U.S. Chemical Weapons and Related Materiel Reference Guide

Final

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Prepared for:

U.S. Army Chemical Materials Activity
Recovered Chemical Materiel Directorate
Recovered Chemical Warfare Materiel Integrating Office
E4585 Hoadley Road
Aberdeen Proving Ground, Edgewood Area
Edgewood, Maryland 21010

Prepared by:

GSI North America
2336 Canyon Blvd.
Boulder, CO 80302-5618

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Wright, Ann W.; Carton, Geoffrey; Green, Mikah; Byrd, Joshua; and Hodgkinson; Eric

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GSI North America
2336 Canyon Blvd
Boulder, CO 80302-5618

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This guide is focused on U.S. munitions and certain materials of interest that in one or more configurations may contain compounds listed in the schedule of chemicals in the Chemical Weapons Convention, which are considered chemical warfare material by the Recovered Chemical Warfare Material Program. It is a compilation of technical information to aid unexploded ordnance qualified personnel in the identification of chemical munitions and related materiel. Because many munitions appear similar, and environmental exposure can obscure characteristics necessary for positive identification, only individuals with extensive training in munitions identification and functioning should approach, disturb, or handle suspect munitions or certain materials of interest. The information is useful to project managers for planning field operations and ultimate disposition of items.

15. SUBJECT TERMS
Recovered chemical warfare material, RCWM, chemical warfare material, CWM, chemical agent, chemical weapon, munitions, bombs, mortars, bomblets, clusters, generators, dispensers, chemical agent identification set, CAIS, grenades, mines, projectiles, artillery, warheads, missiles, rockets

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U.S. Chemical Weapons and Related Materiel Reference Guide

1 Introduction

This document expands, updates, and corrects information in the 2018 *Old Chemical Weapons and Related Materiel Reference Guide*. This guide is focused on U.S. munitions and certain materials of interest that in one or more configurations may contain compounds listed in the schedule of chemicals in the Chemical Weapons Convention (CWC), which are considered chemical warfare material (CWM) by the Recovered Chemical Warfare Material (RCWM) Program. A limited number of other items are included as they appeared in the 1998 guide. Foreign munitions addressed in the 1998 guide are not included in this update (SciTech Services Inc., 1998). This guide is a compilation of technical information to aid unexploded ordnance (UXO) qualified personnel in the identification of chemical munitions and related materiel. Because many munitions with differing fills and fuzing may appear similar, and environmental exposure can obscure critical characteristics necessary for positive identification, only individuals with extensive training in munitions identification and functioning should approach, disturb, or handle suspect munitions or certain materials of interest. All others should follow the 3Rs of explosives safety (Recognize, Retreat, Report). The information is also useful to project managers for planning field operations and ultimate disposition of items. The information provided here is not inclusive of all possible agent fills, physical characteristics, or explosive train configurations. A few experimental munitions are included in this guide; however, not every configuration has been captured here. This document is based on the best information available at the time of publication.

The information used to compile this guide includes historical documents describing ammunition development and manufacture, technical manuals, munitions specifications, and other related sources.

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2 Technical Information - Chemical Agents

A chemical agent, through its chemical properties, produces lethal or other damaging effects on humans. The Department of Defense (DOD) defines chemical agents as a substance that is intended for use in military operations to kill, seriously injure, or incapacitate, through physiological effects (Defense Technical Information Center, 2016 p. 30). Chemical agents have effects that can be immediate or delayed, can be persistent or nonpersistent, and can have significant physiological effects (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. I-1). The chemicals in this guide may be described as chemical agents, chemical warfare agents, or military chemical compounds; however, only those compounds listed in the schedule of chemicals in the CWC (OPCW, 1997) are considered CWM by the RCWM Program.

Chemical agents are classified in groups based on their use: lethal chemical agents (i.e., choking, nerve, blood), blister agents, and incapacitating agents. Other munition fills that were at one time managed by the Chemical Warfare Service (CWS) include riot control agents, smokes, and incendiaries. The chemicals listed in Table 1 are the chemical agent fills in the munitions described in this guide and others that may be encountered in the reference materials. A description of the categories of information provided in the table is presented in the following subsections.

2.1 Chemical Agent Symbols

Chemical agent symbols, or brevity codes, are designed to convey complex information with a few letters. U.S. military chemical agent symbols are generally used in this document to describe the fill of a munition. In some instances, more than one symbol exists because they changed over time. In cases where more than one chemical agent symbol exists, both are provided in the table, with the most common listed first.

2.2 Common Name

Common names, or chemical names, for the chemical fills covered under this guide are provided in Table 1. In cases where chemicals have more than one common name, the one most often used in description of military munitions is listed in Table 1.

2.3 Chemical Abstract Service Registration Number

The Chemical Abstract Service (CAS) is a division of the American Chemical Society. The CAS registry is a collection of chemical substance information containing more than 183 million organic and inorganic substances and 68 million sequences and is a global standard for identification. CAS registry covers substances identified from the scientific literature from 1957 to the present, with additional substances going back to the early 1800s. CAS registry numbers are universally used to provide a unique, unmistakable identifier for chemical substances. A CAS # in and of itself has no inherent chemical significance; however, it provides an unambiguous way to identify a chemical substance or molecular structure when there are many possible systematic, generic, proprietary, or trivial names. A CAS # is a numeric identifier that can contain up to ten digits, divided by hyphens into three parts. The digit furthest to the right is a check digit used to verify the validity and uniqueness of the entire number (Chemical Abstract Service, 2021). The CAS #, if available, is listed in Table 1.

U.S. Chemical Weapons and Related Materiel Reference Guide

Table 1: Symbols for U.S. Chemical Agents and Other Chemical Warfare Service Chemicals

U.S. Chemical Agent Symbol	Chemical Name/Common Name	CAS #	Classification	Persistent/ Nonpersistent	CWC Schedule	Citations
AC or HCN	Hydrogen cyanide or Hydrocyanic acid	74-90-8	Blood Agent	Nonpersistent	3A03	(Department of the Army, 1955 p. 49; Departments of the Army, Navy, and Air Force, 1990 pp. 25-26; OPCW, 1997)
AS	Asbestine (finely ground fibrous magnesium silicate) suspension	1343-88-0	Simulant	Not Applicable	Not Listed	(Secretary of War, 1942 p. 22)
BA	Bromoacetone	598-31-2	Riot Control Agent	Persistent	Not listed	(Prentiss, 1937 p. 6; U.S. Army Corps of Engineers, 2015 pp. 7-32)
BM	Berger Mixture (35.4% Zinc, 41.6% carbon tetrachloride, 9.3% sodium chlorate, 5.4% ammonium chloride, 8.3% magnesium carbonate)	--	Smoke	Not Applicable	Not listed	(SciTech Services Inc., 1998 pp. 1-7; Prentiss, 1937 pp. 7, 242)
BZ	3-quinuclidinyl benzilate	6581-06-2 13004-56-3	Incapacitating Agent	Nonpersistent	2A03	(Department of the Army, 1982 p. Glossary 1; Departments of the Army, Navy, and Air Force, 1990 p. 48; OPCW, 1997 p. 53)
CA* or BBC	Bromobenzyl cyanide or 4-Bromophenylacetylnitrile	16532-79-9 5798-79-8	Respiratory Irritant	Persistent	Not listed	(Departments of the Army, Navy, and Air Force, 1990 pp. 52-53; American Expeditionary Forces, 1919 p. 9; War Department, 1944 pp. 164, 172; U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. III-16)
CG	Phosgene or Carbonyl chloride	75-44-5	Choking Agent	Nonpersistent	3A01	(War Department, 1944 p. 164; War Department, 1945 p. 111; Departments of the Army, Navy, and Air Force, 1990 pp. 14-15; OPCW, 1997)
CK or CC	Cyanogen chloride	506-77-4	Blood Agent	Nonpersistent	3A02	(Department of the Army, 1955 p. 49; Departments of the Army, Navy, and Air Force, 1990 pp. 25, 27-28; OPCW, 1997)
CL	Chlorine	7782-50-5	Choking Agent	Nonpersistent	Not listed	(War Department, 1944 pp. 164, 819; Departments of the Army, Navy, and Air Force, 1990 pp. 70-71; Secretary of War, 1942 p. 136)

Table 1: Symbols for U.S. Chemical Agents and Other Chemical Warfare Service Chemicals

U.S. Chemical Agent Symbol	Chemical Name/Common Name	CAS #	Classification	Persistent/ Nonpersistent	CWC Schedule	Citations
CN	Chloroacetophenone or 2-Chloroacetophenone	532-27-4	Riot Control Agent	Solid: Persistent Burning mixture: Nonpersistent	Not listed	(War Department, 1944 p. 164; War Department, 1945 p. 92; Departments of the Army, Navy, and Air Force, 1990 pp. 53-54; Secretary of War, 1942 p. 92)
CNB	Chloroacetophenone solution: 45% benzene + 10% chloroacetophenone + 45% carbon tetrachloride	532-27-4	Riot Control Agent	Persistent	Not listed	(Department of the Army, 1955 p. 50; Departments of the Army, Navy, and Air Force, 1990 p. 56; Secretary of War, 1942 p. 93)
CNC	Chloroacetophenone solution: 70% chloroacetophenone + 30% chloroform	532-27-4	Riot Control Agent	Persistent	Not listed	(Department of the Army, 1955 p. 50; Departments of the Army, Navy, and Air Force, 1990 p. 55)
CNS	Chloroacetophenone solution: 38.4% chloropicrin + 23% chloroacetophenone + 38.4% chloroform	532-27-4 76-06-2	Respiratory Irritant	Persistent	3A04	(Department of the Army, 1955 p. 50; Departments of the Army, Navy, and Air Force, 1990 pp. 56-57; Secretary of War, 1942 p. 93; OPCW, 1997)
CS or CS2**	2-chlorobenzalmalononitrile or O-chlorobenzylidene malononitrile Compound	2698-41-1	Riot Control Agent	Persistent	Not Listed	(U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. F-1; Bureau of Naval Weapons, 1961 pp. 3-5)
CX	Phosgene oxime or Dichloroformoxime	1794-86-1	Blister Agent	Nonpersistent	Not Listed	(U.S. Army, Marine Corps, Navy, and Air Force, 2005)
DA	Diphenylchloroarsine or Clark I	712-48-1	Respiratory Irritant	Nonpersistent	Not listed	(Department of the Army, 1955 p. 51; War Department, 1945 p. 95; Departments of the Army, Navy, and Air Force, 1990 pp. 62-63)
DF	Methylphosphonic Acid	676-99-3	Precursor	Not Applicable	1B09	(U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-69)
DM	Adamsite or diphenylaminechlorarsine 10-chloro-5,10-dihydrophenarsazine	578-94-9	Respiratory Irritant	Nonpersistent	Not listed	(Department of the Army, 1955 p. 50; War Department, 1945 p. 94; Departments of the Army, Navy, and Air Force, 1990 pp. 65-66)
DP	Diphosgene or Trichlormethyl-chloroformate,	503-38-8	Choking Agent	Nonpersistent	Not listed	(War Department, 1944 pp. 164,170)

Table 1: Symbols for U.S. Chemical Agents and Other Chemical Warfare Service Chemicals

U.S. Chemical Agent Symbol	Chemical Name/Common Name	CAS #	Classification	Persistent/ Nonpersistent	CWC Schedule	Citations
ED	Ethyldichloroarsine	598-14-1	Blister Agent	Persistent	Not Listed	(War Department, 1944 p. 164; War Department, 1945 pp. 91, 127)
FM	Titanium tetrachloride	7550-45-0	Smoke	Not Applicable	Not listed	(War Department, 1944 p. 164; Brophy, et al., 1959 p. 215)
FS	Sulfur trioxide and chlorosulfonic acid	7790-94-5	Smoke	Not Applicable	Not listed	(War Department, 1944 p. 164; Brophy, et al., 1959 p. 135)
GA	Tabun or Ethyl N,N-dimethylphosphoroamidocyanidate	77-81-6	Nerve Agent	Nonpersistent	1A02	(Department of the Army, 1955 p. 48; Departments of the Army, Navy, and Air Force, 1990 pp. 18-19; OPCW, 1997)
GB	Sarin or Isopropyl methylphosphonofluoridate	107-44-8	Nerve Agent	Nonpersistent	1A01	(Department of the Army, 1955 p. 48; Departments of the Army, Navy, and Air Force, 1990 pp. 19-20; OPCW, 1997)
GF	Cyclosarin	329-99-7	Nerve Agent	Nonpersistent	1A01	(Departments of the Army, Navy, and Air Force, 1990 pp. p. 22-23)
H or HS*	Sulfur mustard or Levinstein mustard Dichloroethysulfide	505-60-2	Blister Agent	Persistent	1A04	(Prentiss, 1937 p. 150; War Department, 1944 p. 164; Brophy, et al., 1959 p. 463; Secretary of War, 1942 p. 90; OPCW, 1997)
HC	Zinc oxide and hexachloroethane	1314-13-2 67-72-1	Smoke	Not Applicable	Not listed	(War Department, 1944 p. 164; Brophy, et al., 1959 p. 463)
HD	Distilled mustard, mustard gas, sulfur mustard, or Bis-(2-chloroethyl) sulfide	505-60-2	Blister Agent	Persistent	1A04	(Department of the Army, 1955 p. 47; Departments of the Army, Navy, and Air Force, 1990 pp. 31-32; OPCW, 1997)
HL	Mustard-lewisite mixture	378791-32-3	Blister Agent	Persistent	1A04	(Departments of the Army, Navy, and Air Force, 1990 pp. 40-41; OPCW, 1997; War Department, 1945 p. 47)
HN-1	Nitrogen mustard (Ethyl S) or Bis-(2-chloroethyl)ethylamine	538-07-8	Blister Agent	Persistent	1A06	(Department of the Army, 1955 p. 47; Departments of the Army, Navy, and Air Force, 1990 pp. 32-34; OPCW, 1997)
HN-2	Nitrogen mustard (Methyl) or Bis-(2-chloroethyl)methylamine	51-75-2	Blister Agent	Persistent	1A06	(Departments of the Army, Navy, and Air Force, 1990 pp. 33-34; OPCW, 1997)
HN-3	Nitrogen mustard (Tri) or Tris(2-chloroethyl)amine	555-77-1	Blister Agent	Persistent	1A06	(Departments of the Army, Navy, and Air Force, 1990 pp. 35-36)

Table 1: Symbols for U.S. Chemical Agents and Other Chemical Warfare Service Chemicals

U.S. Chemical Agent Symbol	Chemical Name/Common Name	CAS #	Classification	Persistent/ Nonpersistent	CWC Schedule	Citations
HQ	Mustard-sesquimustard (Q) mixture	505-60-2 3563-36-8	Blister Agent	Persistent	1A04	(Department of the Army, 1967 p. 77; OPCW, 1997 p. 51)
HT	Distilled mustard and T-mixture (60% bis(2-chloroethyl) sulfide (H); 40% bis(2-chloroethyl thioethyl) ether (T))	172672-28-5	Blister Agent	Persistent	1A04	(Department of the Army, 1955 p. 48; Departments of the Army, Navy, and Air Force, 1990 pp. 37-38; OPCW, 1997)
HV or HDV	Thickened mustard or thickened distilled mustard Bis-(2-chloroethyl) sulfide thickened with methyl methacrylate	505-60-2	Blister Agent	Persistent	1A04	(Stockhardt, 1945 p. 4; OPCW, 1997)
IM	Incendiary Mixture isobutyl methacrylate	97-86-9	Incendiary	Not Applicable	Not listed	(Department of the Army, 1969 p. 48; Department of the Army, 1967 p. 19; Chemical Abstract Service, 2021)
KB-16	Methyl N-(2-chloroethyl)-N-nitrosocarbamate	13589-15-6	Blister Agent	Unknown	Not listed	(Hale, et al., 1942)
KJ	Stannic chloride or tin tetrachloride	7646-78-8	Choking Agent	Semi-persistent	Not listed	(War Department, 1945 p. 47; Prentiss, 1937 p. 7.; U.S. Army Corps of Engineers, 2015 pp. 7-34, 7-35, D10)
L or M-1	Lewisite or dichloro-(2-chlorovinyl)arsine	541-25-3	Blister Agent	Persistent	1A05	(War Department, 1944 p. 164; War Department, 1945 p. 91; Departments of the Army, Navy, and Air Force, 1990 pp. 38-40; OPCW, 1997; Prentiss, 1937 p. 6)
MD	Methyldichloroarsine	593-89-5	Blister Agent	Nonpersistent	Not listed	(U.S. Army, Marine Corps, Navy, and Air Force, 2005)
MD2	Methyldifluoroarsine	420-24-6	Blister Agent	Nonpersistent	Not listed	(Edgewood Arsenal, 1918)
MR	Molasses residuum	Not Applicable	Simulant	Not Applicable	Not listed	(War Department, 1945 p. 47; Secretary of War, 1942 p. 22)
NC	Chloropicrin and stannic chloride	76-06-2 7646-78-8	Choking Agent	Semi-persistent	3A04	(American Expeditionary Forces, 1919 p. 19; War Department, 1945 p. 47; OPCW, 1997)
NM	Dimethyl polysulfide mixture (powdered sulfur + dimethyl disulfide)	624-92-0	Precursor	Not Applicable	Not listed	(U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-75)

Table 1: Symbols for U.S. Chemical Agents and Other Chemical Warfare Service Chemicals

U.S. Chemical Agent Symbol	Chemical Name/Common Name	CAS #	Classification	Persistent/ Nonpersistent	CWC Schedule	Citations
OPA	Isopropylamine + Isopropyl Alcohol	75-31-0 67-63-0	Precursor	Not Applicable	Not listed	(U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-72)
NP	Napalm or thickened gasoline with napalm	8031-21-8	Incendiary	Not Applicable	Not listed	(War Department, 1945 p. 47; Brophy, et al., 1959 p. 464)
PD	Phenyldichloroarsine (code may also designate phosgene plus diphenylchlorarsine, which is CWC Schedule 3A04)	696-28-6	Blister Agent	Persistent	Not listed	(War Department, 1944 p. 164; Department of the Army, 1955 p. 163; Departments of the Army, Navy, and Air Force, 1990 pp. 41-42)
PG	Chloropicrin and phosgene	76-06-2 75-44-5	Choking Agent	Semi-persistent	3A01	(American Expeditionary Forces, 1919 p. 19; Prentiss, 1937 p. 476; OPCW, 1997)
PS	Chloropicrin or trichloronitromethane	76-06-2	Choking Agent	Persistent	3A04	(War Department, 1944 p. 164; War Department, 1945 p. 89; Departments of the Army, Navy, and Air Force, 1990 pp. 52, 61; OPCW, 1997)
PT or PT1	Oil and incendiary mixture or thickened fuel	--	Incendiary	Not Applicable	Not listed	(Department of the Army, 1955 p. 53; Departments of the Army and the Air Force, 1957 p. 98; Bureau of Naval Weapons, 1961 pp. 3-8)
PWP	Plasticized white phosphorus	--	Smoke	Not Applicable	Not listed	(Department of the Army, 1967 p. 21; Brophy, et al., 1959 p. 464)
Q	Sesquimustard or 1,2-Bis(2-chloroethylthio)ethane	3563-36-8	Blister Agent	Persistent	1A04	(U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-76, D-1; OPCW, 1997 p. 51)
QL	O-Ethyl O-2-diisopropylaminoethyl methylphosphonite	57856-11-8	Precursor	Not Applicable	1B10	(U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-71)
SA	Arsine or Arsenic trihydride	7784-42-1	Blood Agent	Nonpersistent	Not listed	(War Department, 1943 p. 8; War Department, 1945 pp. 5, 8)
TH3 or Th.	Thermite	--	Incendiary	Not Applicable	Not listed	(War Department, 1944 p. 164; Departments of the Army and the Air Force, 1957 pp. 4, 90; U.S. Army Corps of Engineers, 2015 pp. 7-33)

Table 1: Symbols for U.S. Chemical Agents and Other Chemical Warfare Service Chemicals

U.S. Chemical Agent Symbol	Chemical Name/Common Name	CAS #	Classification	Persistent/ Nonpersistent	CWC Schedule	Citations
VX	O-ethyl S(2-diisopropylamino ethyl) methylphosphonothioate	50782-69-9	Nerve Agent	Persistent	1A03	(Department of the Army, 1969 p. 35; Departments of the Army, Navy, and Air Force, 1990 pp. 23-25; OPCW, 1997; Naval Ordnance Laboratory, 1963 pp. 3-2)
WP	White phosphorus	12185-10-3	Smoke	Not Applicable	Not listed	(War Department, 1944 p. 164; Brophy, et al., 1959 p. 466)

Notes:
* Prior to 1943 (War Department, 1943, pp. C-1; Prentiss, 1937, p. 6)
** CS2 is chemically identical to CS but differs in its physical characteristics. CS2 is a siliconized, microencapsulated form of CS (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. III-3)
CAS – Chemical Abstract Service
CWC – Chemical Weapons Convention
OPCW – Organisation for the Prohibition of Chemical Weapons

2.4 Classification

The classifications of the chemical agents and military chemical compounds in Table 1 are based on the mechanism of action (i.e., the route of penetration and the effect on the human body). Chemical agents and military chemical compounds are commonly divided into several categories: chemical warfare agents (e.g., choking agents, nerve agents, blood agents, blister agents [vesicants], incapacitating agents), riot control agents, respiratory irritants, smokes, and incendiaries. The relationships of the various classifications of the chemical agents and military chemical compounds are shown on Figure 1.

