MUNITIONS RESPONSE PLAN

San Diego Unified School District
Data Center and Serra High School IT Academy
5156 Santo Road
San Diego, CA 92124

29 June 2012

San Diego Unified
SCHOOL DISTRICT

Prepared By:

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(858) 217-5532

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Munitions Response Plan is to provide the San Diego Unified School District (SDUSD) the procedures necessary to ensure safety precautions are taken and the appropriate agencies are notified in the event that munitions / unexploded ordnance (UXO) are encountered during construction activities at the SDUSD Data Center and Serra High School IT Academy field located at 5156 Santo Road, San Diego, California 92124.

1.2 Background

Serra High School and the proposed SDUSD Data Center are located within the limits of the historical Department of the Navy's Camp Elliot (Figure 1). Camp Elliott encompassed the areas that are currently referred to as Tierrasanta, Murphy Canyon, and Mission Trails Regional Park. Camp Elliott was used by the Navy for military training beginning in 1917. Intensive uses conducted during World War II included tank and parachute training for infantry, scout, mortar, and sniper schooling. Munitions training was provided for various inventories at that time, ranging from .22 caliber rifles to 155-millimeter (mm) field artillery pieces, incendiary devices, mines, and explosives. Serra High School is within or adjacent to areas that were historically used for live fire. The hazards associated with the munitions are discussed the attached *UXO Recognition, Avoidance and Reporting Procedures* (Attachment 1). In 1960-1961 Camp Elliott was closed by the Navy and transferred to the General Services Administration, which disposed of the land to different parties.

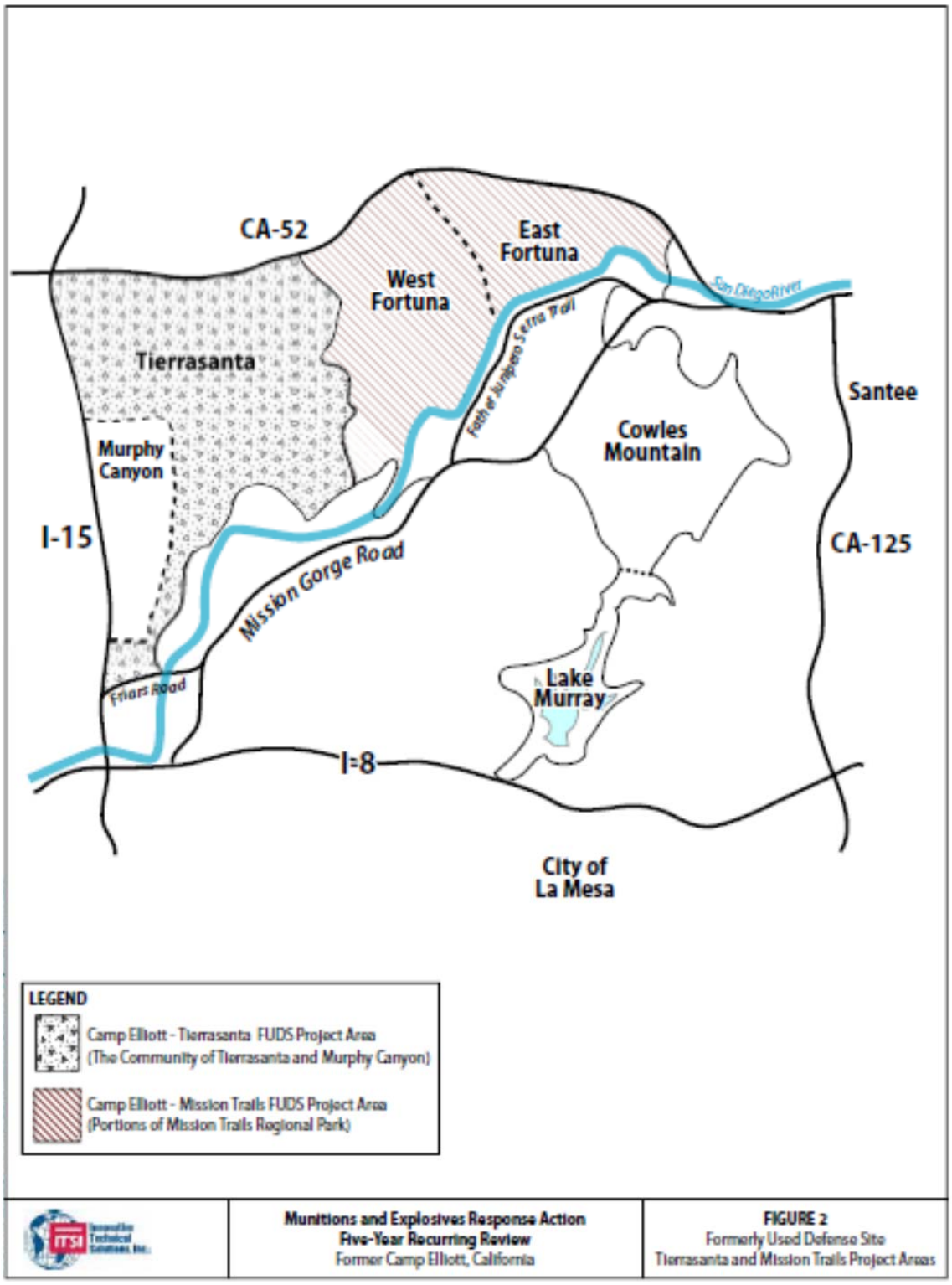

Figure 1. Camp Elliot Location

2.0 PREVIOUS INVESTIGATION RESULTS

The Army, Navy, and U.S. Army Corps of Engineers (USACE) have conducted the following clearance, reports, investigations, and assessments in accordance with the Military Munitions Response Program (MMRP) for environmental response activities on Formerly Used Defense Sites (FUDS).

2.1 1964 to 1973 Army and Navy Clearance

Various inspection and ordnance clearance activities were conducted by the Army and Navy between 1964 and 1973, after the closure of Camp Elliott.

2.2 1983 Army Surface Sweep

In 1983 two boys were killed by a 37-millimeter projectile that they found in an undeveloped area of Tierrasanta. New clearance activities of approximately 326 acres of open space were conducted by the Army later in 1983. Over 50 pieces of ordnance were discovered and 8 were reported to be potentially explosive.

2.3 1988 Feasibility Study

In 1988 the site was transferred to the FUDS program. USACE prepared a Feasibility Study and issued a Record of Decision that recommended ordnance clearance as the remedial action.

2.4 1990-1994 Ordnance Inspection and Clearance

Between 1990 and 1994 USACE conducted ordnance inspection and clearance activities of approximately 1,364 acres of land. The project recovered 4,803 ordnance items and 26,000 pounds of ordnance debris.

2.5 1999 Military Munitions Response Program (MMRP) Five-Year Recurring Review

USACE conducted a site reconnaissance as part of the first scheduled Military Munitions Response Program (MMRP) Five-Year Recurring Review. The review reported that the previous clearance activities were “protective of public safety.” The findings and recommendations of the review were published in 2003.

2.6 2006 Military Munitions Response Program (MMRP) Five-Year Recurring Review

USACE conducted site visits between November 16 and 20, 2006, and on April 22, 2008, as part of the second Five-Year Recurring Review. The Draft report of their findings stated that the previous clearance activities were "protective of public safety." The Draft report also recommended Worker Safety Briefings and MEC Awareness Presentations in Schools.

2.7 2009 Draft Public Involvement Plan and Five-Year Recurring Review

In April 2009 USACE published the *Draft Public Involvement Plan (PIP) for the Tierrasanta and Mission Trails Project Areas, Former Camp Elliott, San Diego, California* and the *Draft Five-Year Recurring Review, Munitions and Explosives Response Action, Former Camp Elliot, Tierrasanta, San Diego, California.* The PIP contains the following three elements: Minimize the Possibility of Injuries from unexploded ordnance (UXO); Keep the Public Informed; and, Provide Opportunities for Public Involvement and Input.

Based on an interview with USACE in June 2012, the final PIP or implementation has not occurred. Although the document is not final, the activities included in the Draft PIP are applicable to the Serra High School Project.

3.0 UXO / MEC Data

Historical records indicate that a wide range of weapons and explosives were used at Camp Elliott, including small arms, artillery, and incendiary devices. Munitions from all of these categories have been discovered and removed during the various clearance actions. However, it is possible that additional rounds of any or all of the munitions employed at Camp Elliott remain at the subject site. All of these munitions should be considered hazardous until inspected by a UXO Technician. Specific information for the various types of munitions used at Camp Elliot are discussed in the attached *UXO Recognition, Avoidance and Reporting Procedures (Attachment 1).*

4.0 MEC SAFETY PRECAUTIONS

General and Specific safety information for the various munitions are discussed in the attached *UXO Recognition, Avoidance and Reporting Procedures (Attachment 1).*

5.0 EVACUATION PROCEDURES

In the event a suspected hazardous munitions item is encountered notify the agencies listed in Section 6.0 and implement the following procedures:

- Cease operations and withdraw personnel 250 feet away from the suspected item until it can be evaluated by the UXO technician on-site or personnel from the San Diego Metro Arson Strike Team (MAST).
- Contact MAST for assistance via the 911 Emergency network.
- If no UXO technician is on-site, keep all personnel away from the item until the proper emergency response personnel declare the area is safe.
- Direct personnel to the Evacuation Rally Point located at the southeast school parking lot. See Figure 2 below for a map identifying the location.
- Stay clear of the hazard until all the following conditions occur:
  - Situation is resolved by the appropriate emergency responders
  - The "All Clear" is given
  - You are instructed to return to the work area by the appropriate responding agency.


DATA CENTER CONSTRUCTION
RALLY POINT
Porto Ct
Fino Dr
Santo Rd
Tierrasanta Blvd
© 2012 Google
Google earth

6.0 PROJECT CONTACT INFORMATION

The following table identifies the key project personnel associated with this project.

CONTACT	TELEPHONE
Serra High School – Principal—Michael Jimenez	(858) 442-3116
Serra High School – Site Operations—Jeffrey Thomas	(858) 504-0687
Serra High School – Plant Operations Supervisor—Carlos Gaines	(858) 231-4381
SDUSD Safety Program Supervisor—Glen Boogren	(858) 637-3698
SDUSD Construction Manager—Dave Machek	(619) 517-7131
SDUSD Risk Management –Ashley Fenton	(858) 627-7354
SDUSD Police/Security--Dispatcher	(619) 725-7002
SDUSD Police/ School Police Officer—Tom Gray	(858) 496-8342 ext. 213
SDUSD Director of Project Management –Gary Stanford	(858) 573-5727
US Army Corps of Engineers - Mr. Lloyd Godard, FUDS Project Manager	(213) 452-4014

7.0 EMERGENCY MEDICAL FACILITY

The closest medical facility to Serra High School is Sharp Memorial Hospital. See the information below for contact information, directions and route map (Figure 3).

Sharp Memorial Hospital
7901 Frost St.
San Diego, CA 92123-2786
(858)-541-3400

Directions to Sharp Memorial Hospital from SDUSD Data Center:

1. Head south on Santo Rd toward Tierrasanta Blvd. go 0.2 miles
2. Take the 1st right onto Tierrasanta Blvd. go 0.8 miles
3. Continue onto Balboa Avenue go 1.6 miles
4. Turn left onto Kearny Villa Road go 1.4 miles
5. Continue onto Mesa College Drive go 0.2 miles
6. Turn left onto Health Center Drive go 0.2 miles
7. Turn left onto Frost Street go 466 feet
8. Turn right into hospital (7901 Frost St, San Diego)

Total Estimated Travel Time: 12 minutes

Total Distance: 4.5 miles

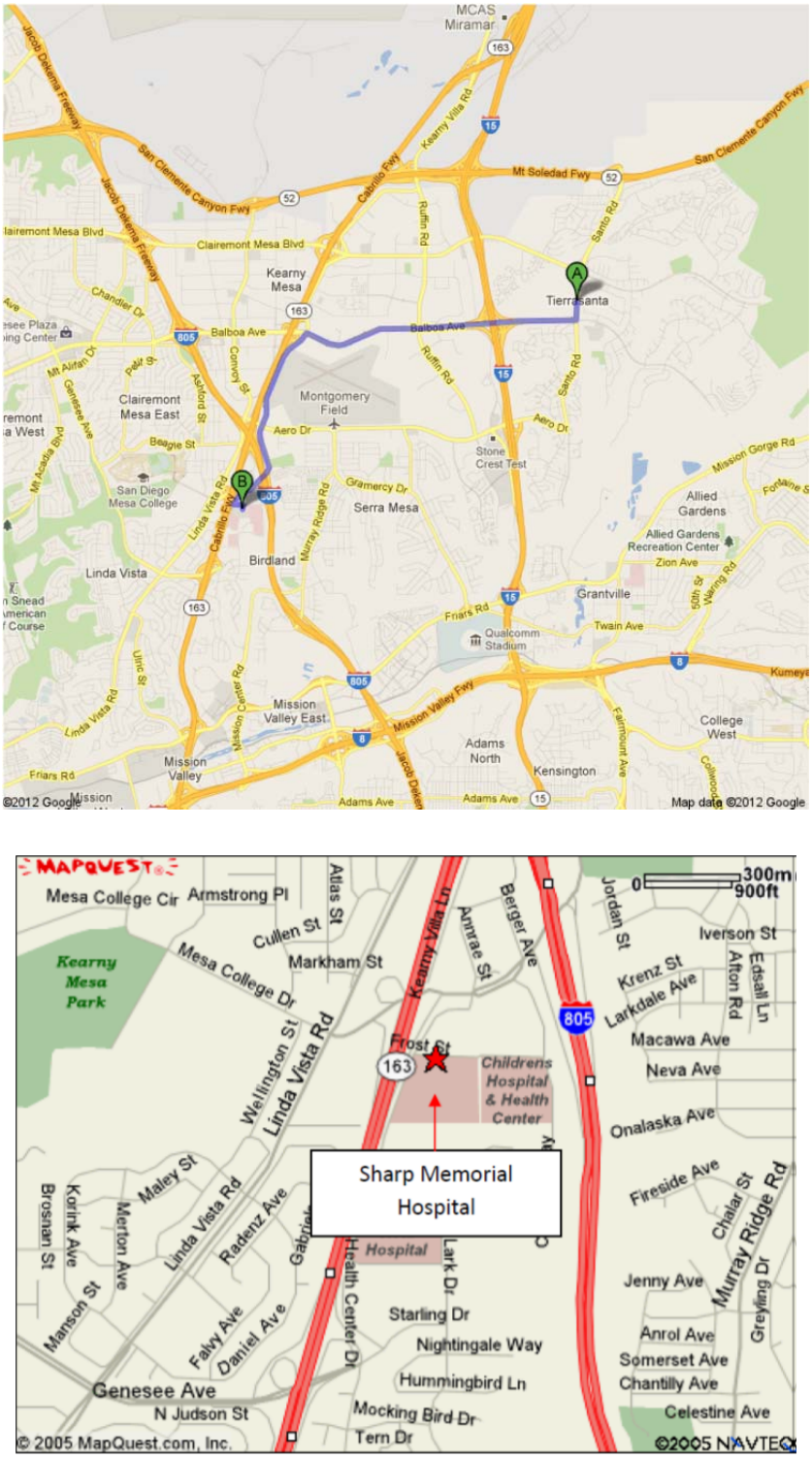

Figure 3. Sharp Memorial Hospital Route Map

ATTACHMENT ONE

UXO Recognition, Avoidance, and Reporting Procedures

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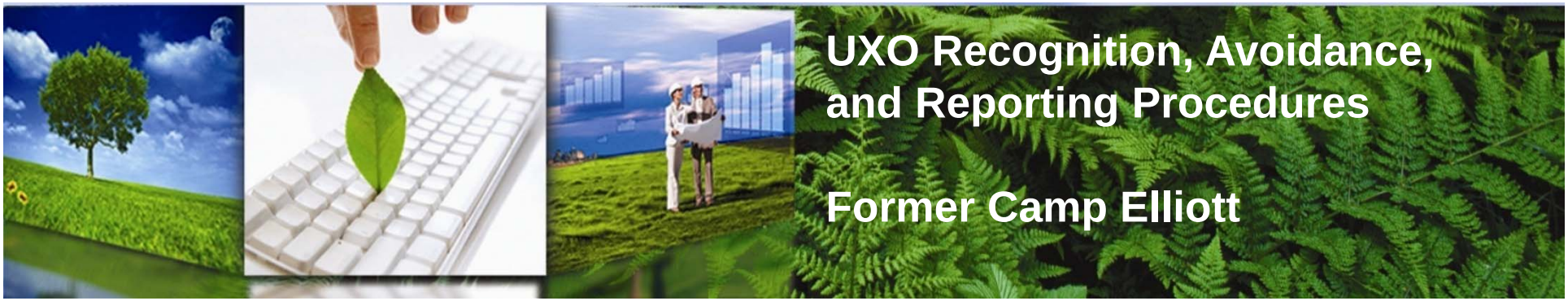
Collaborate. Innovate. Deliver.



