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USCENTAF
MEMORANDUM, 15 Dec 06

B-I



DEPARTMENT OF THE AIR FORCE
UNITED STATES CENTRAL COMMAND AIR FORCES (USCENTAF)
SHAW AIR FORCE BASE, SOUTH CAROLINA 29152

15 December 2006

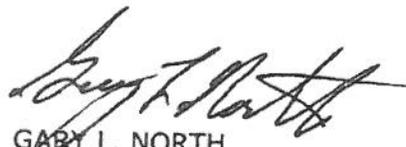
MEMORANDUM FOR REAR ADMIRAL
President, Combined Investigation Board

FROM: USCENTAF/CC
524 Shaw Drive, Suite 200
Shaw AFB, SC 29152

SUBJECT: Combined Investigation Board into the Suspected Friendly Fire Incident Involving USN F/A-18C and United Kingdom Royal Marines that Occurred in the Vicinity of Kandahar, Afghanistan on 5 December 2006

1. This memorandum, in furtherance of the U.S. Central Command memorandum dated 8 December 2006, provides direction to you as president of a legal investigation board conducting an investigation into the circumstances surrounding the suspected friendly fire incident involving U.S. Navy F/A-18C aircraft and United Kingdom Royal Marines in an area southwest of Kandahar, Afghanistan, on 5 December 2006. You are to inquire into all facts and circumstances surrounding the friendly fire incident and will obtain and preserve all available evidence for possible use in litigation, claims, disciplinary actions, or adverse administrative actions. The investigation will include findings of fact, opinions and recommendations, to include the cause of the incident and resulting death, injury and damage. Further, the investigation will make an assessment as to any fault or neglect and make recommendations concerning corrective operational and training measures, as appropriate, and administrative and disciplinary actions.
2. United Kingdom authorities have appointed a senior officer to participate in this investigation board; also, other United Kingdom officers have been appointed to support the CIB and NATO officials have been invited to offer an officer from the International Security Assistance Forces as a liaison to the CIB. The senior United Kingdom officer will serve as a "Senior Representative" for the conduct of the investigation and for the preparation of joint findings of fact. You will collaborate with him on opinions as to the cause of the incident and seek his recommendations as to corrective measures to the extent they address combined or coalition military activities. Should it be necessary, you and the Senior UK Representative may issue additional individual findings of fact, opinions or recommendations or reserve concurrence on specific matter as each of you may deem appropriate. Assessments as to fault or neglect and recommendations concerning administrative and disciplinary actions involving U.S. personnel shall only be made through U.S. personnel board members.

3. The United Kingdom Senior Representative is authorized to act as a liaison with his national representatives in the conduct of their internal Board of Inquiry on this incident. However, information, data, evidence, witness statements or any other material provided to, obtained by or developed by this investigation shall only be provided to United Kingdom authorities subject to the safeguards and use restrictions set forth in applicable U.S. laws and regulations.
4. Similarly, no member of the CIB nor any liaison officer appointed from ISAF forces is to provide any of the materials just described to any person or organization outside of the CIB or Headquarters, Central Command Air Forces (USCENTAF) without my written approval to release the materials; failure to obtain my approval will result in the immediate removal from the board of the member or liaison officer who fails in this regard. All public affairs announcements concerning this investigation will be coordinated and approved at USCENTAF, to be released under my accord.
5. Representatives from the United Kingdom and U.S. military services will be identified and will participate as members of the board. One or more members of ISAF may be identified by NATO as liaisons as well. Pursuant to Article 136, Uniform Code of Military Justice, and relevant Service regulations, active duty U.S. military investigation board members are authorized to administer oaths. Additional administrative personnel and U.S. and United Kingdom military service representatives shall be made available to provide technical and logistics assistance to the board.
6. The investigation is directed pursuant to Department of Defense Instruction 6055.7, paragraphs E4.6 and E4.7. Service regulations regarding investigations may be used as a guide in your conduct of the board and preparation of your report, but they are not authoritative and guidance provided in the just-mentioned DoD Instruction and this memorandum regarding conduct of the investigation and content of the report, takes precedence over such Service regulations.
7. Provide a written report of the board's findings of fact, opinions and recommendations to me no later than 15 January 2007, unless an extension of time is granted. Unless otherwise directed by me or higher authority, investigative duties of all board members and support personnel are expected to take priority over all other duties until this investigation is complete and approved.



GARY L. NORTH
Lieutenant General, USAF
Commander

cc:
1 - USCENTCOM/CS
1 - Each Board Participant

Combined Investigation Board

B-II

DEPARTMENT OF THE AIR FORCE
UNITED STATES CENTRAL COMMAND AIR FORCES (USCENTAF)
SHAW AIR FORCE BASE, SOUTH CAROLINA

SPECIAL ORDER: AB - 15

28 December 2006

Pursuant to DoD Instruction 6055.7, paragraph E4.6 and E4.7, and by delegation of authority from the Commander, United States Central Command, the following individuals, organizations indicated, are detailed to an Investigation Board to investigate the 5 December 2006 incident in Afghanistan involving United Kingdom Royal Marines and an ordnance delivered by a U.S. F/A-18 aircraft. The board will conduct the investigation and prepare the report in accordance with DoDI 6055.7 and the authoritative guidance contained in the 15 December 2006 USCENTAF memorandum, "Combined Investigation Board in the Suspected Friendly Fire Incident Involving USN F/A-18 and United Kingdom Royal Marines that Occurred in Afghanistan on 5 December 2006."

All board members will assist the co-presidents in completing this investigation. Pursuant to Article 136, Uniform Code of Military Justice, 10 United States Code Section 936, and relevant Service Regulations, active duty United States military members appointed to the Investigation Board are authorized to administer oaths. Unless otherwise directed by the convening or higher authority, investigative duties will take precedence until this investigation is complete and the board is adjourned. A written report will be submitted to me no later than 15 January 2007, unless an extension is granted.

With the concurrence of their respective governments and commanders, the following personnel are detailed to the board:

<u>NAME/POSITION</u>	<u>UNIT</u>
United States Co-President	Carrier Strike Group NINE
Senior United Kingdom Representative	RAF Strike Command
U.S. Legal Advisor	
U.S. Pilot Advisor	
U.S. Flight Safety Officer	

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U.S. Investigating Officer

U.S. Aviation Psychologist

U.S. Aerospace Physiology Advisor

Legal Advisor

U.S. Maintenance Officer

U.S. Recorder

U.S. Joint Terminal Area Controller Advisor

Administration/ADP Support

Administration/ADP Support

Court Reporter

Advisor

Advisor

Advisor

GARY L. NORTH
Lieutenant General, USAF
Commander

SO AB - 15

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MEMORANDUM from
Commander, U.S. Central
Command (8 Dec 2006)

B-III



UNITED STATES CENTRAL COMMAND
OFFICE OF THE COMMANDER
7115 SOUTH BOUNDARY BOULEVARD
MACDILL AIR FORCE BASE, FLORIDA 33621-5101

CCJA

DEC 08 2006

MEMORANDUM FOR LIEUTENANT GENERAL GARY L. NORTH, COMMANDER,
USCENTAF

SUBJECT: Investigation into the Friendly Fire Incident Involving United Kingdom Forces that Occurred IVO Lashkar Gah, Afghanistan on 5 December 2006

1. Under the provisions of Department of Defense Instruction 6055.7, I direct you, as Commander, Combined Forces Air Component Command and as Commander, U.S. Central Command Air Forces, to conduct a legal investigation into the subject friendly fire incident. You are to directly liaison the ISAF and the United Kingdom Defence Forces and invite their representation and participation in this investigation. Please extend my invitation to participate both to COMISAF and to the Chief of Joint Operations, U.K. Defence Forces, General N. Houghton. This Combined Investigation Board (CIB) is intended to remove the need for separate investigations and facilitate a prompt, complete and agreed determination of the facts and circumstances surrounding this friendly fire incident. This investigation may complement national boards of inquiry. Should this be the case, your staff should explicitly explain to national staffs the inherent advantages of a CIB in regard to transparent disclosure for the board findings, that might not be available if only a unilateral board is conducted.
2. In coordination with ISAF and the United Kingdom, should they elect to participate, the CIB should be comprised of a legal advisor, a recorder, technical and specialty experts, a sufficient number of qualified administrative personnel and headed by a senior officer(s). The CIB shall catalog, maintain and preserve the evidence with appropriate chain of custody documentation for potential future legal actions. The CIB will operate with appropriate consideration of applicable security, privacy and evidentiary rules. After completion, you are authorized to participate in and collaborate with NATO officials to engage in the Alliance's methodology to share appropriate lessons learned and provide results to improve a common understanding among our forces in the field.
3. Based upon the CIB's findings, you shall make an independent assessment as to any fault or neglect on the part of any US military personnel. You have the authority and responsibility to implement corrective measures, as well as recommending, as appropriate, any administrative and disciplinary actions to the proper authority. You will also prepare a publicly releasable version of the investigation.
4. A CIB is without prejudice to any separate United Kingdom Board of Inquiry (BOI) required by United Kingdom domestic law. The CIB, however, takes precedence. In the event of a United Kingdom BOI, you shall appoint a liaison officer to work with the BOI to facilitate their

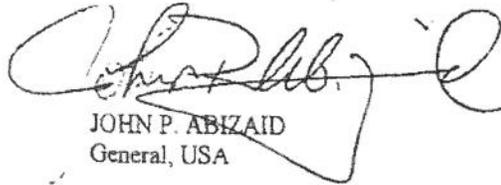
B-III

CCJA

SUBJECT: Investigation into the Friendly Fire Incident Involving United Kingdom Forces that Occurred IVO Lashkar Gah, Afghanistan on 5 December 2006

efforts. All material requested by the BOI will be released through the CIB and shall be subject to such conditions as may be appropriate.

5. I expect the CIB to complete its report within 30 days, unless you ask for an extension based on unusual circumstances. Be prepared to out-brief me when the investigation is complete. As the Combined Forces Air Component Commander, you shall assume responsibility for any public affairs activity required; coordinate with USCENTCOM/CCPA.