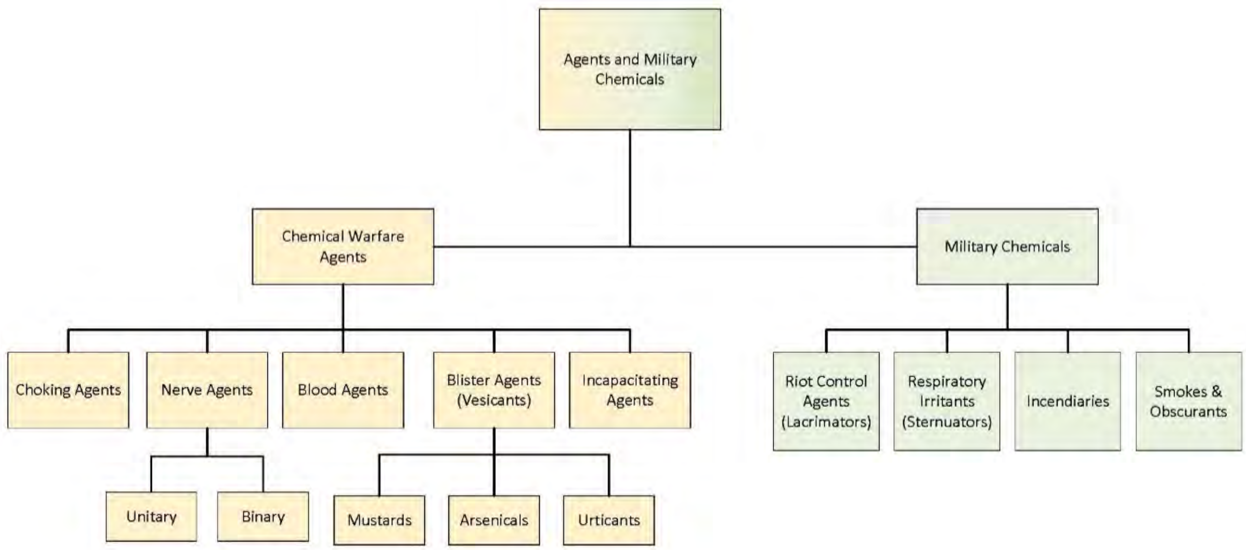

Figure 1: Chemical Warfare Agents and Military Chemicals

2.4.1 Chemical Warfare Agents

Choking Agents

Choking agents, also known as pulmonary agents and lung irritants, are those designed to interrupt normal breathing by causing fluids to build up in the lungs resulting in suffocation. Choking agents cause damage to the lungs, irritation to the eyes and the respiratory tract, and pulmonary edema (commonly known as dryland drowning) (Departments of the Army, Navy, and Air Force, 1990 p. 14; Department of the Army, 1969 p. 38; War Department, 1945 pp. C-2). They cause irritation to the bronchi, trachea, larynx, pharynx, and nose. Initial symptoms may include tears, dry throat, coughing, choking, tightness of chest, nausea, vomiting, and headache. In extreme cases, membranes swell, lungs become filled with liquid, and death results from lack of oxygen; thus, these agents "choke" an unprotected person. Fatalities of this type are called dryland drownings (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-9).

Nerve Agents

Nerve agents affect the transmission of nerve impulses in the nervous system; they are extremely toxic and have a rapid effect. Nerve agents can be vapor, aerosol, or liquid (Departments of the Army, Navy, and Air Force, 1990 p. 17; Department of the Army, 1969). In sufficient doses, nerve agents can lead to an inability of the body to sustain breathing (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. I-4). Nerve agents are more toxic than other chemical agents. They may cause effects within seconds and death within minutes. The nerve agents are all liquids, not nerve gas per se. They can be absorbed through any surface of the body and can penetrate ordinary clothing rapidly (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-13). Prior to 1945, nerve agents were grouped with blood agents and classified as systemic poisons (War Department, 1945 pp. C-2). Nerve agents may be deployed in the field as a single compound (unitary agents) or may be designed to mix two nonlethal chemicals (binary agents) while in flight to a target to form chemical agent.

Blood Agents

Blood agents (e.g., cyanogenic agents) are distributed through the blood, generally enter the body via inhalation, and inhibit the ability of blood cells to utilize and transfer oxygen. Prior to 1945, blood agents were classified as systemic poisons (Departments of the Army, Navy, and Air Force, 1990 p. 25; Department of the Army, 1969 p. 38; War Department, 1945 pp. C-2). Blood agents include hydrogen cyanide or hydrocyanic acid (AC or HCN), cyanogen chloride (CK), and arsine (SA). The cyanogen blood agents, AC and CK, affect the bodily functions by inactivating the cytochrome oxidase system. This poisoning prevents cell respiration and the normal transfer of oxygen from the blood to body tissues. Arsine causes hemolysis of the red blood cells. Cyanogen agents are highly volatile and, therefore, nonpersistent. Exposure at high concentrations causes effects within seconds and death within minutes in unprotected personnel (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-31).

Blister Agents

Blister agents, also known as vesicants, act via inhalation and contact with skin. Blister agents are noted for producing reddening and blistering of the skin. Eye exposure results in reddening of the eyes and temporary blindness or permanent effects. Inhaled mustard damages mucous membranes and the respiratory tract. Blister agents are used to produce casualties, to degrade fighting efficiency, and to restrict use of terrain and equipment. Blister agents are chemical agents that act on the eyes, mucous membranes, lungs, skin, and blood-forming organs. The most toxic route of exposure is inhalation/ocular.

The severity of a blister agent burn relates directly to the concentration of the agent, the duration of contact with the skin, and the location on the body. Most blister agents are insidious in action except for lewisite (L or M-1) and phosgene oxime (CX), which cause immediate pain on contact. The blister agents are divided into three groups: mustards, arsenicals, and urticants (Departments of the Army, Navy, and Air Force, 1990 p. 30; Department of the Army, 1969 p. 33; War Department, 1945 pp. C-2; U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. I-5, II-37).

Mustard agents include the sulfur mustards (mustard [H or HS] and distilled mustard [HD]) and the nitrogen mustards (HN-1, HN-2, and HN-3). Because of their physical properties, mustards are persistent under cool conditions; however, evaporation increases as the temperature increases. It is possible to increase their persistency even more by dissolving them in thickeners (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-37).

Arsenical vesicants are organic dichloroarsines. They are respiratory tract irritants and produce lung injury on sufficient exposure. The vapors are irritating to the eyes and the liquid may produce serious eye lesions. Skin damage leading to vesication is produced by sufficient exposure to the vapor or by contact with the liquid. Absorption of vapor or liquid through the skin may lead to systemic intoxication or death (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-50).

Urticants are not true vesicants because, unlike mustard and L, they do not produce fluid-filled blisters; rather, they produce solid lesions resembling urticaria. CX is the primary urticant of military interest and has also been classified as a lung poison. It can penetrate garments and rubber much more quickly than other agents. It affects the skin, eyes, and lungs. No other chemical agent produces such an immediately painful onset that is followed by rapid tissue necrosis. The skin lesions are similar to those caused by a strong acid. The rapid skin damage renders the skin more susceptible to a second type of agent. Droplets on the skin are potentially lethal (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-62).

Incapacitating or Harassing Agents

Incapacitating agents are chemicals that cause physiological or mental effects (or both) that lead to temporary disability. Unlike riot control agents with effects lasting only a few minutes, incapacitating agents produce effects that may last for hours or days after exposure to the agent has ceased (Departments of the Army, Navy, and Air Force, 1990 p. 47). Used in a military context, incapacitation is understood to mean inability to perform one's military mission. Since missions vary, for the purpose of this guide, incapacitation means the inability to perform any military task effectively and implies that the condition was achieved via the deliberate use of a nonlethal weapon.

Incapacitating agents differ from other chemical agents in that the lethal dose is theoretically many times greater than the incapacitating dose. Thus, they do not seriously endanger life except in cases exceeding many times the effective dose, and they produce no permanent injury. Virtually all drugs whose most prominent effects are psychological or behavioral can be classified into four discrete categories: deliriants, stimulants, depressants, and psychedelics. They interfere with the higher functions of the brain such as attention, orientation, perception, memory, motivation, conceptual thinking, planning, and judgment (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. II-64). Incapacitating agents were introduced as a separate category in 1967. Prior to 1967, they were described as "Irritant Agents" (SciTech Services Inc., 1998 pp. 1-11; U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. I-5).

2.4.2 Military Chemicals

Riot Control Agents

Riot control agents are chemicals that rapidly produce sensory irritation or disabling physical effects in humans, which disappear within a short time. Riot control agents can be divided into lachrymators (eye irritants), sternutators (cause sneezing and upper respiratory track irritation), and vomiting agents (Department of the Army, 1969 p. 40). Generally, riot control agents produce a rapid onset of effects (seconds to several minutes), and they have a relatively brief duration of effects (15 to 30 minutes) once the victim has escaped the contaminated atmosphere and has removed the contamination from clothing. Because tear compounds produce only transient casualties, they are widely used for training, riot control, and situations where long-term incapacitation is unacceptable. When used against poorly equipped forces, these compounds have proven extremely effective. When released indoors, they can cause serious illness or death (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. III-1). Prior to 1967, riot control agents were identified as "Harassing Agents," and prior to 1945, they were classified as irritants, specifically lachrymators (Department of the Army, 1967; War Department, 1945 pp. C-2; U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. I-5).

Respiratory Irritant Agents

Respiratory irritant agents were previously called vomiting agents; however, their primary action is irritation of the respiratory tract. The principal respiratory irritants are adamsite (DM), diphenylchloroarsine (DA; also referred to as Clark I), and chlorine (CL). They were originally designed as "mask breakers" during World War (WW) I. Their intended purpose was to penetrate the canister, forcing troops to remove their masks and be exposed to more toxic materials.

Two characteristics make these compounds different than riot control agents. The first characteristic is that the effects do not appear immediately on exposure or seconds afterwards, but several minutes later. In the absence of symptoms, personnel will not mask immediately; by the time they mask, a significant amount of the compound will have been absorbed. The effects may then cause an individual to unmask. The second characteristic of these compounds is that there may be more prolonged systemic effects, such as headache, mental depression, chills, nausea, abdominal cramps, vomiting, and diarrhea, which last for several hours after exposure. They are dispersed as aerosols, and they produce their effects by inhalation or by direct action on the eyes. When released indoors, they can cause serious illness or death. The protective mask gives adequate protection against field concentrations (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. III-7).

Smokes and Obscurants

Smokes and obscurants are combat multipliers. Their use provides tactical advantages for offensive and defensive operations. Smoke is an aerosol that owes its ability to conceal or obscure to its composition of many small particles suspended in the air. These particles scatter or absorb the light, thus reducing visibility. When the density or amount of smoke material between the observer and the object to be screened exceeds a certain minimum threshold value, the object cannot be seen.

Many types and combinations of smokes are used, but the three basic types of screening smokes are hexachloroethane (HC), phosphorous, and fog oil. White phosphorous (WP) and HC are hygroscopic; they absorb water vapor from the atmosphere. This increases their diameters and makes them more efficient at reflecting light rays. Fog oils are nonhygroscopic and depend upon vaporization techniques to produce extremely small diameter droplets to scatter light rays. Most smokes are not hazardous in concentrations that are useful for obscuring purposes. However, any smoke can be hazardous to health if the concentration is sufficient or if the exposure is long enough (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. III-16).

Incendiaries

Incendiaries cause maximum fire damage to flammable materials and objects and illuminate. The initial action of an incendiary munition may destroy these materials, or the spreading and continuing of fires started by the incendiary may destroy them (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. III-22).

2.5 Persistence

Persistent agents can cause casualties for more than 24 hours after use.

Nonpersistent agents dissipate or lose the ability to cause casualties after 15 minutes.

The terms "persistent" and "nonpersistent" describe the time chemical agents remain in an area and do not classify the agents technically (U.S. Army, Marine Corps, Navy, and Air Force, 2005 pp. I-4). Prior to and during WWI, a chemical agent was classified as persistent if, when released, it remained able to cause casualties for more than 24 hours to several days or weeks. A semi-persistent agent could persist for more than an hour in the open. A chemical agent was classified as nonpersistent if when released it dissipated and lost its ability to cause casualties after 10 to 15 minutes in the open. After WWI, the semi-persistent category was dropped and agents were considered persistent if the effects lasted for more than 10 minutes in an open field and nonpersistent if the effects lasted for less than 10 minutes (Prentiss, 1937 pp. 116-117). After WWI, the system for marking munitions that contain chemical agents included one colored band for nonpersistent effect agents and two colored bands for persistent effect agents (U.S. Naval Ordnance Laboratory, 1968 pp. 2-4). Currently, persistent agents are defined as those that, when released, remain able to cause casualties for more than 24 hours and a nonpersistent agent is one that dissipates or loses its ability to cause casualties after 15 minutes (Defense Technical Information Center, 2016).

2.6 Chemical Weapons Convention Schedule

The CWC established the Organisation for the Prohibition of Chemical Weapons (OPCW). The CWC prohibits the production and use of chemical agents and CWM. The CWC organizes certain toxic chemicals and precursors that have, or could play, a role in chemical weapons activity into three "schedules." The Schedules of Chemicals are ordered to reflect an assessment of the risk posed to the object and purpose of the CWC, the elimination of chemical weapons. Scheduled chemicals means specific chemicals listed and families of chemicals and any other chemicals meeting the criteria included in the CWC (Bureau of Industry and Commerce, 2004 p. 6). For the purposes of the RCWM Program, only those compounds on the CWC Schedules of Chemicals are potentially considered chemical agents. Table 1 provides the CWC schedule, if applicable, for each chemical listed.

2.6.1 Schedule 1 Chemicals

The Schedule 1 chemicals pose the highest risk to the object and purpose of the CWC. They include nerve agents such as O-Ethyl S(2-diisopropylaminoethyl) methylphosphonothioate (VX) and blister agents such as mustard (H/HS). Schedule 1 also includes final stage precursors used in the manufacture of the Schedule 1 chemical agents (OPCW, 1997 pp. 51-52).

The following criteria were taken into account in considering whether a toxic chemical or precursor was included in Schedule 1:

1. It has been developed, produced, stockpiled, or used as a chemical weapon as defined in Article II of the CWC;
2. It poses a high risk to the object and purpose of the CWC by virtue of its high potential for use in activities prohibited under the CWC because one or more of the following conditions are met:
    a. It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
    b. It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon; and
    c. It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere.
3. It has little or no use for purposes not prohibited under the CWC.

2.6.2 Schedule 2 Chemicals

The Schedule 2 chemicals include toxic chemicals and precursors possessing properties that would enable them to be used in chemical weapons activities. Schedule 2 chemicals may be produced in large commercial quantities for purposes not prohibited under the CWC (OPCW, 1997 p. 53).

The following criteria were taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, was included in Schedule 2:

1. It poses a significant risk to the object and purpose of the CWC because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
2. It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
3. It poses a significant risk to the object and purpose of the CWC by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A; and
4. It is not produced in large commercial quantities for purposes not prohibited under the CWC.

2.6.3 Schedule 3 Chemicals

The Schedule 3 chemicals include first generation chemical weapons and other toxic chemicals and precursors that might enable them to be used in chemical weapons activities. The U.S. chemical industry produces Schedule 3 chemicals in large commercial quantities for purposes not prohibited under the CWC (OPCW, 1997 p. 54).

The following criteria were taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, was included in Schedule 3:

1. It has been produced, stockpiled, or used as a chemical weapon;
2. It poses an otherwise high risk to the object and purpose of the CWC because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;
3. It poses a risk to the object and purpose of the CWC by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B; and
4. It may be produced in large commercial quantities for purposes not prohibited under the CWC.

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3 Brief History of Chemical Agents in the United States

Following is a brief history of chemical agent introduction, production, and use in the United States, including chemical munitions and elimination from U.S. stockpile.

The United States' history relating to chemical warfare stretches to before WWI. Once chemical warfare was a battlefield reality, the United States developed several research and development facilities, chemical and filling plants, proving grounds, and chemical training areas, to protect our Military Forces on the battlefield and to ensure they had the capabilities needed to defeat our nation's adversaries. Today, the United States, a signatory to the CWC, is in the process of destroying the last of its chemical munitions stockpile. As such, the United States no longer maintains an offensive chemical warfare capability. The DOD has already remediated several former chemical facilities and training areas located in the United States and continues to do so today. Some of the major events relating to the involvement of the United States in chemical warfare are presented in Table 2.

Table 2: A Selected Timeline of the United States' Involvement

1915	Germany conducted the first successful use of lethal chemicals occurred on a battlefield in Europe; following this, the United States began researching chemical warfare.
1918	U.S. Army established the CWS to create, study, and train Soldiers in chemical warfare.
1925	Geneva Protocol, signed by the United States (though not ratified by Senate) and 28 other countries, condemned the use of gas and bacteriological warfare.
1940-1945	The CWS produced approximately 146,000 tons of chemical agents at locations throughout the United States. Research and production of nerve agents began in 1945. Agents produced by the United States during WWII were not used in combat. President Roosevelt established a no first-use policy for chemical weapons.
1960s	Chemical warfare was seen as less than viable in the face of atomic weapons.
1969	President Nixon unilaterally renounced the first-use of lethal or incapacitating chemical weapons.
1972-1976	The United States destroyed a significant portion of its unitary chemical agent stockpile.
1990	The United States ceased binary chemical weapons programs.
1993	The United States and 180 other countries signed the CWC. The U.S. Explosive Destruction System, a mobile system for treating chemical munitions, entered service. First inventory of former U.S. CWM sites was published.
1997	The United States ratifies the CWC, agreeing to dispose of its unitary chemical weapons stockpile, binary chemical weapons, RCWM in storage and former chemical weapons production facilities.
2001	First deployment of Explosive Destruction System treats ten sarin-filled bomblets recovered at Rocky Mountain Arsenal, Colorado.
2004	Single Chemical Agent Identification Set (CAIS) Access and Neutralization System treats first CAIS at Fort McClellan, Alabama.
2006	All former U.S. chemical agent production facilities were destroyed. Completed destruction of existing stores of binary agents.
2007	Revised inventory of former U.S. CWM sites was published.
2012	Chemical Stockpile Elimination mission completes destroying 89.75% (27,000 U.S. tons) of the nation's chemical weapons stockpile stored at seven sites, 2,700 tons await destruction at the Blue Grass Chemical Activity, Kentucky and Pueblo Chemical Depot, Colorado.
2021	The United States completes the destruction of the last nerve agent projectile in its stockpile.

3.1 Prior to World War I

International efforts to prevent the use of poisonous (toxic) chemicals in land warfare began in the 19th century. The first attempt at an international agreement limiting the use of such weapons was the 1874 International Declaration Concerning the Laws and Customs of War, which included in Article 13(a), a prohibition against poison or poisoned arms. The next attempt was The Hague Convention of 1899. In all, 27 nations, including Austria-Hungary, France, Germany, Great Britain, and Russia, eventually agreed to this provision. In the 20th century, Article 23 of the 1907 Hague Convention on Land Warfare explicitly prohibited the use of "poison or poisoned weapons" in warfare (Recovered Chemical Warfare Material Program, 2016).

3.2 World War I (1914-1918)

Despite these international efforts, WWI saw the first large-scale use of toxic chemical weapons in land warfare. French (August 1914) and German (October 1914) forces first used limited quantities of the riot control agents, ethyl bromoacetate and chloroacetone, against entrenched troops. The concentrations achieved in the field were reportedly so small that the use of chemicals went largely unnoticed.

After the use of chlorine gas at Ypres by Germany in 1915, the U.S. Army began studying chemical warfare. Initial research took place at the American University Experiment Station near Washington, District of Columbia (DC) (Brophy, et al., 1959 pp. 18, 76-77). Today this location is the Spring Valley Site and is being remediated under the Formerly Used Defense Sites Program, part of the larger Defense Environmental Restoration Program.

Determining that chemical warfare was a significant threat to U.S. forces and an offensive weapon that could not be discounted, the Army Ordnance Department assigned chemical defensive methods and chemical weapons production to the CWS. Established 28 June 1918, the CWS (Brophy, et al., 1959 p. 13) had seven main divisions:

1. Research – responsible for identification of chemical agents in Washington, DC;
2. Gas Defense – responsible for production of gas masks in Long Island City, New York;
3. Gas Offense – responsible for chemical agents and weapons production at Edgewood Arsenal, Maryland;
4. Development – responsible for charcoal production and pilot plant work on mustard agent production;
5. Proving Ground – responsible for testing munitions at Lakehurst, New Jersey;
6. Training – responsible for CWS officer training at Lakehurst, New Jersey; and
7. Medical – responsible for the pharmacological aspects of chemical defense.

Nearly two years passed between the first-use of toxic gas at Ypres and the declaration of war by the United States. The United States faced major challenges in establishing large-scale production facilities for chemical agents, chemical-filled shells, and the machinery for filling the shells. In February 1917, the U.S. Bureau of Mines offered assistance to the War Department (predecessor to DOD). One area studied by U.S. Bureau of Mines involved development of large-scale methods for the manufacturing of chloropicrin (PS) and phosgene (CG). In 1917-1918, the CWS built large-scale production plants at Edgewood Arsenal, Maryland (later the Edgewood Area, Aberdeen Proving Ground) and at several contractor-owned facilities.

At Edgewood Arsenal, four plants produced CL, PS, H, and CG. There were also three shell-filling plants. The first filled 75-millimeter (mm), 155-mm, 4.7-inch, and Livens projectiles with CG. A second plant filled 155-mm projectiles with H and with PS. The third planned shell-filling plant was not completed before the end of the war.