UXO Recognition, Avoidance, and Reporting Procedures

Former Camp Elliott

June 27, 2012

Recognize Retreat Report

San Diego Unified SCHOOL DISTRICT

E2 ManageTech

Dec 8, 2010 Incident

Tierrasanta Blvd & Tumbor Rd

Safety Video

- http://www.youtube.com/watch?v=c97j68SGq7Y

Overview

- Purpose and Scope
- Objectives
- Acronyms and Definitions
- Site History
- MEC Terminology
- UXO Characteristics
- UXO Safety Procedures
- Reporting Procedures

UXO – How Do I Protect Myself?

If you discover or think you have discovered a UXO item the best way to protect yourself and your coworkers is **do not touch** or **disturb it**.

Remember the "**3 Rs**"

- **RECOGNIZE:** Recognize when you may have encountered a munition (UXO or DMM).
- **RETREAT:** Do not touch, move or disturb it, but carefully leave the area.
- **REPORT:** Immediately leave the area and report the suspected item in accordance with the established project / SDUSD procedures.

Purpose and Scope

- The Purpose of this training is to **minimize the munitions risk to personnel** working on the Camp Elliott Formerly Used Defense Site.

- **Describe procedures** that apply to all District personnel and their contractors or subcontractors performing site work or visiting the Camp Elliott Formerly Used Defense Site.

Understanding of:

- Basic MEC language and terms.
- Munitions used at the Former Department of the Navy, Camp Elliot facility.
- What munitions look like and how they function.
- What to do and what not to do if you encounter UneXploded Ordnance (UXO).
- How to perform your job safely within a MEC environment.

Acronyms and Definitions

BD	Base Detonating
BIP	Blow in Place
DMM	Discarded Military Munitions
EOD	Explosive Ordnance Disposal
FFAR	Folding-Fin Aircraft Rocket
HE	High Explosives
HEI	High Explosives Incendiary
HEAT	High Explosive Anti-Tank
MEC	Munitions and Explosives of Concern
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented As Safe
MDEH	Material Documented as an Explosive Hazard
MPPEH	Material Potentially Presenting an Explosive Hazard
SCAR	Sub-Caliber Aircraft Rocket
TP	Target Practice
UXO	Unexploded Ordnance
WP	White Phosphorous

Site History

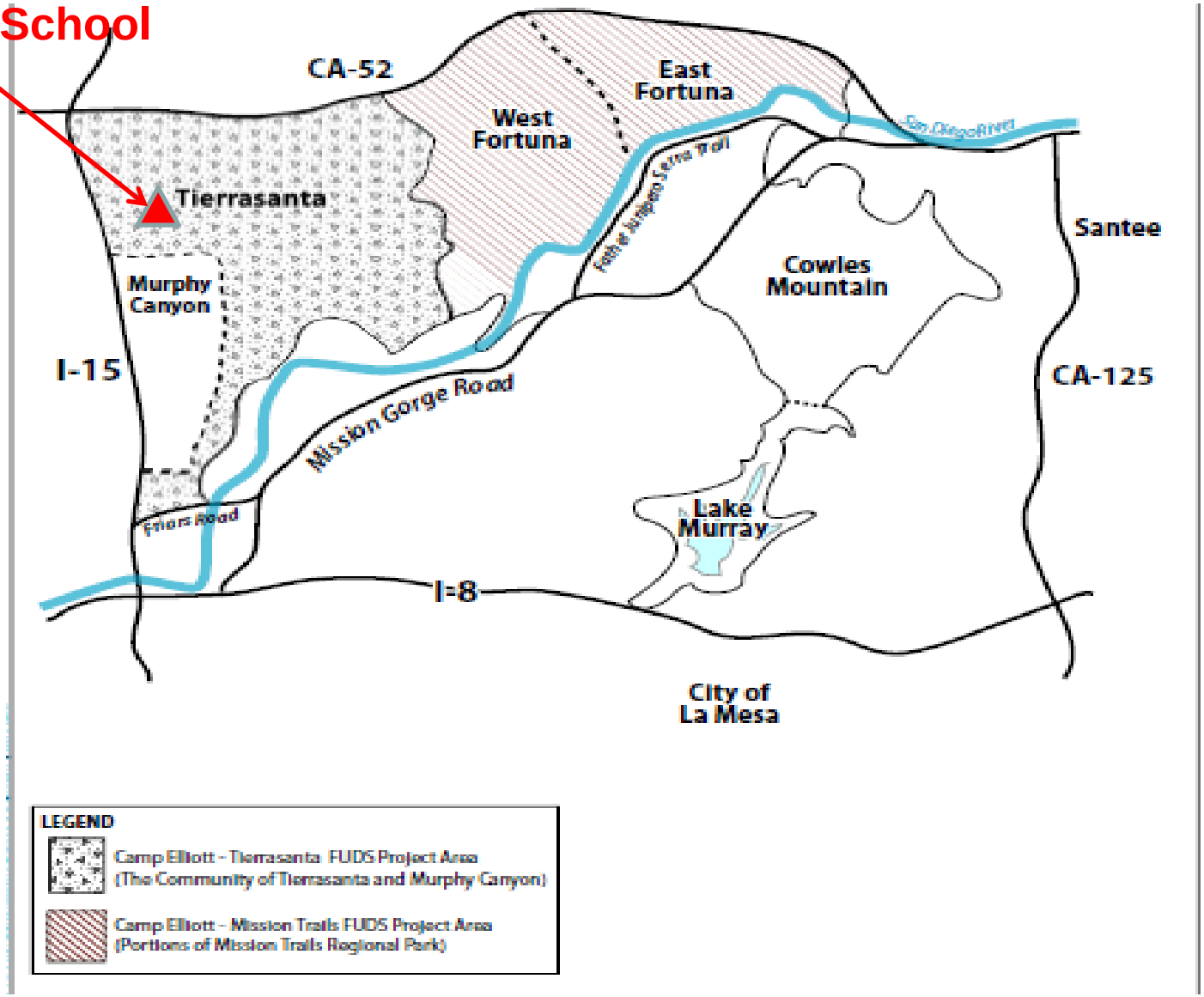
- **1917** – Initially known as **Camp Kearny**, used by the US Army infantry for machine gun and artillery training during World War I.
- **1934** – Further development as **Camp Holcomb**, used by Marine Corps for **artillery, anti-aircraft, and machine gun firing practice**.
- **1940s** – Renamed as **Camp Elliott**. Used by Navy and Marine Corps as training facility. World War II training ranging from **.22 caliber rifles to 155-mm field artillery pieces, as well as incendiary devices, mines, and explosives**.
- **1950s** – Navy training during Korean Conflict.
- **1960-61** – Closed by the Navy and transferred to the General Services Administration.
- **1967 to 1973** – Inspection and ordnance clearance activities conducted by the Army and Navy.

Site History

- **1983** – **Two boys killed by 37-millimeter projectile found in undeveloped area of Tierrasanta**. New clearance activities of 326 acres later in 1983.
- **1988** – Site transferred to FUDS program. USACE prepared a Feasibility Study and issued a Record of Decision that recommended ordnance clearance.
- **1990-1994** – USACE conducted ordnance inspection and clearance of 1,364 acres. Recovered 4,803 ordnance items and 26,000 pounds of ordnance debris.
- **1999** – USACE site reconnaissance as part of the first scheduled Military Munitions Response Program (MMRP) Five-Year Recurring Review.
- **2008 – USACE site visits as part of second Five-Year Recurring Review**
- **2009** – USACE published the Draft Public Involvement Plan (PIP). Currently remains in Draft form.

Site History

Serra High School



MEC Terminology

What is MEC?

Munitions and Explosives of Concern (MEC): Specific categories of military munitions that may pose unique explosives safety risks.

MEC is comprised of the following subcategories:

- **UXO** – **U**ne**X**ploded **O**rdnance
- **DMM** – **D**iscarded **M**ilitary **M**unitions
- **MC/MD** – **M**unitions **C**onstituents/**M**unitions **D**ebris

MEC Terminology

What is UXO?

UneXploded Ordnance (UXO): Items used (fired, thrown or dropped) for their intended purpose but failed to function as designed.

MEC Terminology

What is DMM?

Discarded Military Munitions (DMM): Munitions that were never fired from a weapons system and were abandoned without proper disposal.

What is MC?

Munitions Constituents (MC): Any material originating from UXO and DMM.

- Includes explosive and non-explosive materials, emission, and degradation or breakdown elements of such ordnance or munitions.
  - Chemically reactive materials (explosives)
    - Material present in sufficient concentration to constitute an explosive hazard (e.g., TNT greater than 10% in soil).

- Traditionally non-explosive materials (such as shell casings and fragmentation).

MEC Terminology

What is MD?

Munitions Debris (MD): Consists of remnants of munitions remaining after munitions use, demilitarization or disposal.

✓ **All munitions debris is considered an explosive hazard until it is inspected by a UXO Technician.**

UXO Characteristics

UXO – Why didn't they function as designed?

- UXO are munitions that have failed to function as designed; commonly referred to as "Duds".
- Typically munitions of this era experienced, on the average, a 10% to 20% dud-ratio.
- The reasons why munitions fail to function as designed are varied and many (Incorrect fuse settings, incorrect trajectory and/or impact area surface conditions)

UXO - Why are they still dangerous?

- Fusing systems may be partially armed and your actions may be the final step in the arming/firing sequence.
- Explosive fillers may react with metal, other explosives, air, or chemicals in the earth to produce extremely sensitive explosive salts and compounds.
- Exposure to the elements may degrade as the stabilizing agents in the explosives which may now be more sensitive to movement, shock and friction.
- Corrosion of internal components may render a previously unarmed item to be armed and waiting for additional forces to fire the item.

✓ The age or condition of an ordnance item does not decrease its effectiveness to kill.

UXO Characteristics

Munitions Types

- Practice Bombs
  - 3 lb. and 4.5 lb. Miniature Practice Bombs
  - MK 15 100 lb. Water/Sand – Filled Bombs
- Rockets
  - 2.25’ Sub – Caliber Aircraft Rocket

REMEMBER, even though some munitions are categorized as **PRACTICE MUNITIONS**, it may still contain an explosive charge that has the potential to cause injury!

UXO Characteristics

37mm – Caliber HE Projectile

UXO Characteristics

155mm – Caliber Projectile

UXO – How Do I Protect Myself?

If you discover or think you have discovered a UXO item the best way to protect yourself and your coworkers is **do not touch or disturb it**.

Remember the "**3 Rs**"

- **RECOGNIZE:** Recognize when you may have encountered a munition (UXO or DMM).
- **RETREAT:** Do not touch, move or disturb it, but carefully leave the area.
- **REPORT:** Immediately leave the area and report the suspected item in accordance with the established project / SDUSD procedures.

UXO Safety Procedures

UXO – How Do I Protect Myself?

DO NOT ASSUME

- **DO NOT assume that the area you are entering is safe because it falls outside the mapped boundary of a historic range**. Many historical maps reviewed during archive searches contradict each other. Keep in mind that these were training ranges, which means personnel using these ranges were in many cases, not experts, and were attempting to hit the target. High percentage of munitions did not hit their intended target.
- **DO NOT assume that since you have performed work on the site previously, that a new task within the same area will not need to be assessed before execution.** Hazards differ in accordance with actions performed within the same area and may require escort or additional engineering controls to perform. It is for this reason that communication is so important in this process.

UXO – How Do I Protect Myself?

General MEC Safety Precautions

- **DO NOT** move a MEC item in an attempt to make a positive identification. Visually examine the suspect item and note markings and other external features such as shape, size, and external fittings and report in accordance with reporting procedures.
- **DO NOT** depress plungers, turn vanes, rotate spindles, levers, setting rings or other external fittings on munitions items. Such actions may arm or activate the item.
- **DO NOT** attempt to remove any fuse(s) from munitions. Do not dismantle or strip components from any MEC items.
- **DO NOT** remove MEC items from the site for use as souvenirs/training aids.
- **DO NOT** rely on the color coding of MEC for positive identification of a munitions filler. Munitions are color-coded to identify specific filler/hazards. However, munitions having incomplete or improper color codes have been encountered. Exposure to the elements can cause the markings to fade or change to another color

UXO Safety Procedures

UXO – How Do I Protect Myself?

General MEC Safety Precautions

- **DO NOT** touch expended practice or pyrotechnic devices. Expended pyrotechnic and practice devices can contain red or white phosphorus residue. Due to incomplete combustion, the phosphorous residue may re-ignite spontaneously if the crust is broken and exposed to air.
- **DO NOT** smoke within 50 feet of a munitions item.
- **DO** assume that practice munitions contains a live charge until it can be determined otherwise.
- **DO** consider MEC items, which may have been exposed to fire and detonation, as extremely hazardous. Chemical and physical changes may have occurred to the contents, which might render it more sensitive than its original state.