JOHN P. ABIZAID
General, USA

B-III

MEMORANDUM from
President, Combined
Investigation (Interim Report
on Findings In Regard to PGU
Series 20 Millimeter
Ammunition, 30 Dec 2006)

B-IV



DEPARTMENT OF THE AIR FORCE
UNITED STATES CENTRAL COMMAND AIR FORCES (USCENTAF)
COMBINED INVESTIGATION BOARD

30 December 2006

MEMORANDUM FOR Commander, U.S. Central Air Forces

FROM: President, Combined Investigation

SUBJECT: Interim Report on Findings In Regard to PGU Series 20 Millimeter Ammunition

1. Pursuant to your Memorandum dated 8 December 2006 a Combined Investigation Board (CIB) has been investigating the alleged friendly fire incident that occurred on or about 5 December 2006 involving a United States Navy F/A-18C and British Royal Marines.
2. On 5 December 2006, a 20 millimeter projectile was recovered and retained by the Royal Marines. This was one of several intact 20 millimeter projectiles seen immediately following a friendly fire strafe by the U.S. Navy F/A-18C on an irrigation trench occupied by the Royal Marines.
3. Despite approximately 213 rounds of 20 millimeter ordnance being expended by the F/A-18 in the vicinity of the Royal Marines, there were only two casualties out of fourteen individuals present in the trench during the incident. In addition, witnesses state that the 20 millimeter rounds did not exhibit the characteristics of Semi-Armor Piercing High Explosives Incendiary (SAPHEI) ordnance.
4. Preliminary photographic analysis of the recovered projectile by Naval Air Warfare Center and Naval Surface Warfare Center engineers indicated that it is either a 20 millimeter PGU-27 – commonly referred to as a TP (practice round), or a PGU 28 A/B SAPHEI round that failed to detonate. The distinct characteristic of the slender iron rotating band clearly identifies this 20 millimeter projectile as PGU A/B series.
5. The round appears to have been recently expended compared to previously deposited battlefield ordnance. Historically, expended PGU rounds subjected to ambient conditions begin to corrode within weeks based on NAVAIR tests. Despite corrosive conditions present in the battlefield, the round does not exhibit corrosion one would expect of a round that had been present on the ground for weeks. In addition, there is no record of any 20 millimeter ordnance being expended in the vicinity of the friendly incident since 20 November 2006.
6. The round was subsequently examined and x-rayed by [redacted] who is currently serving as the [redacted] for the United Kingdom's Counter IED Branch located at [redacted]. His analysis states that it is a "solid slug type round and does

not appear to contain any form of explosive as no fuse is visible." This would be consistent with a 20 millimeter PGU-27.

6. On 29 December 2006, the round was recovered from the Special Investigations Branch of the British Army in Kandahar and delivered to the CIB. The round was turned over to the CIB on the condition that it would be returned to UK authorities if requested upon completion of the CIB's inquiry.

7. The round was subsequently examined and x-rayed by _____, an Explosive Ordnance Disposal Craftsman assigned to the 379th Expeditionary Civil Engineer Squadron as the _____. Based on his examination of the round and the x-rays, _____ opinion is that the round is a "non-explosive 20 millimeter round." Additional analysis of the round shows a paint scheme consistent with PGU-28 A/B SAPHEI rounds.

8. As a result, the CIB's initial conclusion is that there were either PGU-27 (TP) rounds with PGU-28 A/B SAPHEI markings or that multiple PGU-28 A/B SAPHEI that did not go high order at the time of the incident.

9. Further investigation of this matter is outside the purview and competency of this board. However, given the seriousness of the board's initial conclusion, it is imperative that this matter be referred to appropriate authorities for immediate investigation. Since the round is believed to be from the F/A-18C involved in the friendly fire incident and used mainly by the US Navy in theater, it recommend that this matter be referred to Commander, U.S. Naval Forces Central Command. Copies of all pertinent materials collected in the course of this investigation are attached. The CIB has retained custody of the 20 millimeter round for transfer to the Navy at the earliest opportunity.

Attachments:
As Stated

Attachments

Witness Statement of [redacted] (with x-ray).....TAB A

Memorandum for the Record dated 29 December 2006 (with x-ray).....TAB B

Excerpt from undated testimony of [redacted]TAB C

Memorandum for the Record, undated.....TAB D

Section VI, NAVAIR 11-1-119.....TAB E

Analysis of Strafe Incident of 5 December 2006.....TAB F

Photo of 20 millimeter round.....TAB G

Photos of PGU-27/PGU-28 form CVN-69.....TAB H

Photo of PGU-28 Fragmentation.....TAB I

PGU-28A/B Diagram.....TAB J

PGU Color Coding Configuration.....TAB K

20 December Email.....TAB L

21 December Email.....TAB M

Case Ref No: 83187/06

MOD Form 266A/B
(Introduced 12/03)



**SERVICE POLICE
WITNESS STATEMENT**

(CJ Act 1967, S.9;MC Act 1980, SS.5A(3a) and 5B;MC Rules 1981,r70)

Statement of: I _____	
Rank/Status: Major	
Age if under 18: Over 18	Occupation: HM Forces (Army)
This statement (consisting of 3 pages each signed by me) is true to the best of my knowledge and belief and I make it knowing that, if it is tendered in evidence, I shall be liable to prosecution if I have wilfully stated in it anything which I know to be false or do not believe to be true.	
Signature: _____	Dated the 22 nd day of December 2006.

On Tue 12 Dec 06, I, _____ RMP (SIB), handed to me a large calibre round contained within a Police exhibit bag which was marked as follows:

- 20mm Round

I have signed and dated the exhibit bag.

Later that day I was present when exhibit : _____ was x-rayed using the Gordon Electronics XR200 x-ray equipment. The system does not produce film format images, instead, images are viewable on a monitor.

From looking at the image produced, I can state that exhibit _____ is a solid slug type round and does not appear to contain any form of explosive as no fuse is visible. The 20mm round is used in various coalition aircraft but it is not possible for me to say from which nationality or type of aircraft the round is from, nor can I state the how long the round may have been on the ground.

The XR200 system does not store images of the x-rays unless made to do so, therefore no image of the initial x-ray is available.

Today, at the request of : _____, RMP (SIB), exhibit : _____ has been x-rayed again and an image produced. An exhibit label has been attached to the image and marked as follows:

- X-ray image of exhibit of exhibit _____ 20 mm round

Handwritten mark

(Continuation Sheet)

Sheet No	2	Case No:	83187/06
Continuation of statement of:			

I have signed and dated the exhibit label.

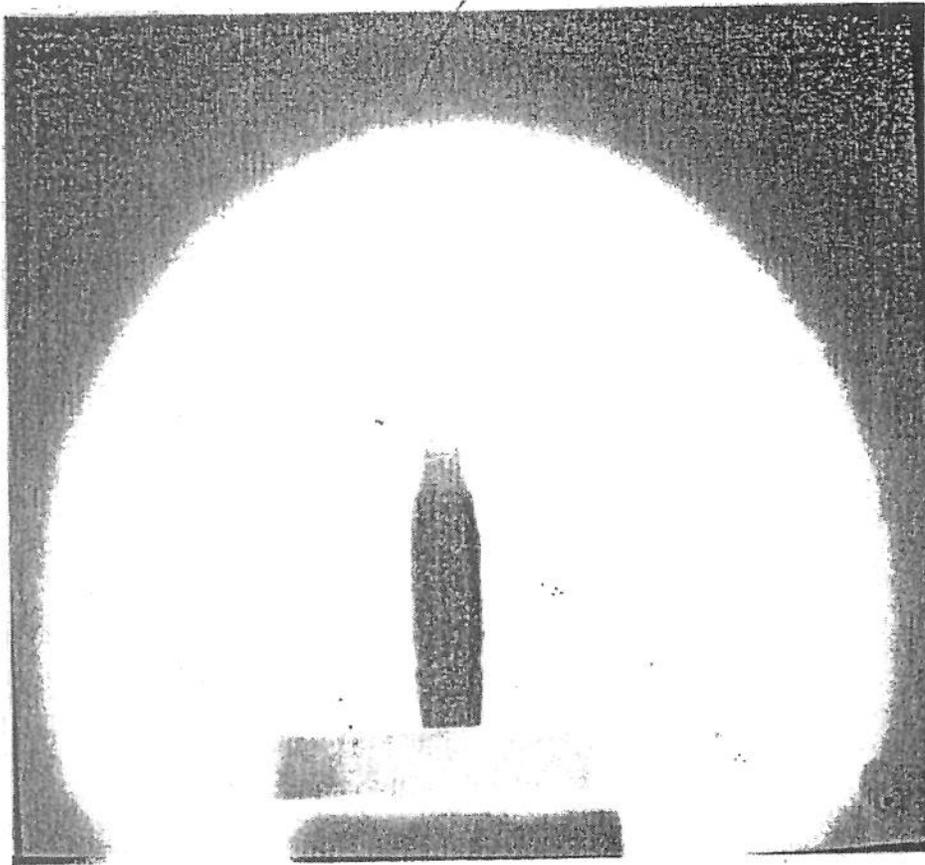
I have handed both exhibits and 1 to

Signed:

Signed:

Sgt
RMP (SIB)

[Handwritten mark]



SIGNED [Signature]

TRAIL OF EXHIBIT

20mm ROUND

[Handwritten marks and scribbles]

29 December 2006

SUBJ: MEMORANDUM FOR THE RECORD (20 Millimeter)

Memorandum submitted to document X-ray of 20 millimeter round recovered by Royal Marines from the incident site immediately strafing incident that occurred on 5 December 2006.

I received the subject round via Wing Commander [redacted] Royal Air Force, on 29 December 2006. The round was hand carried by me to [redacted] USAF. [redacted] is an Explosive Ordnance Disposal Craftsman assigned to the 379th Expeditionary Civil Engineer Squadron / CED as the [redacted]

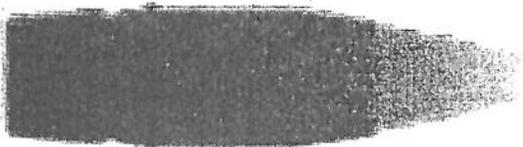
[redacted] conducted several X-rays of the subject round with a varied "number of pulses" using a portable X-ray device. The most successful of these X-rays were saved as photos; copies of which are contained in the photo tab of evidence as 20 Pulses 20MM, 35 Pulses 20MM, 43 Pulses 20MM, and 60 Pulses 20MM. X-rays taken with less than 20 or more than 60 pulses did not produce a good image.

Based on the X-rays [redacted] t concluded "in his opinion" that the round X-rayed was a non-explosive 20 millimeter round. [redacted] did not have an X-ray of an explosive 20 millimeter round for comparison; however, he did have X-rays of other ordnance which had been X-rayed using the same device. The X-rays I viewed of the "other ordnance" were sufficient to show interior details of the ordnance not visible in the 20 millimeter round recovered from the incident site.