Edgewood Arsenal produced more than 935 tons of CG, 711 tons of H, 1,163 tons of PS, and an unknown amount of CL by 1918. Government contractors also produced CL, PS, L, H, and PS plus CG (known as PG). Total U.S. toxic chemical agent production in WWI was about 2,500 tons. Despite the production, during WWI, the United States did not employ any domestically produced chemical agents or weapons in combat. L was in transit to Europe on 11 November 1918 (the date the Armistice went into effect) and was disposed of in the Atlantic Ocean.

During the war, the Army used foreign-made offensive chemical weapons and delivery systems. American forces fired both British and French chemical rounds from 75-mm, 4.7-inch, 155-mm, and larger-caliber guns; most were French shells filled with CG and H, and British shells filled with H and L (Recovered Chemical Warfare Material Program, 2016).

3.3 Inter-War Years (1919-1939)

After 1919, all CWS Divisions except Headquarters moved to Edgewood Arsenal, which continued research and development, stockpiling of chemical agents and munitions, training, and testing. Chemical agents and munitions unused during WWI became the basis of the Army's stockpile.

On 1 July 1920, the CWS became a permanent part of the Regular Army, and began to standardize chemical agents, defensive measures, and the means of delivery.

In 1928, the CWS selected seven chemical agents and smoke/obscurants for military use: H, methyldichloroarsine (MD), DM, chloroacetophenone (CN), titanium tetrachloride (FM), WP, and zinc oxide and HC. Of lesser importance were CL, PS, L, and CG. In 1937, Edgewood Arsenal rehabilitated the H production line from WWI produced an additional 154 tons of H. Concurrently, the CWS upgraded the Edgewood Arsenal CG plant and standardized CG as a primary chemical agent.

Figure 2: Soldiers Deploying Livens Projectors

During the 1920s and 1930s, the CWS stockpiled Livens projectors and cylinders as well as Stokes mortars. In addition, the Army manufactured chemical agent-filled shells for 75-mm, 105-mm, and 155-mm artillery pieces. In 1924, the United States standardized the design of the Livens Projector and the 4-inch Stokes chemical mortar. A weapons system includes the projectile and the delivery system used to fire them (Recovered Chemical Warfare Material Program, 2016).

During the inter-war years, the Army's involvement with chemical agents and munitions was restricted to research, development, testing, evaluation, and training. In 1928, the United States introduced the Model M1 4.2-inch Chemical Mortar. The M1 mortar projectiles could be filled with any one of several compounds including high explosive (trinitrotoluene [TNT]), a chemical agent (e.g., HD) and smoke/obscurant (e.g., WP) variants.

Having seen the importance of aviation during WWI, the CWS developed the M1 30-pound chemical bomb. This bomb, never used in combat, held about 10 pounds of chemical agent. In 1933, the CWS developed the M10 Spray Tank. This tank held 320 pounds of H, 470 pounds of L, or smoke/obscurants. Likewise, the use of mine warfare led to the standardization of the M1 Chemical Land Mine in 1933. This mine held nearly 10 pounds of H and used a detonating cord to burst the can and disseminate the agent (Recovered Chemical Warfare Material Program, 2016).

3.4 World War II (1939-1945)

Partly a response to the war in Europe, 1940 and 1941 saw a major expansion of CWS infrastructure in the United States. The CWS built new arsenals in Huntsville, Alabama; Pine Bluff, Arkansas; and Denver, Colorado, and established the Dugway Proving Ground in western Utah.

Between 1940 and 1945, the CWS produced approximately 146,000 tons of chemical agents at locations throughout the United States. The expansion of chemical agent stockpiles included a corresponding increase in the number of delivery systems. The U.S. Army began the war with 44 each 4.2-inch chemical mortars. Demands for these versatile mortars grew rapidly as dedicated chemical mortar battalions were incorporated into the standard Army divisional structure. Concurrently, there were needs for improvements in accuracy, durability, ease in manufacturing, and maximum range. The first redesigned mortar was the M1A1; the next generation was the M2 4.2-inch mortar. During the war, the CWS procured more than 8,000 M2 chemical mortars for chemical mortar battalions. Although the mortar could fire H-filled shells, and more than 450,000 H-filled shells were produced, none were used in combat by U.S. forces.

Field Artillery units had 75-mm, 105-mm, and 155-mm shells filled with H or L for the standard artillery cannon and howitzers of the time. For the Army Air Force, the CWS produced 100-pound H-filled bombs; 500-pound CG or CK bombs; 1,000-pound CG, CK, or AC bombs; and the M33 airplane tank holding 749 pounds of HD to 1,099 pounds of L.

The CWS also developed detection capabilities: the M4 HS Vapor Detector Kit, the M5 liquid detector paint, the M6 liquid detector paper, and the M7 detector crayon. The M9 Chemical Agent Detector Kit was a milestone. Produced in 1943, the M9 kit had a sampling pump, four bottles of reagents, and six clips of detector tubes. It could detect arsenicals (e.g., L), H, and CG, using simple color-based tests.

Drawing on the experience of WWI and the efforts in the inter-war years to institute international agreements prohibiting use of chemical weapons, early in the war, President Roosevelt established a no-first-use policy for chemical weapons. The Axis nations wisely chose not to initiate wide-scale chemical warfare against the Allied powers. Thus, none of the U.S. chemical weapons were used on the battlefield during the war (Recovered Chemical Warfare Material Program, 2016).

3.5 Post-war Years (1946-1960)

The end of WWII in 1945 triggered a massive demobilization of the U.S. Armed Forces. By early 1946, the CWS was demobilized to pre-war levels. The Army did continue some Technical Services, including the CWS, as part of the post-war Regular Army. One recognition of the need for a chemical warfare organization with the Army was Public Law 607, enacted on 2 August 1946, changing the name of the CWS to the U.S. Army Chemical Corps.

In the post-war period, the Chemical Corps concentrated on maintaining the existing stockpiles from WWI and WWII, and on producing new chemical agents (e.g., the organophosphate nerve agent – sarin

[GB]), decontamination equipment, delivery systems, and detection systems. One of the first tasks undertaken was to evaluate the capabilities of the German and Japanese chemical warfare programs.

In the aftermath of the war in Europe, the Allies found the vast stockpile of German chemical weapons, some 296,100 tons. In response, the Continental Committee on Dumping agreed that America, Britain, France, and the Soviet Union would destroy the German chemical weapons in any convenient manner. The limited choices of the day were expending significant resources to build facilities specifically designed to destroy CWM; burial on land; open burning of the chemical agents and munitions; or sea disposal. The environmental understanding of the day, coupled with the desire to keep the CWM from potential enemies and to go home after six long years of war that encompassed the world, resulted in selection of sea disposal as the most efficient and effective alternative (Recovered Chemical Warfare Material Program, 2016).

3.6 Chemical Warfare's Decline as a Viable Military Option (1960-1980)

With the advent of atomic and thermonuclear weapons, the U.S. military began shifting emphasis away from chemical weapons.

Although the Army maintained the Chemical Corps, and continued development of both defensive and offensive measures, the aging stockpile of artillery shells, bulk containers, and rockets began to require demilitarization and disposal. The options for disposal remained limited. In the 1960s, under Project EAGLE, the Army developed incineration and neutralization systems, and, in the 1970s, destroyed 3,000 tons of H and 4,000 tons of GB at Rocky Mountain Arsenal, Colorado (Recovered Chemical Warfare Material Program, 2016).

3.7 End of United States Development of Chemical Warfare (1980-Present)

In the early 1980s, the Army developed binary chemical weapons to modernize the aging chemical weapons stockpile. Designed to mix two nonlethal chemicals while in flight to a target to form chemical agent, binary chemical weapons development helped move the Soviet Union into arms reduction negotiation and the signing of a bilateral agreement in 1990. This agreement led to the CWC, an international treaty signed by more than 180 countries that mandates the elimination of CWM and former chemical weapons production facilities.

In 1992, in response to Public Law 102-484, the Army established the Non-Stockpile Chemical Materiel Project (NSCMP) to develop systems to safely assess, treat and destroy five categories of CWM not part of the declared stockpile:

- Binary CWM;
- Former chemical weapons production facilities;
- Miscellaneous CWM;
- Buried CWM; and
- RCWM.[1]

[1] "Buried CWM" refers to the material currently covered by the RCWM Program. The RCWM referred to in P.L. 102-484 was CWM that was recovered prior to 1992 and was in storage at that time.

In 1997, the U.S. Senate ratified the CWC, subject to a series of specific limitations. Complete details on the U.S. ratification, the implementing statutes and regulations, and the requirements for reporting and verification are available at the U.S. CWC Website.

From 1990 to 2000, when Johnston Atoll Chemical Agent Disposal System destruction operations ceased, the United States destroyed more than 400,000 chemical rockets, projectiles, bombs, ton containers, and mines containing GB, H, and VX. This represented about four percent of the U.S. chemical agent stockpile. The Johnston Atoll Chemical Agent Disposal System facility was closed and decommissioned permanently in 2003 (Recovered Chemical Warfare Material Program, 2016).

Between 1995 and 2006, the United States demolished its former chemical warfare production facilities; meetings its obligation under the CWC to destroy all production facilities by 2007. Also in 2006, the NSCMP completed destruction of the existing stores of binary chemical warfare material.

In 2002, the NSCMP completed destruction of items in the CWC category "Miscellaneous Chemical Warfare Material." This category included both treaty and non-treaty items, such as unfilled munitions, support equipment, and devices designed for use with chemical weapons. These included complete assembled rounds without chemical fill and with or without bursters and fuzes, simulant-filled munitions, inert munitions, dummy munitions, bursters and fuzes, empty rocket warheads and motors, projectile cases, other metal and plastic part components, research and development compounds, chemical samples, and ton containers.

In 2012, destruction of the chemical weapons at seven of the nine stockpile chemical weapons storage facilities was completed. The destruction of the last stockpile chemical weapons at two storage sites in the United States, Pueblo Chemical Depot and Blue Grass Chemical Activity, is currently underway. The destruction of the former CWM production facilities and stockpile CWM is summarized in Table 3.

Table 3: United States Destruction of Former Production Facilities and Stockpile

Former Production Facility Destruction		Destruction of Stockpile CWM	
1995	DC Production Facility Rocky Mountain Arsenal, Colorado	2000	Johnson Atoll Chemical Agent Disposal System, Johnston Island, U.S. Minor Outlying Islands 2,031 tons of agent destroyed
1999	BZ Fill Facility Pine Bluff Arsenal, Arkansas	2006	Aberdeen Proving Ground, Maryland 1,622 tons of agent destroyed
1999	APG Pilot Plant Complex Aberdeen Proving Ground, Maryland	2008	Newport Chemical Depot, Indiana 1,269 tons of agent destroyed
2001	HD Distillation Facility Rocky Mountain Arsenal, Colorado	2010	Pine Bluff Chemical Activity, Arkansas 3,851 tons of agent destroyed
2002	Mustard (HD) Fill Facility Rocky Mountain Arsenal, Colorado	2011	Umatilla Chemical Depot, Oregon 3,720 tons of agent destroyed
2003	GB (Sarin) Production and Fill Facility Rocky Mountain Arsenal, Colorado	2011	Anniston Chemical Activity, Alabama 2,254 tons of agent destroyed
2006	Newport VX Production and Fill Facility Newport Chemical Depot, Indiana	2012	Deseret Chemical Depot, Utah 13,617 tons of agent destroyed
2006	Mustard Production, Distillation and Fill Facility Aberdeen Proving Ground, Maryland	Ongoing	Pueblo Chemical Depot, Colorado 2,051 tons of destroyed as of end of FY2021 (2,613 tons of agent was in stockpile at site)
2006	Integrated Binary Production Facilities (DC, QL and DF) Pine Bluff Arsenal, Arkansas	Ongoing	Blue Grass Chemical Activity, Kentucky 173 tons of destroyed as of end of FY2021 (523 tons of agent was in stockpile at site)

4 Basic Types of Munitions and Containers

Chemical agents were used in many munitions and containers.

a. Bomb
b. Bomblet
c. Bomb Clusters, Generators, and Dispensers
d. Chemical Agent Identification Set
e. Grenade
f. Mine
g. Miscellaneous types
    i. Candles
    ii. Bulk Containers
    iii. Cylinders
    iv. Drone Weapon Systems
    v. Drums
    vi. Tanks
h. Mortar
i. Projectile
j. Warhead, Missile, and Rocket

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5 U.S. Marking System

The importance of color marking of ammunition to facilitate identification was recognized during WWI. Subsequently, the United States painted and marked munitions with visual aids for identification of the item and fill. Ammunition markings include a color code and stenciled or stamped markings, which provide information necessary for complete identification of the ammunition (e.g., model, fill) (Office of the Chief of Gas Service, 1918 p. M 1). The marking system for chemical munitions changed over time (Department of the Army, 1969 p. 4). U.S. markings during WWI are provided in Table 4. Table 5 shows the U.S. system of marking for chemical munitions from WWI through 1924, Table 6 covers 1925 through 1960, Table 7 covers 1960 to 1976, and Table 8 covers post 1976.

To identify a particular ammunition design, a model designation was assigned at the time it was classified as an adopted type. This model designation became an essential part of the nomenclature and is part of the marking of the item. Prior to WWI, the year in which the design was adopted (preceded by an M) was used as the model designation; for example, M1914 (because chemical weapons were not developed until WWI, this is not applicable to the munition but may apply to fuzes). From WWI to 1 July 1925, it was the practice to assign mark numbers; that is, the word “mark”, abbreviated “Mk,” which was followed by a Roman numeral. The first modification of a model was indicated by the addition of MI to the mark number, the second by MII, etc. However, the use of Roman numerals was discontinued, and all records began using Arabic numerals (Kaye, 1978 p. M 146).

The present system of model designation consists of the letter “M” followed by an Arabic numeral, for example, “M1.” Modifications are indicated by adding the letter “A” and the appropriate Arabic numeral. Thus, “M1A1” indicates the first modification of an item for which the original model designation was “M1” (Kaye, 1978 p. M 146). Wherever a “B” suffix appears in a model designation, it indicates an item of alternative or substitute design, material, or manufacture (Kaye, 1978 pp. M-18). To continue with the previous example, there is a 155-mm M105 shell and a modification designated M105B1. The M105 round had a flat base in the inner cavity; M105B1 had a hemispherical base. Certain items standardized for use by both Army and Navy are designated by the letters “AN” preceding the model designation.

A munition with an “E,” “T,” or an “X” preceding the “M” or following the number designation indicates that the munition is in development or experimental (Kaye, 1978 pp. M146-147) (U.S. Army Combined Arms Support Command, 2011 pp. 3-4). When the experimental item has been modified, the letter (e.g., E, T, X) and the number of the modification are added to the end of the designation. For example, XM67E2 would indicate the second experimental modification of XM67 (U.S. Army Combined Arms Support Command, 2011 pp. 3-4).

Chemical munitions manufactured after WWI and before January 1961 follow the Five-Element Marking System (U.S. Naval Ordnance Laboratory, 1968 pp. 2-4). Using this marking system, chemical munitions are identified by a background color of gray and were circumscribed with one or two bands to indicate the duration of effectiveness. One band circumscribed about the center of the munition indicated a nonpersistent effect agent; two bands indicated a persistent effect agent (Department of the Army, 1969 p. 4). Green markings on a gray background signified toxic chemical agents, red markings indicated irritant agents, purple indicated incendiaries, and yellow indicated smokes. A descriptive word such as gas, smoke, or incendiary indicated the general nature of the agent. A chemical agent symbol (e.g., GB, VX, HD) indicated the exact filling (Department of the Army, 1967 p. 21).

In 1972, the military standard was modified again and brought more changes in color-coding. “Toxic Chemical Agents” were coded with dark green bands and black markings instead of using green for everything. “Riot Control Agents” were re-identified as “Irritants,” and black was used for markings instead of red. White replaced light red for markings on smoke munitions containing WP and plasticized white phosphorus (PWP) (Recovered Chemical Warfare Material Program, 2016).

In 1976, another change to the military standard occurred (Table 7). It introduced several changes which simplified color-coding. All “Toxic Chemical Agents” were grouped together and color-coded as one type of fill, without regard to toxicity or persistency. Chemical symbols were used to provide the exact identification of a particular fill. “Riot Control Agents” (previously identified as “Irritant Agents”) and “Incapacitating Agents” received similar treatment. Only one colored band was used for each type of fill, whereas up to three colored bands had been used previously. This standard also applied to chemical munitions manufactured or renovated after 6 May 1976. Since the manufacture of unitary chemical agents and chemical munitions were terminated in 1968 this standard likely applies only to renovated munitions containing unitary chemical agents. However, the United States began production of binary chemical weapons in the 1980s, and in 1990, the United States agreed to end its production and that these would be marked with the new standard (Recovered Chemical Warfare Material Program, 2016).

Table 4: U.S. Markings WWI

Type of Fill		**Chemical**	**1st Band**	**2nd Band**	**3rd Band**	**Body**	**Stencil**
GAS	Nonpersistent (toxic and lethal)	DA	White	None	None	Gray	SPECIAL GAS
		CG	White	White	None	Gray	SPECIAL GAS
		PD	White	White	White	Gray	SPECIAL GAS
	Semi-persistent (penetrative and suffocant)	PS	Red	White	None	Gray	SPECIAL GAS
		NC	Yellow	Red	White	Gray	SPECIAL GAS
		PG	White	Red	White	Gray	SPECIAL GAS
	Persistent (lachrymatory and vesicant)	BA	Red	None	None	Gray	SPECIAL GAS
		CA	Red	Red	None	Gray	SPECIAL GAS
		HS	Red	Red	Red	Gray	SPECIAL GAS
Smoke	Solid (WP)	WP	Yellow	None	None	Gray	SPECIAL SMOKE
	Liquid (FM)	FM	Yellow	Yellow	None	Gray	SPECIAL SMOKE
Incendiary (e.g., thermite [Th.])		Th.	Purple	None	None	Gray	SPECIAL INCEND

Notes:
BA - bromoacetone
CA - bromobenzyl cyanide
CG - phosgene
DA - diphenylchloroarsine (Clark I)
FM - titanium tetrachloride
HS - sulfur mustard
NC - chloropicrin and stannic chloride
PD - phosgene plus diphenylchlorarsine
PG - chloropicrin plus phosgene
PS - chloropicrin
Th. - thermite
WP - white phosphorous
Citations:
(American Expeditionary Forces, 1919 p. Figure 3; American Expeditionary Forces, 1919 p. 21; Fries, et al., 1921 p. 28; Prentiss, 1937 pp. 116-117, 126-127, Table IV)

Table 5: U.S. Markings World War I through 1924

Type of Fill	1st Band	2nd Band	3rd Band	Body	Black Stencil
BA	Red	None	None	Slate Gray	SPECIAL-GAS/GAS
CA	Red	Red	None	Slate Gray	SPECIAL GAS
CG	White	White	None	Slate Gray	SPECIAL-GAS/GAS/C.G.
CL	None	None	None	Slate Gray	Chlorine
DA	White	None	None	Slate Gray	SPECIAL GAS / GAS
FM	Yellow	Yellow	None	Slate Gray	FM SMOKE/SPECIAL SMOKE
FS	Yellow	None	None	Slate Gray	FS SMOKE
HS	Red	Red	Red	Slate Gray	SPECIAL-GAS
KJ	None	None	None	Slate Gray	KJ
NC	White	Red	Yellow	Slate Gray	GAS
PD	White	White	White	Slate Gray	SPECIAL GAS / GAS
PG	White	Red	White	Slate Gray	SPECIAL-GAS
PS	White	Red	None	Slate Gray	SPECIAL GAS/P.S.
Th.	Purple	None	None	Slate Gray	SPECIAL INCENDIARY THERMITE/Th.
VX	White	None	None	Slate Gray	SPECIAL-GAS
WP	Yellow	None	None	Slate Gray	SPECIAL-GAS/SMOKE/ SPECIAL – SMOKE/W.P.