Response:

- Clearly mark the item for avoidance, note the location, take photo, provide GPS coordinate, if possible.
- Evacuate personnel 250 feet away from item.
- Contact the following , in order:
  - **San Diego Metro Arson Strike Team (MAST) - 911**
  - **District Contact List (next slide)**

Reporting Procedures

District Contact List

CONTACT	TELEPHONE
Serra High School – Principal—Michael Jimenez	(858) 442-3116
Serra High School – Site Operations—Jeffrey Thomas	(858) 504-0687
Serra High School – Plant Operations Supervisor—Carlos Gaines	(858) 231-4381
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SDUSD Police/ School Police Officer—Tom Gray	(858) 496-8342 ext. 213
SDUSD Director of Project Management –Gary Stanford	(858) 573-5727

Contact Information

Daryl Hernandez
E2 ManageTech
858 - 217-5306 (Office)
dHernandez@e2managetech.com

Lloyd Godard
US Army Corps of Engineers
(213) 452-4014 (Office)
lloyd.e.godard@usace.army.mil

Military Ordnance and Explosive Awareness

San Diego County Sheriff's Bomb/Arson

Detective Arnold Vanlingen

(619) 956-4980

The Power of Explosives

Explosives

- Blast Pressure
  - Blunt Injury
- Fragmentation
  - Trauma
- Thermal
  - Burns

Explosives

Explosives


Random Fragments
Conventional
Munition
Exploding
20 mm
Warhead

Explosives

Improved conventional munitions fragments 200-500 mg

Explosives

Explosives

Military Ordnance in San Diego

- Formerly Used Defense Site (FUDS)
- Approx. 25 in SD County
  - Tierrasanta
  - Mira Mesa
  - UCSD
  - Scripps Ranch
  - Linda Vista
  - La Mesa
  - Escondido
  - Vista
  - Ramona
  - Borrego Springs
  - Brown Field

What is Ordnance?

Initial Actions

- 3 R's for UXO
  - Recognize
    - Metal, Fins, etc.
  - Retreat
    - 1,000 feet
  - Report
    - Call 911
      - Request SDSO for County and SDFD for City

Explosive Awareness Actions

- SIN
  - Safety
    - Time, Distance, Shielding (TDS)
    - Secondary Hazards (electrical lines, propane, etc.)
  - Isolate and Deny Entry
    - Evacuate or Shelter in Place
    - 1,000 feet minimum
  - Notify
    - Per Agencies SOP’s (911)

First Responder and Bomb Squad Capabilities

- First Responder
  - Perimeter
  - Safest Route
  - Site Expertise
- Bomb Squad
  - Explosives
    - Fireworks
    - Ammunition
    - Military Ordnance
    - Improvised Explosive Devices
    - Investigation

Some Final Thoughts

Overpressure Effect

- Being a Dad is tougher than being a Bomb Tech.

Some More Final Thoughts

- Automakers Response to Terrorism

FUZE, PROJECTILE, BASE DETONATING, M66

[redacted]
Cl 06/15/93

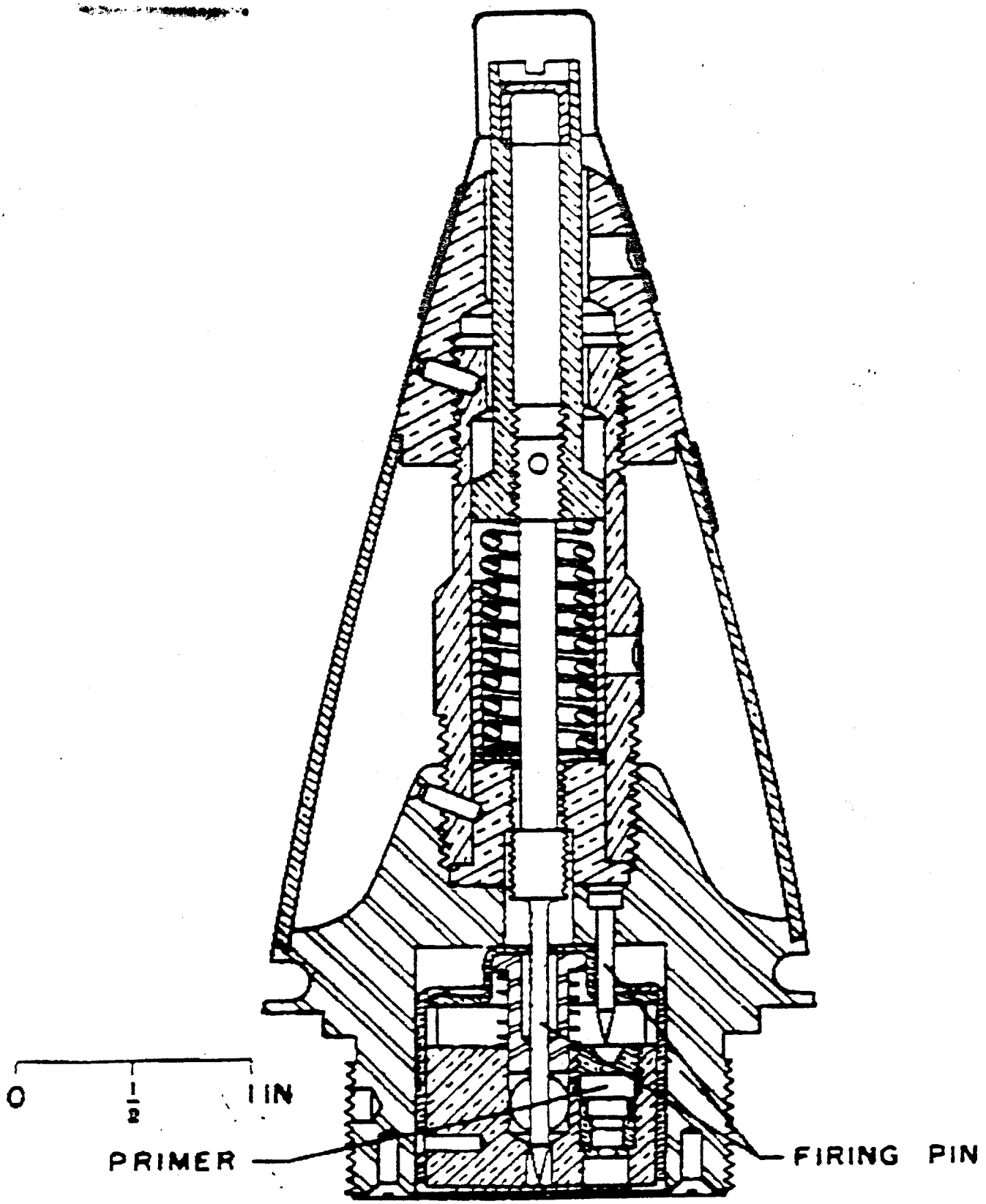
Projectiles used in: 75mm, 76mm, and 3" APC Rounds

* Length: 3.45"
* Weight: 1 lb
* Construction: Fuze body and housing made of steel.
* When assembled to projo, fuze extends out in the form of a boat tail approximately .6" beyond the base of projo.
* Fuze is not considered boresafe since there is no separation between the detonator and booster.
* Fuze contains tracer assembly.
* A1 modification consists of strengthening of body and enlargement of booster.

Function: No action upon setback or in flight except burning of the tracer in the head of the fuze. On impact , the firing pin collapses the brass safety washer and impacts primer. Primer ignites delay pellet which burns for .1 sec and functions detonator and in turn booster.

Reference: TM9-1904, TM9-1385-51, 147 Data Sheet

Location Found: TS, MT


0
1/2
1 IN
PRIMER
FIRING PIN

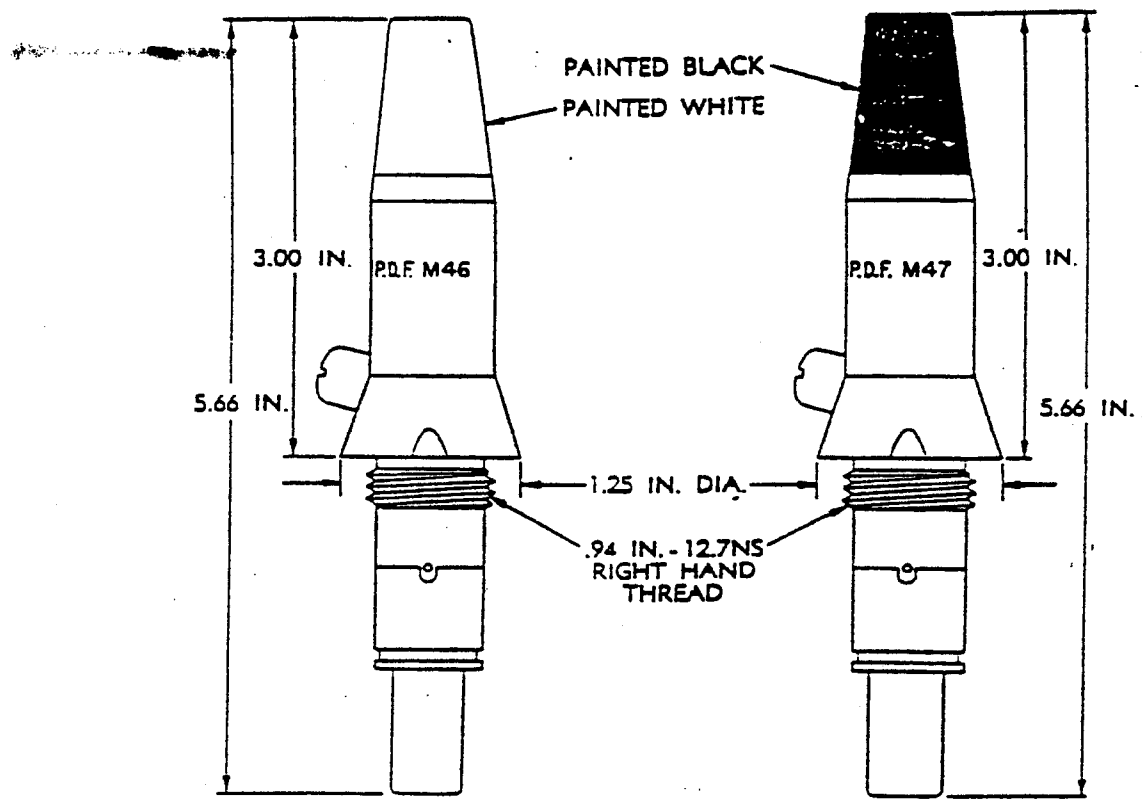
FUZE, PROJECTILE, POINT DETONATING, M39A2 [redacted] C1 06/15/93

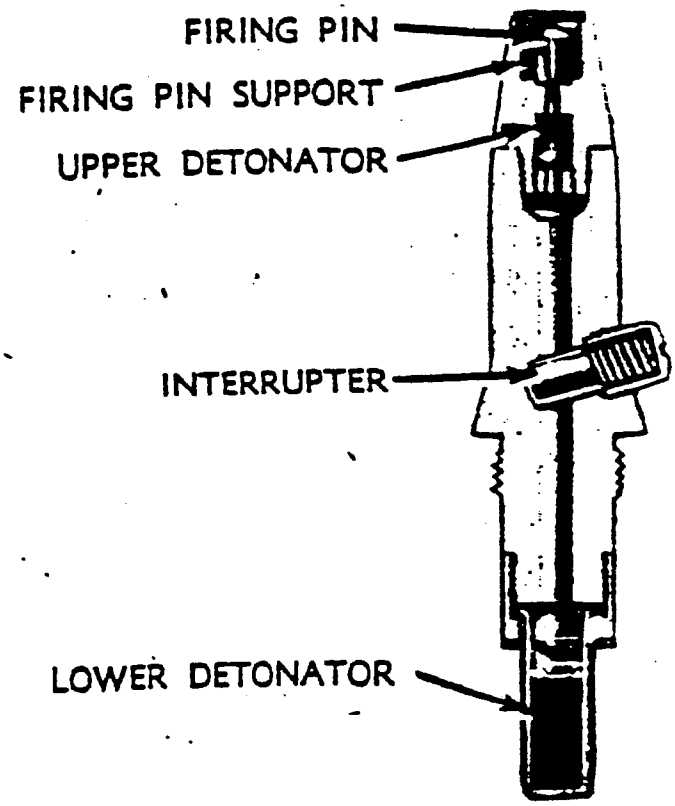
Projectiles used with: HE projos 75mm and up

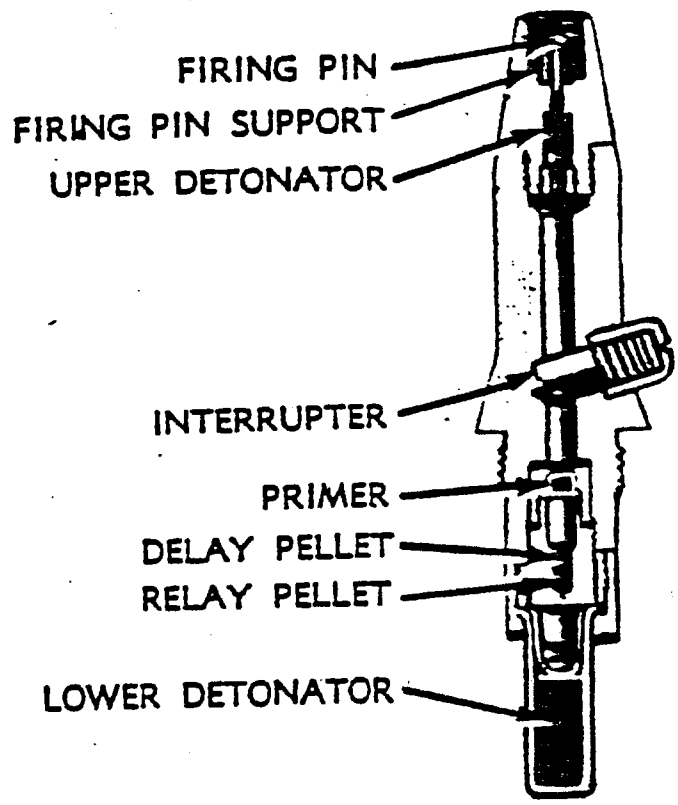
* Length: 5.24"
* Weight: 1.8 lb
* Construction:
* Explosive train is not interrupted.
* M39A2 was replaced by the M48A3 fuze.
* M39A2 same as M39A1 except it has no booster

Reference: MIL-HDBK-137

Location found: TS, MT


PAINTED BLACK
PAINTED WHITE
3.00 IN.
P.D.F. M46
5.66 IN.
P.D.F. M47
3.00 IN.
5.66 IN.
1.25 IN. DIA.
.94 IN. - 12.7NS
RIGHT HAND
THREAD