LT USN

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29 December 2001
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B-IV

V. A. ... of Round Taken 29 December 2006 379 EOD QHTA 60 Pubs



B-IV

TAB C

B-IV

[Excerpt from the undated testimony of _____, Fire Team Commander and Joint Tactical Air Controller, 148 Bty, 29 Cdo Royal Army, with Royal Marines on 5 December 2006.]

Commander _____ (Interim Combined Investigation Board member): Yes, one more question. Around about the time of the strafing, was there any smoke near your position?

WIT: No, sir. That is another thing, another aspect I looked into but it just didn't seem right, I could see the strafe coming in, I say literally a blurb but this came across me and immediately one guy with an arm wound and another guy was on the ground on his back and getting sort of dealt with____ but the rounds, I have seen them land before, a 20 mil and a 30 mil, big old explosion, well, not big it is like a small grenade going off at each location and I never saw that in those however, when I went down to deal with the casualty there was there was 20 mil rounds laying around, now the other thing to do with that is 20 mil being fired from a dive is going to embed itself in the deck, sir. So, this place as you can see where the bomb craters have been strafed continuously for about 4 months now, so I am not 100% sure. In my eyes a 20 mil kind of going through your back, whether it hits your body armor or not is going to punch through your chest.

Maj _____ (Legal Advisor Interim Combined Investigation Board): So, in other words the rounds that were coming in at you when you were calling the airplane do you think they were exploding and causing smoke, near your position?

WIT: I cannot tell you that, it happened in a snap.

Maj _____ Because there was smoke from the bomb that went off from hitting the compound---

WIT: There is no way the smoke from the bomb had lifted itself and drifted over to my position.

Maj _____ Right.

WIT: One, because if there was any wind, it would have been pushing away from us and there was no wind.

Maj _____ How about from the incoming fire you were receiving?

WIT: The incoming fire there was a bit of splashing around; you got leaves coming off the trees.

Maj _____ But not smoke that you are aware of?

WIT: No smoke. There was a couple RPGs that flew over and when they airburst they created smoke almost like flak guns if you could imagine.

B-IV

PRESIDENT Interim Combined Investigation Board : Were the RPGs during the time of bndr's final strafe pass?

WIT: Can't tell you that, they were coming over sporadic, whoosh and blow up behind you, so.

PRES: When the ammo started hitting the deck, was it your impression that it was HEI or not HEI?

WIT: I couldn't tell you, I was looking at the target and the next thing I knew, it had come passed me.

B-IV

TAB D

B-IV

PGU Series 20mm – Statement of Facts and Analysis

The PGU A/B series is multi-purpose ammunition developed to be more effective for use in aviation assets than previous series of 20 millimeter ammunition. The PGU-27 A/B Target Practice (TP) projectile is composed of a steel body with a solid aluminum nose piece swaged or crimped to the steel body. The PGU-28 A/B Semi-Armor Piercing High Explosive Incendiary (SAPHEI) projectile incorporates a steel body with an aluminum nose that contains RS 41 incendiary mix and is threaded into the steel body.

On 05 December 2006 a projectile was recovered and retained by the Royal Marines. This was one of several projectiles discovered post friendly strafe incident in the vicinity ditch occupied by the British forces.

Preliminary visual and photographic analysis of the recovered projectile indicates that it is most likely either a 20 millimeter PGU-27 A/B – commonly referred to as a TP (practice round) or a PGU-28 A/B round that did not detonate high order. The distinct characteristic of the slender iron rotating band clearly identifies this 20 millimeter projectile as being from the PGU A/B series family.

Preliminary analysis of the projectile by EOD subject matter experts in theater further refines it most likely is a PGU-27 A/B (TP) vs. a PGU-28 A/B (SAPHEI) round. Current analysis reveals that the projectile has no fuse nor does it contain any form of explosive expected in an HEI round. X-ray analysis of the recovered device performed to date does not demonstrate the unique thread pattern and internal disc characteristics that would be present in a PGU-28 round.

The round appears to be recently expended compared to previously deposited battlefield ordnance. Historically, expended PGU rounds subjected to ambient conditions begin to corrode within weeks based on NAVAIR tests. Despite corrosive conditions present in the battlefield, the round does not exhibit corrosion one would expect of a round that had been present on the ground for weeks.

The USN F/A-18 currently utilizes the 20 millimeter PGU A/B series. Current directives dictate aircraft attached to CVW-7 utilize 20 millimeter PGU-28 A/B “Semi-armor piercing high explosive incendiary” (SAPHEI) rounds in the battle space. There is no explanation as to why a 20 millimeter PGU-27 A/B round would be utilized and discovered in the battle space.

Current analysis indicates that there have been no other sources of 20 millimeter ordnance expenditures in or around location of the strafe incident of 05 December 2006 during the preceding two weeks and that the recovered projectile from 05 December 2006 is most likely a 20 millimeter round from a USN F/A-18 that was expended on or around 05 December 06.

TAB E

SECTION VI

20-MM PGU CONFIGURATION AMMUNITION

6-1 PGU CONFIGURATION 20-MM AMMUNITION.

The improved 20-mm (PGU) configuration ammunition for the M61A1/A2 and M197 Navy and Marine Corps aircraft guns is issued in the form of cartridges (figure 6-1). All service cartridges have matched ballistics and are electrically primed. Initially procured ammunition is not graded, and all accepted lots are serviceable for issue and use in applicable weapons. Unless otherwise noted, all dimensions are in inches. Weight is in grams and is abbreviated as gr.

6-2 Classification of Ammunition. The 20-mm PGU configuration ammunition currently issued is classified as follows:

- a. Target Practice Cartridge PGU-27/B
- b. Semi-armor Piercing High Explosive Incendiary Cartridge PGU-28/B (SAPHED)
- c. Target Practice-Tracer Cartridge PGU-30/B (TP-T)

6-3 Identification. Ammunition type is identified by the color that the projectile is painted. Refer to figures 6-2, 6-3, and table 6-1 for color coding.

a. The projectile lot number will be stenciled in waterproof marking ink around the body of the projectile after it is painted. The lettering will be placed 1/4-inch above the rotating band and will consist of the lot number followed by 20-mm. The projectile lot number information may be metal-stamped on the rotating band with .062 ± .016-inch high characters as shown in figure 6-2.

b. Case lot information is stenciled on the lower 1 1/2-inch of the case by the case manufacturer (figures 6-4 and 6-5). Case lot information may be stenciled longitudinally or circumferentially and shall include the information in figure 6-5.

c. Cartridge lot number information shall be stenciled circumferentially approximately 2 inches above the base of the case and shall include the information in figure 6-5.

6-4 GENERAL CHARACTERISTICS.

6-4.1 PGU Service and Target Practice Cartridges. The general characteristics are listed in table 6-2.

6-4.2 Cartridge Assembly. The cartridges are assembled in the following order at the loading facility:

a. The primer is secured in the cartridge with a 360 degree circular stake. The stake is located such that the thickness of metal between staking groove and primer cap is not less than 0.010 inch at any point.

b. After the primer is staked in the cartridge case, the joint between the contacting surfaces of the primer and cartridge case is waterproofed with lacquer.

c. The propellant is loaded into the cartridge case.

d. The projectile crimp groove is coated with a sealing compound. The projectile is inserted into the cartridge case mouth (while the compound is still wet) and seated on the rotating band.

e. The case is crimped to the projectile with a full 360 degree crimp to provide a minimum projectile extraction force of 1,100 pounds. The crimping is accomplished by applying a load to a confined flexible washer or ring that completely encircles, and is in contact with, the cartridge case neck. The load is applied to the flexible washer so that pressure built up within the washer is transmitted directly to the cartridge case. The flexible washer exerts a uniform pressure up to 39,000 psi (maximum) resulting in the formation of the entire crimp at once.

6-5 CARTRIDGE COMPONENTS, GENERAL DESCRIPTION.

6-6 Cartridge Case M103. The M103 cartridge case is manufactured from brass and weighs 1,855 ± 50 gr (figure 6-4).

a. The cartridge case is marked longitudinally or circumferentially with the caliber/case designation on the first line.

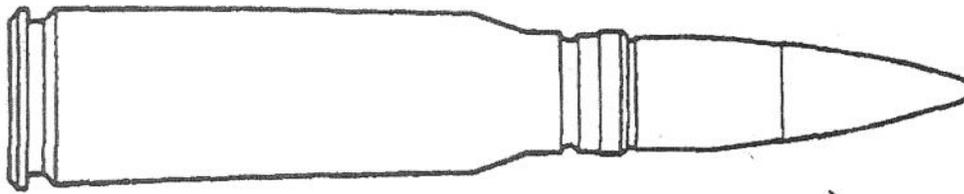
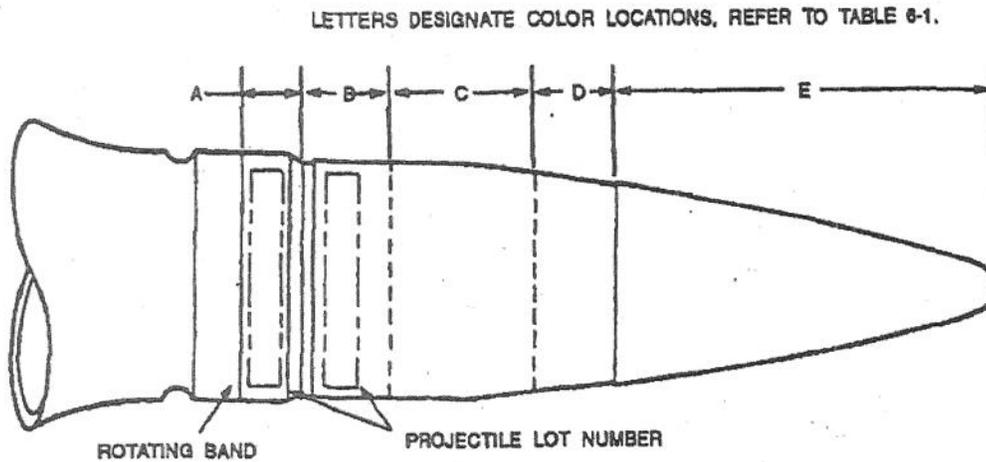


Figure 6-1. PGU Configuration Cartridge

GUN0155



GUN0156

Figure 6-2. Color Coding and Marking for PGU Configuration Ammunition

b. The symbol of the manufacturer is on the second line.