Notes:
BA - bromoacetone
CA - bromobenzyl cyanide
CG - phosgene
CL - chlorine
DA - diphenylchloroarsine (Clark I)
FM - titanium tetrachloride
HS - sulfur mustard
KJ - stannic chloride
NC - chloropicrin and stannic chloride
PD - phosgene plus diphenylchlorarsine
PG - chloropicrin plus phosgene
PS - chloropicrin
Th. - thermite
VX - O-Ethyl S(2-diisopropylaminoethyl) methylphosphonothioate
WP - white phosphorous
Citations: (American Expeditionary Forces, 1919 p. Fig 3; Prentiss, 1937 pp. 116-117, 126-127, Table IV)

Table 6: U.S. Markings 1925 through June 1960

Fill	1st Band	2nd Band	Body	Stencil	Citation
AC/HCN	Green	None	Gray	AC GAS or HCN Gas	(Prentiss, 1937; War Department, 1945 p. 7; Department of the Army, 1955 p. 66)
AS	Green	Green	Gray	AS	(War Department, 1945 p. 155)
BA	Green	Green	Gray	BA GAS	(Prentiss, 1937 p. Table IV; War Department, 1945 p. 128)
CA/BBC	Red	Red	Gray	CA GAS	
CG	Green	None	Gray	Green marking CG GAS	(Prentiss, 1937; Secretary of War, 1942 pp. 89, 111; War Department, 1945 p. 111; Department of the Army, 1955 p. 66)
CK	Green	None	Gray	Green marking CK GAS	(War Department, 1945 p. 5; Department of the Army, 1955 p. 66)
CL	Green	None	Gray	Green marking CL gas	(Prentiss, 1937; Secretary of War, 1942 pp. 88, 92; War Department, 1945 pp. 88, 105, 130)
CN	Red	None	Gray	CN GAS	
CNB	Red	None	Gray	CNB GAS	(Secretary of War, 1942 p. 93; War Department, 1945 p. 132)
CNC	Red	None	Gray	CNC GAS	(Department of the Army, 1955 p. 50)
CNS	Red	None	Gray	CNS GAS	(Secretary of War, 1942 p. 93; War Department, 1945 p. 131)
DA	Red	None	Gray	DA GAS	

Table 6: U.S. Markings 1925 through June 1960

Fill	1st Band	2nd Band	Body	Stencil	Citation
DM	Red	None	Gray	DM GAS	(Prentiss, 1937; War Department, 1945 pp. 94-95, 136, 138)
ED	Green	Green	Gray	ED Gas	(Prentiss, 1937; War Department, 1945 pp. 91, 127, 144-145)
FM	Yellow	None	Gray	FM SMOKE	
FS	Yellow	None	Gray	FS SMOKE	
GB	Green	None	Gray	GB GAS	(Department of the Army, 1955 p. 66)
H/HS	Green	Green	Gray	H or HS GAS	(Prentiss, 1937; Secretary of War, 1942 p. 90; Department of the Army, 1955 pp. 47, 66)
HC	Yellow	None	Gray	HC SMOKE	(Prentiss, 1937; War Department, 1945 p. 146)
HD	Green	Green	Gray	HD GAS	(Department of the Army, 1955 pp. 47, 66)
HS	Green	Green	Gray	HS gas	(Secretary of War, 1942 p. 90; War Department, 1945 pp. 90, 122)
HN1	Green	Green	Gray	HN GAS	(Department of the Army, 1955 p. 47)
HT	Green	Green	Gray	HT GAS	(Department of the Army, 1955 p. 48)
L or M-1	Green	Green	Gray	L GAS or M-1 gas	(Prentiss, 1937; Secretary of War, 1942 pp. 91, 126; Department of the Army, 1955 p. 48)
MR	Green	Green	Gray	MR	(War Department, 1945 p. 153)
NP	Purple	None	Gray	NP INCEND.	(Department of the Army, 1955 p. 66)
PD	Greed	Green	Gray	PD Gas	(War Department, 1945 p. 7)
PS	Green	Green	Gray	PS GAS	(Prentiss, 1937; War Department, 1945 pp. 89, 116)
SA	Green	None	Gray	SA GAS	(War Department, 1945 p. 5)
Th.	Purple	None	Gray	TH INCEND.	(Prentiss, 1937; Department of the Army, 1955 pp. 66, 149)
WP	Yellow	None	Gray	WP SMOKE	(Prentiss, 1937; War Department, 1945 p. 149; Department of the Army, 1955 p. 66)
PT1	Purple	None	Gray	INCEND	(Department of the Army, 1955 p. 66)
PWP	Yellow	None	Gray	PWP Smoke	

Notes:
AC/HCN - hydrogen cyanide/hydrocyanic acid
AS - asbestine suspension
BA - bromoacetone
CA/BCC - bromobenzyl cyanide/ bromobenzyl cyanide
CG - phosgene
CK - cyanogen chloride
CN - chloroacetophenone
CNB - chloroacetophenone solution (45% benzene + 10% chloroacetophenone + 45% carbon tetrachloride)
CNC - chloroacetophenone solution (70% chloroacetophenone + 30% chloroform)
CNS - chloroacetophenone solution (38.4% chloropicrin + 23% chloroacetophenone + 38.4% chloroform)
DA - diphenylchloroarsine (Clark I)
DM - adamsite
ED - ethyldichloroarsine
FM - titanium tetrachloride
FS – sulfur trioxide and chlorosulfonic acid
GB – sarin
H – mustard
HC – zinc oxide and hexachloroethane
HD – distilled mustard
HN1 – nitrogen mustard (Ethyl)
HS – sulfur mustard
HT – distilled mustard and T-mixture
L or M-1 – lewisite
MR – molasses residuum
NP – napalm
PD – phosgene plus diphenylchlorarsine
PS – chloropicrin
PT1- oil and incendiary mixture/thickened fuel
PWP – plasticized white phosphorus
SA – arsine
Th. – thermite
WP – white phosphorous

Table 7: U.S. Markings after 27 June 1960 through 1976

Type of Fill		1st Band	2nd Band	3rd Band	Body	Stencil
Toxic Chemical Agents (Casualty)	Nonpersistent Agents (e.g., AC, CG, CK)	Green	None	None	Gray	"GAS," Chemical symbol
	Persistent Agents (e.g., H, HD, HT)	Green	Green	None	Gray	
	All Nerve Agents (e.g., GA, GB, VX)	Green	Green	Green	Gray	
Incapacitating Agents	Persistent Agents (e.g., BZ)	Red	Red	None	Gray	"GAS" Chemical symbol
Riot Control Agents	Nonpersistent Agents (e.g., CN, CNB, CS, DM)	Red	None	None	Gray	"Riot," Chemical symbol
Incendiaries (e.g., Th.)		None	None	None	Light red	"Incendiary" Brevity Code
Smokes	All except WP and PWP (e.g., FM, FS)	None	None	None	Light green	"Smoke" Brevity Code
	WP and PWP	None	None	None	Light green	"Smoke" "WP" or "PWP"
Explosive Components	High Explosive	Yellow, this in an additional marking band on chemical munitions				
	Low Explosive	Brown, this in an additional marking band on chemical munitions				

Notes:

AC - hydrogen cyanide
BZ - 3-quinuclidinylbenzilate
CG - phosgene
CK - phosgene oxime
CN - chloroacetophenone
CNB - chloroacetophenone solution (45% benzene + 10% chloroacetophenone + 45% carbon tetrachloride)
CS - 2-chlorobenzalmalononitrile
DM - adamsite
FM - titanium tetrachloride
GA - tabun
GB - sarin
H - mustard
HD - distilled mustard
HT - distilled mustard and T-mixture
PWP - plasticized white phosphorus
Th. - thermite
VX - O-Ethyl S(2-diisopropylaminoethyl) methylphosphonothioate
WP - white phosphorous

Citations:
(Department of the Army, 1967 pp. 21-28; U.S. Naval Ordnance Laboratory, 1968 pp. 2-4)

Table 8: U.S. Markings 1976 and Later

Fill	1st Band	Body	Stencil	Citation
Toxic Chemical Agents	Dark Green	Gray	Dark Green	(Departments of the Army, Navy, and Air Force, 1976 pp. 9-12; Department of Defense, 2009 pp. 23-24)
Incapacitating	Violet	Gray	Violet	
Riot Control	Dark Red	Gray	Dark Red	
Binary Nerve Agent	Broken Dark Green	Gray	Dark Green	
Smoke (WP)	None	Light Green	Light Red	
Smoke (other than WP)	None	Light Green	Black	
High Explosive	Yellow band is applied when a HE burster is present			
Low Explosive	Brown band is applied when a low explosive is present			

Notes:
WP - white phosphorous

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6 Bomb

A bomb is a type of ammunition designed to be dropped from an aircraft in flight. It usually consists of a metal container filled with explosives or chemicals, a device for stabilizing its flight so that it can be aimed accurately, a mechanism for exploding the bomb at the target, and such safety devices as may be necessary to make it reasonably safe to carry. The metal container, called the bomb body is usually streamlined with a rounded (ogival) nose and a tapered tail. The stabilizing device is attached to the tail end of the body prior to development and generally consists of a sheet metal fin assembly. The mechanism for exploding the charge is called a fuze and is generally placed in the nose or in the tail end of the body. Two or more fuzes are occasionally used in the same bomb for different effects: for flexibility in use or to increase functioning reliability. Safety devices are provided in the fuze and are protected by sealing wires, cotter pins, etc. An arming wire is substituted for the sealing wire and/or cotter pin when the bomb is readied for use.

6.1 Bomb, 30-pound, E2 Series, E4

Figures

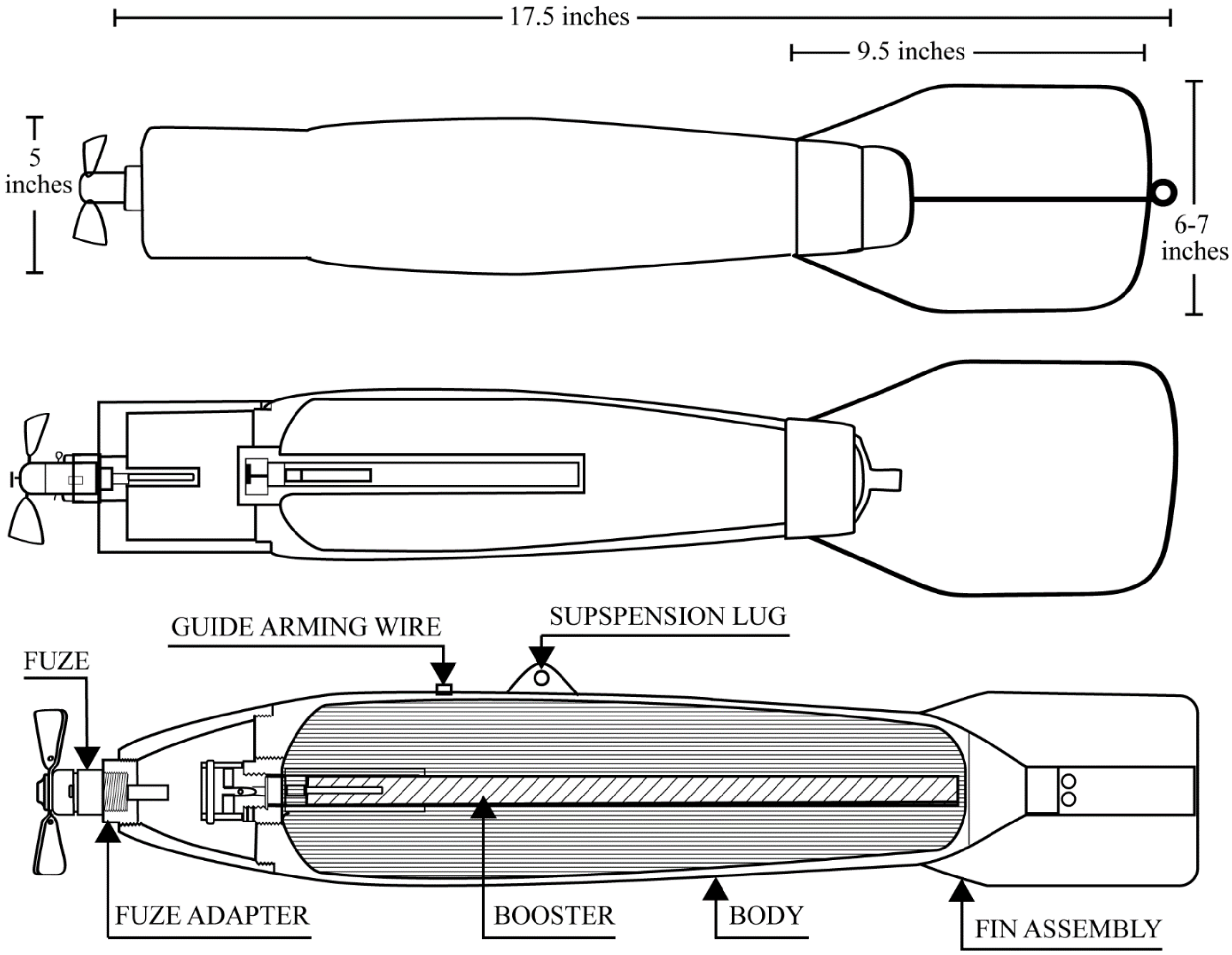

Figure 3: Bomb, 30-pound, E2 Series - Line Drawing, Top: E2R5 intact, Middle: E2R5, Bottom: E2

Figure 4: Bomb, 30-pound, E2R5 - Photograph

Bomb, 30-pound, E2 Series, E4 Series

Specifications

Bomb, 30-pound, E2 Series, E4 Series - Specifications and Other Data		**Citation**
Historical Name	Bomb, Chemical, 30-lb. Air Burst, Expulsion Type E2, E4	1 (p. 5, 16), 2 (p. 1)
Developmental Information	E2, E4	1 (p. 5), 5 (p. 1-2)
Type	Bomb	1 (p. 1), 2 (p. 1), 3 (p. 1), 4, 5 (p, 1)
Size	30-pound	1 (p. 1), 2 (p. 1), 3
Diameter	5 in. (12.7 centimeters [cm])	2 (p. 3), 5 (p. 2)
Length	E2R5: Body: 16.75-17.5 in. (42.5-44.5 cm) E4: Body: 16.75 (42.5 cm) Fuzed: 32 in. (81.2 cm) Tail fin: 9.43 in. (23.9 cm) E4R1: Body: 17.3 in. (43.9 cm)	1, 3 (p. 1-2), 4, 5 (p. 2, 7)
Width	Tail fin: 6.5-7 in. (16.5-17.78 cm)	4, 3
Wall Thickness	E2R5: 0.134 in. (0.34 cm) E4: 0.187 in. (0.474 cm) E4R1: 0.134 in. (0.34 cm)	1 (p. 5), 3 (p. 2), 4, 5 (p. 7)
Other Engineering Data	Primer-detonator: MIIA, Mk. IIB, Mk. I Weight, Empty: E2R5: 18.3-26.3 pounds (lb.) (8. 3-11.9 kilograms [kg]) E4: 34 pounds (15.4 kilograms)	1 (p. 3), 3 (p. 1, 4), 4 (p. 2), 5 (p. 1-2), 7
Construction Material	Forged steel or seamless steel tubing	1 (p. 5), 3 (p. 2), 5 (p. 3)
Drawing	E2: BX14-1.2-8 E2R1: BX14-1.2-16 E2R2: BX14-1-1 E2R3: BX14-2-1 E2R4: BX14-2-3 E2R5: BX 14-2-5 E4: CX14-7-1, CX14-7-2D E4R1: Detailed: CX14-7-4 Body: CX14-7-5D	1 (p. 1-2), 2 (p. 1), 3 (p. 1-2, 6), 4 (p. 6-11, 16), 5 (p. 2)

General Use and Description

The E2 series of expulsion-type bombs were developed to replace the M1 chemical bomb and provide an airburst at a predetermined height above ground surface (1 p. 1), 2 (p. 1). The expulsion-type bombs provided a true trajectory when dropped from a plane at altitudes greater than 200 feet, impacted nose-on, penetrated the ground until it came to rest after which it was expelled into the air to a predetermined height where it burst and dispersed the chemical filling (4).

The E2 series of bombs were developed utilizing the 25-pound Mk. I-E7 bomb (later designated, bomb, chemical, 30-pound, M1). The E2 used the body of the empty Mk. I-E7 modified so the expulsion charge could be placed in the nose (1 p. 5-7). The E2R5 was redesigned to be better adapted to quantity production and conformance to Ordnance Department and Air Corps requirements. The E2R5, as redesigned, was designated "Bomb, Air-Burst, E4" (4 p. 16), (3 p. 1). The E4 was redesigned to increase the filling capacity and redesignated E4R1 (3 p. 1).

The E4 and E4R1 bombs were designed so that the burster tube, primer detonators and fuzes could be assembled to the bomb after it had been attached to the bomb rack of an airplane (3).

Explosive Train

Upon impact with the ground the fuze causes the primer-detonator in the nose of' the bomb to start functioning. In the meantime, the bomb penetrated the ground until it came to rest, at which point the primer-detonator caused the black powder expulsion charge to function which expelled the body of the bomb into the air. The forces of the expulsion charge, in addition to forcing the bomb body upward, actuated a firing which started the primer-detonator, contained in the bursting charge to function. The bomb was caused to burst in the air at a predetermined height by the bursting charge which was set off by the functioning of the primer-detonator contained therein (4 p. 6), (7 p. 1), (8).

Fuzing

Bomb, 30-pound, E2 Series, E4 Series - Fuzing		
Fuze	**Notes**	**Citation**
M9	Nose. Rifle grenade fuze used in E2R4	4 (p. 9, 11)
MK IIA	Nose, primer-detonator, used in E2R5	4 (p. 11)
MK V M1	Tail, used in E4	4 (attached drawing), 5 (p. 3, 5)
MK VIII	Nose. Rifle grenade used in E2R1 and E2R2	4 (p 7)
MK XIV	Nose	4 (p. 6), 2 (p. 3), 5 (p. 1), 5 (p. 3), 7

Booster, Adapter-Booster, or Burster

Bomb, 30-pound, E2 Series, E4 Series - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Unspecified burster	0.18-0.19 lbs. (0.081-0.086 kg)	Tetryl	-	4 (p. 12), 5 (p. 3)
Unspecified booster	0.19 lbs. (0.088 kg)	Tetryl	E2R5	2 (p. 1)

Fills

Bomb, 30-pound, E2 Series, E4 Series - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
FM	10[1, 2] 13.8-14[3] 16[4]	4.53[1, 2] 6.25-6.35[3] 7.25[4]	35[2] 47.7-48[3] 43[4]	15.8[2] 32.63-21.7[3] 19.5[4]	[1] E2 [2] E2R1, E2R2 [3] E4 [4] E4R1	4 (p. 6, 7, 12-13, 16), 3 (p. 4-5, 7)
HC	21.8	9.88	38.9	17.6	E2R5	1 (p. 5)
HS	7.93[4] 8.13[5] 11.6[6]	3.59[4] 3.68[5] 5.26[6]	31.2[4] 39.6[5] N/A	14.1[4] 17.9[5] N/A	[4] E2R6 [5] E2R5 [6] E4R1	2 (p. 1), 6 (p. 2)
Simulant-HS	5.93	2.68	32.2	14.6	E2R5	4 (p. 12)
WP	11.4[7] 16.8[8]	5.17[7] 7.62[8]	34.7[7] 44.8[8]	15.7[7] 20.3[8]	[7] E2R6 [8] E4R1	6 (p. 2), 7

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not provide this information.

Sources

1. Davis, Captain M.H. and Woodberry, D.L. 1930. Report No. EATR 37, Development of Air-Burst Bomb (Expulsion-Type). Chemical Warfare Service.

2. Brigham, C.E. 1930. Bomb, Aerial, General Design of, Chemical Filled. Chemical Warfare Service.

3. MacIntire, R.G. 1930. Memorandum to: Chief, Engineering Division: Bomb, Chemical, 30-lb. Experimental Type E2R5, H.S., Booster charge 88.4 grams of Tetryl. Engineering Division. 28 March.

4. Crawford, J.S. 1932. Memorandum to Chief, Chemical Warfare Service, Bomb, Chemical, 30-lb., M-1. Ordnance Department.

5. Davis, Captain M.H. and Woodberry, D.L. 1930. Report No. EATR 37, Development of Air-Burst Bomb (Expulsion-Type). Chemical Warfare Service.

6. Sub-Committee on Bombs. 1931. Item 8925, Test of Bombs - Chemical Expulsion Type at Langley Field. Ordnance Committee. 7 May.

7. Brigham, C.E. 1930. Estimate for Bombs, Air Burst, Expulsion Type. Chemical Warfare Service. 3 December.

8. Spragins, R.L. 1930. Memorandum to Chief of Infantry, Washington, D.C.: Expulsion Type, Air-Burst Bomb. War Department. 28 October.

6.2 Bomb, 30-pound, M1

Figures

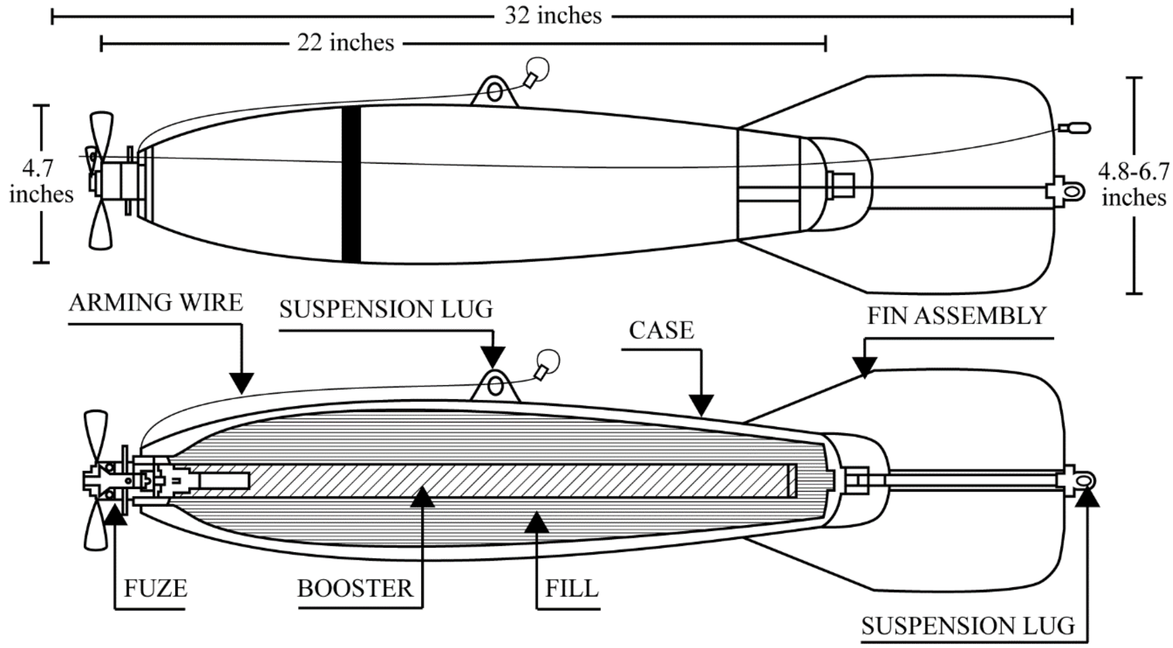

Figure 5: Bomb, 30-pound, M1 - Line Drawing

Figure 6: Bomb, 30-pound, M1 - Photograph

Specifications

Bomb, 30-pound, M1 - Specifications and Other Data		**Citation**
Historical Name	Bomb, Gas, Persistent, HS, 30-Pound, M1	1 (p. 86)
Type	Bomb	1 (p. 86), 2 (p. 669)
Size	30-pound	1 (p. 86), 2 (p. 669)
Conflict	WWII	2 (p. 669)
Diameter	Body: 4.7 in. (12 cm)	3 (p. 105)
Length	Overall: 32 in. (81 cm) Body: 22 in. (56 cm)	1 (p. 85), 3 (p. 105)
Width	Fin: 4.8-6.7 in. (12-17 cm)	1 (p. 85), 3 (p. 105)
Other Engineering Data	Wire, arming assembly, 82-3-234N was used. A single lug was 7.85 inches from the base of the tail fin assembly and 10 inches from the nose.	1 (p. 86-87)
Construction Material	Seamless steel tubing	2 (p. 669), 3 (p. 105)
Drawing	82-0-20	1 (p. 86)

Bomb, 30-pound, M1

General Use and Description

The 30-pound M1 chemical bomb was developed to meet the requirement for a bomb case strong enough to withstand "safe dropping" on normal soil from a height of 7,000 feet. It was intended to produce such an irritating physiological effect upon enemy personnel to make them ineffective (1 p. 86), (2 p. 669).