FIRING PIN
FIRING PIN SUPPORT
UPPER DETONATOR
INTERRUPTER
LOWER DETONATOR


FIRING PIN
FIRING PIN SUPPORT
UPPER DETONATOR
INTERRUPTER
PRIMER
DELAY PELLET
RELAY PELLET
LOWER DETONATOR

FUZE, PROJECTILE, POINT DETONATING, M46 & M47 [redacted]t

Cl 06/15/93

Projectiles used in: 75mm - 12" Chemical and HE

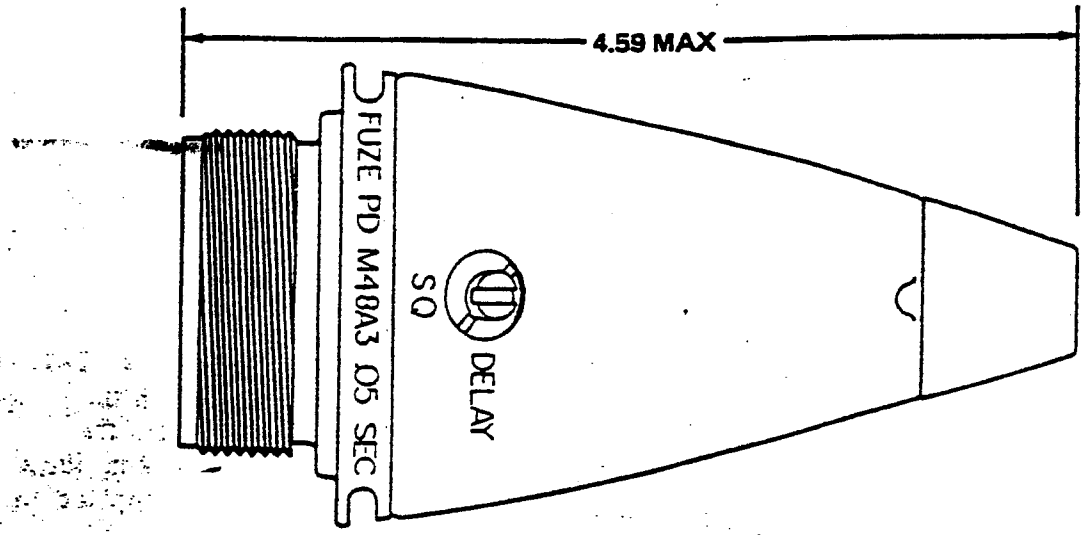
* Length: 5.66"
* Weight: M46 = .74 lb, M47 = .69 lb
* Construction: Brass
* Marking: M46 Head painted white
  M47 Head painted black
* M46 = Instantaneous (SQ)
* M47 = Short delay (.05sec)

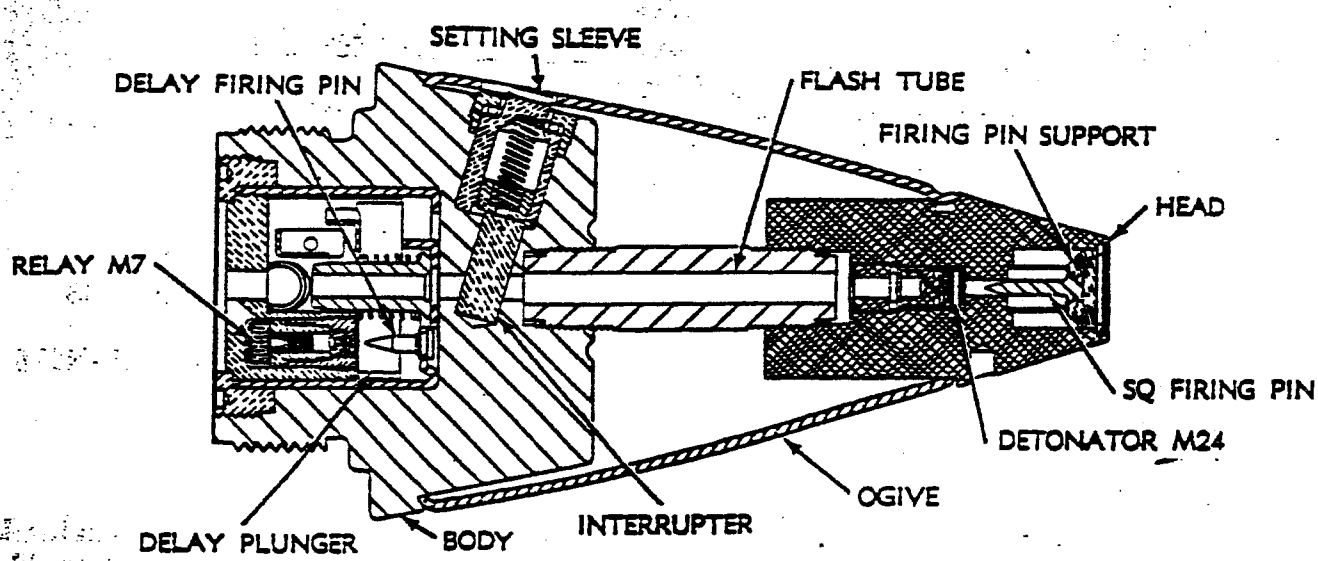
Function: Fuze is ready for functioning when screwed into shell. During flight, centrifugal force causes interrupter to move outward clearing the flash channel. On impact, the firing pin crushes the firing pin support and is driven into the upper detonator.....

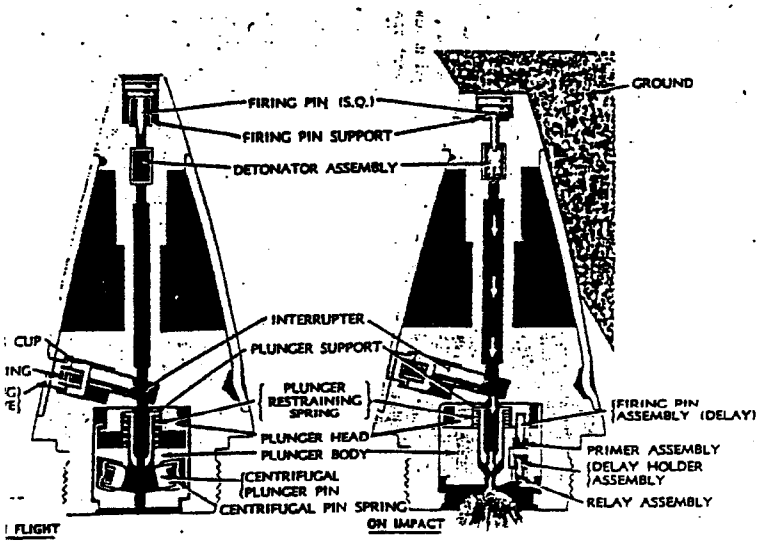
M46	M47
Flash from upper detonator travels through clear flash channel and functions lower detonator, which sets off booster.	Flash from upper detonator travels through clear flash channel and functions primer. Primer ignites delay pellet, which burns for .05 sec and functions relay pellet. Relay pellet functions lower detonator and in turn booster.

Reference: TM9-1904, TM 9-1385-51, 147 data sheet

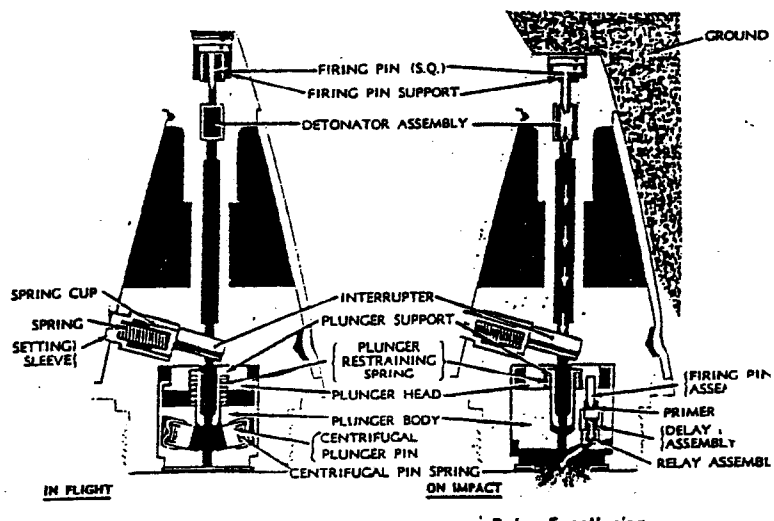
Location found: TS, MT







Superquick Functioning



Delay Functioning

FUZE, PROJECTILE, POINT DETONATING, SQ & DELAY, M48

[redacted]
C1 06/15/93

Projectiles Used in: 75mm, 90mm, 4.2"

* Length: visible 3.74", overall 4.59"
* Weight: 1.41 lbs
* Construction: Fuze body and flash tube made of steel, Ogive made of aluminum or stamped steel, setting sleeve made of brass.
* Fuze is used with the M20 booster.

Function:

SUPERQUICK

When projo is fired, setback force combined with spring pressure holds fuze parts in the unarmed condition. As setback force decreases, centrifugal force causes interrupter to move outward, clearing the superquick passage. Upon impact, SQ firing pin is driven into the detonator. Flash from detonator passes through the clear flash hole directly to the detonator in the booster.

DELAY

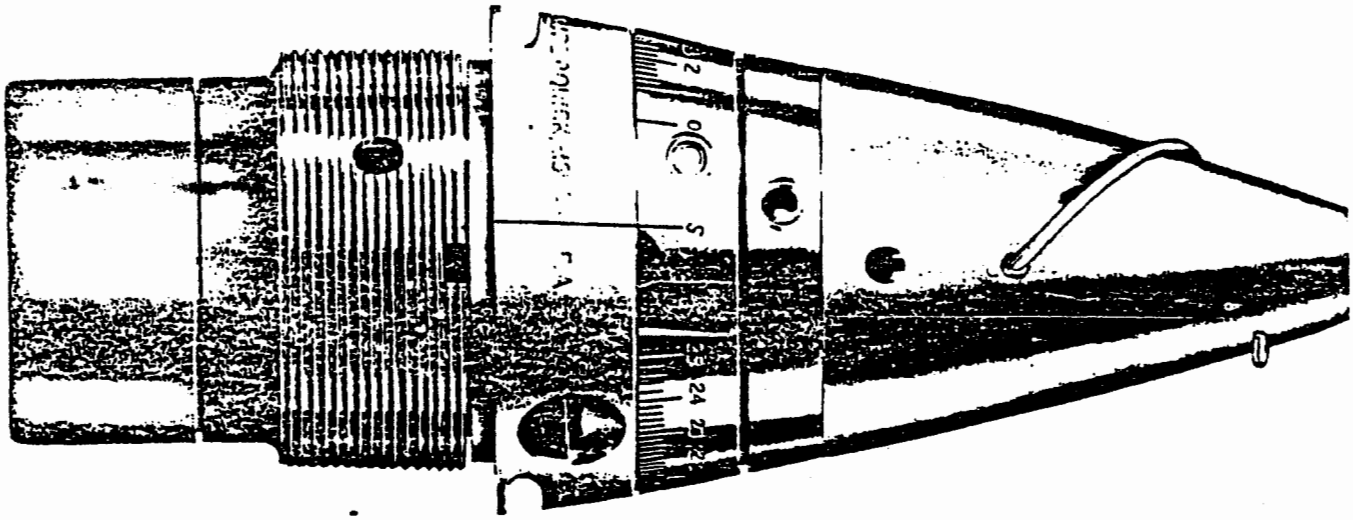
Delay plunger is armed by centrifugal force which withdraws plunger lock pins. Upon impact, plunger assembly with primer is driven into the firing pin assembly. Flash from primer ignites delay, which burns to relay. Relay sends flash to detonator in the booster.

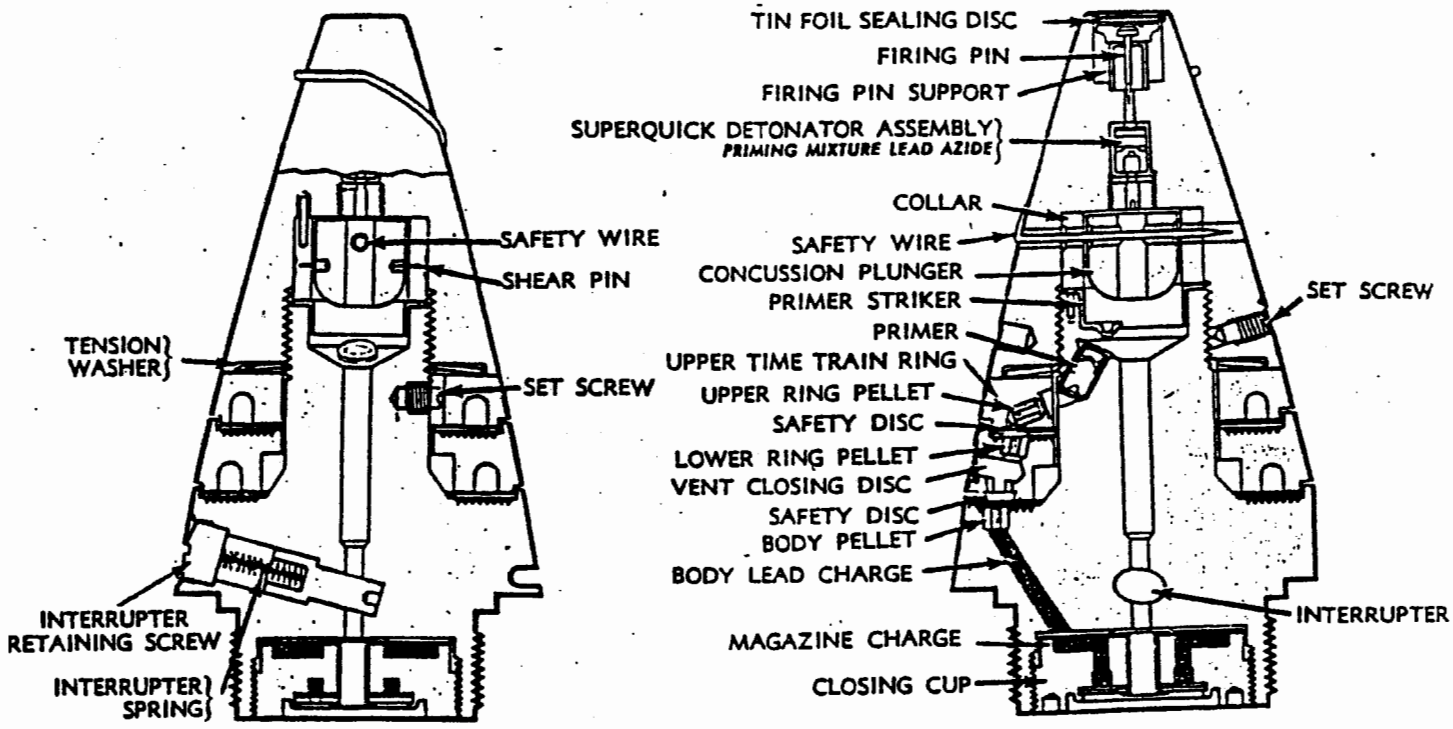
NOTE

The delay train will always function even though the fuze may be set for superquick. If set on "delay" the flash from "superquick" is blocked and fuze functions through the delay assembly.