c. The interfix number, lot serial number, and year of manufacture are on the third line (figure 6-5).

d. Drawing 7553815

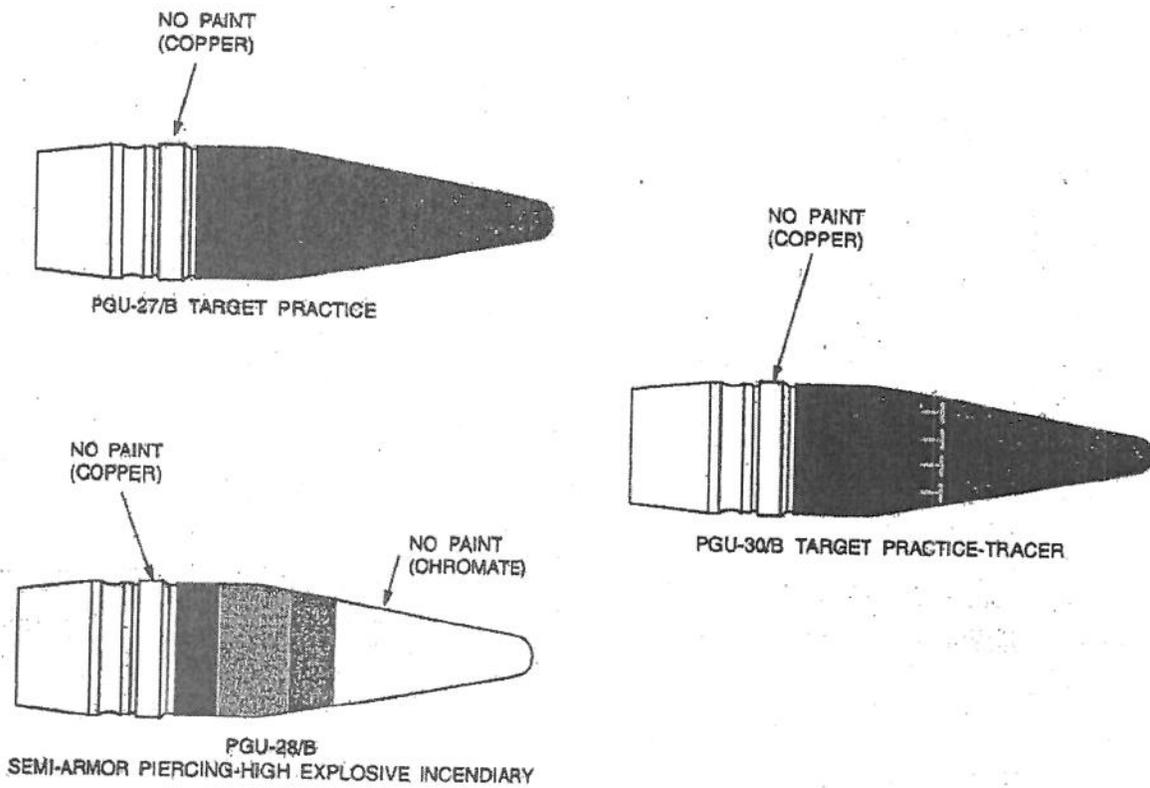
e. Specification MIL-C-46540

6-7 Propellant. All PGU Configuration cartridges are loaded with ball (spherical), WC 867 (Dwg 1575AS110) propellant in accordance with specification MIL-P-3984.

6-8 Electric Primer. M52A3B1. The electric primer is used in all 20-mm PGU Configuration service cartridges. Refer to paragraph 4-8 and figure 4-5.

6-9 Projectile. All the projectiles have essentially the same external configuration (figure 6-3). The rotating band is copper alloy swaged into a circumferential groove near the aft end of the steel body. The following projectiles are used in the PGU Configuration cartridges:

a. The PGU-27/B Target Practice (TP) projectile. A steel body with a solid aluminum nose piece swaged or crimped to the steel body.



GUN0157

Figure 6-3. Color Coding for PGU Configuration Projectiles

6-3/(6-4 Blank)

R-IV

Table 6-2. PGU Series Configuration Ammunition Characteristics

Cartridge				Approximate Unit Weight (gr)					Total wt. (gr) (approx.)
Designation	Type	Weapon	Packing	M103 case	M52A3B1 Electric primer	Propellant (585 gr)	Projectile	Chamber Pressure	
PGU-27/B	TP	M81A1/A2, M197	Bulk, Link	1,855	22	Ball, WC 887	1,550	Not to exceed 60,500 psi	3,900
PGU-28/B	SAPHEI	M81A1/A2, M197	Bulk, Link	1,855	22	Ball, WC 887	1,580	Not to exceed 60,500 psi	3,900
PGU-30/B	TP-T	M81A1/A2, M197	Bulk, Link	1,855	22	Ball, WC 887	1554	Not to exceed 60,500 psi	3,900
PGU-30A/B	TP-T	M81A1/A2, M197	Bulk, Link	1,855	22	Ball, WC 888	1654	Not to exceed 60,500 psi	3,900
PGU-27A/B	TP	M81A1/A2, M197	Bulk, Link	1,855	22	Ball, WC 888	1,550	Not to exceed 61,500 psi	3,900
PGU-28A/B	SAPHEI	M81A1/A2, M197	Bulk, Link	1,855	22	Ball, WC 888	1,522	Not to exceed 61,500 psi	3,900

1. Packing

Bulk..... 250 ctgs. M548 container

Link, M14..... 100 ctgs. M548 container

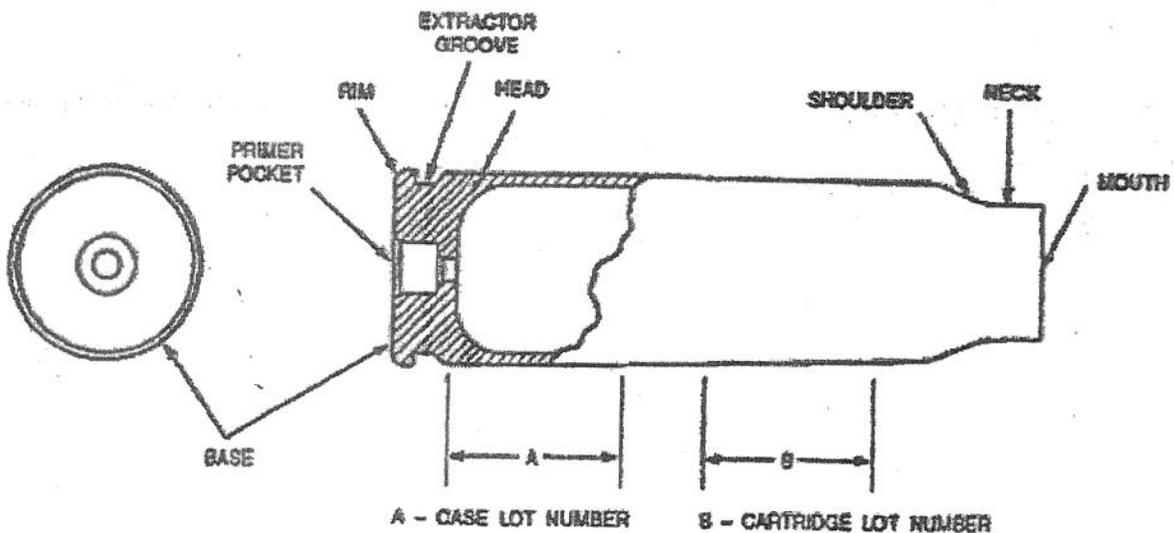


Figure 6-4. M103 Cartridge Case

Table 6-1. Color Coding and Marking for PGU Configuration Ammunition

Projectile Type	Color of Painting					Color of Marking
	Locations (See Figure 6-2)					
	A	B	C	D	E	
Target Practice (TP) PGU-27/B	No paint (copper)	Blue	Blue	Blue	Blue	White
Semi-Armor Piercing High Explosive Incendiary (SAPHEI) PGU-28/B	No paint (copper)	Black	Yellow	Red	No paint (chromate)	White
Target Practice Tracer (TP-T) PGU-30/B	No paint (copper)	Blue	Blue	Blue	Blue	White with Orange T's (location D)