The M1 bomb was made by swaging a length of seamless steel tubing to a streamlined shape, fully closed at the tail end. A full-length burster well was assembled to the nose end of the body by means of pipe threads that sealed the bomb against leakage of the filler. A full-length burster of tetryl was used.

The two authorized fills for the M1 were H and WP (1 p. 86-87), (2 p. 669).

Explosive Train

Available references did not provide this information.

Fuzing

Bomb, 30-pound, M1 - Fuzing		
Fuze	**Note**	**Citation**
MK XIV	Nose- used with MK IIB or MK IIC instantaneous primer-detonator	1 (p. 86-87), 2 (p. 669), 3 (p. 81)

Booster, Adapter-Booster, or Burster

Bomb, 30-pound, M1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M100 Burster assembly	0.26 lbs. (0.12 kg)	Tetryl	Used with H-fill	1 (p. 86), 3 (p. 43, 105)
M101 Burster assembly	0.19 lbs. (0.86 kg)	Tetryl	Used with WP-fill	1 (p. 86), 3 (p. 103)

Fills

Bomb, 30-pound, M1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CNS (chloroacetophenone solution)	9.86	4.47	32.0	14.5	Experimental	3 (p. 104), 4
FM	11.7	5.31	Information Not Available (N/A)	N/A	-	5 (p. 14)
HS	8.31-9.00	3.76-4.08	29.1	13.1	-	1 (p. 86), 2 (p. 669), 4, 5 (p. 14)
WP	12.3-13.2	5.57-5.98	32.7	14.8	-	1 (p. 87), 2 (p. 669), 4, 5 (p. 15)

Shipping/Packing

The M1 was packaged two per crate with two each of the Mk. XIV nose fuze, the MK. IIB primer detonators, M101 booster, and the 82-3-234N arming wire assembly. Each bomb displaced 2.27 cubic feet. Each M1 crate (including components) weighed 84 pounds if H/HS-filled or 90 pounds of WP-filled (1 p. 87, 107), (3 p. 103-105).

Miscellaneous

This bomb was originally known as Bomb, Chemical, 25-lb, MI but the designation was changed to Bomb, Chemical, 30-lb, MI to better reflect the increase in weight due to design changes (6 p. 4).

Key Dates

Bomb, 30-pound, M1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1923	Ordnance Committee Meeting (OCM) 2705 (Approval of design and manufacture of 50 bodies)	6
Standardized	1926	OCM 5812, 5859 (Persistent gas-fill)	6, 7
Standardized	1928	OCM 7209 (WP-fill)	7 (p. 7)
Standardized	1940	OCM 15601, 15656 (M1 changed to Limited Standard)	9 (p. 7), 10 (p. 9)

Sources

1. Secretary of War. 1942. Technical Manual, TM 9-1980, Bombs for Aircraft. War Department.

2. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.

3. Chief of Ordnance. 1930. Technical Regulation, TR 1370-G, Miscellaneous Ammunition Bombs for Aircraft TR 1370-G. War Department.

4. Office of the Commandant. 1932. Office of the Commandant, Maxwell Field Alabama, Memorandum to The Chief of the Air Corps, Washington DC. Subject: Bomb Chemical, 30-lb, M1 and Indorsements. Air Corps Tactical School.

5. Bouder, N.M., & Powell, H.C. 1931. Approximate Average Weights of Fillings in Chemical Munitions. Information Division.

6. Sub-Committee on Bombs. 1926. Ordnance Committee Meeting, OCM Item # 5812, Bomb, Chemical, 25-lb. MI – Standardization, and Designation Changed to "Bomb, Chemical, 30-lb, MI". Ordnance Committee.

7. Sub-Committee on Bombs. 1928. Ordnance Committee Meeting, OCM Item # 7209, Standardization of 30-lb, Chemical Bomb MI with WP Filling. Ordnance Committee.

8. Finklestein, Leo. 1964. History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 - 31 December 1945) Screening Smokes Part III. Chemical Research and Development Laboratories (CRDL).

9. Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15656, Bomb, Chemical, 30-lb. M46 and Fuze, Bomb, Nose, M108 – Clearance for Procurement and Classification as Standard, Read for Record. February 29.

10. Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15601, Bomb, Chemical, 30-lb. T2E1 with Fuze, Bomb, Nose, T21 – Classified as Standard; Bomb Designated Bomb, Chemical, 30-lb., M46; Fuze designated Fuze, Bomb, Nose, M108 – Bomb, Chemical, 30-lb., M1 – Reclassified from Standard to Limited Standard. February 8.

6.3 Bomb, 30-pound, M46, M46A2

Figures

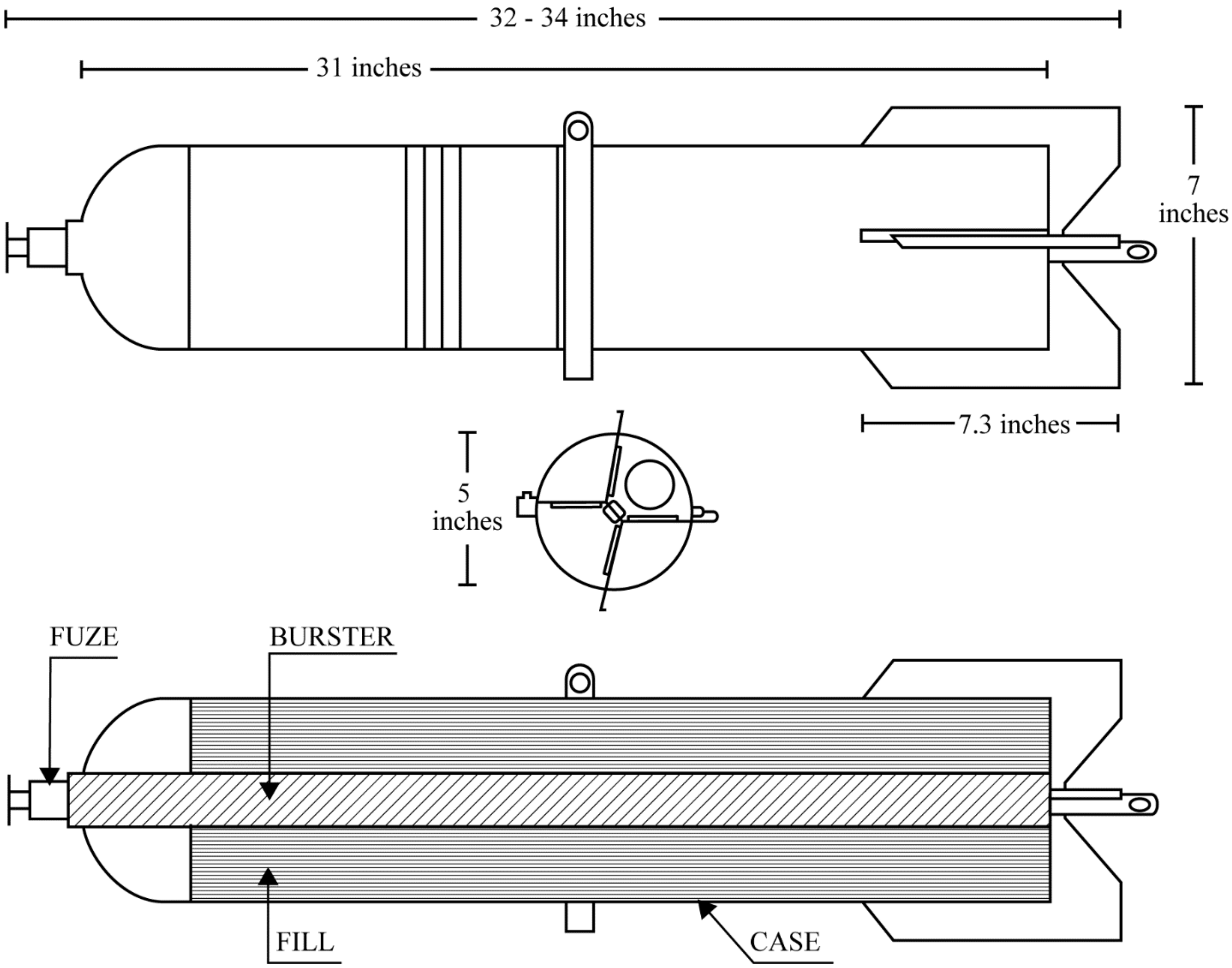

Figure 7: Bomb, 30-pound, M46 - Line Drawing

Figure 8: Bomb, 30-pound, M46 - Photograph

Bomb, 30-pound, M46, M46A2

Specifications

Bomb, 30-pound, M46, M46A2 - Specifications and Other Data		Citation
Historical Name	Bomb, Gas, Persistent, HS, 30-Pound, M46A2	1 (p. 89)
Developmental Information	T2E1: M46 Fuze T21: Fuze M108	6 (p. 1, 8)
Type	Bomb	1 (p. 89), 2 (p. 669)
Size	30-pound	1 (p. 89)
Conflict	WWII	2 (p. 669)
Service	Air Force	2 (p. 669)
Diameter	5 in. (13 cm)	3 (p. 33)
Length	Body: 31 inches (79 cm) With fuze: 32-34 inches (84-86 cm) Tail: 7.3 in. (18.5 cm)	1 (p. 88), 2 (p. 669, 670), 3 (p. 33), 4
Width	Tail: 7 in. (17.8 cm)	3 (p. 33)
Wall Thickness	0.0625 in. (0.1588 cm) (M46A1 and M46A2)	3 (p. 33)
Construction Material	Body: sheet steel Tail: sheet steel, four vanes	3 (p. 33)
Drawing	82-0-38	1 (p. 89)

General Use and Description

The M46 and M46A2 were intended to produce an irritating physiological effect upon enemy personnel making them ineffective. It was also used for screening troop movements (1 p. 89, 90), (2 p. 669), (3 p. 32).

The M46 was standardized in 1940, replacing the M1 chemical bomb. It was a thin case bomb, cylindrical in shape and made of sheet metal. The bomb had a lug on a band at the center of gravity and a lug welded to the tail assembly.

The M46A2 was a modification of the M46. The modifications consisted of changes in fin assembly to make it more stable in flight, and body construction. It was adapted for a nose fuze only. A suitable closing plug was fitted to the adapter to keep the fuze and burster cavities free of foreign matter.

The M46A2 consisted of a sheet steel tube with a hemispherical sheet steel nose welded to the tube and a male type base plate welded to the body (1 p. 89, 90), (2 p. 669), (3 p. 33), (4), (5 p. 87).

Explosive Train

Available references did not provide specific information on the explosive train.

Fuzing

Bomb, 30-pound, M46, M46A2 - Fuzing		
Fuze	**Notes**	**Citation**
AN-M126A1	Nose - Replaced M108	5 (p. 87)
M108	Nose	1 (p. 89, 90), 2 (p. 669), 3 (p. 33), 6 (p. 8), 7 (p. 6)

Booster, Adapter-Booster, or Burster

Bomb, 30-pound, M46, M46A2 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M3 Burster assembly	0.143 lbs. (0.065 kg)	Tetryl	The assembly was 30 inches long. Available references did not provide weight information.	1 (p. 89, 90), 2 (p. 669), 6 (p. 5)

Bomb, 30-pound, M46, M46A2

Fills

Bomb, 30-pound, M46, M46A2 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
HS	19.8-21.1	8.98-9.57	31.1-39.7	14.1-18.0	-	1 (p. 89-90), 2 (p. 669), 4, 5 (p. 87)
WP	28.1	12.8	39.7	18.0	-	1 (p. 90), 2 (p. 669), 3 (p. 33), 5 (p. 87)

Shipping/Packing

The M46A2 was packaged two per crate with two each of the M108 nose fuze, and the 82-3-234RA arming wire assembly. Each bomb displaced 1.86 cubic feet. The M46A2 crate (including components) weighed 102 pounds (1 p. 106-107).

Miscellaneous Information

Redesign of the M1 to create the M46 began with the T1E1 in 1931. This involved the change to a cylindrical body design and a decrease in the mean thickness of the tube to allow an increase in the chemical fill. This redesign also involved moving the suspension lug and redesign of the fin assembly to work with the bomb racks in use at the time. In addition, the outer booster casing was eliminated (8 p. 2, 3).

The M46 -series was not well suited to the changes in aircraft design. The bombs were not space efficient and were obsoleted. The empty stocks on hand or under manufacture when obsoleted in 1942 were no M46, 205,675 M46A1, and 80,198 M46A2. About 3,200 additional bombs were being loaded with WP at the time of the recommendation for obsolescence (9 p. 9).

Key Dates

Bomb, 30-pound, M46, M46A2 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1940	OCM 15656, 15601 (M46, Persistent agent)	2 (p. 669), 7 (p. 7)
Obsoleted	1942	CCTC 586, OCM 18457 (M46, M46A1, and M46A2)	2 (p. 669), 9 (p. 10)

Sources

1. Secretary of War. 1942. Technical Manual, TM 9-1980, Bombs for Aircraft. War Department.

2. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.

3. Chief of Ordnance. 1942. Technical Manual, TM 9-1984, Disposal of American and Allied Bombs and Fuzes. War Department.

4. Aberdeen Proving Ground. 1942. Bomb Disposal Technical Data, 1064, Bomb Disposal Headquarters. Department of the Army.

5. U.S. Navy Bomb Disposal School. 1944. United States Bombs and Fuzes, Pyrotechnics, Land Mines, Firing Devices. Department of the Army.

6. Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15601, Bomb, Chemical, 30-lb. T2E1 with Fuze, Bomb, Nose, T21 – Classified as Standard; Bomb Designated Bomb, Chemical, 30-lb., M46; Fuze designated Fuze, Bomb, Nose, M108 – Bomb, Chemical, 30-lb., M1 – Reclassified from Standard to Limited Standard. February 8.

7. Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15656, Bomb, Chemical, 30-lb. M46 and Fuze, Bomb, Nose, M108 – Clearance for Procurement and Classification as Standard, Read for Record. February 29.

8. Ordnance Committee. 1931. Ordnance Committee Meeting, OCM Item # 8932, Bomb, Redesign of Bomb, Chemical, 30-lb., M1. May 21.

9. Ordnance Committee. 1942. Ordnance Committee Meeting, OCM Item # 18457, Bomb, Chemical, 30-lb. M46, M46A1, and M46A2 – Obsoletion Recommended. July 9.

6.4 Bomb, 5-gallon/50-pound, LC-50

Figures

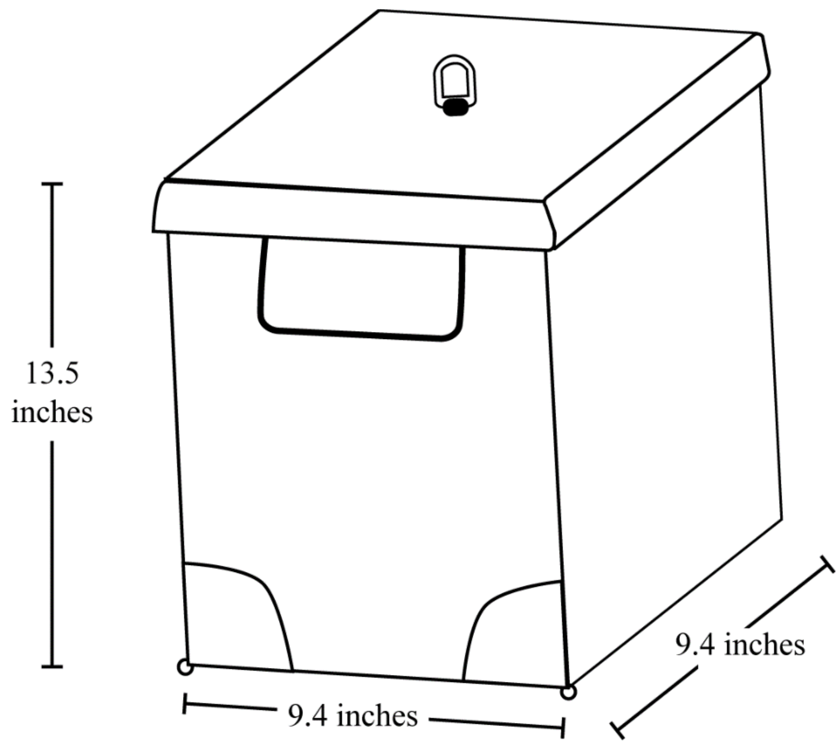

Figure 9: Bomb, 5-gallon, LC-50 – Line Drawing

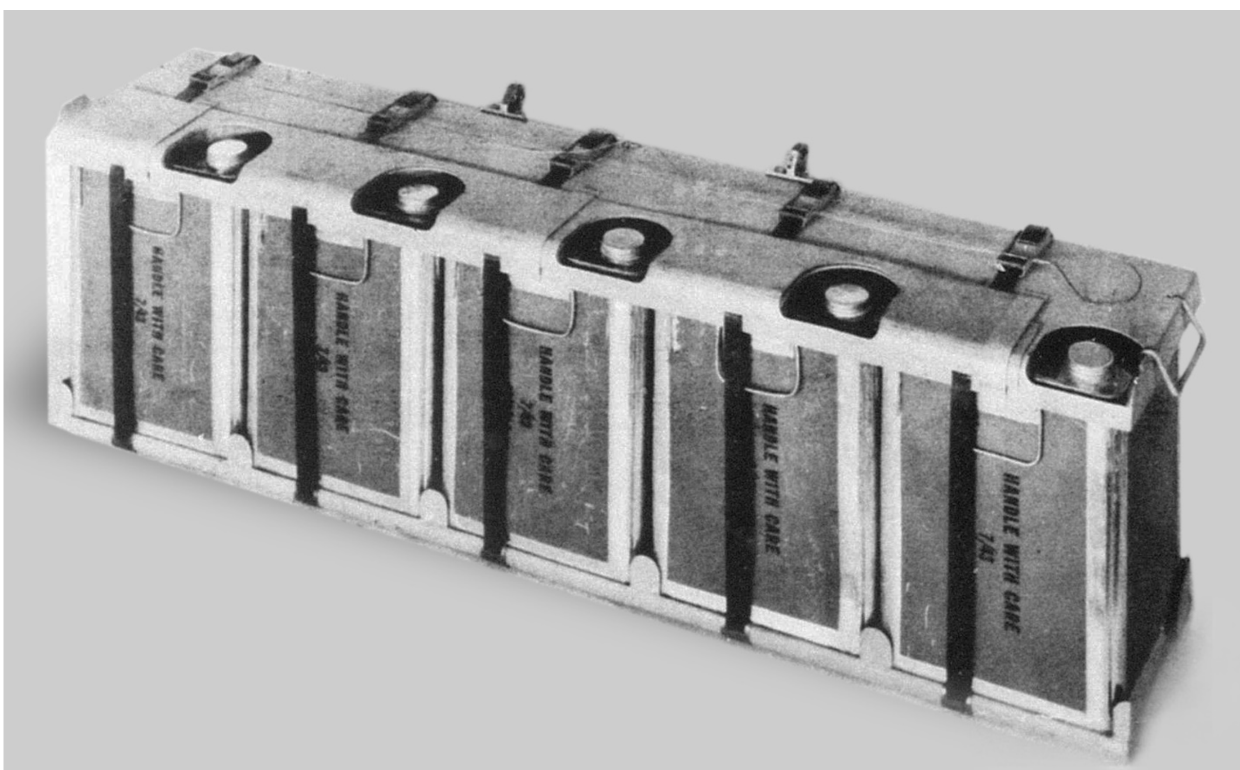

Figure 10: Bomb, 5-gallon, LC-50 – Photograph: E27R1 Cluster of Five LC-50 Bombs

Bomb, 5-gallon/50-pound, LC-50

Specifications

Bomb, 5-gallon, LC-50 – Specifications and Other Data		Citation
Historical Name	LC-50, 5-gallon Capacity, H-Filled	1 (p. 1)
Type	Bomb	-
Size	5-gallon/50-pound	1 (p. 1), 2 (p. 2), 3
Conflict	WWII	1, 2, 3
Service	Army	1 (p. 1)
Length	9.4 in. (24 cm)	1 (p. 1)
Width	9.4 in. (24 cm)	1 (p. 1)
Height	13.5 in. (34 cm)	1 (p. 1)
Construction Material	Tin plate	1 (p. 1)

General Use and Description

The LC-50 bomb was similar in dimension and structural characteristics to the British bomb, chemical, aircraft, 65-pound, Mk. 1. The primary use of the LC-50 was as an antipersonnel weapon to produce casualties. Tests of the LC-50 bomb determined that it was suitable for limited use by the Army Air Forces in tactical applications that required heavy contamination of specialized ground targets to create chemical barriers and traversal and occupational hazards (1 p. 3).