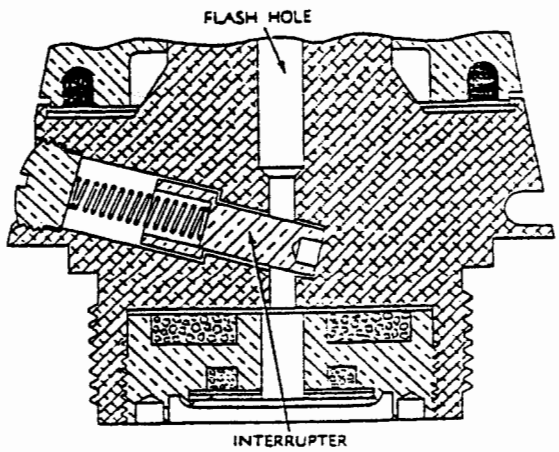
Reference: TM9-1904, TM43-000-128, TM9-1385-51, 147 Data Sheet

Location Found: TS, MT





FUZE, Combination, 25-second, T&SQ, M54



FUZE, PROJECTILE, TIME AND SQ, M54

[redacted]
Cl 06/15/93

Projectiles used in: 75mm to 240mm

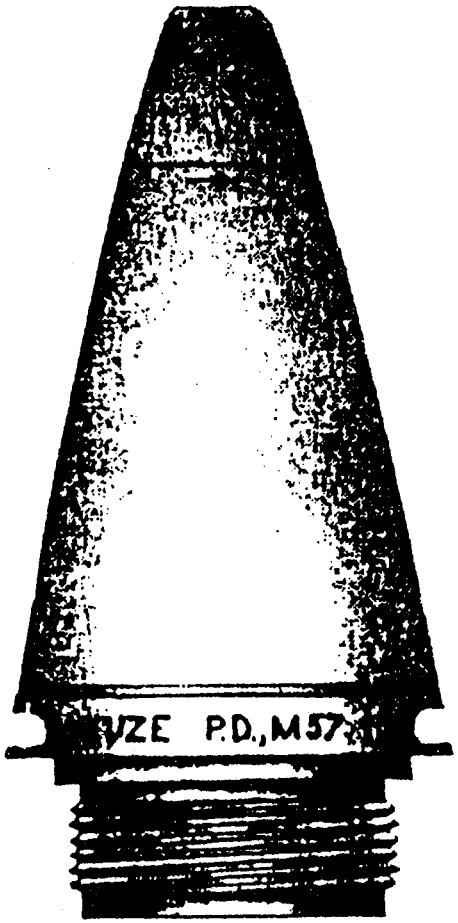
M54 with M20 booster = T & SQ, M54, used with 75 & 105mm
M54 with M21 booster = M55, used with 155mm and 4.5" projos
M54 with M21A1 booster = M55A1, used with 155mm and 4.5" projos
M54 with adapter = M5, used with 4.2" mortar

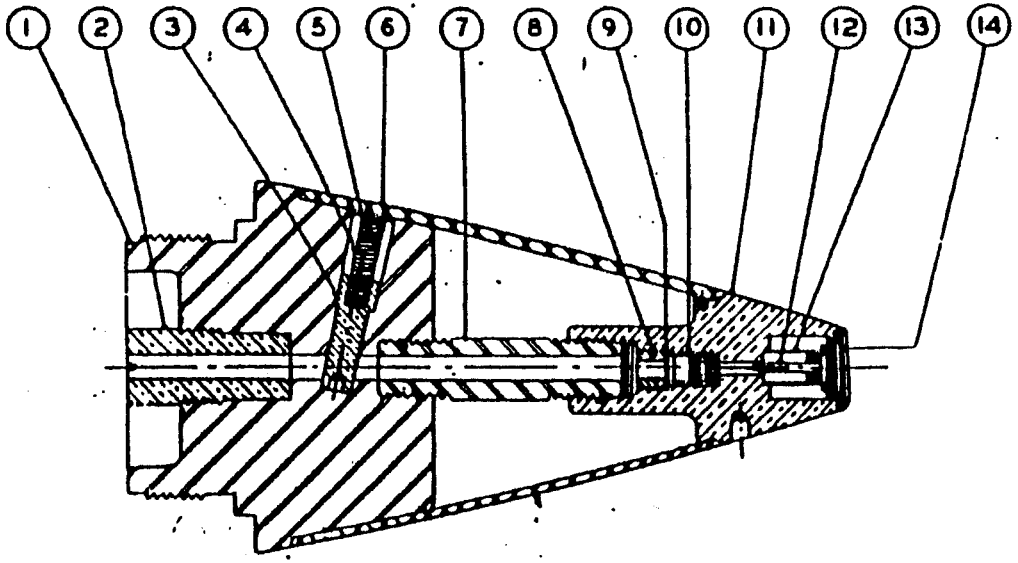
* Length: 4.59"
* Weight: 1.42 lbs
* Construction: Aluminum with brass time rings
* Superquick element identical to SQ element of M48 PD fuze
* Time Ring graduated from 0 to 25 sec; 1 to 25 in div of .2 sec

Function: Safety wire is removed and time set on fuze. When projo is fired, setback drives time action plunger against primer striker, which impinges primer initiating upper ring pellet. Upper ring pellet ignites upper time ring, which burns CCW to graduated ring pellet. Graduated ring pellet ignites graduated time ring, which burns CW to body pellet. Body pellet ignites body charge, which fires magazine charge. Magazine charge initiates booster charge. If fuze is set for impact functioning, the time train is blocked and the fuze will be initiated on impact. Centrifugal force pushes the interupter outward. Upon impact, the firing pin is driven into the detonator. Flash from the detonator passes through the flash hole and initiates the booster. The fuze will be initiated on impact regardless of the time setting.

Reference: TM9-1904, TM9-1385-51, 147 data sheet

Location Found: TS, MT





1. BODY
2. BODY TUBE
3. INTERRUPTER
4. SPRING
5. INTERRUPTER CLOSING DISK
6. OGIVE
7. TUBE
8. DETONATOR RETAINER SCREW
9. RETAINER WASHER
10. DETONATOR ASSEMBLY
11. HEAD
12. FIRING PIN ASSEMBLY
13. FIRING PIN SUPPORT
14. CLOSING DISK

FUZE, PROJECTILE, POINT DETONATING, M57 [redacted]t
Cl 06/01/93

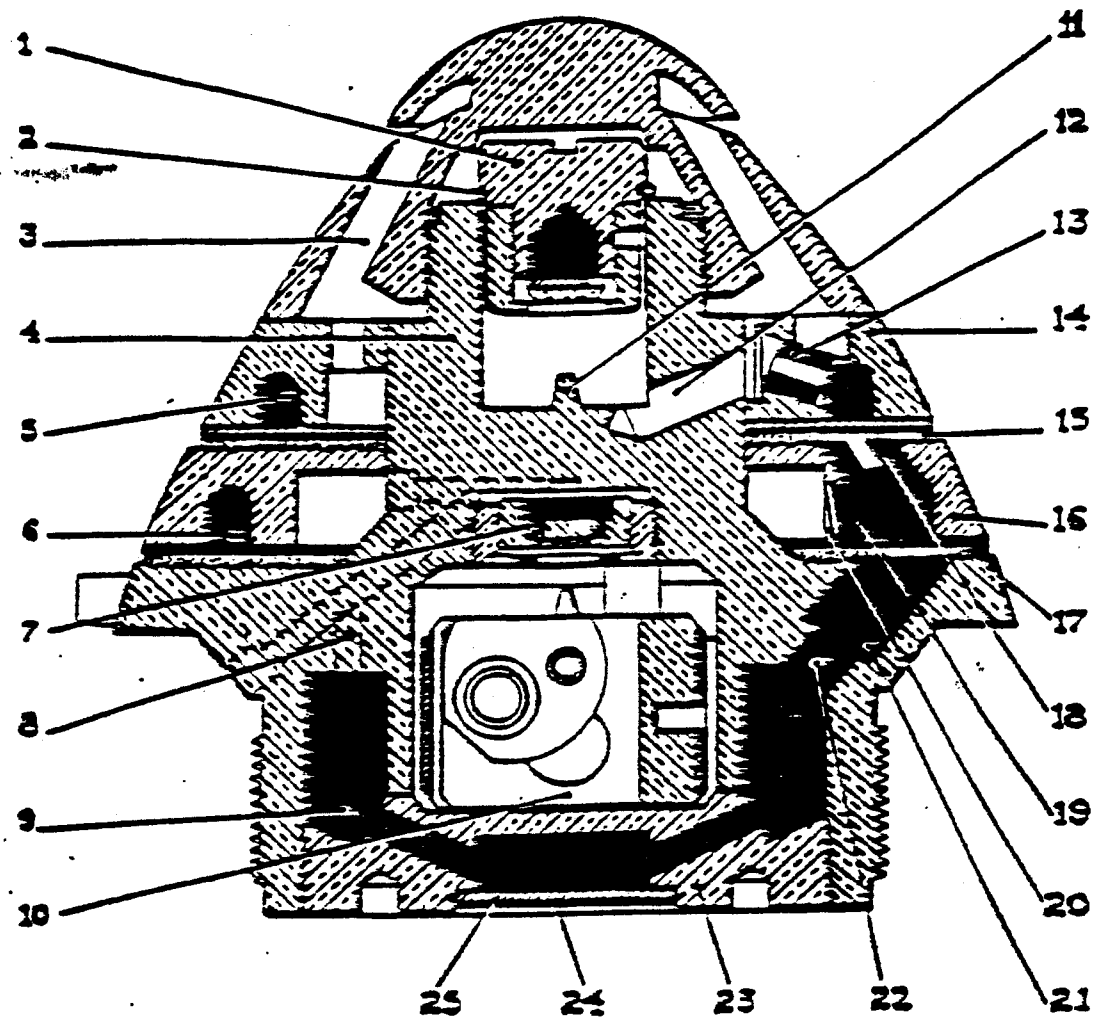
Projectiles used in: 75 & 105mm Chemical rounds

* Length: 4.55"
* Weight: 1.41 lb
* Construction: Body = steel or brass, Head = brass, Ogive = Aluminum
* Fuze designed primarily for chemical rounds.
* Fuze similar to M48 except contains no delay element.
* M22 booster used in conjunction with this fuze.

Function: In flight, centrifugal force move interrupter outward, clearing the flash channel. On impact, the closing disc is crushed, causing the firing pin to crush the firing pin support and penetrate the superquick detonator. Detonating wave passes through the open flash tube and functions the booster.

Reference: TM9-1904, TM9-1385-51, 147 data sheet

Location found:



1. CONCUSSION PLUNGER.
2. CONCUSSION RESISTANCE RING, BRASS.
3. VENTS IN CLOSING CAP.
4. BODY, BRONZE.
5. UPPER TIME TRAIN, COMPRESSED POWDER.
6. LOWER TIME TRAIN, COMPRESSED POWDER.
7. PERCUSSION PRIMER.
8. VENTS LEADING FROM PERCUSSION PRIMER TO MAGAZINE.
9. POWDER MAGAZINE.
10. PERCUSSION PLUNGER.
11. FIRING PIN, BRASS.
12. VENT LEADING TO UPPER TIME TRAIN.
13. COMPRESSED POWDER PELLET.
14. UPPER TIME-TRAIN RING, TOBIN BRONZE.
15. WASHER FOR GRADUATED TIME-TRAIN RING, FELT CLOTH.
16. GRADUATED TIME-TRAIN RING, TOBIN BRONZE.
17. WASHER FOR BODY, FELT CLOTH.
18. COMPRESSED POWDER PELLET IN VENT LEADING TO LOWER TRAIN.
19. COMPRESSED POWDER PELLET IN LOWER TIME-TRAIN VENT.
20. BRASS DISC, CRIMPED IN PLACE.
21. COMPRESSED POWDER PELLET IN VENT LEADING TO MAGAZINE.
22. VENT LEADING TO MAGAZINE.
23. BOTTOM CLOSING SCREW, BRASS.
24. WASHER FOR CLOSING SCREW, BRASS.
25. WASHER FOR CLOSING SCREW, MUSLIN.

FUZE, PROJECTILE, COMBINATION, M1907M 21 seconds & M1907M 45 sec

E[redacted]t
Cl 06/16/93

Projos Used In: 75mm Shrapnel Mk I, 155mm Shrapnel Mk I

* Combination - Dual Action (Time and Impact).
* Constructed of brass and bronze.
* Weight: 1.25lbs.
* Overall Length: 2.88".
* Fuze has no det element.
* Time action similar to M54 Combination fuze.
* Impact action similar to Mk V or Mk X Base Detonating fuzes.
* When fuze is set on safe, powder train is out of line and magazine will not ignite.

Function: Time: When fired, set-back causes concussion plunger to overcome the concussion resistance ring and strikes the firing pin. Concussion plunger ignites compressed powder pellet in the upper time ring, which ignites upper time train. Upper time train burns clockwise to compressed powder pellet in graduated time ring (lower train). Lower train burns counter-clockwise to compressed powder pellet in vent to magazine charge. Pellet ignites magazine charge.
Impact: Firing pin is unlocked by centrifugal force and rotates to armed position. On impact, firing pin strikes primer. Flash Flash from primer enters magazine charge through flash path igniting magazine charge.