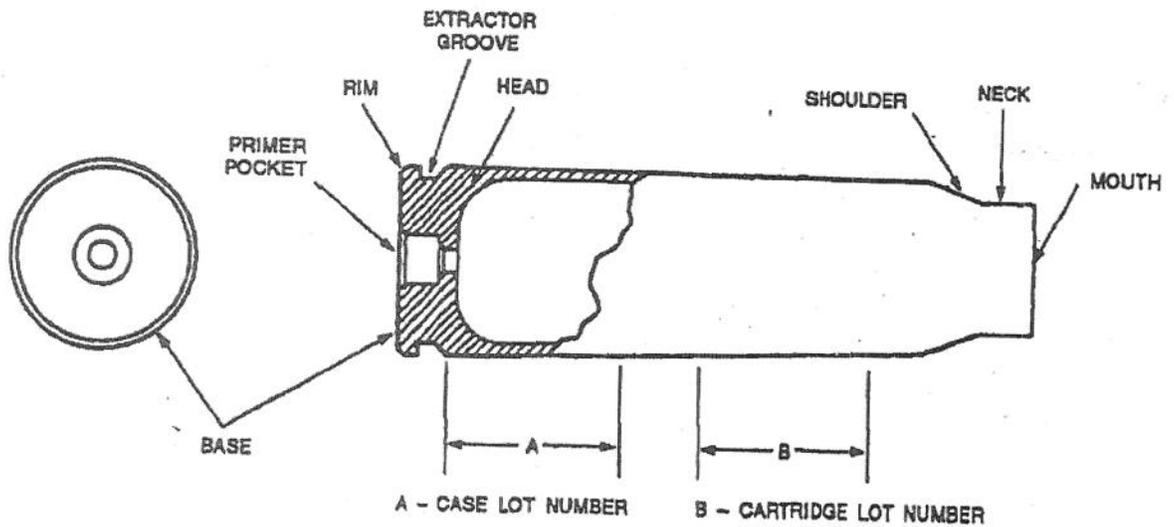


Figure 6-4. M103 Cartridge Case

6UND158

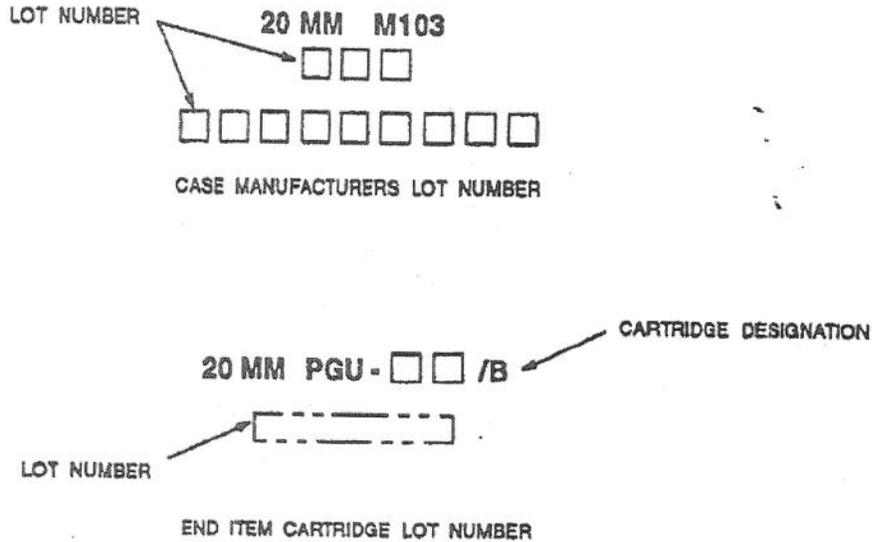


Figure 6-5. Example of Lot Numbering

Table 6-2. PGU Configuration Ammunition Characteristics

Cartridge		Approximate Unit Weight (gr)				Total wt. (gr) (approx.)
Designation	Type	M103 case	M52A3B1 Electric primer	Propellant	Projectile	
PGU-27/B	TP	1,855	22	585	1,550	3,900
PGU-28/B	SAPHEI	1,855	22	585	1,580	3,900
PGU-30/B	TP-T	1,855	22	585	1554	3,900
1. Chamber Pressure		Not to exceed 60,500 psi (copper)				
2. Muzzle Velocity		3,410 ft/sec at 78 ft				
3. Primer		Electric				
4. Weight		Service rounds 3,930 gr (.56 lbs) (9.0 oz) (maximum)				
5. Length		6.61 inches				
6. Cartridge Case		M103				
7. Propellant		Ball, WC 867				

B-IV

2. Requirement AR-68/47

100 ctgs, M14 link, M548 container

6-12 Semi-Armor Piercing High Explosive Incendiary Cartridge PGU-28/B. This cartridge (figure 6-7) is for use against aircraft and light material targets, and functions with semi-armor piercing, high explo-

1. The aluminum nose containing another incendiary mix completes the projectile.

b. Specification MIL-C-85717

Weapon Gun, Automatic, 20-mm, M61A1/A2, M197

c. Ballistic Single shot-test barrel Performance

2. Chamber Pressure:

Not to exceed 60,500 psi (copper)

6-12.1 Semi-armor piercing high explosive incendiary cartridge components and identification data consists of the following:

a. Cartridge:

Dwg 1575AS100, wt 3,930 gr (approx)

1. Case:

M103

2. Electric Primer:

M52A3B1

3. Propellant:

WC 867

4. Projectile:

Dwg 1575AS101

(a) Charged Projectile Body

Dwg 1575AS102

(b) Charged Nose

Dwg 1575AS103

b. Color Identification:

Projectile, yellow with black and red bands; marking, opaque white

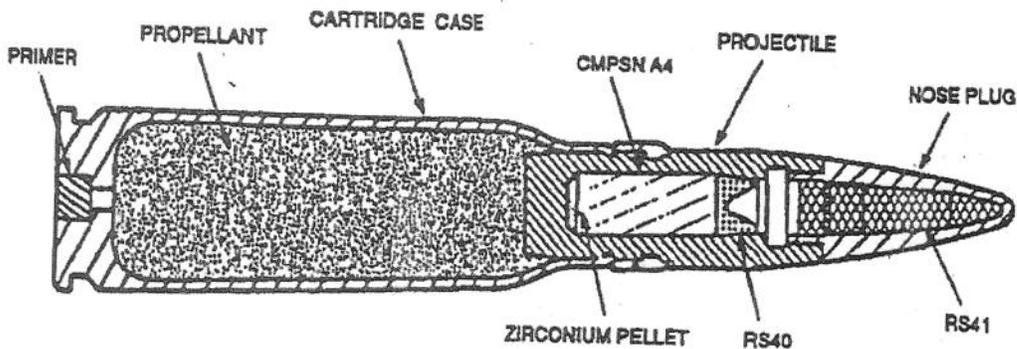


Figure 6-7. PGU-28/B Semi-Armor Piercing High Explosive Incendiary

GUN0160

TAB F

B-IV

Analysis of Strafe Incident of 05 December 2006

By Naval Air Warfare Center

POC:

Assumptions

- PGU-28 fragmentation characteristic
- 5000 feet target elevation
- 2.6mrad gun dispersion

Lethal Area

start firing: 7947 to 9934 ft in front of aircraft position at time of firing
 cease firing: 6586 to 8540 ft in front of aircraft position at time of firing

FRAGMENT TRAJECTORY DATA

PGU-27A/B Start Firing			
Fragment Initial Angle (deg)	Dist from projectile impact to frag impact (feet)	frag impact vel (ft/sec)	frag impact energy (ft lbs)
0.	23.	4515.	12672.
1.	823.	229.6	32.8
2.	948.	158.7	15.6
3.	1022.	129.0	10.3
4.	1074.	112.8	7.9
5.	1114.	103.2	6.6
10.	1227.	89.4	5.0
179.	-662.	250.2	38.9
178.	-790.	171.3	18.2
177.	-866.	137.8	11.8
176.	-919.	119.3	8.8
175.	-961.	107.9	7.2

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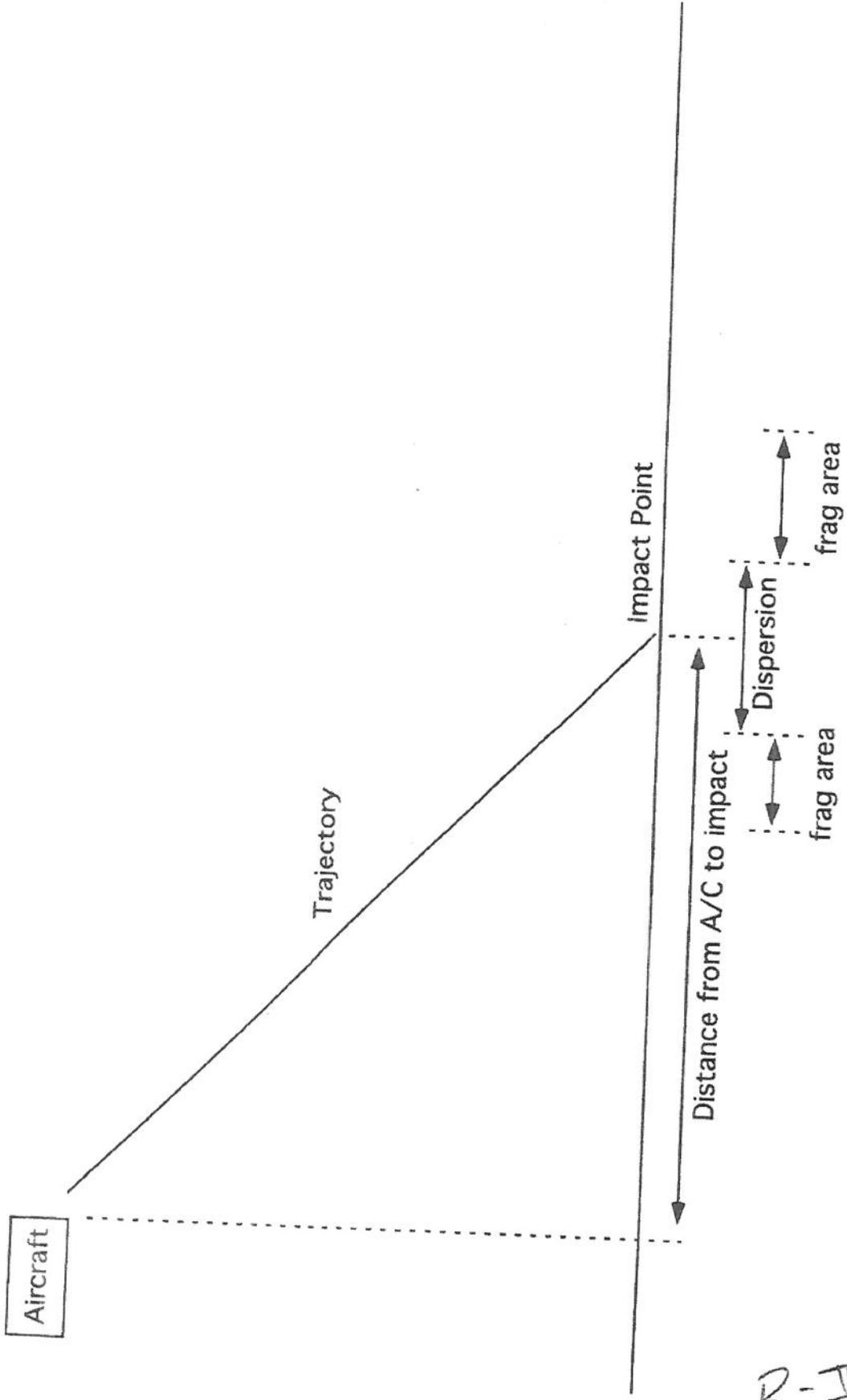
PGU-27A/B Cease Firing			
0.	25.	4769.	14138.
1.	845.	227.0	32.0
2.	970.	157.2	15.4
3.	1043.	127.8	10.2
4.	1095.	112.1	7.8
5.	1135.	102.6	6.5
10.	1246.	89.5	5.0
179.	-630.	254.8	40.4
178.	-759.	174.2	18.9
177.	-835.	139.8	12.1
176.	-889.	120.8	9.1
175.	-930.	109.0	7.4
PGU-27/B Start Firing			
0.	24.	4549.	12863.
1.	826.	229.2	32.6
2.	951.	158.5	15.6
3.	1025.	128.8	10.3
4.	1077.	112.7	7.9
5.	1117.	103.1	6.6
10.	1230.	89.5	5.0
179.	-658.	250.8	39.1
178.	-785.	171.7	18.3
177.	-862.	138.1	11.8
176.	-915.	119.5	8.9
175.	-956.	108.1	7.3
PGU-27/B Cease Firing			
0.	25.	4835.	14532.
1.	850.	226.4	31.9
2.	975.	156.8	15.3
3.	1049.	127.7	10.1
4.	1100.	111.9	7.8
5.	1140.	102.5	6.5
10.	1251.	89.5	5.0
179.	-622.	256.1	40.8
178.	-750.	175.0	19.0
177.	-826.	140.4	12.2
176.	-880.	121.2	9.1
175.	-922.	109.4	7.4