Five LC-50 bombs were clustered in the E27R1 cluster bomb with the E19R1 cluster adapter. The LC-50 bomb was a rectangular, thin tin plate can. Two corrugated stiffeners were located on the face of the can to strengthen the can and act as a separator between the can and the drop bar of the bomb container in which the bomb was carried. A charging hole with a screw cap and washer was provided in the top of the can. (1, p. 1). The LC-50 was to be filled "only shortly before use" (1 p. 5).

The E27R1 cluster of LC-50 bombs was designed to be installed in vertical bomb racks (e.g., A-26, B-25, B-24, and B-17 aircraft) (1 p. Inclusion), (5 p. 1).

Explosive Train

The LC-50 bomb is non-explosive and depends entirely upon force of impact to break the thin container and disperse its contents over the target area (1 p. 2).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Bomb, 5-gallon, LC-50 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
H	50	22.7	N/A	N/A	1 (p. 2), 2 (p. 2, 8)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

Due to the fragile construction of the LC-50 case, extra care was required in filling, handling, and transportation to prevent dents or other damage. Decontaminants increased corrosion of the LC-50; therefore, close attention was required to prevent spilling of agent on the case. The LC-50 was not standardized; it was considered an extra reserve and temporary expedient for limited tactical application. (1 p. 4)

Key Dates

Available references did not provide this information.

Sources

1. Neuberg, Gustav Lt. Colonel. 1945. Report of the Army Air Forces Board, Test of Bomb, Chemical, LC-50, 5-GAL. Capacity, H-Filled in E27R1 Cluster. ADB972784. Army Air Forces Board.
2. Technical Staff 9769 (TSU) CWS Mobile Unit. 1945. Mobile Unit Special Report, MUSR No. 2, Assessment of Traversal Hazards by Standardized Methods. Chemical Warfare Service.
3. Technical Staff 9769 (TSU) CWS Dugway Proving Ground Mobile Unit. 1945. Dugway Proving Ground Special Report, DPGSR No. 47, Low Altitude Dropping Tests of Modified M47A2 and M70 Bombs. Chemical Warfare Service.

6.5 Bomb, 100-pound, MK 42

Figures

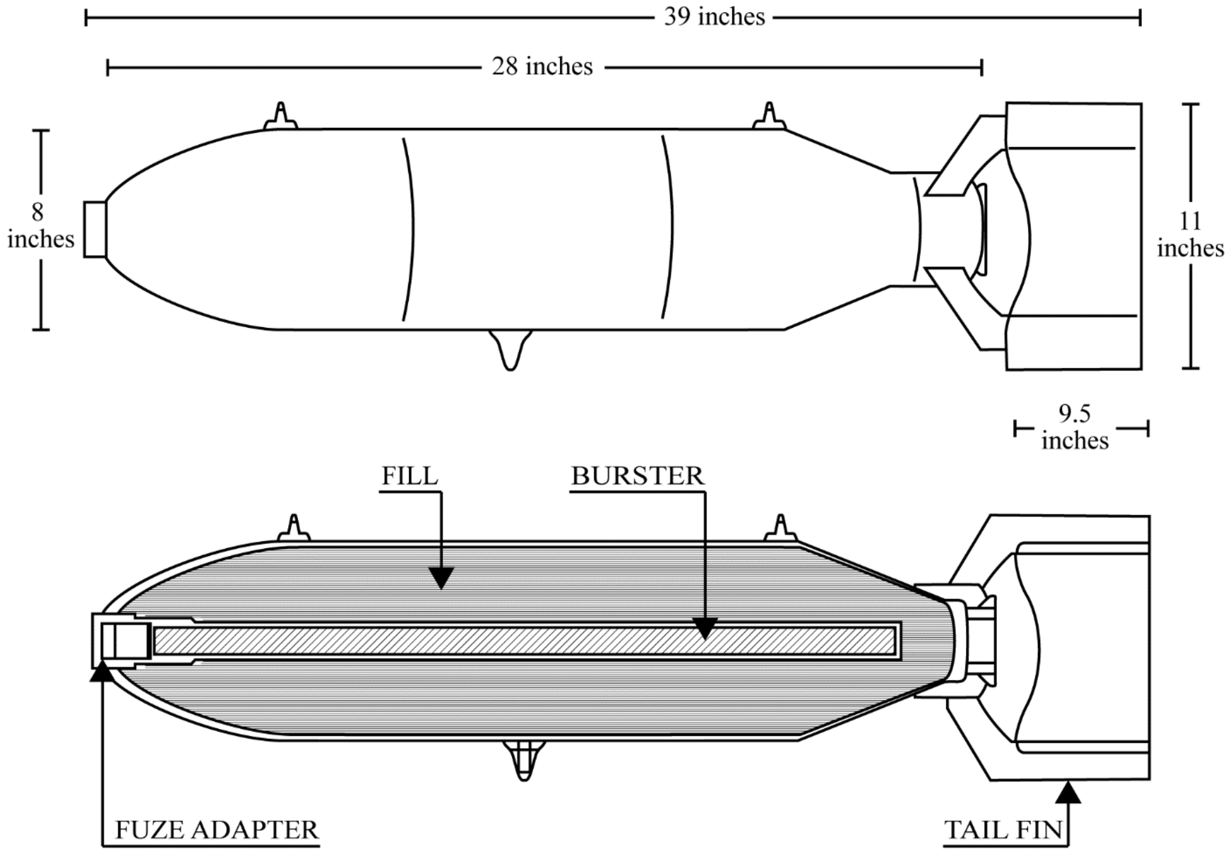

Figure 11: Bomb, 100-pound, MK 42 - Line Drawing

Figure 12: Bomb, 100-pound, MK 42 - Photograph, recovered (without fin)

Bomb, 100-pound, MK 42

Specifications

Bomb, 100-pound, MK 42 - Specifications and Other Data		Citation
Historical Name	100-Pound Chemical, Bomb MK 42	1 (p. 425)
Type	Bomb	1 (p. 425)
Size	100-pound	1 (p. 425)
Conflict	WWII	2
Service	Navy	2 (p. 78)
Diameter	8 in. (20 cm)	1 (p. 425), 2 (p. 79)
Length	Overall: 39 inches (99 cm) Body: 28 in. (71 cm) Tail: 9.5 in. (24 cm)	1 (p. 425), 2 (p. 79)
Width	Tail: 11 in. (28 cm)	1 (p. 425)
Wall Thickness	0.17 in. (0.43 cm)	1 (p. 425), 2 (p. 79)
Other Engineering Data	Tail: box-type, four-fin Lugs: 14 in. (35.6 cm) apart	2 (p. 79)
Construction Material	Body: steel tube Tail: sheet steel	2 (p. 79)

General Use and Description

The MK 42 was for use against personnel and material (3 p. 91).

The steel tube was swaged aft. An adapter screwed into the nose and was threaded to receive the fuze. A burster tube containing TNT ran the length of the bomb and screwed into the after end of the adapter. The after end of the body was closed by a male base plate, which was threaded for the tail assembly to be fitted. The bomb was filled through the nose. Suspension was by two lugs seven inches on either side of the center of gravity or a single lug 180 degrees removed and at the center of gravity. The bomb had a box-type, four-fin tail, secured by a locking nut (1 p. 425), (2 p. 79).

Explosive Train

The fuze used the rotor system of arming and would function on impact with water or denser medium if it was dropped from a high enough altitude. Upon impact, the fuze function would initiate the burster charge, split the bomb case, and disperse the filling over the area to be contaminated (1 p. 425).

Fuzing

Bomb, 100-pound, MK 42 - Fuzing		
Fuze	**Notes**	**Citation**
AN-MK 219	Nose	1 (p. 425), 2 (p. 79), 4 (p. 63)
MK 119	-	2 (p. 78, 79)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Bomb, 100-pound, MK 42 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
H	40.5-43.0	18.3-19.5	86.5-92.0	39.2-41.7	-	1 (p. 425), 2 (p. 79), 4 (p. 62)
HE	75.0	34.0	N/A	N/A	TNT	2 (p. 79)

Shipping/Packing

The bomb was shipped with two lug protectors (4 p. 62).

Key Dates

Bomb, 100-pound, MK 42 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Obsoleted	1952	CCTC 2503 (H-fill)	-

Sources

1. Bureau of Ordnance. 1947. Ordnance Pamphlet, OP 1664 (Vol. 1), U.S. Explosive Ordnance. Department of the Navy.
2. Chief of Ordnance. 1942. Technical Manual, TM 9-1984, Disposal of American and Allied Bombs and Fuzes. War Department.
3. U.S. Navy Bomb Disposal School. 1944. United States Bombs and Fuzes, Pyrotechnics, Land Mines, Firing Devices. War Department.
4. Bureau of Ordnance Publication. 1944. NAVORD Ordnance Data, OD 5603, Complete Round Chart for Aircraft Bombs. July. Department of the Navy.

6.6 Bomb, 100-pound, Cube, E132

Figures

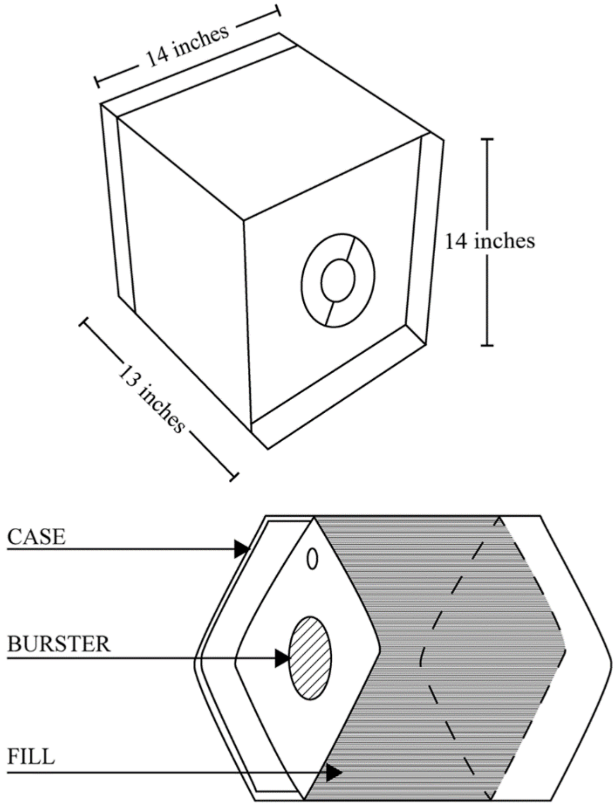

Figure 13: Bomb, 100-pound, Cube, E132 - Line Drawing

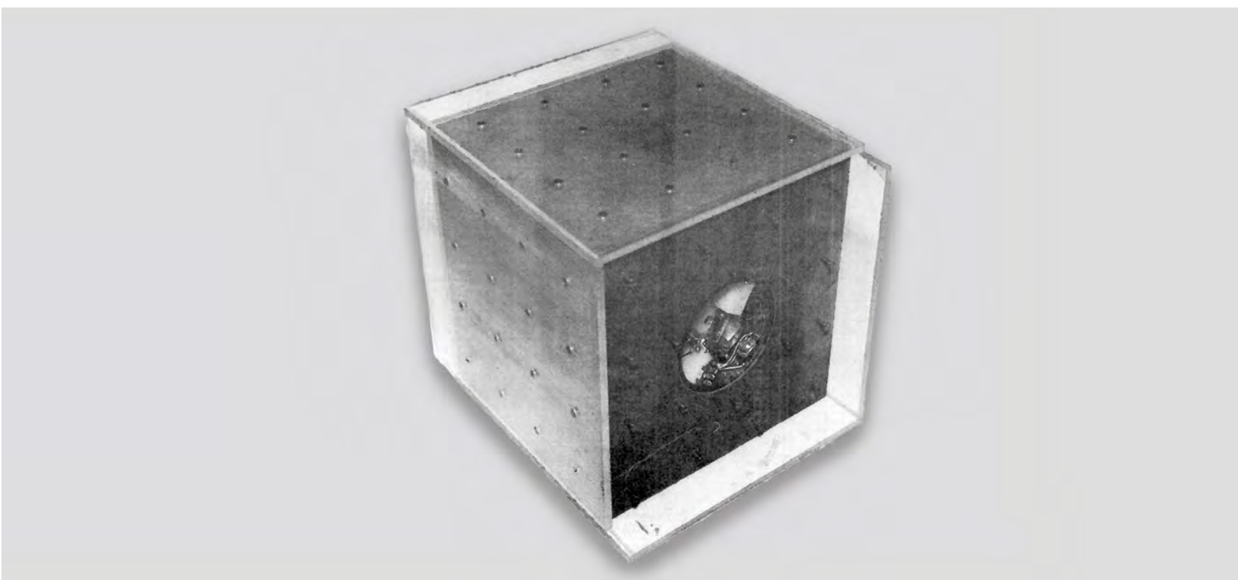

Figure 14: Bomb, 100-pound, Cube, E132 - Photograph, Model

Bomb, 100-pound, Cube, E132

Specifications

Bomb, 100-pound, Cube, E132 - Specifications and Other Data		Citation
Historical Name	Bomb, Gas, Nonpersistent, GB, 100-Pounds, E132	1 (p. 4-20)
Type	Bomb	1 (p. 4-20)
Size	100-pound	2 (p. 4-21)
Conflict	Cold War	1 (p. 4-20)
Service	Air Force, Navy	1 (p. 4-20), 2 (p. 4-21)
Length	14 in. (35.5 cm)	1 (p. 4-21), 2 (p. 4-22)
Width	14 in. (35.5 cm) Fins: 1.5 in. (3.8 cm); diagonally opposed	1 (p. 4-21), 2 (p. 4-22)
Height	13 in. (33 cm)	1 (p. 4-21), 2 (p. 4-22)

General Use and Description

The E132 100-pound bomb was designed to disseminate chemical agents from aircraft (1 p. 4-20), (2 p. 4-21).

The E132 was a compact munition designed with maximum performance and payload weight per total systems weight. It provided the greatest area coverage consistent with the potential of the agent (e.g., GB, VX) employed. This inferred widely dispersed multiple source points, and an efficient agent dissemination through improved fuzing and burster system. Self-dispersion was accomplished by driving vanes on the cube body to provide spin during flight. The fuze system could be set for air or ground burst.

The E132 could be dropped from aircraft using Boeing-Hays (XMC-1) dispensers carrying 72 bombs (1 p. 4-20), (2 p. 4-21, 4-22).

Explosive Train

The electric fuze functioned at either airburst or upon impact. When the fuze functioned, the burster was initiated breaking the shell and disseminating the agent (2 p. 4-21, 4-22).

Fuzing

Bomb, 100-pound, Cube, E132 - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Proximity - When using a GB-fill, a new fuze or a compromise fuze could be used. No further details were provided in available references.	1 (p. 4-20)

Booster, Adapter-Booster, or Burster

Bomb, 100-pound, Cube, E132 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	N/A	Electric fuze burster with a 1.75-inch diameter. Available references did not provide weight information.	2 (p. 4-22)

Fills

Bomb, 100-pound, Cube, E132 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	70.0	31.7	125	56.7	-	1 (p. 4-20, 4-21), 2 (p. 4-22)
VX	70.0	31.7	125	56.7	-	1 (p. 4-20, 4-21), 2 (p. 4-22)

Bomb, 100-pound, Cube, E132

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The E132 was designed for use in the XMC-1 dispenser, which carried 72 each E132 bombs (1 p. 4-20, 4-21), (2 p. 4-22). The development history is described in CMLC project 4-04-15-032-08.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