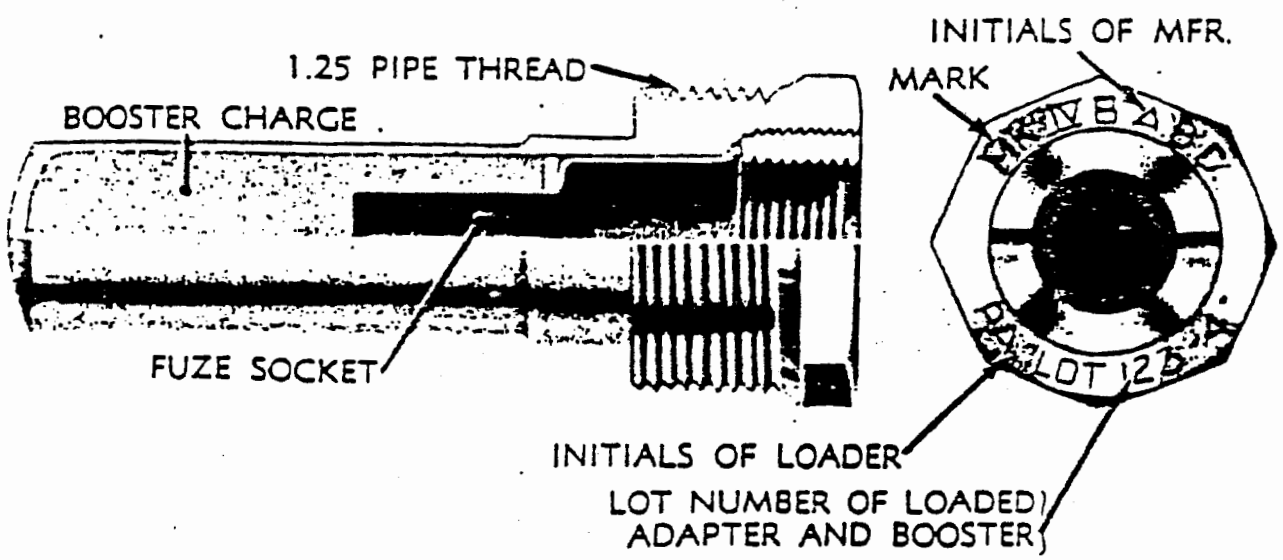
Reference: TM 9-1904, 147 data sheet

ADAPTER BOOSTER, PROJECTILE, Mk IV

[redacted]t
C1 06/15/93

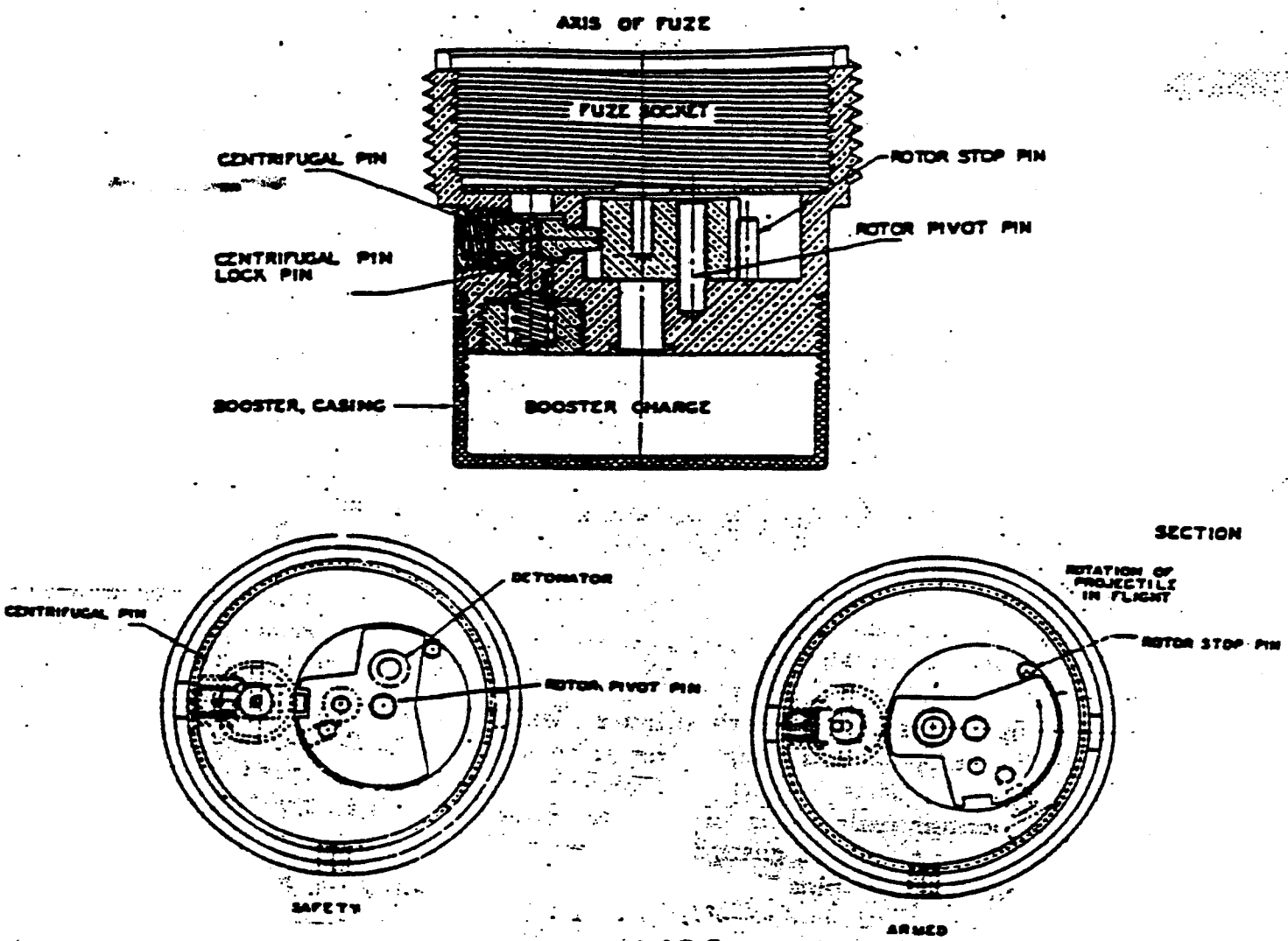
Projectile used in: 75mm Chemical, Mk II

* Construction: Steel, 1 piece, with pipe threads.
  Mk IVB = Octogonal head, Mk IVM1 = Hexagonal head.
* Booster charge: 1.5 oz Tetryl or 50/50 Tetryl TNT
* Adapter booster performs the function of bursting the projo.
* Adapter booster not entirely efficient in bursting the projo, sometimes fragmenting only the upper half and leaving the lower half in the form of a cup, which may carry a portion of the chemical filler onto the ground undispersed.

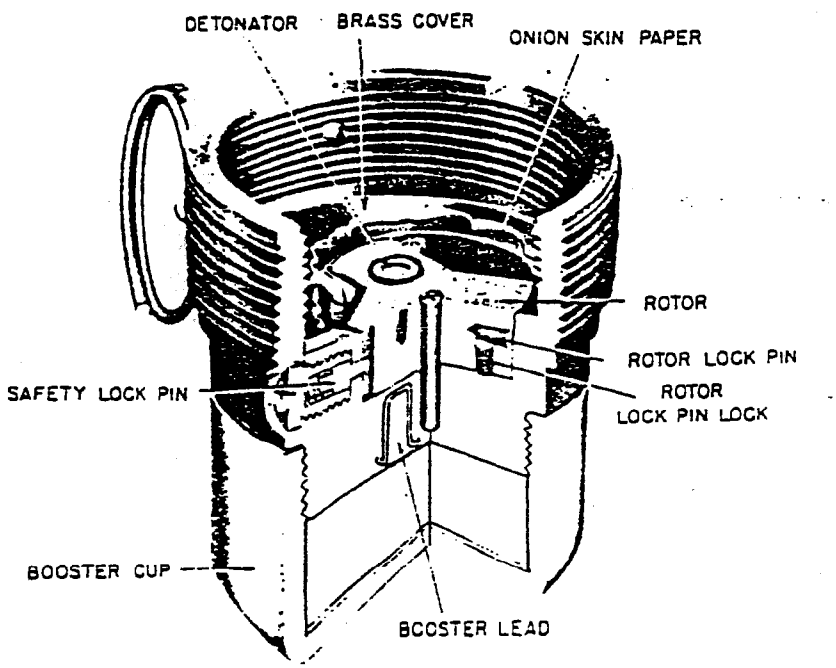


References: TM9-1904

Location Found: TS, MT



Booster M20



BOOSTER, M21A1

BOOSTER, PROJECTILE FUZE, M20, M20A1, M21, M21A1 [redacted]t
C1 06/15/93

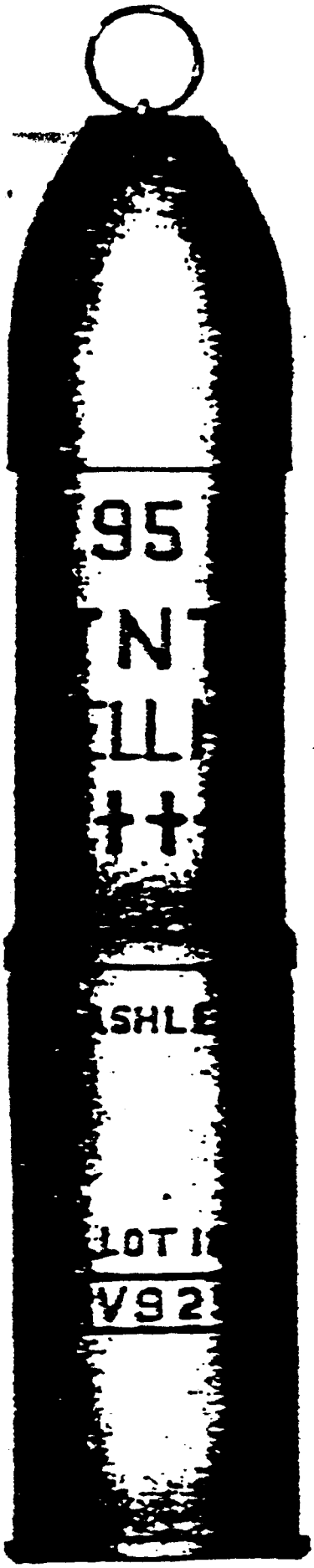
Projos Used With: M20, M20A1 = 75mm projos
M21, M21A1 = 155mm projos

* A1 modification consists of the enlargement of the flash hole in the rotor cover.
* Provides bore-safety when used with non bore-safe fuzes by use of a rotor with an out of line detonator.
* M20 and M21 identical except for the omission of the centrifugal pin lock pin in the M21.

Function: On setback, the centrifugal pin lock pin (not present in the M21 or M21A1) moves rearward and is held by acceleration forces. When centrifugal force is great enough to overcome the friction of acceleration force, the centrifugal pin is thrown outward releasing the rotor. The rotor moves by centrifugal force about the pivot pin until it strikes the rotor stop pin. The booster detonator detonator is now in line with the flash channel of the fuze. The rotor is locked in in the armed position by the lock pin, which is thrown outward by centrifugal force into the hole closed by the body plug. The lock pin lock moves by creep force behind the lock pin, locking it in place. Both these locking devices are contained within the rotor. Function of the fuze will now sucessfully explode the rotor detonator, relay and booster.

References: TM9-1904, TM9-1300-200

Location Found: TS, MT


95
N
L
SHL
LOT
V92

[redacted]t

C1 06/15/93

PROJECTILE, 75mm, HE, Mk I

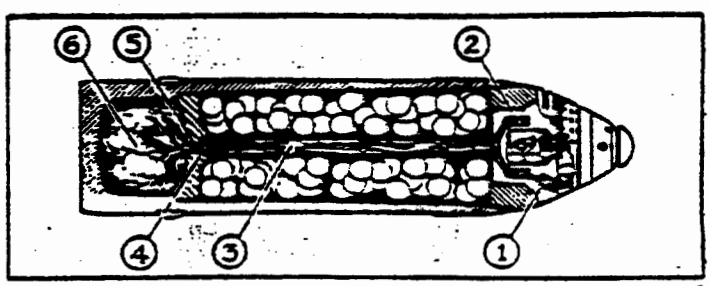
Fuzes Used: M46 & M47 PD (Mk III, MkIV, and M35 PD Fuzes may be substituted.)

Adapter booster used: Mk III

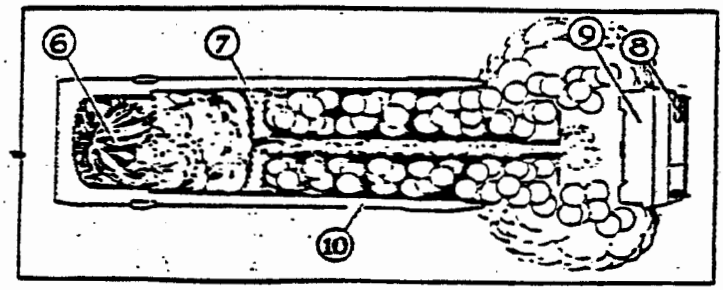
* Length: 10.49"
* Diameter of bourrelet: 2.938"
* Width of rotating band: .49"
* Diameter of base: 2.93"
* Total weight with fuze: 12.18 lb.
* Weight/Type filler: 1.64 lb. cast TNT.
* Construction: Steel with brass and lead base plate.
* Paint and markings: Painted yellow with black stencilling or OD with yellow stencilling; "75 G, TNT, SHELL MK. I."
* Projo has a square base and a base plate of brass covering a lead plate. The base plate is crimped to the base of projo.
* Nose of projo will not take fuzes directly but requires an adapter/booster.
* Old style WW I type projectile.
* Similar in appearance to the Mk II Chem projo, except Mk I HE has base plate.

References: TM9-1904, 147 data sheet

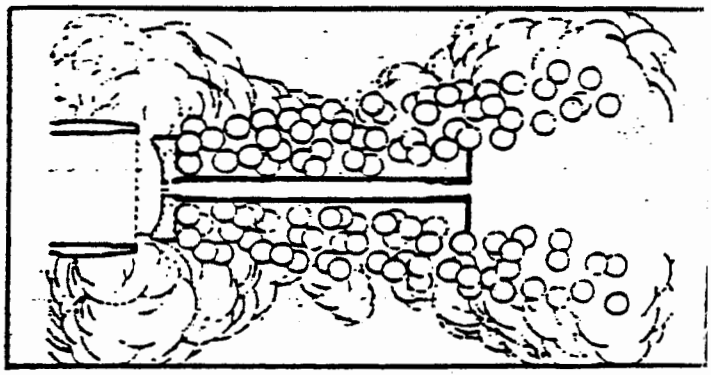
Location: TS



ACTION OF FLAME THROUGH CENTRAL TUBE AND IGNITION OF BASE CHARGE



ACTION OF BASE CHARGE AND FORMATION OF SMOKE BALL FROM MATRIX



ACTION OF BASE CHARGE COMPLETED. SMOKE BALL AUGMENTED BY BASE CHARG SHRAPNEL BALLS SPREADING TO FORM C

PROJECTILE, 75mm, SHRAPNEL, MkI [redacted]ht
C1 06/15/93

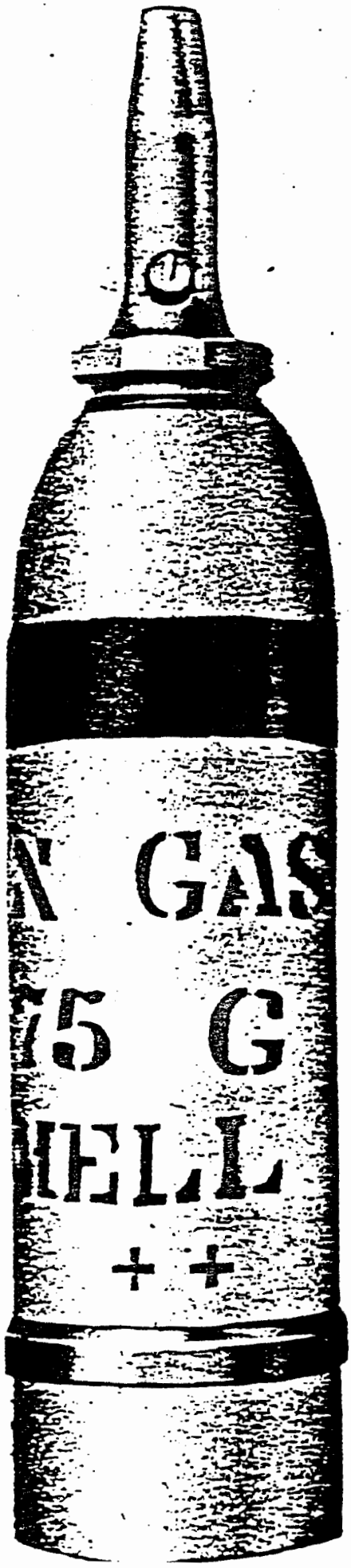
Fuzes Used: M1907M 21 sec Combo

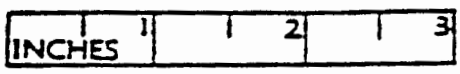
* Length: (with fuze) 11.23"
* Diameter of bourrelet: 2.938"
* Width of rotating band: .49"
* Diameter of base: 2.928"
* Total weight with fuze: 15.95 lbs
* Weight/Type filler: Base charge 3 oz black powder; 270 steel or lead balls, 6.5 lb; and matrix compound, .4 lb.
* Construction: Made of steel with solid base.
* Paint and markings: Painted red with black stencilling: - "2.95 G" or " 75 G".

Function: The shrapnel projo is actually a gun within a gun. Flame from magazine charge (2) of fuze (1) flashes down central tube (3) and ignites the black powder base charge (6). In some shrapnel projos a fiber cup (4) and cloth disc may be found. Flash burns through these if they are present. Explosion of this charge forces the lower diaphragm (7), matrix and balls, and flash tube (3) upward, blowing off the fuze (8) and head (9) as a unit, the rupture occuring at the fine threads between the fine threads between the head and the case (10). The resin matrix is melted and ignited and the lead balls are ejected from the case in a whirling cone-shaped pattern due to the rotation of the projo.