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PGU-28A/B Start Firing			
0.	24.	4531.	12762.
1.	824.	229.4	32.7
2.	949.	158.6	15.6
3.	1024.	128.9	10.3
4.	1076.	112.8	7.9
5.	1115.	103.1	6.6
10.	1228.	89.5	5.0
179.	-660.	250.4	39.0
178.	-788.	171.5	18.3
177.	-864.	137.9	11.8
176.	-918.	119.4	8.9
175.	-959.	108.0	7.2
PGU-28A/B Cease Firing			
0.	25.	4803.	14340.
1.	848.	226.7	31.9
2.	972.	157.0	15.3
3.	1046.	127.8	10.2
4.	1098.	112.0	7.8
5.	1137.	102.6	6.5
10.	1249.	89.5	5.0
179.	-626.	255.5	40.6
178.	-754.	174.6	19.0
177.	-830.	140.1	12.2
176.	-884.	121.0	9.1
175.	-926.	109.2	7.4
PGU-28/B Start Firing			
0.	24.	4547.	12852.
1.	826.	229.2	32.6
2.	951.	158.5	15.6
3.	1025.	128.8	10.3
4.	1077.	112.7	7.9
5.	1117.	103.1	6.6
10.	1230.	89.5	5.0
179.	-658.	250.7	39.1
178.	-786.	171.7	18.3
177.	-862.	138.1	11.8
176.	-916.	119.5	8.9
175.	-957.	108.0	7.2

PGU-28/B Cease Firing			
0.	25.	4832.	14514.
1.	850.	226.4	31.9
2.	975.	156.9	15.3
3.	1048.	127.7	10.1
4.	1100.	111.9	7.8
5.	1140.	102.5	6.5
10.	1251.	89.5	5.0
179.	-622.	256.1	40.8
178.	-750.	175.0	19.0
177.	-826.	140.4	12.2
176.	-880.	121.2	9.1
175.	-922.	109.3	7.4