6.7 Bomb, 100-pound, M47 Series, AN-M47 Series

Figures

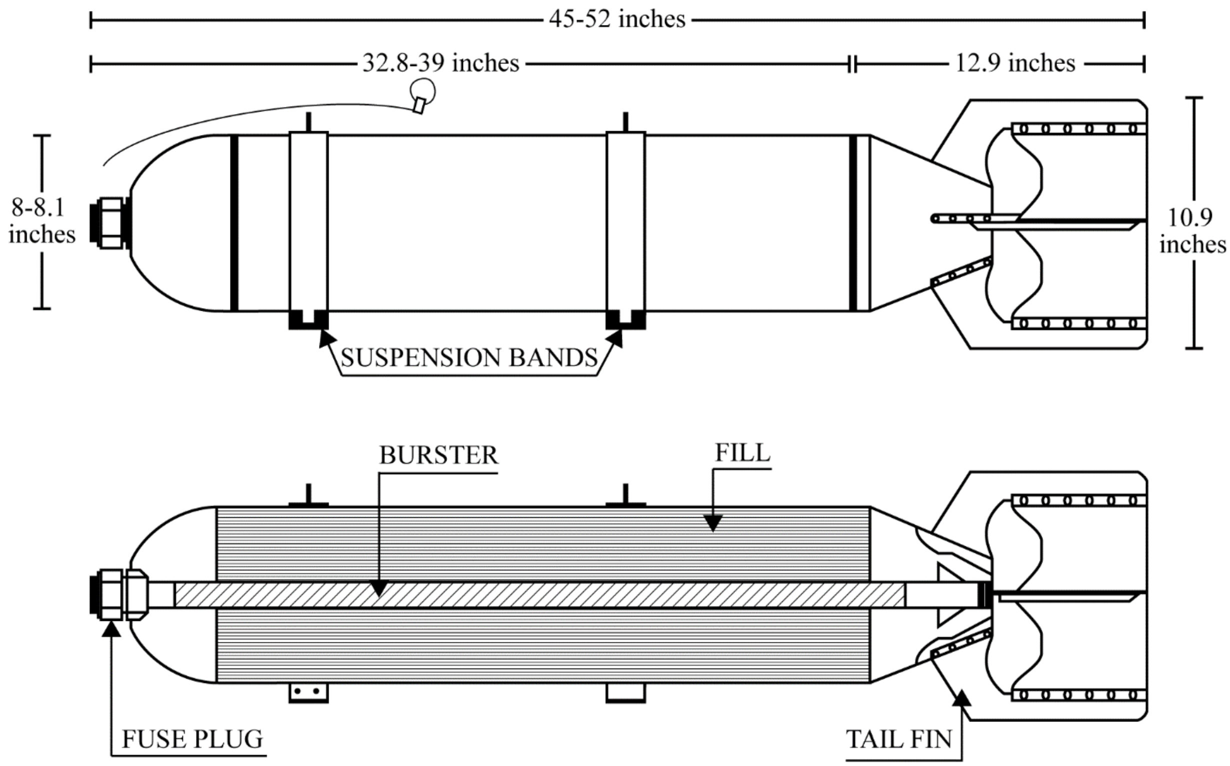

Figure 15: Bomb, 100-pound, M47 Series, AN-M47 Series - Line Drawing

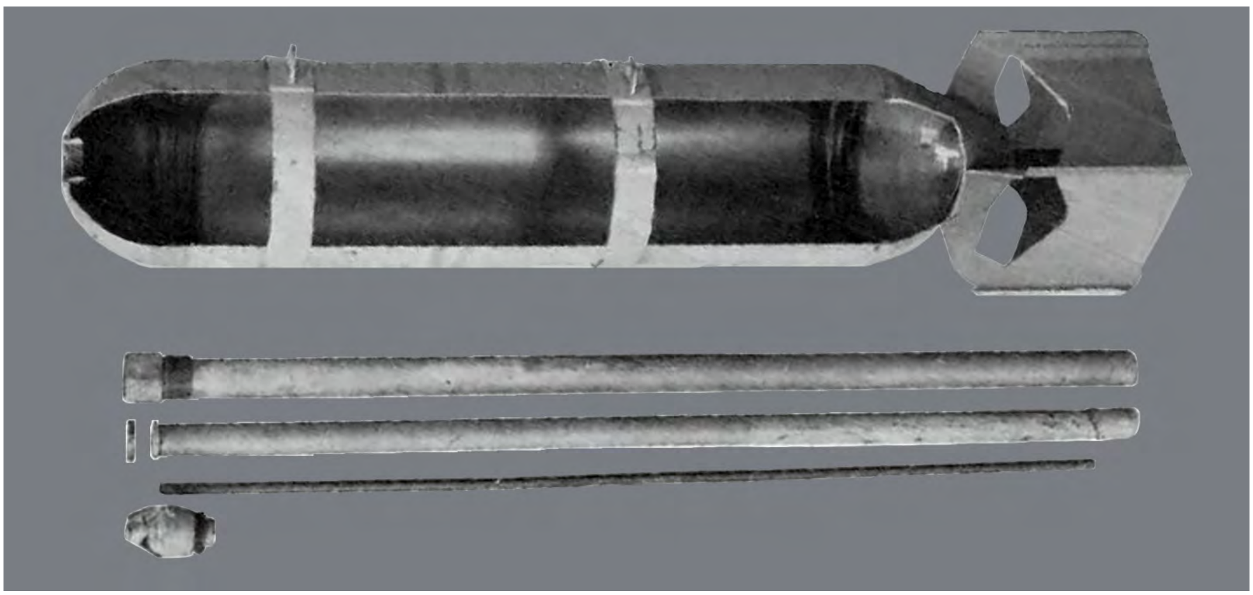

Figure 16: Bomb, 100-pound, AN-M47A2 - Photograph, Cutaway View

Figure 17: Bomb, 100-pound, M47A2 - Photograph

Specifications

Bomb, 100-pound, M47 Series, AN-M47 Series - Specifications and Other Data		**Citation**
Historical Name	Bomb, Chemical, Incendiary, or Smoke, 100 Pound, T6E1, M47, M47A1, M47A2, M47A2C, M47A3, M47A3C, M47A4, AN M47A2, AN M47A3, AN M47A4	1 (p. 671-676), 2 (p. 432), 3 (p. 35, 37, 38), 4 (p. 4-22), 5 (p. 126, 127), 6 (p. 93), 7 (p. 10, 11, 35, 36), 8 (p. 8, 30), 9 (p. 32, 33), 10 (p. 91, 84, 94), 11 (p. 10-12), 12 (p. 46), 13 (p. 33), 14 (p. D1, D2), 15 (p. 2)
Developmental Information	T6E1	13 (p. 33), 14 (p. D1)
Type	Bomb	1 (p. 671), 2 (p. 432), 3 (p. 35)
Size	100-pound	1 (p. 671), 2 (p. 432), 3 (p. 35)
Conflict	WWII	1, 5, 9
Service	Air Force, Army, Navy	1 (p. 671), 2 (p. 433), 3 (p. 4), 4 (p. 4-22), 5 (p. 127), 7 (p. 10, 11, 35, 36)
Diameter	AN-M47A1: 8.12 in. (20.6 cm) AN-M47A2: 8.12 in. (20.6 cm) AN-M47A3, AN-M47A4: 8.5 in. (21.6 cm) AN-M47A3C: 8 in. (20.3 cm) M47, M47A1: 8.0-8.1 in. (20.3-20.6 cm) M47A4: 8.1 in. (20.6 cm)	1 (p. 671, 674), 2 (p. 432), 3 (p. 53), 6 (p. 93), 9 (p. 33), 10 (p. 91, 94), 11 (p. 10-12), 12 (p. 46), 16 (p. 106), 17 (p. 49), 18 (p. 33)
Length	Body: M47A1: 32.8 in. (83.3 cm) AN-M47A2: 39 in. (99 cm) Tail: AN-M47: 12.9 in. (32.8 cm) AN-M47A2: 12.9 in. (32.8 cm) M47A1: 12.9 in. (32.8 cm) M47A3: 15.9 in. (40.8 cm) Overall: AN-M47A2: 48.9 in. (124 cm) AN-M47A3, AN-M47A4: 52.6 in. (134 cm) AN-M47A3C: 51.9 in. (132 cm) AN-M47A4: 51.7 in. (131 cm) M47: 49-51 in. (124-129 cm) M47A1 unfuzed: 45 in. (114 cm) M47A1, fuzed: 48 in. (121 cm) M47A4: 52.6 in. (134 cm)	1 (p. 671, 673 - 676), 2 (p. 432), 3 (p. 36, 38, 53, 55), 4 (p. 4-23), 6 (p. 93), 7 (p. 10, 11, 35, 36), 9 (p. 33), 10 (p. 91), 11 (p. 10-12), 12 (p. 46), 16 (p. 106), 17 (p. 49), 18 (p. 33), 19, 20 (p. 31, 41)
Width	Tail: AN-M47A2 10.9 in. (27.7 cm) AN-M47A4: 11 in. (28 cm) M47A1, M47A2: 10.9 in. (27.7 cm)	2 (p. 432), 6 (p. 93), 9 (p. 33), 18 (p. 33), 21

Bomb, 100-pound, M47 Series, AN-M47 Series - Specifications and Other Data		Citation
Wall Thickness	M47: 0.03 in. (0.07 cm) M47A1: 0.05-0.06 in. (0.12-0.15 cm) AN-M47A2: 0.06 in. (0.15 cm)	1 (p. 674), 2 (p. 432), 3 (p. 38), 5 (p. 127), 6 (p. 93), 9 (p. 33), 10 (p. 91, 94), 16 (p. 106)
Construction Material	Tube made of sheet steel with a longitudinal seam weld with nose and rear welded on.	2 (p. 432), 3 (p. 36), 4 (p. 4-22), 9 (p. 33), 10 (p. 91, 94), 13 (p. 33), 17 (p. 49)
Other Engineering Data	Cluster adapter: M24 (T19), holds 4 to 6 AN-M47 Cluster adapter: M22 (T9), holds 4 An-M47	5 (p. 127)
Drawing	AN-M47A3 (PWP-fill): 82-0-80 AN-M47A4 (PWP and WP-fill): 82-0-80 AN-M47A3 (NP-fill): C14-5-651 AN-M74A4 (PT1 fill): C14-5-651	4 (p. 4-23), 7 (p. 10, 11, 35, 36), 11 (p. 10-12)
Specification	AN-M47A3 (PWP-fill) AN47A4 (PWP-fill): MIL-F-10746 AN-M74A4 (PT1 fill): MIL-B-10746	7 (p. 11, 35, 36)
Federal Stock Number (FSN)	AN-M47A3 (NP-fill): 1325-219-8525 AN-M47A3 (PWP-fill): 1325-219-8507 AN-M47A4 (PT1 fill): 1325-219-8563 AN-M47A4 (PWP-fill): 1325-219-8508 AN-M47A4 (WP-fill): 1325-219-8509	7 (p. 10, 11, 35, 36)
National Stock Number (NSN)	AN-M47A3 (PWP-fill): 1325-00-219-8507 AN-M47A4 (PWP-fill): 1325-00-219-8508 AN-M47A4 (WP-fill): 1325-00-219-8509	8 (p. 30)

General Use and Description

The M47 series of bombs was developed to meet the requirements of the Air Force for a chemical bomb for “bombardment” purposes. It was a thin case bomb whose design and construction was such as to provide maximum efficiency after release from the bomb bay of the plane. The 100-pound smoke and the 100-lb. incendiary bombs are similar in outward appearance and in many details, the chief differences consisting of their chemical fillings, their functioning, and their use (1 p. 671, 674, 676) (11 p. 10-12) (21).

The 100-pound AN-M47 series included the AN-M47A2, which could be filled with H, WP, or gasoline gel; the M47A2 Gas, Chemical, Smoke, or Incendiary; the M47A1 Gas, Smoke, or Incendiary; the M47 Chemical; the AN-M743A Incendiary; and the AN-M47A4 incendiary.

The bodies of these bombs were made of 1/32-inch sheet metal rolled and lap welded into a cylindrical shape eight inches in diameter. The nose was hemispherical and welded to the body as was the box-type tail fin assembly that formed the tail taper of the bomb body. The burster well was screwed into the bomb body by means of pipe threads to make a gastight seal at the nose. It was held in place at the tail of the bomb body by an attached cone in the inner side of the fin assembly. It was internally threaded to receive a sleeve that had a groove in its lower portion to seat the fuze, which was pressed in place. The pipe threads were coated with either white lead-in-oil, red lead-in-oil, or varnish shellac before the burster was inserted to make a leak tight joint. Around the bomb body were two suspension bands 14 inches apart, which provided suspension lugs for horizontal suspension. One blade of the fixed box-type tail assembly was in line with the suspension lug.

The M47A1 bomb was designed to replace the 100-pound M47. The 100-pound M47 was found to have too thin a wall section, and in handling and storage, it developed leaks due to corrosion and rough treatment. Consequently, the wall thickness was increased from 1/32 inch to 1/16 inch, and the case was protected by coating inside with acid proof black paint. However, H was still found to leak from the bomb case and the only standard fills were WP and PT.

The M47A2 bomb was designed to be able to receive the chemical filler H without leaking. It was coated on the inside with a special oil that proved, in theoretical tests, to be resistant to filler pressure having a resistance of 350-pound pressure. It did not differ from the 100-pound M47A1 in any appreciable way. It was found; however, that this bomb was also subject to leaking, but not to such an extent as its predecessors. H was still to be loaded into this bomb as a temporary emergency filler. It could also be filled with HD, WP, gelled gasoline, or NP.

The M47A2C Chemical Bomb added a vent plug near the nose to allow release of gas pressure built up during storage and had sharper threads on the fuze adapter to prevent leakage. At a later date, a model with the welded fin increased three inches in length in order to provide greater stability in flight was designated the M47A3C. Subsequently, for a version designated the M47A4C, the thickness of the suspension lugs was increased from 0.15 to 0.30 inches and a phenolic protective coating was prescribed for the interior of the bomb to increase storage life (1 p. 671, 674, 676), (2 p. 432), (3 p. 53, 54), (4 p. 4-22), (9 p. 33) (14 p. D1) (18 p. 33).

Explosive Train

On impact, the striker would be forced inward, which would shear the shear wire and bring the firing pin into the detonator. The detonator consisted of priming mixture, lead azide, and tetryl. When detonated it sent a wave to the burster charge of tetryl or black powder in the burster casing. The burster split the shell and the chemical filler was spread (1 p. 670), (3 p. 75), (5 p. 127), (7 p. 10, 11, 35, 36), (11 p. 10-12).

Fuzing

Bomb, 100-pound, M47 Series, AN-M47 Series - Fuzing		
Fuze	**Notes**	**Citation**
AN-M126	Preferred over the M108	6 (p. 93), 12 (p. 46), 19, 22 (p. 179)
AN-M126A1	Preferred over the M108	2 (p. 432), 3 (p. 133), 4 (p. 4-23), 5 (p. 177), 6 (p. 93), 7 (p. 10, 11, 35, 36), 12 (p. 46), 17 (p. 49), 19
AN-M147	-	2 (p. 432), 5 (p. 183)
AN-M159	Nose- preferred for incendiary fill	3 (p. 36, 133), 4 (p. 4-23), 7 (p. 10, 11, 35, 36), 11 (p. 10-12)
M108	Nose	1 (p. 671, 676), 2 (p. 432), 3 (p. 131), 5 (p. 127), 9 (p. 32), 10 (p. 91, 95), 14 (p. D2)
M126	Nose	1 (p. 676), 2 (p. 432), 5 (p. 127), 6 (p. 93), 9 (p. 33)
M126A1	-	9 (p. 33), 17 (p. 49)
M159	M126A1 in development	2 (p. 432), 17 (p. 49)

Booster, Adapter-Booster, or Burster

Bomb, 100-pound, M47 Series, AN-M47 Series - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
AN-M12 Burster	1.1 lbs. (0.50 kg)	50% black powder 50% magnesium	Used for PWP-filled AN-M47A4, IM-filled AN-M47A2 and AN-M47A3 and NP-filled AN-M47A2	2 (p. 432), 3 (p. 131, 133, 137), 7 (p. 10, 11), 11 (p. 3-9), 15 (p. 2), 17 (p. 49)

Bomb, 100-pound, M47 Series, AN-M47 Series - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
AN-M13 Burster	0.13-0.15 lbs. (0.06-0.07 kg)	TNT and tetryl pellets	Used in conjunction with igniter AN-M9 (WP or NP) in AN-M47A2, AN-M47A1 AN-M47A3, or AN-M47A4 incendiary bombs	2 (p. 432), 11 (p. 3-10), 15 (p. 2), 17 (p. 49), 22 (p. 179)
AN-M18	N/A	N/A	Used with WP or PWP-fill in AN-M47A4	3 (p. 54, 133, 137), 11 (p. 10-12)
AN-M20	N/A	N/A	Used with WP or PWP-fill in AN-M47A4	3 (p. 54, 133, 137), 4 (p. 4-23), 7 (p. 35, 36), 11 (p. 10-12)
M4 Burster	1.3-2.4 lbs. (0.59-1.09 kg)	1-inch tetryl pellets	Used for WP or H-fill in the M47A1 and the M47A2. Authorized for high altitude bombing in the M47A2 smoke bomb	1 (p. 671), 2 (p. 432), 6 (p. 93), 9 (p. 33), 10 (p. 91), 19 (p. 582), 20 (p. 56), 22 (p. 179, 251)
M4E1 Burster	N/A	N/A	Used for PWP-filled M47A2 and M47A3	15 (p. 1)
M7 Burster	1-2 lbs. (0.45-0.91 kg)	Black powder	Used in AN-M47A2 with WP-fill	1 (p. 674), 2 (p. 432), 6 (p. 93), 10 (p. 95), 19 (p. 582), 22 (p. 179)
M12 Burster	N/A	Magnesium powder and black powder	Used in AN-M47A2	5 (p. 127), 6 (p. 93), 16 (p. 107)
M13 Burster	N/A	TNT and WP	Used in AN-M47A2	5 (p. 127), 6 (p. 93)
M18 Burster	0.6 lbs. (0.27 kg)	Black powder	Authorized for low-altitude bombing. Used in the M47A2 smoke bomb	2 (p. 432), 4 (p. 4-23), 22 (p. 179)
M20 Burster	0.87 lbs. (0.39 kg)	0.75-inch tetryl pellets	Required for PWP-fill in the AN-M47A4 incendiary bomb	2 (p. 433), 5 (p. 127)

Fills

Bomb, 100-pound, M47 Series, AN-M47 Series - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	37.5	17.0	N/A	N/A	Experimental fill for M47A1	41 (p. 2)
AS	N/A	N/A	N/A	N/A	Training	23 (p. 86, 87, 88)
CNS	80.0	36.3	N/A	N/A	Experimental fill, for M47A2	42 (Appendix C-3)
Gasoline liquid or solid*	39	17.7	49	22.2	Used in M47 and M47A2.	22 (p. 243)
H	68.5-73.0	30.8-33.1	92.8-102	42.1-46.2	Not to be used in M47A1	1 (p. 674, 676), 2 (p. 432), 7 (p. 1), 9 (p. 33), 10 (p. 91), 12 (p. 46), 13 (p. 33), 14 (p. D2), 19, 22 (p. 178)
HD	66.7-71.0	30.3-32.2	95.6-98.5	43.4-44.7	Used in M47A2	7 (p. 2), 12 (p. 46), 14 (p. D2), 24 (p. 1, 2), 25 (p. 36)
HL	N/A	N/A	N/A	N/A	Experimental fill for M47A2	15 (p. 30), 26 (p. 43)
HN	N/A	N/A	N/A	N/A	Experimental fill for M47A2	43

Bomb, 100-pound, M47 Series, AN-M47 Series - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
HP [HD & WP]	66.4-70.9	30.1-32.2	91.5-100	41.5-45.4	Experimental fill for M47A2	24 (Appendix)
IM	40.0-47.0	18.1-21.3	61.0-67.2	27.6-30.5	Experimental fill for M47, M47A1, and M47A2	2 (p. 432), 3 (p. 36, 131), 6 (p. 93), 16 (p. 41), 17 (p. 49), 20 (p. 41), 27
L	N/A	N/A	N/A	N/A	Experimental fill, for M47A2	15 (p. 30), 26 (p. 43)
NP	40.0-47.0	18.1-21.3	60.0-68.6	27.1-31.1	Fill for M47, M47A1, M47A2, AN-M47A2, AN-M47A3, and AN-M47A4 bombs.	2 (p. 432), 3 (p. 36, 131, 133), 7 (p. 10), 16 (p. 41), 17 (p. 49), 30
PT1**	40.0-65.0	18.1-29.4	85.0-90.0	38.5-40.8	Fill for M47, M47A1, AN-M47A2, AN-M47A3, and AN-M47A4 bombs.	1 (p. 674, 676), 3 (p. 8, 131), 7 (p. 11), 10 (p. 94)
PWP	74.0-75.0	33.5-34.0	105	47.6	Required the M20 burster.	2 (p. 433), 3 (p. 53, 133), 4 (p. 4-23), 7 (p. 35, 36)
WP	68.5-103	31-46.7	98-131	44.4-59.4	Used in the M47A1 and M47A2 smoke bombs.	1 (p. 676), 2 (p. 432), 3 (p. 54, 133), 4 (p. 4-23), 6 (p. 93), 7 (p. 35, 36), 19, 22 (p. 179)
* Used brevity code GA, which is the same as tabun and not repeated here. **PT1 described as “incendiary mixture,” “gasoline and rubber,” “gasoline gel,” or “oil gel” in cited references.						

Shipping/Packing

When shipped filled, this bomb was packed one per wooden box, which weighed between 118 and 179 pounds depending on fill, without fuze, arming wire or burster charge. When shipped unfilled, they were packed two per crate at a weight of 82 pounds per crate (1 p. 674), (3 p. 133), (7 p. 10, 11, 35, 36), (8 p. 30), (10 p. 106, 107), (11 p. 10-15), (22 p. 257).

Miscellaneous Information

The M47, M47A1, AN-M47A2, AN-M47A3, and AN-M47A4 bombs could be loaded with an incendiary filler of rubber and gasoline in the field. The base filling was gasoline supplemented by one of four different incendiary ingredients as follows:

1. LA-60. Consisted of crude latex or sap in combination with caustic soda, coconut oil, and water.
2. Crepe rubber. This is crude latex but was reduced to a solid by precipitation and kneading.
3. LA-100. This is crude latex dried until it was approximately 100 percent solid.
4. Smoked rubber sheets. This is crude latex which had been dried over a smoky fire until it was approximately 100 percent solid.

The CWS experimented with a solution of WP in HD with carbon disulphide fill (carrying the code: HP). The HP fill was between 66 and 70 pounds per bomb.

In 1942, it was recognized that the HS-filled M47A2 were subject to leakage. However, the need for these bombs was such that they continued to be filled until the M70 (T1) became available in sufficient quantity.

In 1946, the authorization for Bombs, Chemical, l00-lb., HL [mustard-lewisite mixture] & L, M47A2 was canceled with no stocks in storage. Filling with L was never authorized, and HL was an experimental fill (1 p. 674, 676), (25 p. 43), (29 p. 3, 4), (30 p. II-2).

In 1949, there were 1,122 H-filled M47A2; no H-filled M47A2C or M47A3C; no PWP or WP-filled M47A4, 24 WP-filled M47A2 bombs; and 32 WP-filled M47A1 bombs on hand. In 1950, the H-filled bombs were obsoleted with none on hand and the M70 series was the preferred munition in this weight with the M113 being a substitute standard.

As of 1950, it was reported that only the M47A1 and M47A2 models were produced in quantity, total of 539,727 units being filled during the years 1942 to 1945 (1 p. 674, 676), (14 p. D2), (26 p. 43), (28), (29 p. 46, 47), (30 p. 95, 96).

Key Dates

Bomb, 100-pound, M47 Series, AN-M47 Series - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1937	OCM 14005	31 (p. 14, 15)
Standardized	1940	OCM 16142 and 16059 (HS-fill standard for M47)	13 (p. 33), 32 (p. 1)
Obsoleted	1942	CCM 19111 (M47A1)	32 (p. 2)
Standardized	1942	OCM 19111 (M47A2)	32 (p. 2, 4)
Standardized	1942	OCM 19301 (Continue H-filling of M47A2 until M70 available, then restrict to WP or incendiary fill)	29 (p. 49)
Standardized	1943	CCTC 803 (incendiary bombs M47, M47A2, M47A1)	33 (p 240)
Standardized	1943	CCTC 881 (WP-fill Standard)	34 (p. 92)
Standardized	1945	CCTC 1461 (HD-fill Standard and HS-fill Limited Standard for M47A2C and M47A3C)	35 (p. 136)
Standardized	1945	CCTC 1348 (IM- and NP-fill Standard for M43A3; M47A2 Limited Standard)	23 (p. 88)
Obsoleted	1946	CCTC 1601 (AS-fill)	26 (p. 43)
Obsoleted	1946	CCTC 1672 (HL & L-fill for the M47A2)	17 (p. 51)
Standardized	1946	CCTC 1673 (IM and NP-fill Standard for M47A4)	36 (p. 64)
Standardized	1946	CCTC 1565 (PWP-fill Standard for M47A2)	37 (p. 54, 55)
Standardized	1946	CCTC 1988 (PT1-fill Standard for M47A4; IM and NP-fill reclassified as Substitute Standard)	14 (p. D1-D4)
Obsoleted	1950	CCTC 2085 (HD-fill for M47A4; H-fill for M47A2, M47A2C, and M47A3C)	38 (p. D1)
Obsoleted	1952	CCTC 2527 (WP-fill for AN-M47A1 and AN-M47A2)	33 (p. 240)
Obsoleted	1956	CCTC 3193 (IM and NP-fill AN-M47A3 and AN-M47A4)	17 (p. 49)
Substitute Standard	1957	CCTC 1673 (NP-fill AN-M47A3)	39 (p. 106, 107)
Standardized	1958	CCTC 3408 (PT1-fill for M47A3- Standard-Air Force, PWP-fill for M47A4- Standard-Air Force, NP-fill for M47A3-Ltd Standard-Air Force, and WP-fill for M47A4-Ltd Standard-Air Force)	40 (p. 213)
Standard Modernization	1959	CCTC 3525 (NP and PWP-fill for M47A3- Standard-C-Air Force, WP-fill for M47A4 - Standard-C-Air Force)	13 (p. 33), 32 (p. 1)

Sources

1. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.

