMS EXERCISE (CAX). During a CAX, the requirements of this order are waived as follows:
- a. During the CAX FINEX, there is no requirement to compute safety data based on Minimum Safe Lines (MSLs), prior to occupation of the firing position.
 - b. The waiver also applies while supporting other CAX events where the requirements of this order are incompatible with mission accomplishment. Otherwise all procedures outlined in this order will be enforced.
 - c. While the waiver is in effect, battery FDOs will continue to ensure that firing data is computed using two means (i.e. AFATDS, BUCS) and also verify that the two sets

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of data agree to the tolerances listed in para. 3002.7.c.(2). The FDO will also ensure that no rounds are fired prior to receiving clearance to the target grid from the TTECG controller.

d. There is no requirement for units to compute safety boxes and safety T's. Minimum Safe lines and Minimum Range Lines (see paragraph 2 above) will still be used but the TTECG will clear each mission. No target can be fired on without positive clearance by grid from the TTECG who has representatives with the maneuver units. **Minimum Safe Lines are guidance.** Missions may be still be fired below the MSL in effect if maneuver units are at least 1000 meters from the target. **Permission to fire missions below the MSL must be approved by the TTECG controller.**

4. EMERGENCY FIRE MISSIONS (HIP SHOOT). The safety requirements contained in this SOP are applicable to all occupations, including emergency occupations, except as follows:

a. When the Battalion Commander determines that the firing position physically prohibits the battery from firing outside the authorized impact area; and when the area forward of gun line, including the entire impact area, is free of all personnel and protected facilities, he may authorize a waiver of certain safety requirements in order to perform Hip shoots. The waiver is explained below.

b. Minimum conditions that must exist to make the above determination are:

(1) Unobstructed vision of the entire impact area between howitzer traverse limits, forward of the gunline.

(2) Size of impact area exceeds the maximum range of the charge fired.

(3) Positive confirmation that the entire area between howitzer traverse limits, forward of the gun line to the maximum range of the impact area, is free of all personnel and restricted firing areas such as historical sites, etc.

c. When the above conditions are met, the Battalion Commander may authorize the unit to perform emergency fire using procedures described in FM 6-50/MCWP 3-16.3. The following requirements are waived: firing from a surveyed location with a safety T, specified prefire checks, safety circles, second means of determining data.

5. LASERS. Appendix O of CCO P3500.4 contains laser employment guidance.

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- a. Designating OPs. There are 57 laser OPs available for use. Specific OPS locations/overlays will be provided to CAX LRSO's by the MCAGCC Range Safety Officer during the LRSO brief before CAX.
- b. Laser Range Safety Officers. A trained LRSO will be present on the OPS any time that a laser is being employed. The LRSO must receive the Laser Range Safety Brief by the Range Safety Officer prior to conducting laser operations.

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APPENDIX K

FORT BRAGG RANGE SAFETY

1. INFORMATION. The Commanding General, XVIII Airborne Corps and Fort Bragg is the controlling authority for use of the Fort Bragg-Camp Mackall Range/Training Area Complex. All training and live fire is governed by the current edition of XVIII Abn Corps and Fort Bragg Reg 350-6.
2. COORDINATION
 - a. A weekly range conference is held every Friday at 1300 in the Range Division HQ Building, intersection of Gruber Road and Longstreet Road, for the purpose of distributing live fire safety data (Weekly Range Bulletin), known check fires, and for making final coordination.
 - b. Commanders will ensure a representative is present who is qualified and authorized to effect coordination.
3. TRAINING AREAS
 - a. Fort Bragg consists of three artillery target areas; MacRidge Impact Area, Coleman Impact Area and McPherson Impact Area. The weekly range bulletin list the impact area grids. The general instructions on the bulletin then tell units to ensure that the probable errors are included.
 - b. The small arms and crew served weapon ranges aboard Fort Bragg are listed in the 350-6.
4. RED-COCKADED WOODPECKERS (RCW)
 - a. The red-cockaded woodpecker is an endangered bird protected by federal law. RCW's are cavity-nesting birds and depend on live pine trees for their survival. Cavity trees are marked with two bands of red or white paint around the lower portion of the trunk. Trees that form the perimeter of a protected area around cavity trees are marked with single bands of red or white paint or red reflective material.
 - (1) Training activities within the entire protected area, marked with single red/white bands are prohibited except for the following:
 - (a) Transient foot travel.
 - (b) Transient vehicle travel only on existing roads and firebreaks.
 - (2) If protected areas are not clearly marked, then the restrictions in (1) above apply within 200-foot radius of double banded trees.

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5. ENDANGERED PLANTS AND FOLIAGE. Certain plants and foliage resident to the Fort Bragg area are on the endangered list. These areas will be marked by trees with single white bands of paint or the area will be encircled in concertina. All movement in these areas is prohibited.