B-IV



B-IV

Start of run

Aircraft

Trajectory

DR = 7947 to 9899

Impact Point

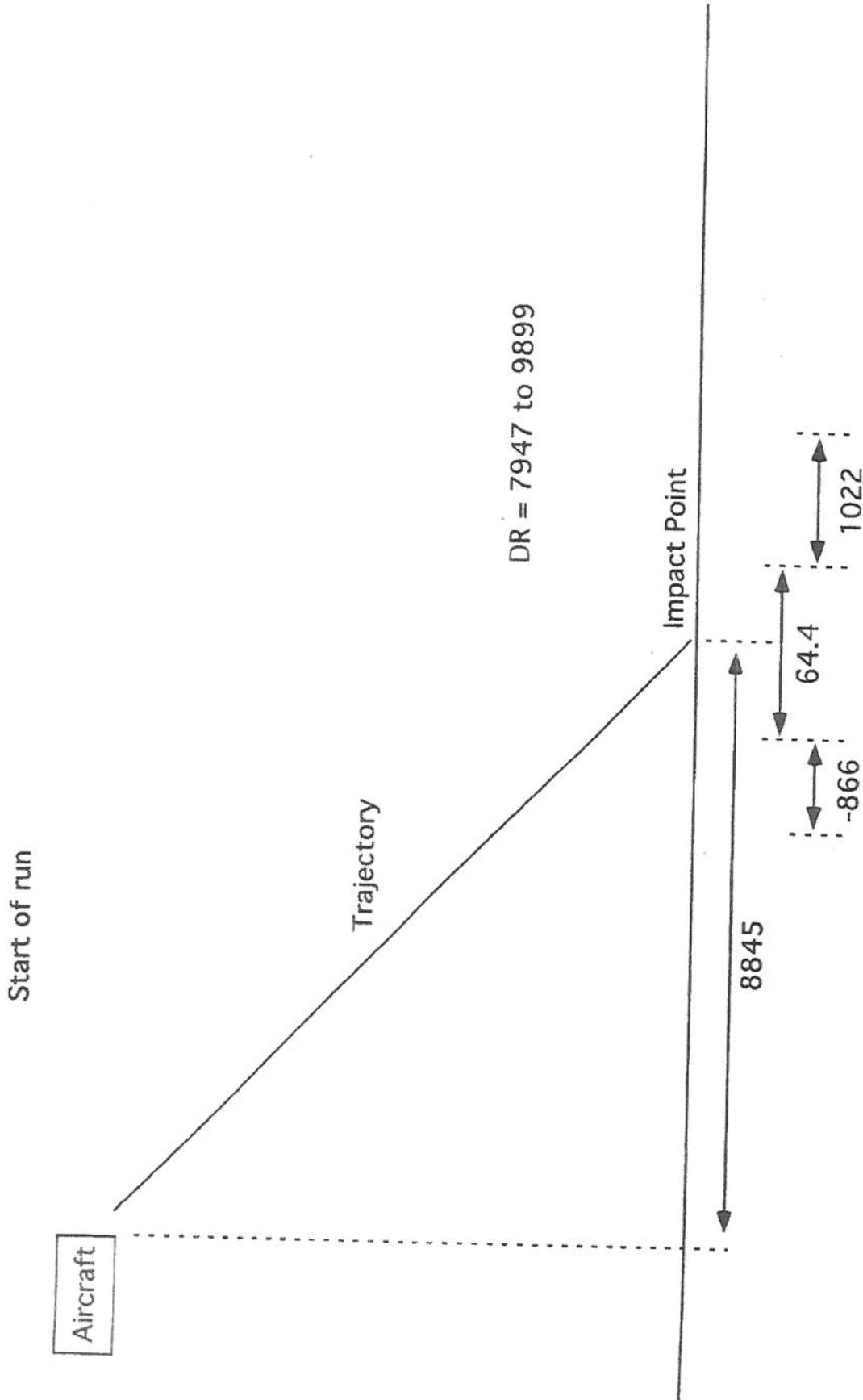
8845

64.4

-866

1022

B-IV



End of run

Aircraft

Trajectory

DR = 6586 to 8520

Impact Point

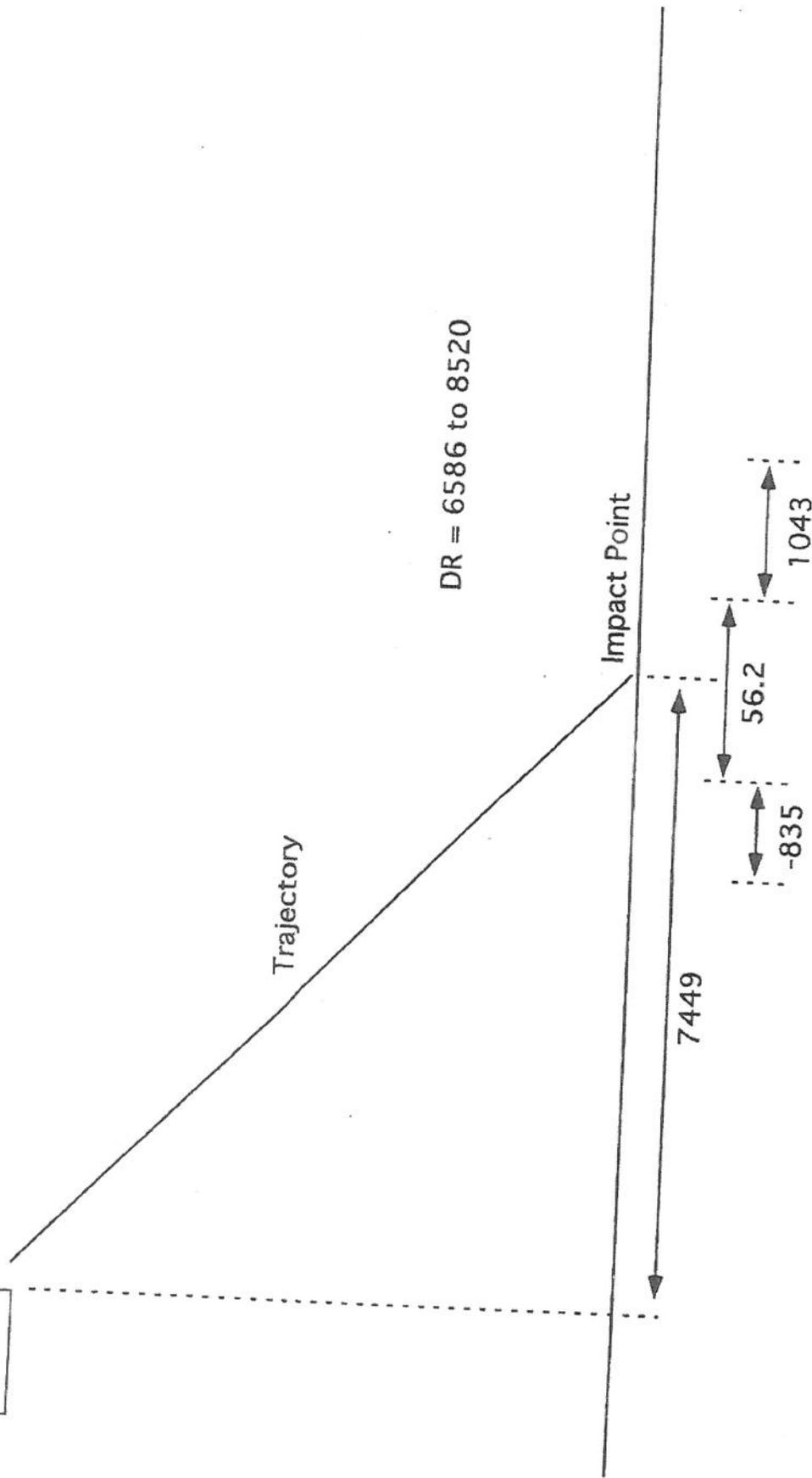
7449

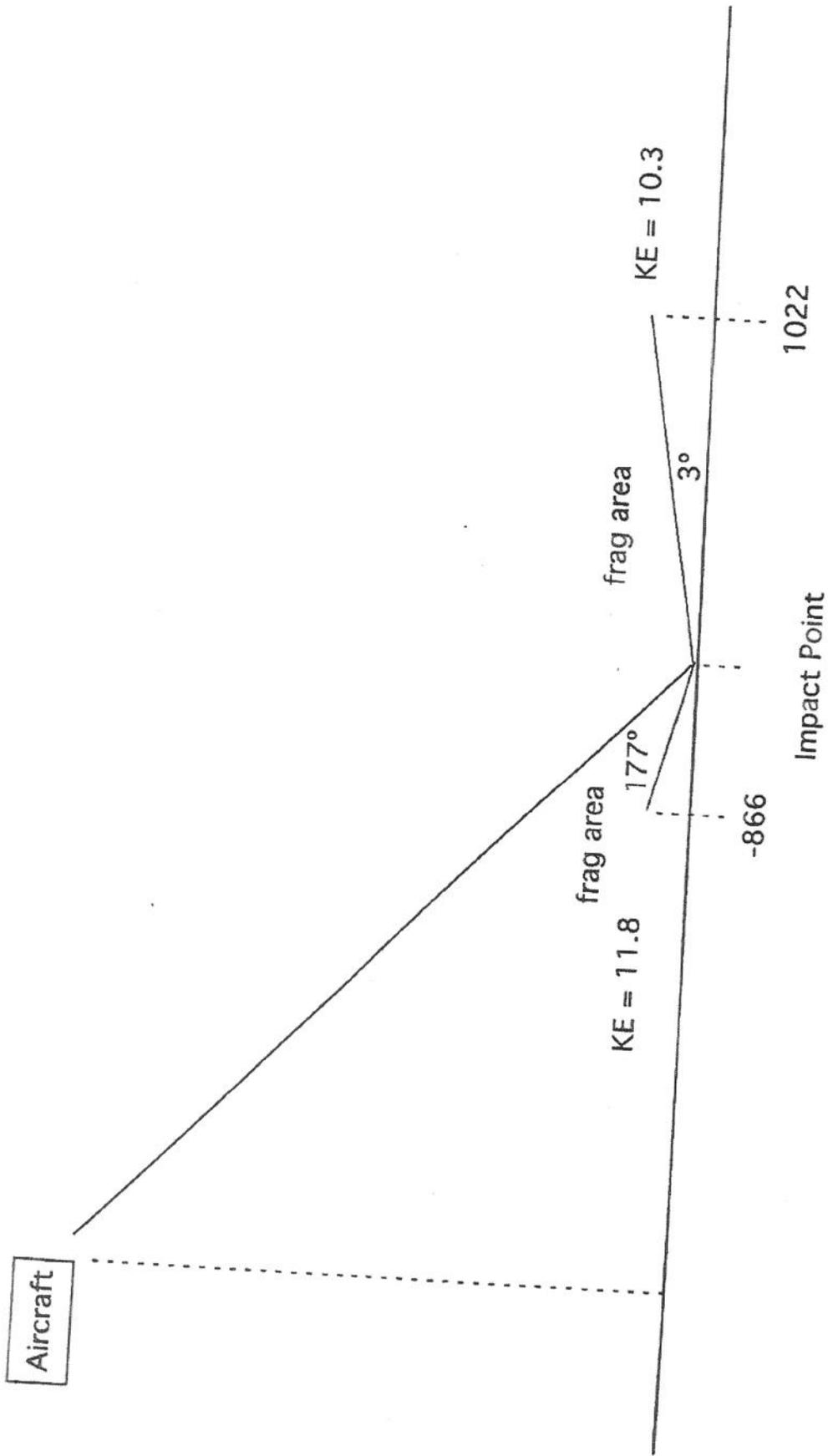
56.2

-835

1043

B-IV





B-IV

TAB G

B-IV

20mm Contacts

Qatar:
TSgt
379 ECES/EOD
(Note departed AOR)

Naval Air Warfare Center - Aircraft Division 21960 Nickles Road Bldg
201 - Suite 1A Patuxent River MD 20670-1539
EMAIL
COM:
Cell:
DSN:
FAX:

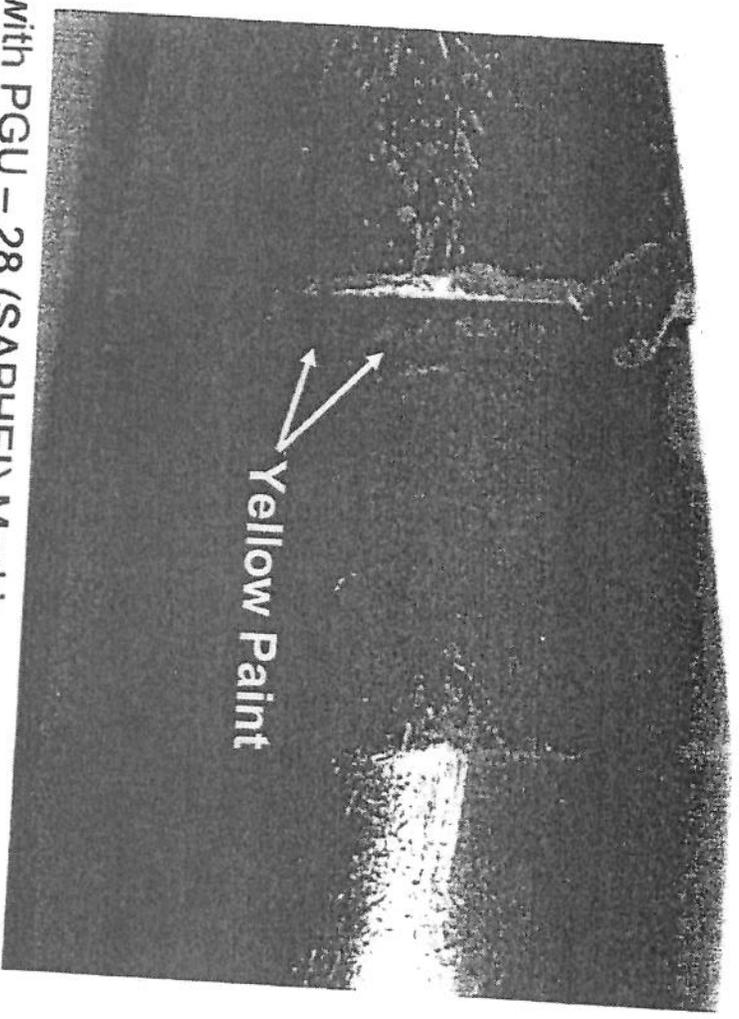
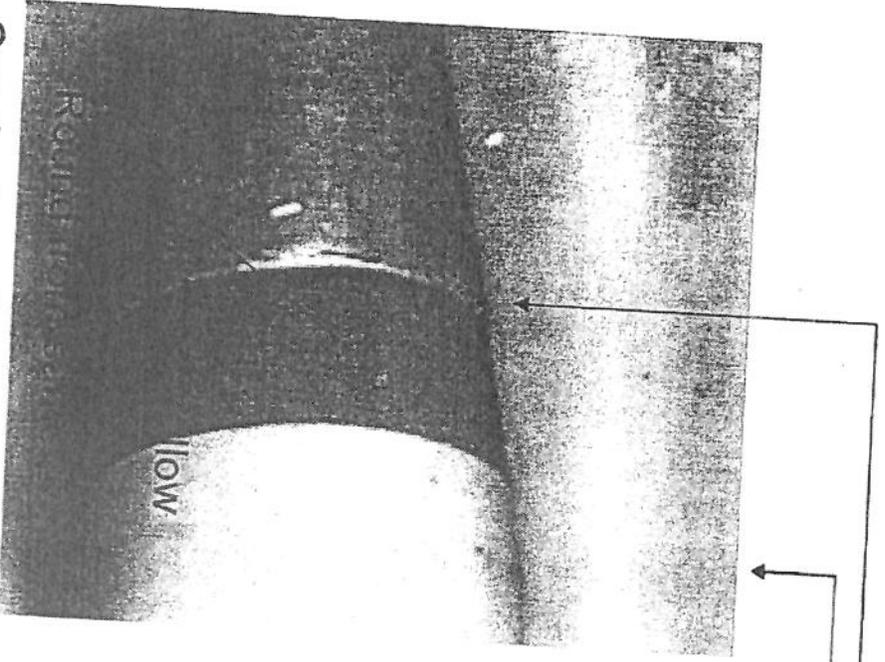
Crane Division, Naval Surface Warfare Center (NSWC Crane) Harnessing
the Power of Technology for the Warfighter Code 4022, BLDG 121 300
Highway
361 Crane, IN 47522-5001
Email
Com:
DSN:

TAB H

B-IV

Possibility of Incorrect Marking

B-IV



Conclusions: PGU – 27 (TP) rounds with PGU – 28 (SAPHEI) Markings
-or- Multiple PGU -28 rounds that did not go high order – (Duds)