References: TM9-1904, 147 data sheet

Location Found: TS, MT


GAS
G
ELL
+ +


INCHES
1
2
3

PROJECTILE, 75mm, CHEMICAL, Mk II

[redacted]
C1 06/15/93

Fuzes Used: M46

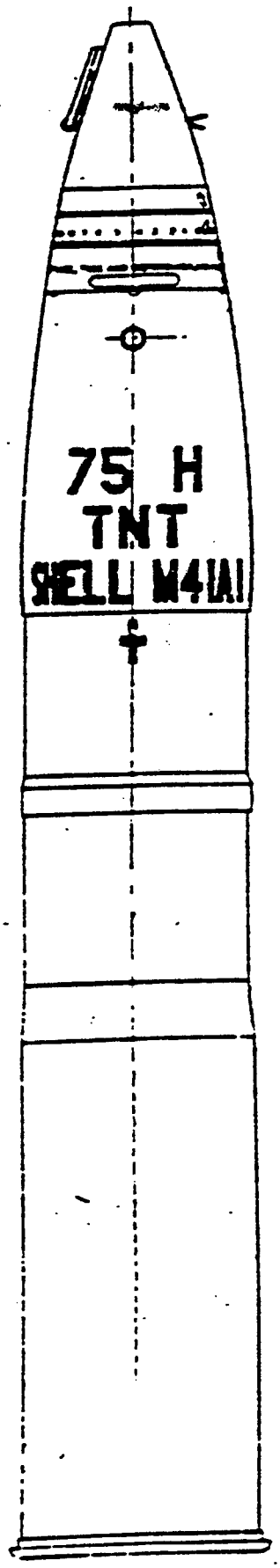
Adapter booster used: Mk IV

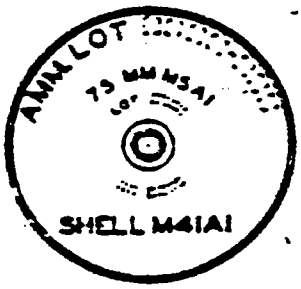
* Length: 10.49"
* Diameter of bourrelet: 2.938"
* Width of rotating band: .49"
* Diameter of base: 2.85"
* Total weight, less fuze: WP = 12.12 lb, FS = 12.20 lb
* Weight of filler: WP = 1.82 lb, FS = 1.90 lb
* Construction: Steel with pipe-threaded nose.
* Old stlye WW I type projectile.
* Differs from the Mk I HE projo only in that it is pipe-threaded in the nose and has no base plate.
* Pipe threads in the nose insure gastight seal between adapter booster and nose of projectile.
* Adapter booster performs the function of bursting the projo.
* Adapter booster not entirely efficient in bursting the projo, sometimes fragmenting only the upper half and leaving the lower half in the form of a cup, which may carry a portion of the chemical filler onto the ground undispersed.
* Projo will be found with 5 different fillers; FM, FS, H, NC, and WP.
* The base color of chemical projo regardless of agent contained, is gray.
* The marking of projo for the various fillers is shown in the following table.

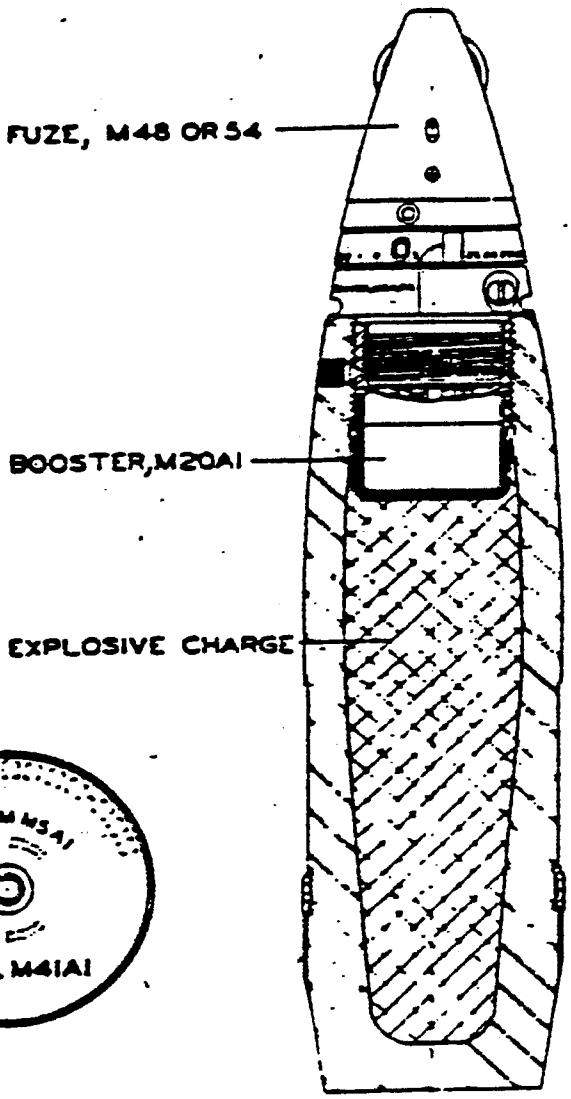
Chemical Filler	Marking on Shell	
	Present Color Scheme	Old Color Scheme
H—persistent gas	H—GAS and 2 bands (all in green)	3 red bands
NC—persistent gas	NC—GAS and 2 bands (all in green)	1 white, 1 red and 1 yellow band
FM—smoke	FM—SMOKE and 1 band (all in yellow)	2 yellow bands
FS—smoke	FS—SMOKE and 1 band (all in yellow)	None
WP—smoke	WP—SMOKE and 1 band (all in yellow)	1 yellow band

References: TM9-1904, 147 data sheet

Location: TS, MT


75 H
TNT
SHELL M41A1


AMX LOT
SHELL M41A1


FUZE, M48 OR 54
BOOSTER, M20A1
EXPLOSIVE CHARGE

PROJECTILE, 75mm, HE, M41A1

[redacted] Cl 06/15/93

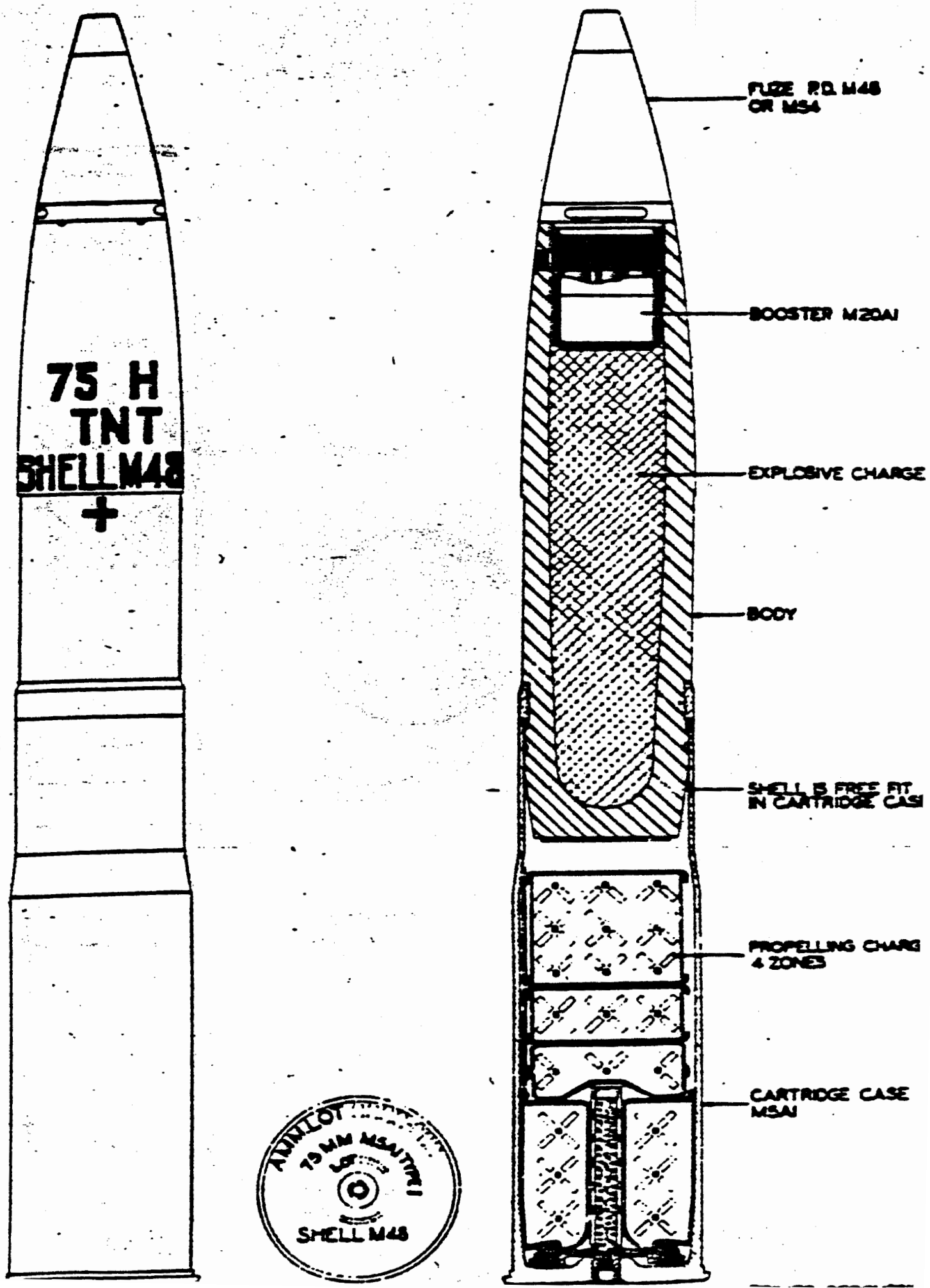
Fuzes Used: M48 PD, M39A2 PD, M54 TSQ

Booster Used: M20

* Length less fuze: 9.77"
* Diameter of bourrelet: 2.938"
* Width of rotating band: .49"
* Diameter of base: 2.5"
* Total weight with fuze: with M48 = 13.76 lb, with M39A2 = 14.15 lb, with M54 = 13.78 lb.
* Weight of filler: 1.11 lb TNT
* Construction: Steel with boat-tail base and soldered steel base plate. Copper rotating band.
* New type streamlined projo.
* Paint and markings: Olive Drab with yellow markings or Yellow with black marking. " 75H, TNT, SHELL, M41A1"
* Fuze is screwed into and staked to shell or booster.

References: TM9-1904, 147 data sheet

Location Found: TS, MT


75 H
TNT
SHELL M48
+
FUZE P.D. M48
OR M54
BOOSTER M20A1
EXPLOSIVE CHARGE
BODY
SHELL IS FREE FIT
IN CARTRIDGE CASE
PROPELLING CHARGE
4 ZONES
CARTRIDGE CASE
M5A1
AMMLOT
75 MM M5A1 TYPE I
SHELL M48

PROJECTILE, 75mm, HE, M48

[redacted]
C1 06/15/93

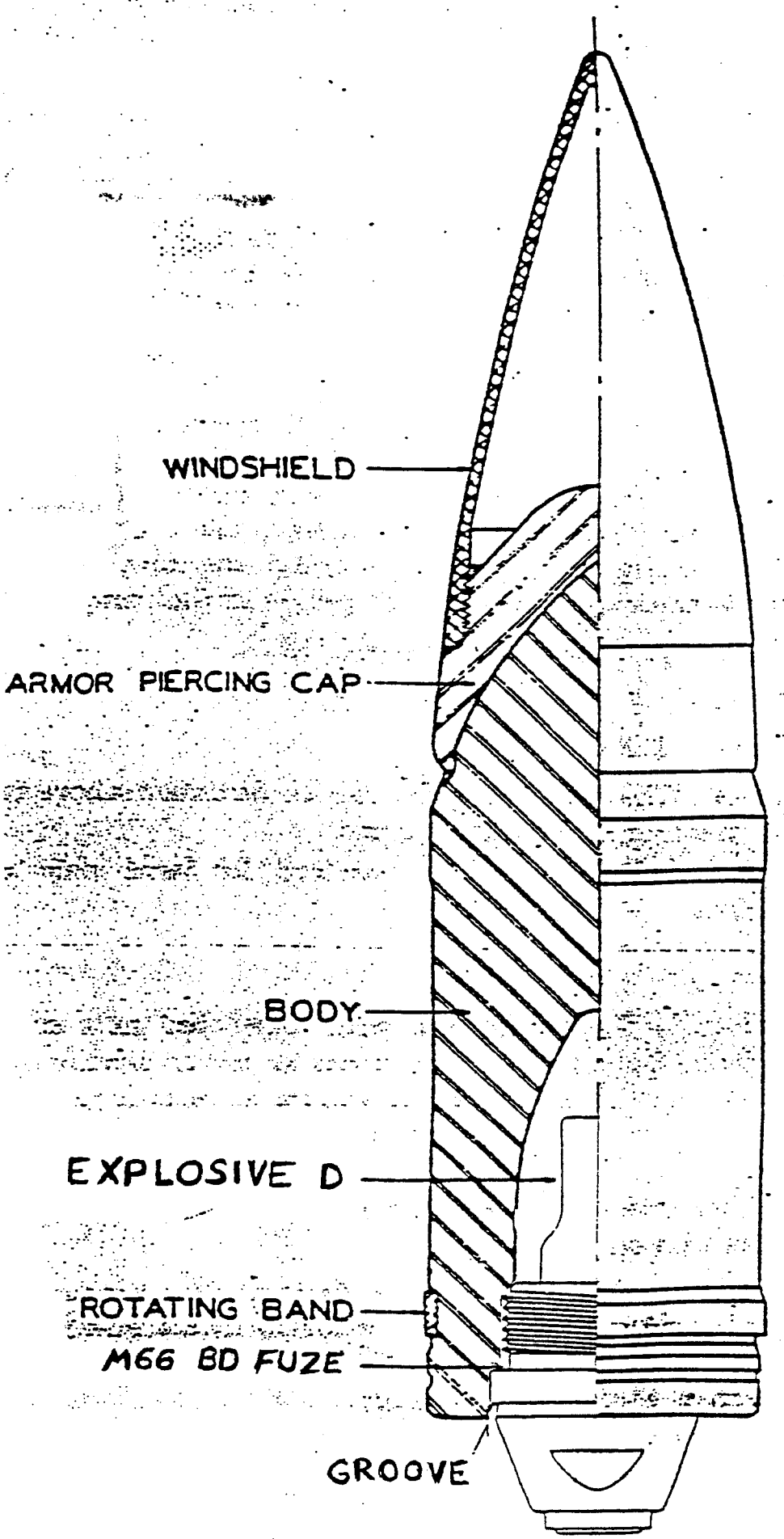
Fuzes Used: M48 PD, M54 TSQ

Booster Used: M20 & M20A1

* Length less fuze: 11.26"
* Diameter of bourrelet: 2.945"
* Width of rotating band: .49"
* Diameter of base: 2.48"
* Total weight with fuze: 14.6 lb with M48 fuze.
* Weight/Type filler: 1.47 lb cast TNT
* Construction: Body made of forged steel with boat-tail base.
* New type streamlined projo.
* Paint and markings: Olive Drab with yellow markings or yellow with black marking. " 75H, TNT, SHELL, M48"
* Booster held in place by set screw in nose and fuze is screwed into and staked to booster.