6. GENERAL RULES

a. Prior to firing tracer ammunition, any type of incendiary, demolition or flares, the OIC will first contact Range Control for clearance.

b. All Field Artillery units firing indirect fire will select the lowest charge with the greatest angle of fall for the appropriate range to target.

c. During indirect fire no quadrant below 267 will be fired.

e. The AFATDS/BUCS computed center of battery must be within 100 meters of the grid used in the construction of the range safety diagram.

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APPENDIX L

JAPAN RANGE SAFETY

1. INFORMATION

a. Live fire artillery training is suspended aboard Okinawa. However, the United States Government retains the flexibility to conduct contingency artillery firing on Okinawa. In the event live fire is authorized, the Commanding Officer of Marine Corps Base, Camp Butler is the controlling authority for training areas and live fire on the island of Okinawa. The current edition of BO P3500.1_, Range and Training Area Regulations, promulgates training regulations for Okinawa.

b. Live fire of U.S. artillery is currently permitted at five sites on the main islands of Japan. At two of these sites, East and North Fuji, the Commanding Officer, Headquarters Battalion, Camp Fuji, Japan, is the controlling authority for U.S. training areas and live fire at Camp Fuji. The remaining three sites are under the control of the local Japanese Ground Self Defense Force.

c. Artillery live fire training in Japan is highly visible and receives close scrutiny from external agencies to include the Defense Facility and Administration Bureau, Prefectural Governments, and local media. The strict adherence to local range regulations and the JtRegt Safety SOP is imperative.

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APPENDIX M

ARTILLERY DEMONSTRATION UNIT MCB QUANTICO

1. INFORMATION. The Commanding General, Marine Corps Base, Quantico, is the controlling authority for training areas and live fire aboard MCB Quantico. The current edition of BO P3570.1 (Base Range Control SOP) promulgates training regulations specific to MCB Quantico.

a. The Artillery Demonstration Unit located at Camp Barrett is a unique Marine Artillery Organization. Due to its special mission and table of equipment and organization, several special considerations regarding their safety requirements must be made. Unless otherwise stated in this Appendix, all elements of this SOP remain in effect.

2. COMMAND SAFETY CERTIFICATION PROGRAM

a. The only personnel requiring certification described in the Command Safety Certification Program (2001.1) are those Artillery officers (0802) and enlisted (0811, 0844, 0848, 0861) assigned to the ADU. Artillery officers assigned to TBS, who temporarily fill any billets within a firing position, will also be safety certified. All personnel must successfully pass the prescribed examinations for their billet and be certified in writing by the Commanding Officer, The Basic School.

b. The S-3, TBS, maintains original copies of all safety examinations, answer sheets, and answer keys. ADU is responsible for reproducing additional copies of the safety examinations and answer sheets as required. The OIC of ADU is responsible for performing the duties listed in para 3004, including physical security of examinations and will appoint in writing individual(s) to administer the exam.

c. ADU is the only Marine Artillery Unit to continue to use the M101A1 105mm howitzer. Therefore, Part IV: Safety Computations of the Safety Examination will be limited to computation of low and high angle safety for WP, Illum, and HE before and after registration, using FT H-7.105 AS-3. The minimum number of personnel required to operate the M101A1 is one section chief and four cannoneers.

3. DUTIES OF SAFETY PERSONNEL

a. ADU operates independently of Battalion or Regimental Organizations. Therefore, applicable duties of Regimental Artillery Safety Officer will be assumed by the S-3, TBS, who may delegate the applicable duties and responsibilities associated with this billet to the OIC, ADU, or to another safety certified

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Artillery officer (0802). In the event an Firing Incident Investigation, The S-3, TBS will assign, in writing, a safety certified Artillery Officer, other than the OIC of ADU, as Investigating Officer.

b. The OIC, ADU, in addition to his duties as OIC of firing, performs the duties listed in paragraph 3002.3.a-c, e, and f; as well as the responsibilities of the Battalion Artillery Safety Officer listed in para 3002.4.

c. The Battery Gunnery Sergeant performs the duties of Position Commander. He is not authorized to sign or approve subsequent safety data and safety Ts.

d. The Operations Chief performs the duties of the FDO. Either the Ops Chief, OIC of Firing, or another safety certified officer must be present in the FDC during live firing.

e. Section chiefs will ensure safety stakes are emplaced as traverse limiting marks in accordance with the FM 6-50/MCWP 3-16.7.

4. COMPUTATION OF SAFETY

a. Surface Danger Diagrams and/or Range safety cards will be verified by a command safety certified Marine, and approved by S-3, TBS. The number of doglegs will be at the discretion of the OIC of ADU.

b. Changes requiring computation will be verified by a safety certified Marine and approved by S-3, TBS.