TAB I

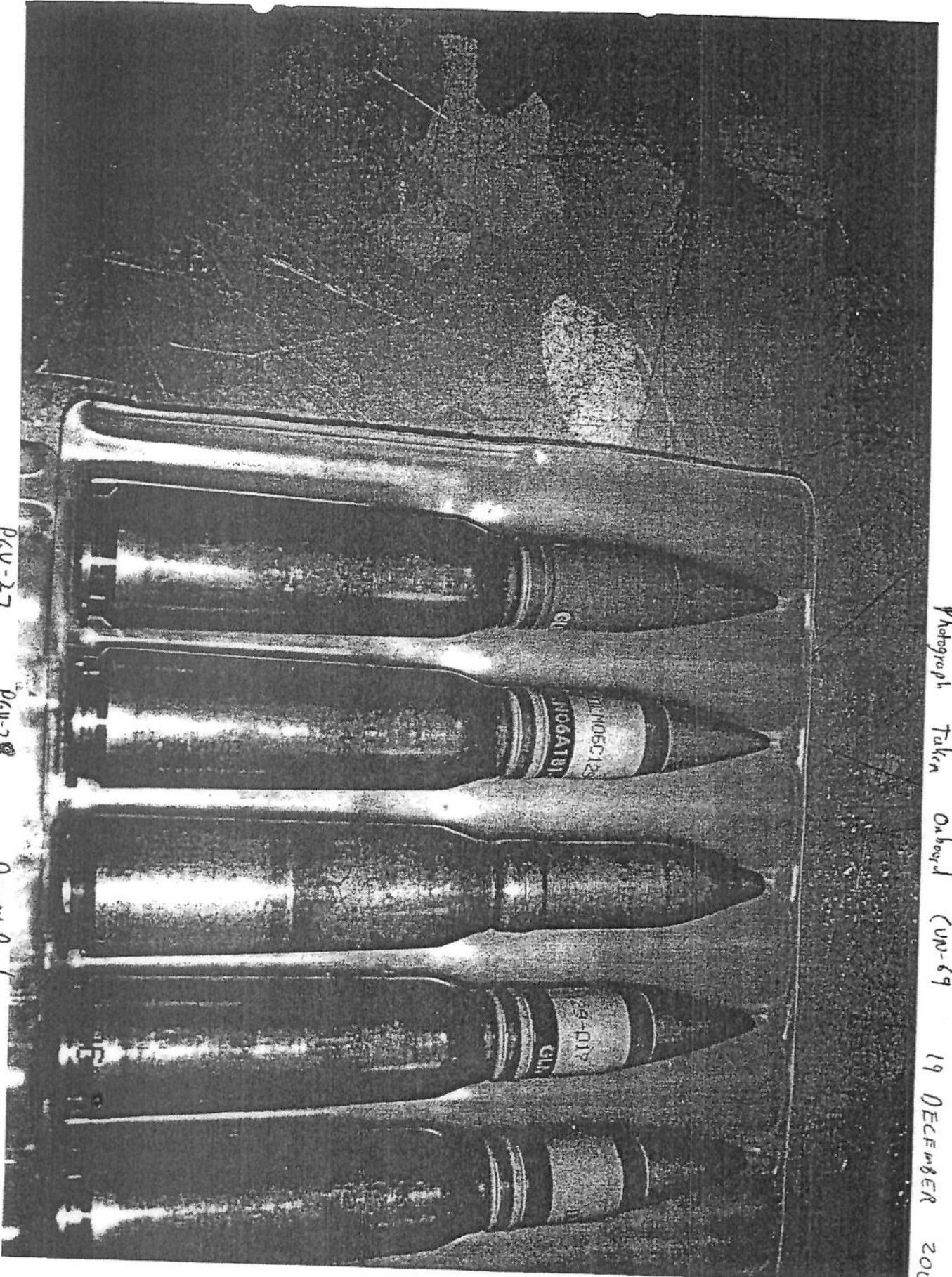
B-IV

Photograph Taken Onboard CVN-69

19 DECEMBER

2006

B-IV



PGU-27

PGU-28

Dummy Round

29 Dec 06

Combined Incident Board (via Wg Cdr

EXHIBIT CERTIFICATE

1. The attached exhibit numbered ... and briefly described as 1 by 20mm round silver in colour has been recovered by Special Investigations Branch (Army) in connection with case number 13167/02 an investigation into the death of Marine
2. The exhibit is surrendered to your safe care and custody for the purposes of identification and examination by the Combined Investigation Board convened in accordance with United States Department of Defence Direction and under United States Central command direction on 15 December 2006.
3. Upon completion of the Combined Investigation Board's inquiries the exhibit may be required by authorities of the United Kingdom in connection with it's own national inquiries.

B-IV

TAB J

B. IV

TAB L

20MM-EVIDENCE

From:
Sent:
To:
Subject:

USN NAVAIR 4112
weanesaav. December 20, 2006 8:44 PM
RE: Photographs & Data

CDR

Received your email. I had just gotten off the phone with our Ballistics folks when it arrived. I have forwarded the parameters and they will begin their analysis right away. I asked for an ETA, best guess at this point is 2-3 days. I have also spoken with PMA-242 and requested information in regards to PGU/M50 series fuzing for HEI rounds. I will forward that information as soon as I receive it, independent of the Ballistics analysis.

I looked at the photos, my initial impression is that the projectile is from a PGU-27 TP round (sand blasted from the looks of it). We have a gun firing tunnel here at Pax and we use sand as a bullet trap, the projectile looks very similar to 20mm TP ammo pulled from the sand at the end of testing. Based on the solid nose cone and its angle in relation to the body of the projectile as well as the pronounced boat tail, I am confident that the projectile is from a PGU-27 TP round. I will do a comparison by superimposing the photos over known M50 series (M55) and PGU series (PGU-27 and PGU-28) projectiles to verify its lineage.

Let me know if you have any addition questions.

-----Original Message-----

From:
Sent: Wednesday, December 20, 2006 10:11
To:
Subject: Photographs & Data

<<BAF_0011.JPG>>
<<BAF_0005.JPG>>
D <<BAF_0009.JPG>> ean,

Examine the attached pictures and relay what you think the source is.

Secondly Data you requested for analysis:

Airframe: F/A-18C

Gun Run:

Initiate:
On trigger start time:
Airspeed:

airspeed)
Altitude:
relative altitude)

Dive Angle:
OAT:
Remaining Round Count

Terminate:
Off trigger stop time:
Airspeed:
Altitude:
Dive Angle:
Remaining Round Count:

B-IV

Don't read too much into the fidelity of the time elapse we took it off the HUD tape with an elapsed time counter. But roughly 2 to 3 seconds on the trigger with 213 rounds expended. We suspect that the fire rate was but could have been selected at (we will attempt to ascertain).

Please run analysis for both fire rates and all three ammunition types (TP, PGU-28/B, PGU-28A/B). Let me know if you need additional supporting documentation.

V/R

CDR

Naval Safety Center

TAB M

B-IV

20MM - Evidence

From:
Sent: Thursday, December 21, 2006 9:30 PM
To:
Subject: FW: PGU-28 Question

Attachments: Effectivness.pdf; fusing.pdf; LethalityAndFrag.pdf; Ammo Color Code.jpg



Effectivness.pdf
(429 KB)



fusing.pdf (289 KB)



LethalityAndFrag.p
df (697 KB)



Ammo Color
Code.jpg (122 KB)

CDR

As I mentioned yesterday, I forwarded the projectile photo to some of our ammo guys; including the Ammo Team Lead in PMA-242, the Item Manager, the DPML, and 2 ammo engineers from Crane IN. The general consensus is that the projectile is "MOST LIKELY" from a PGU-27A/B TP round. However, without the ability to physically examine the round, most prefer to error on the side of caution. It is highly recommended that the round be handled as if were a live PGU-28A/B until its identification can be positively determined. As far as X-raying the projectile, that option is presently being discussed among the engineers at Crane. I will pass on any information as soon as I receive a call from Crane.

I touched on this a bit yesterday, but let me give you some background on the PGU round; and why we are so sure that the projectile is from the PGU A/B series family. The PGU round was meant to replace the older M50 series ammunition, and was originally designated as PGU /B. This round has much better ballistic as well as lethality characteristics, particularly in regard to air-to-air use. Shortly after the round was fielded, the fleet began to report a increased number of gun maintenance issues, including high speed gun jams. An investigation revealed that /B rounds were generating significantly higher chamber pressure when fired, as compared to the old M50 series round. In addition, there were a number of incidents involving in-bore detonations with the PGU-28/B round. If I remember correctly the cause of the in-bore problem was identified as a combination of assembly techniques; involving installation of the nose cap during production. In an effort to improve the performance of the round, a product improvement program (PIP) was initiated. The first efforts of the PIP focused on lowering the chamber pressure produced by the round. The fix for lower chamber pressure included a chemical change to the propellant and a change in the size and material of the rotating band on the projectile. The fix for the PGU-28 in-bore detonation involved a change in fuzing and improved manufacturing processes. I know this is a very broad brush summary, I can provide a more in-depth information if needed. The main point I'm trying to make is, the slender iron rotating band observed in the photos makes it easy to identify the projectile as coming from a A/B series round.

I have attached some information received from PMA-242 about the PGU round. As (PMA-242 Ammo Team Lead) indicates in email below, please be aware that the attached PDF files are considered proprietary information. I have also attached a page from the NA11-1-119 ammo manual that shows the identification color codes of the particular PGU rounds.

If you need to reach me outside of the office, please give me a call on my cell. I live close to the base, don't have any big plans for the weekend, and my schedule is very flexible, so don't hesitate to call if you need some leg work done or answers to questions. I spoke with our Ballistics folks this morning, they seem to be on track and I hope to have some ballistic frag and dispersion information within the next two days (that is still a guess on my part).

Naval Air Warfare Center - Aircraft Division 21960 Nickles Road Bldg 201 - Suite 1A
Patuxent River, MD 20670-1539

EMAIL:
COM:
DSN: :
Cell:
FAX:

-----Original Message-----

From: NAVAIR
Sent: weanesday, December 20, 2006 14:59
To: USN NAVAIR
Cc: NAVSURFWARCENDIV Code 4022; NAVSURFWARCENDIV
Crane Code 4022, BLDG 2540; DIV NAVAIR PMA242;
Subject: PGU-28 Question

In addition to the question you received this morning about fusing and fragmentation, our office received questions yesterday from VFA-11. Their question had to do with the minimum velocity a round must be traveling upon impact to detonate. They said they were trying to dispel at rumor. There's more information in their email below.

The engineers at Crane are currently researching these question. But, I'd thought I'd send it to you as well to see if you had any insight in this area.

I looked through my files here this morning and found some information relating to lethality, effectiveness, fragmentation and fusing. Please note that most if it is proprietary information.

Very Respectfully,

NAVAIR Medium Caliber Ammunition Team Lead
Ph:
Fax:

-----Original Message-----

From:
Sent: weanesday, December 20, 2006 12:28
To: NAVSURFWARCENDIV Code 4022
Subject: FW: HSI round requirements to go high order

I have included the e-mail which may have started a lot of the discussion you are hearing about. The topic is sparked from the ranges/altitudes we are employing the gun. Please let me know your thought on the matter or if you have any further questions.

V/R.

VFA-11 Training Officer

After talking with my Gunner and having my A/G WTO do some research this is what we came up with.....

PGU-28 will be ballistically stable and not tumbling at speeds as low as 750 ft/sec. As long as the round is stable and not tumbling it will go high order upon impact.

Current Hornet software computes "in range" que with rounds arriving at the target with a minimum of 1000 ft/sec. To employ high slant range shots....i.e. beyond ranges were the round decelerates below 1000' ft/sec will require the pilot to use a slightly offset aim point. Bullet drop to increase time of flight and decreased bullet velocity must be taken into account and the aim point adjusted 100-400 ft long.

All of this is predicated on a 30 deg dive pattern and can be referenced in Top gun Chapter 21 page 71.....hope this helps

Very Respectfully