References: TM9-1904, TM43-0001-28, 147 data sheet

Location Found: TS


WINDSHIELD
ARMOR PIERCING CAP
BODY
EXPLOSIVE D
ROTATING BAND
M66 BD FUZE
GROOVE

PROJECTILE, 75mm, APC, M61 & M61 w/FUZE

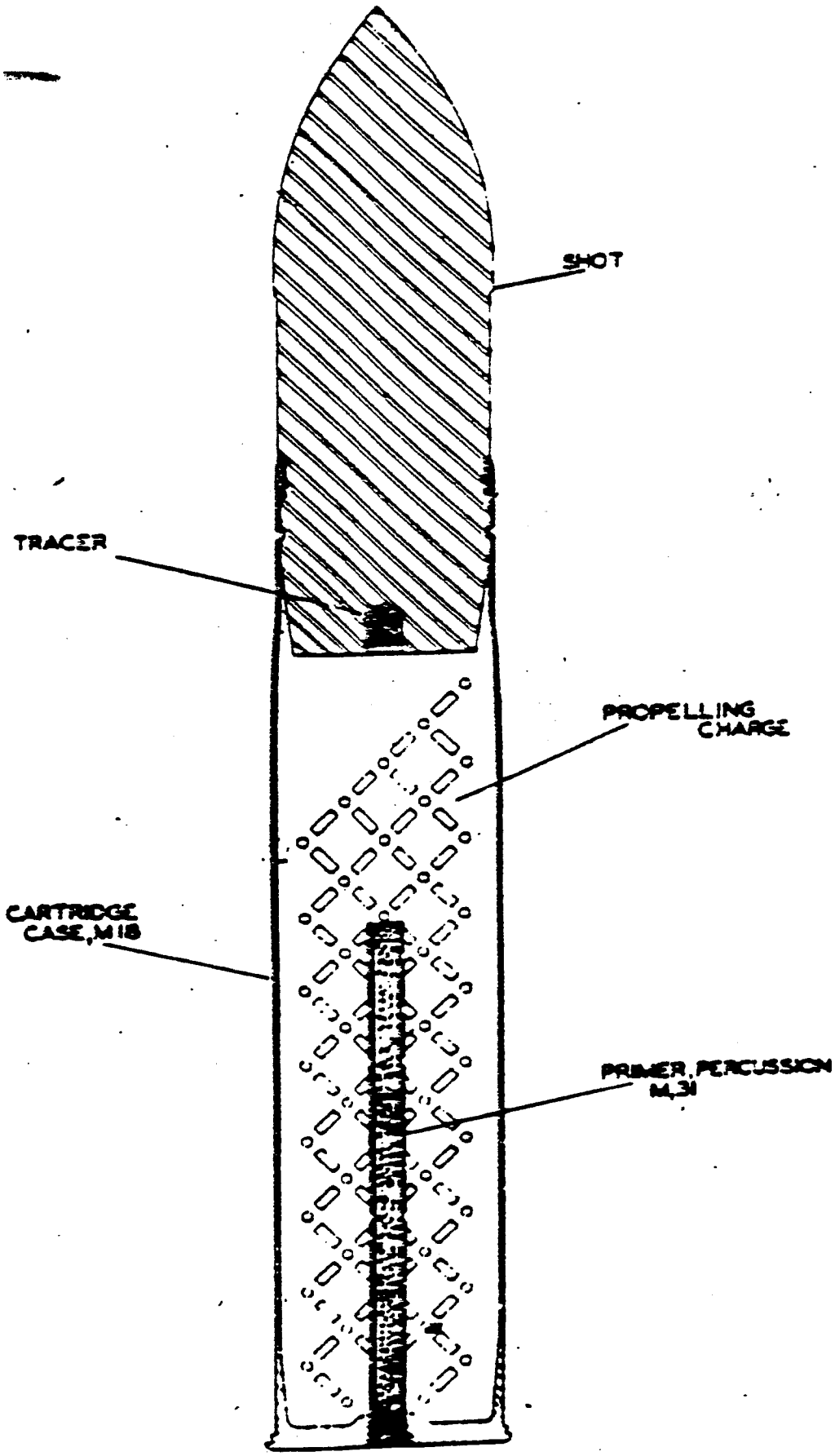
[redacted]t
C1 06/15/93

Fuzes Used: M61, M61A1 BD fuzes.

* Length:
* Diameter of bourrelet:
* Width of rotating band:
* Diameter of base:
* Weight:
* Weight/Type filler: .15 lb explosive D.
* Construction: Body of projo is made of hardened forged steel with machined cavity for explosive filler. Cap is crimped and soldered to nose. An die-cast aluminum windshield is threaded to cap.
* Paint and markings: Painted OD with yellow stencilling.
* A notch in the fuze body is so shaped that a dove-tailed groove is left between the fuze body and the base of the projectile. Lead wire is hammered into this groove so as to seal the joint between fuze and projectile against seepage of the propelling charge gases, protecting against premature detonation of explosive D filler.

References: TM9-1904, 147 data sheet

Location Found: TS


SHOT
TRACER
PROPELLING CHARGE
CARTRIDGE CASE, M18
PRIMER, PERCUSSION M,31

PROJECTILE, 75mm, AP, M72

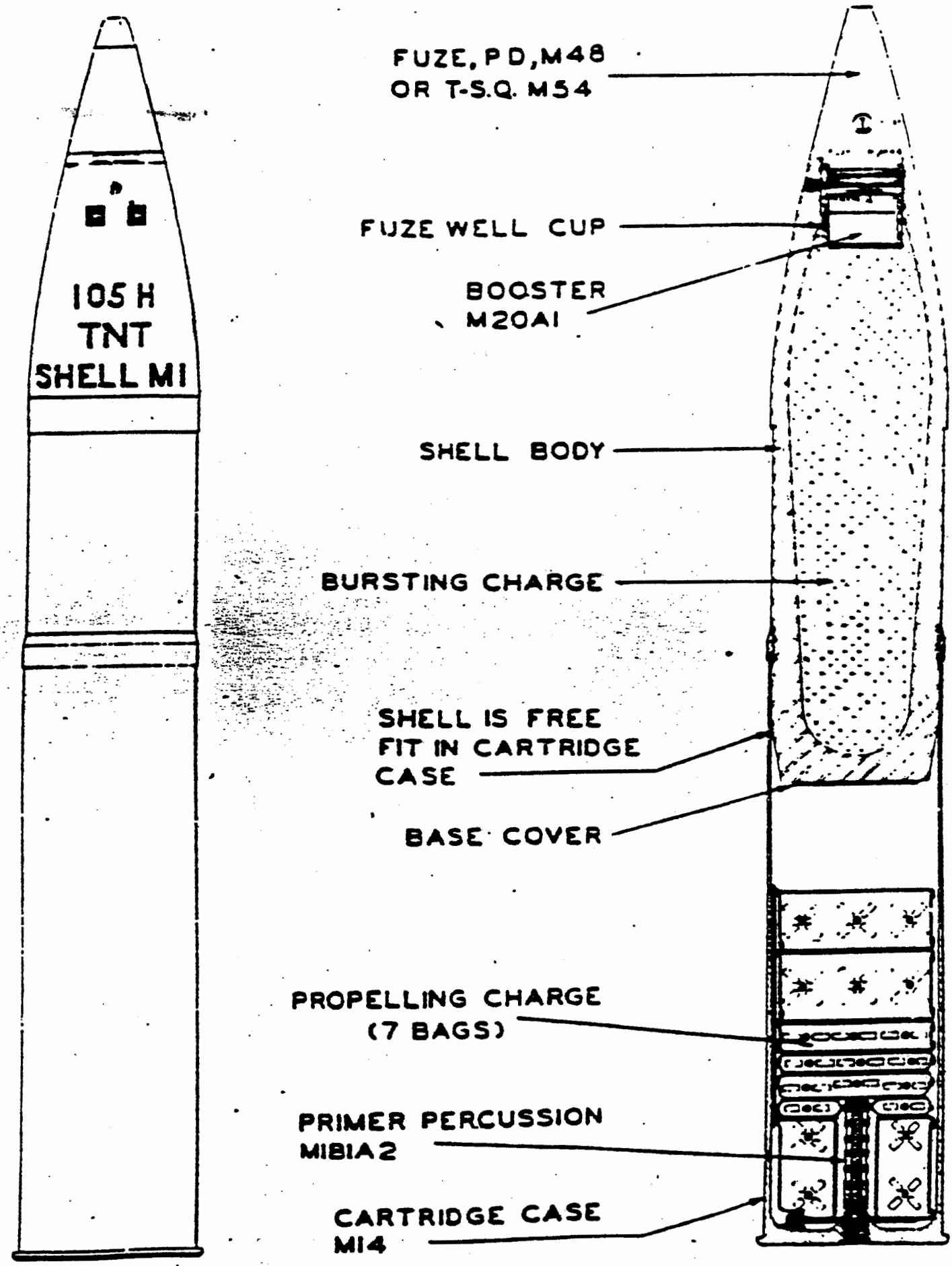
[redacted]t
C1 06/15/93

Fuzes Used: None

* Length: 9.17"
* Diameter of bourrelet: 2.945"
* Width of rotating band: .49"
* Diameter of base: 2.65"
* Weight: 13.94 lbs.
* Construction: Solid hardened steel with tracer.
* Paint and markings: Painted black with white stencilling " SHOT A.P. M72, 75G".
* Tracer composed of 69 gr red tracer and igniter composition, designed to burn for approximately 3 sec.

References: TM9-1904, 147 data sheet

Location Found: TS


105 H
TNT
SHELL MI
FUZE, P D, M48
OR T-S.Q. M54
FUZE WELL CUP
BOOSTER
M20A1
SHELL BODY
BURSTING CHARGE
SHELL IS FREE
FIT IN CARTRIDGE
CASE
BASE COVER
PROPELLING CHARGE
(7 BAGS)
PRIMER PERCUSSION
MIBIA2
CARTRIDGE CASE
MI4

PROJECTILE, 105mm, HE, M1

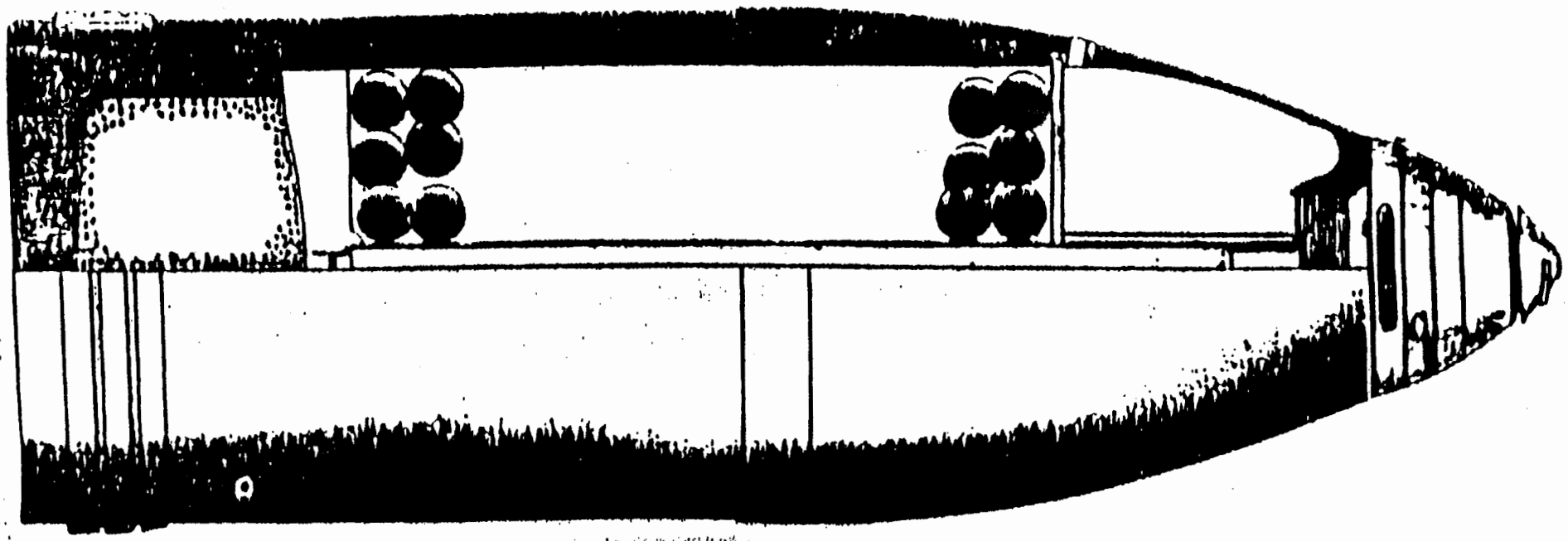
[redacted]rt
C1 06/15/93

Fuzes Used: M39A2 PD, M48 PD, M54 TSQ

* Length: 19.33"
* Diameter of bourrelet: 4.146"
* Width of rotating band: .81"
* Diameter of base: 3.45"
* Weight: 33 lbs.
* Weight/Type filler: 4.9 lb. cast TNT, 4.57 lb 50/50 Amatol, or 4.96 lb. Trimonite.
* Construction: Made of forged steel with boattail base and welded base cover.
* Paint and markings: Painted yellow with black stencilling or OD with yellow stencilling: "105 H, TNT, SHELL M1."
* A base cover of thin steel is welded to the base to minimize the danger of premature detonation of the bursting charge by the propellant.

References: TM9-1904, TM43-0001-28, 147 data sheet

Location Found: TS



PROJECTILE, 155mm, SHRAPNEL, MkI

[redacted]
C1 06/15/93

Fuzes Used: M1907M 45 sec Combo, M1914/15M or G Combo Fuzes.

* Length: 18.83"
* Diameter of bourrelet: 5.95"
* Width of rotating band: 1.21"
* Diameter of base: 5.68"
* Total weight: 95 lbs
* Weight/Type filler: Base charge 1.21 lbs. black powder; 800 antinony/lead balls in a resin matrix compound.
* Construction: Made of steel with solid base.
* Paint and markings: Painted red with black stencilling: - "155 G (or H)".

Function: The shrapnel projo is actually a gun within a gun. Except for size the 155mm shrapnel projo is the same as the 75mm shrapnel. Flame from magazine charge of fuze flashes down the central tube and ignites the black powder base charge. In some shrapnel projos a fiber cup and cloth disc may be found. Flash burns through these if they are present. Explosion of this charge forces the lower diaphragm, matrix and balls, and flash tube upward, blowing off the fuze and head as a unit, the rupture occuring at the fine threads between the fine threads between the head and the case. The resin matrix is melted and ignited and the lead balls are ejected from the case in a whirling cone-shaped pattern due to the rotation of the projo.

References: TM9-1904, 147 data sheet

Location Found: TS, MT