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APPENDIX N

OTHER TRAINING AREAS

1. INFORMATION. The following are the safety references for the listed training areas.

- a. Korea: COMNAVFORKOREA 5004
- b. Pohakuloa: USASCH 210-11
- c. Schofield: USASCH 210-6

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APPENDIX O

MISFIRING/CHECKFIRING PROCEDURES

1. GENERAL. To avoid injury to personnel and damage to equipment, all personnel must understand proper malfunction procedures. Procedures for removing chambered rounds associated with malfunctions are specified in the technical manual (TM) applicable to the weapon involved.

(a) **MISFIRE**. The failure to fire after an attempt to fire has been made. This failure may be due to the failure of the primer, the igniter, the propellant, or the firing mechanism, wholly or in part. A misfire in itself is not dangerous; however, it cannot be immediately distinguished from a hangfire. MISFIRES MUST BE TREATED AS HANGFIRES UNTIL DETERMINED OTHERWISE. When batteries are firing Suppression of Enemy Air Defense (SEAD) missions, time on target missions, or other fires which involve close coordination and timing, misfire procedures must be modified to ensure that only two additional attempts to fire the weapon are made. After the two initial attempts to fire have been made the weapon will be placed in a checkfiring status, called out of action, and misfire procedures will be suspended to prevent the weapon from being fired when it is unsafe to do so. For example, when a time on target (TOT) mission is being fired in support of the final assault on an objective and the weapon fails to fire after additional attempts, that weapon must be restricted from firing as the assault moves across the minimum safe line. When clearing a misfire under these circumstances, permission to fire the round must be authorized by the controlling FSCC or artillery headquarters.

(b) **HANGFIRE**. A delay in the functioning of the primer, igniter, or propellant. This delay is unpredictable and may range from a fraction of a second to ten minutes.

(c) **COOKOFF**. The functioning of the propelling charge or projectile initiated by the heat of the weapon.

(d) **STICKER**. A projectile that is lodged in the tube after firing. Stickers result from insufficient chamber pressure. When the projectile lodges in the tube, hot gases are under pressure and trapped within the chamber. Therefore, extreme caution must be used when removing the primer. Procedures in the weapon TM will be followed to remove the primer. All nonessential personnel will be

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evacuated from the gun. Extracting the primer will be conducted by the Section Chief and the process will be supervised by the OIC of Firing, Position Commander, Battery FAC/Gunnery Sergeant. If a round is lodged in the tube, retain the howitzer in the firing position and notify the senior headquarters involved and request specific guidance. If the senior headquarters concurs lay the weapon on safe data, replace the primer, and fire out the lodged projectile with a charge five or higher utilizing a 25' lanyard. If the weapon can not be laid on safe data with charge five or higher EOD must be notified to extract the projectile.

(e) **HOT TUBE.** Determined by the thermal warning device or any tube that causes water from a wet swab to boil, fry, or steam off. The OIC of firing or Position Commander determines if a hot tube situation exists and ensures the appropriate technical manual precautions are followed.

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APPENDIX P

CHECK ROUNDS

1. GENERAL. Ensure one check round is fired after initial occupation of a position.

a. Location. Selecting a target for check rounds may be made by the FDC or the observer. The location of check rounds should meet the following criteria:

(1) Located in center of the target area.

(2) Located near the center of transfer limits. This requirement applies only to manual computations and prevents acceptable error from affecting the validity of check rounds.

(3) Located as accurately as possible. Surveyed, recorded, or targets located by laser or radar, are considered accurate. If unable to accurately locate a target for check rounds, the observers accuracy in locating the target and spotting rounds must be incorporated into assessing the validity of the check rounds.

b. Accuracy. The following procedures may be used to mathematically determine the accuracy of check rounds.

(1) Fire two check rounds at the selected target.

(2) Take the average of the refinements/corrections for the two rounds and apply them as a subsequent adjustment in a dry fire mission.

If using AFATDS:

(3) Compare Location field with target location to determine the number of meters error. Go to step 5.

If other:

(4) Compare the initial data fired with the data from the dry

(5) Determine the range correction from the DQE using column 5 Table F from the TFT. Determine the lateral correction from the DDF by using the mil relation formula.

(6) If the data is within 4PER of the aimpoint, and 50 meters or 4PED laterally of the aimpoint, whichever is greater, then the check rounds are valid.

c. Validity. If the data is not within the above stated tolerances, there are three possibilities: Firing data error, target location error, or unaccounted for nonstandard condition (such as MET staleness). The unit must recheck all data within the battery position for possible errors. The FDO must use his best judgment in determining whether the error exists in his firing data, target location error, or from changing nonstandard conditions. If no error can be found, improve firing data according to Chapter 11 of FM 6-40/MCWP 3-16.4 by performing either a subsequent MET technique or the five steps to improved firing data.

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