2. Bureau of Ordnance. 1947. Ordnance Pamphlet, OP 1664 (Vol. 1), U.S. Explosive Ordnance. Department of the Navy.

3. Departments of the Army and Air Force. 1953. Technical Manual, TM 3-400/Technical Order, TO 39B-15C-1, Chemical Bombs and Clusters. Department of the Army.

4. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

5. David, J.P. 1945. United States Bombs and Fuzes Pyrotechnics. U.S. Navy Bomb Disposal School. 1 September.

6. David, J.P. 1944. United States Bombs and Fuzes: Pyrotechnics, Land Mines, Firing Devices. U.S. Navy Bomb Disposal School. 1 June.

7. Army Chemical Center. 1957. Reclassification, obsoletions, and related actions which have occurred since publication of EP 79, Chemical Corps Equipment Data Sheets. U.S. Army Chemical Corps Engineering Command.

8. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.

9. Chief of Ordnance. 1942. Technical Manual, TM 9-1984, Disposal of American and Allied Bombs and Fuzes. War Department.

10. Secretary of War. 1942. Technical Manual, TM 9-1980, Bombs for Aircraft. War Department.

11. Bureau of Naval Weapons. 1960. NAVWEPS Ordnance Pamphlet, OP 2216, Aircraft Bombs, Fuzes and Associated Components. U.S. Government Printing Office.

12. War Department. 1946. Field Manual, FM 3-6, Employment and Characteristics of Air Chemical Munitions. October. War Department.

13. Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 16059, Bomb, Chemical, 100-lb T6E1 - Classified as Standard and Designated Bomb, Chemical 100-lb. M47. Chemical Warfare Service. 29 August.

14. Chemical Corps Technical Committee. 1950. CCTC Item # 2085, Obsoletion of M47 Series Gas Bombs. Department of the Army.

15. Office of the Chief, Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office.

16. Chemical Warfare Service. 1946. Report of Activities of the Technical Division During World War II. Army Service Forces. 1 January.

17. Chemical Corps Technical Committee. 1946. CCTC Item # 1673, Standardization of Bomb, Incendiary, 100-lb, M47A4. Department of the Army.

18. Ortynsky, R.L., & Haiger, W.H. 1946. Technical Division Memorandum Report, TDMR 1236, Filling for the M47-A Type 100-LB Incendiary Bomb. Technical Division.

19. Technical Division. 1944. Catalogue of Standard Ordnance Items, Second Edition 1944, Volume III. Office Chief of Ordnance.

20. Reed, Melvin. 1961. Chemical Corps Safety Directive (CCSD) No. 385-17, General Instructions for Disposal of Bulk Chemical Agents and Munitions. Department of the Army. 3 April.

21. Chemical Warfare Center. 1942. Field Manual, FM 3-5 (Tentative), Chemical Warfare Service Field Manual, Tactics of Chemical Warfare. Chemical Warfare Service.

22. War Department. 1944. Technical Manual, TM 9-1980, Bombs for Aircraft. U.S. Government Printing Office.

23. Chemical Corps Technical Committee. 1946. CCTC Item # 1601, Obsoletion of Simulated Mustard, AS. Department of the Army.

24. Gottlieb, B., & Reilly, W. 1945. Technical Command Informal Report, TCIR 232, Pilot Plant Filling of M47A2 with HP. Chemical Warfare Service.
25. Chemical Corps Technical Committee. 1945. CCTC Item # 1461, Classification of Persistent Agent Fillings for Chemical Bombs. Chemical Warfare Service.
26. Chemical Corps Technical Committee. 1946. CCTC Item # 1672, Cancellation of Experimental Type Bombs and Clusters. Department of the Army.
27. Chemical Warfare Service. 1943. Chemical Warfare Service Field Materiel Data. U.S. Government Printing Office.
28. Carroll, Jos L. 1943. "L" Filled Shell and Bombs. Department of the Army.
29. Ordnance Committee. 1942. Ordnance Committee Meeting, OCM Item # 19301, BOMB, CHEMICAL, 115-lb, M70 – Recommendation for Adoption as Standard for HS filling; BOMB, CHEMICAL, 100-LB, M47A2 – Recommendation for Temporary Emergency Loading with HS and Subsequent Restriction to WP and Incendiary Filling; BOMB, CHEMICAL, 100-Lb, M47A1 – Recommendation for Restriction to WP and Incendiary Filling.
30. Chemical Corps Technical Committee. 1949. CCTC Item # 2000, Incorporation of Gas and Smoke Bombs in Chemical Corps Records. Department of the Army. June 15.
31. Ordnance Committee. 1937. Ordnance Committee Meeting, OCM Item # 14005, Bomb, 100-lb Thin Case, Chemical – Approval of Military Characteristics (Read for Record). November 4.
32. Sub-Committee on Bombs. 1942. Ordnance Committee Meeting, OCM Item # 19111, Subject: Bomb, Chemical, 100-lb, M47A1 - Modification of, to Bomb, Chemical, 100-lb, M47A2. Ordnance Committee.
33. Chemical Corps Technical Committee. 1956. CCTC Item # 3193, Obsoletion of Clusters, Incendiary Bomb, 500-lb, M20, M20A1, M21, M22; & Bombs, Incendiary, 100-lb, AN-M47A3 & M47A4. Department of the Army.
34. Chemical Corps Technical Committee. 1943. CCTC Item # 881, Classification of Fillings for Chemical Munitions. Department of the Army.
35. Chemical Corps Technical Committee. 1945. CCTC Item # 1348, Standardization of Bomb, Incendiary, 100-lb., AN-M47A3. Department of the Army.
36. Chemical Corps Technical Committee. 1946. CCTC Item # 1565, Standardization of Screening Smoke, PWP, 100-lb, M47A4. Department of the Army.
37. Chemical Corps Technical Committee. 1949. CCTC Item # 1988, Authorization of Incendiary Mixture, PT1 as a Filling for 100-lb. Incendiary Bombs. Department of the Army.
38. Chemical Corps Technical Committee. 1952. CCTC Item # 2527, Obsoletion of Bombs, Smoke, WP, 100-lb, AN-M47A1 and AN-M47A2. Department of the Army.
39. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
40. Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.
41. Macintire, B. 1943. Dugway Proving Ground Memorandum Report, DPGMR No. 3, Preliminary Tests of HCN in M70 and M47A1 Bombs (January 1, 1943 to January 14, 1943). Chemical Warfare Service. January 26.
42. Dugway Proving Ground. 1945. Dugway Proving Ground Special Report, DPGSR No. 42, The Behavior of CNS Dispersed from M47A2 Bombs in Wooded Terrain Under Semi-Tropical Conditions. Chemical Warfare Service.
43. Peake, M. 1944. Office Chief of Chemical Warfare Service, Memorandum to Commanding Officer, Dugway Proving Ground Mobile CWS Unit, Bushnell, FL. Subject: Field Test of HN-1. 19 December.

6.8 Bomb, 115-pound, E46 Series

Figures

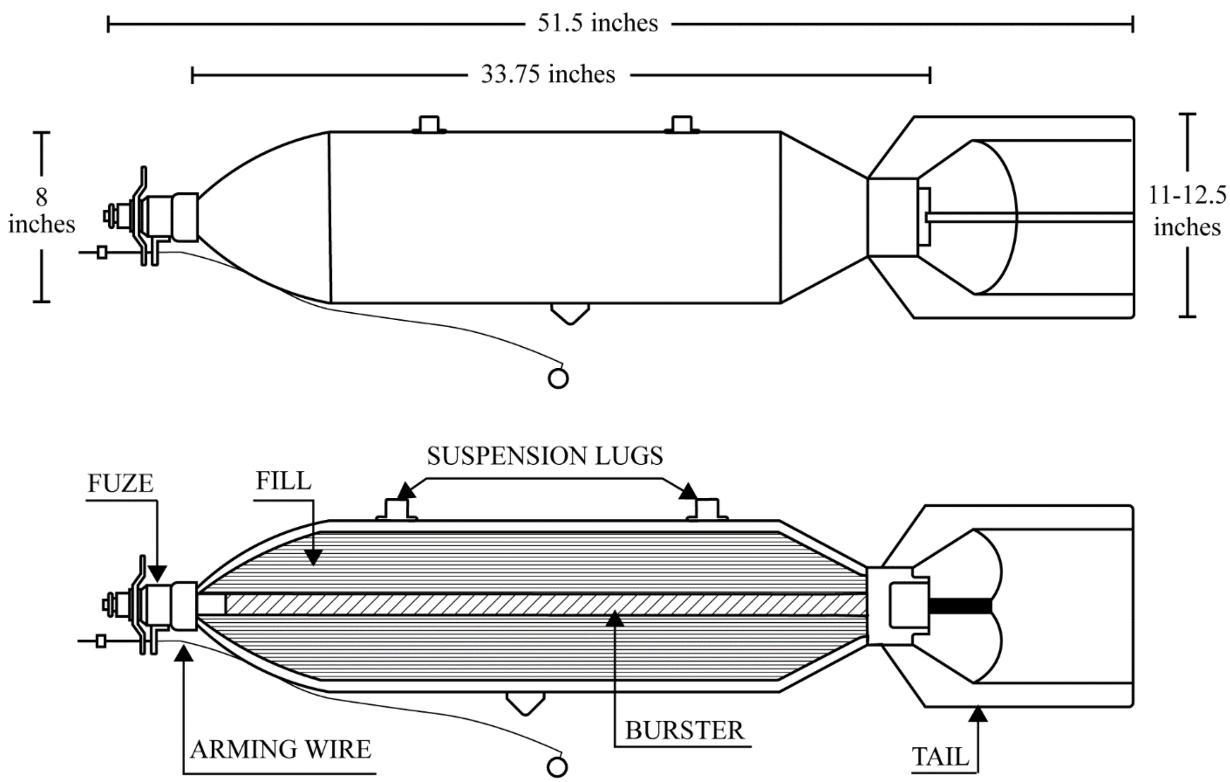

Figure 18: Bomb, 115-pound, E46 Series - Line Drawing

Figure 19: Bomb, 115-pound, E46 Series - Photograph – Simulated, Top: Intact, Bottom: Cutaway View

Bomb, 115-pound, E46 Series

Specifications

Bomb, 115-pound, E46 Series - Specifications and Other Data		Citation
Historical Name	115 Pound Bomb, Chemical, E46, E46R1	1 (p. 1), 2 (p. i)
Type	Bomb	1 (p. 1), 2 (p. 2), 3 (p. 10, 11), 4 (p. 1)
Size	115-pound	1 (p. 1, 10), 2 (p. 2), 4 (p. 1)
Conflict	Post WWII	2, 3
Service	Army	1
Diameter	Body: 8 in. (20.3 cm) Burster: 3 in. (7.6 cm)	1 (p. 2)
Length	Body: 33.75 in. (85.7 cm) Body, with tail support: 35.25 in. (89.5 cm) Overall: 51.5 in. (131 cm) Burster: 32 in. (81.2 cm)	1 (p. 2, Figure 1)
Width	Tail fin: 11-12.5 in. (27.9-31.75 cm)	1 (Figure 1)
Other Engineering Data	The agent to burster ratio of the E46R1 from the E46 was increased to 5:1.	4 (p. 1)

General Use and Description

The development of the E46 was undertaken to determine the effectiveness of the 115-pound chemical bomb (M70) as a munition for the dispersal of G-agents and to gain fundamental knowledge of the agents in the field (2 p. 1).

The E46R1 bomb was a 115-pound GB or GA bomb. It used the same casing as the M70 bomb fitted with an experimental burster. The bomb was nose-fuzed with a modified M103A1 for static firing. Field test 111 was conducted in 1948 to determine whether the E46R1 chemical bomb was suitable for dispersing GB. For field test 111, the E46 was fitted with an experimental burster, which gave an agent to burster ratio of 5:1, and was designated E46R1 (1 p. 1, 2).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Bomb, 115-pound, E46, E46R1 - Fuzing		
Fuze	**Note**	**Citation**
M108	Nose- used with E46	2 (p. 3)
Modified M103A1	Nose- fuzed for static firing	1 (p. 2)

Booster, Adapter-Booster, or Burster

Bomb, 115-pound, E46, E46R1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Experimental burster	8.59 lbs. (3.90 kg)	Tetrytol	Used with E46R1	1 (p. 2)
M10 burster	1.5 lbs. (0.68 kg)	Tetryl	Used with E46	2 (p. 2)

Fills

Bomb, 115-pound, E46, E46R1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GA	41-49	18.5-22.2	N/A	N/A	Experimental	2 (p. i, 29), 3 (p. 10), 4 (p. 1)
GB	42.0	19.0	115	52.1	Experimental	1 (p. 2), 3 (p. 11)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Milly, George H. 1948. Technical Command Informal Report, TCIR 426, Report of Field Test 111, Static Test of a Single E46R1, 115 LB. Chemical Bomb Filled with GB. Technical Command.
2. Milly, George H. 1948. Technical Command Report, TCR 2, Static Test of 115-LB. Chemical Bomb E46 Filled with GA. ADB970171. Chemical Corps Technical Command.
3. Milly, George H. 1950. Technical Command Informal Report, TCIR 566, Report of Field Tests of G Agents at Dugway Proving Ground During Summer 1949. Technical Command.
4. Milly, George H. 1949. Technical Command Informal Report, TCIR 436, Report of the Field Test 112, Static Test of a Single E46R1, 115 lb. Chemical Bomb Filled with Water. Test Division, Technical Command.

6.9 Bomb, 115-pound, M70, M70A1

Figures

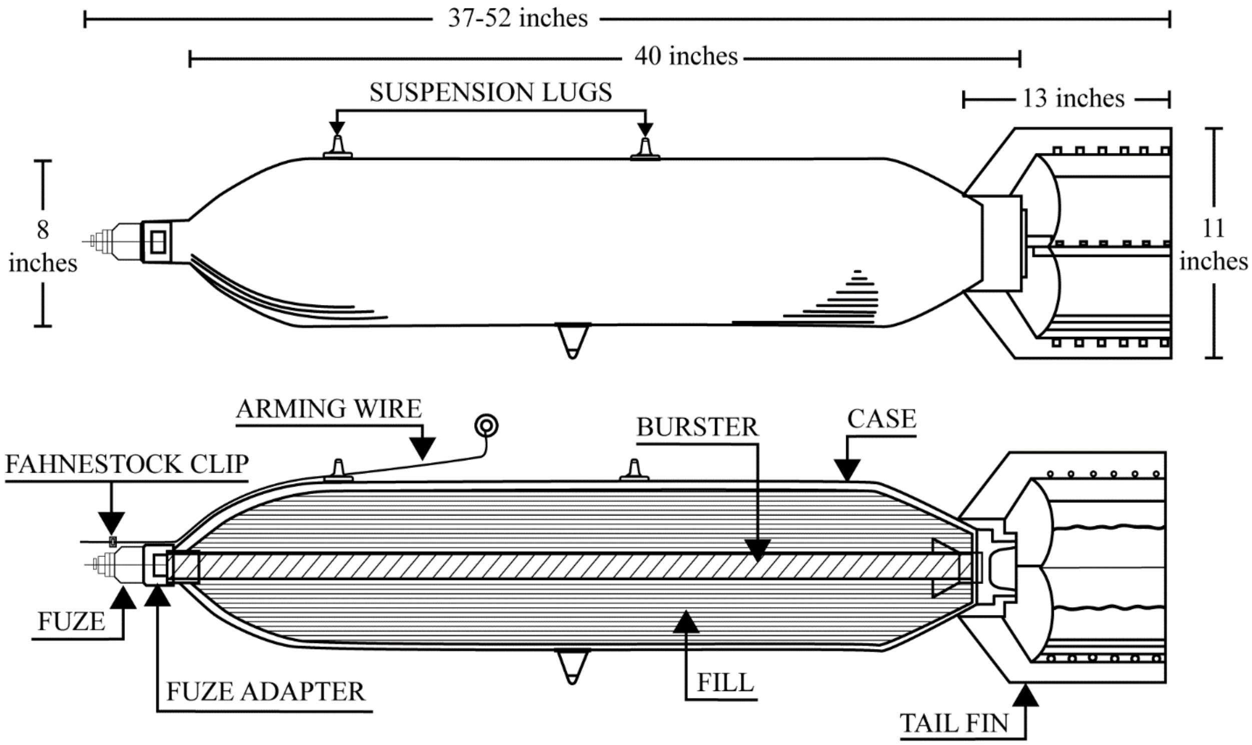

Figure 20: Bomb, 115-pound, M70, M70A1 - Line Drawing

Figure 21: Bomb, 115-pound, M70A1 - Photograph

Specifications

Bomb, 115-pound, M70, M70A1 - Specifications and Other Data		**Citation**
Historical Name	Bomb, Gas, Persistent, HD, 115-Pound M70A1	1 (p. 4-24)
Developmental Information	T1: M70	4 (p. 2)
Type	Bomb	2 (p. 4-25)
Size	115-pound	2 (p. 4-25), 3, 4 (p. 1)
Conflict	WWII	5
Service	Air Force, Army, Navy	1 (p. 4-24), 2 (p. 4-26)
Diameter	8.0 in. (20.3 cm)	6 (p. 420), 7 (p. A-12), 8 (p. 8), 25 (p. 1-10)

Bomb, 115-pound, M70, M70A1

Bomb, 115-pound, M70, M70A1 - Specifications and Other Data		Citation
Length	Body: 40 in. (101 cm) Tail: 13 in. (33 cm) Overall: 37-52 in. (93.7-131 cm)	6 (p. 420), 7 (p. A-12), 8 (p. 8), 9 (p. 4-26), 10 (p. 35), 25 (p. 10-1)
Width	Tail: 11 in. (28 cm)	6 (p. 420)
Wall Thickness	0.125-0.244 in. (0.317-0.619 cm)	6 (p. 420), 8 (p. 8), 10 (p. 35), 26 (p. 95)
Other Engineering Data	The tail fin assembly: M102A2, AN-M103A1, or M102.	2 (p. 4-26), 6 (p. 423), 7 (p. A-12), 25 (p. 10-1)
Construction Material	Seamless steel tube	2 (p. 4-25), 10 (p. 35)
Drawing	M70: 82-3-382, 82-3-390, 82-0-83 M70A1: 82-0-88, D14-6-1187 82-0-63, D 14-5-1187 M70A1 HD-fill: 82-0-83, D14-5-1187	1 (p. 4-25), 2 (p. 4-26), 7 (p. A-12), 15 (p. 258), 25 (p. 10-1)
FSN	M70: 1325-219-8571 (H-fill) M70A1: 1325-219-8572 (HD-fill)	11

General Use and Description

The M70 bomb was developed to replace the M47A1, which was unsatisfactory due to the development of leaks and the inability to withstand the pressures developed from an HS-fill (21 p. 43, 48, 49).

The M70A1 115-pound Bomb was designed for use with propeller-driven aircraft. It was used primarily for antipersonnel effects (2 p. 4-25, 4-26), (7 p. A-12), (12 p. 15-2).

It was a central burst, fin stabilized bomb. The bomb was round, with an ogival nose and truncated conical rear section. The body was cast of forged steel. Both double and single suspension lugs were welded to the body. Two lugs, 14 inches apart were provided for double suspension and a single lug was located at the center of gravity for single suspension. The rear section tapered down to about four inches where a threaded extension closed the rear and provided support for the tail fin. A force fitted burster well extended the axial length of the bomb. It fit into a cup brazed inside the bomb rear section, and its nose end had a threaded fuze adapter. The interior coating was phenolic varnish. The tail fin assembly was secured to the bomb by a fin lock nut installed on the external threads of the rear closure extension. The M70A1 was identical with the M70A1 except that the body of the M70 had no interior phenolic varnish coating (2 p. 4-25, 4-26), (3), (7 p. A-12 - A-14), (12 p. 15-2).

Explosive Train

Upon release from the aircraft, vane rotation armed the fuze. The fuze functioned upon impact and detonated the burster. The burster shattered the bomb and released the fill (7 p. A-12, A-14), (9 p. 60, 67), (1 p. 15-22).

Fuzing

Bomb, 115-pound, M70, M70A1 - Fuzing		
Fuze	**Notes**	**Citation**
AN-M110A1	Nose- authorized alternate (1.0 pound)	2 (p. 4-26), 3, 6 (p. 420), 13 (p. 2-73), 14 (p. 648, 670), 15 (p. 73, 251)
AN-M126	Nose (0.68 lbs. [0.308 kg])	3, 14 (p. 670 - 671)
AN-M126A1	Nose (1.1 lbs. [0.499 kg])	3, 13 (p. 2-103)
AN-M158	Preferred, impact arming vane nose type fuze with M20 detonators	2 (p. 4-26), 7 (p. A-12, A-14), 9 (p. 67), 22 (p. 113), 25 (p. 10-1)
M110	Nose- may be reworked and substituted if required	15 (p. 180, 251)

Bomb, 115-pound, M70, M70A1 - Fuzing		
Fuze	**Notes**	**Citation**
M126	Nose- arming vane	14 (p. 670-671)
M127	Nose	13 (p. 2-107), 15 (p. 251)
M159	Nose- impact arming vane with M20 detonators	2 (p. 4-26), 6 (p. 420), 7 (p. A-12), 9 (p. 60, 67), 12

Booster, Adapter-Booster, or Burster

Bomb, 115-pound, M70, M70A1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M10 Burster	0.51 lbs. (0.23 kg)	Tetryl	Used with M70A1	1 (p. 4-25), 2 (p. 4-26), 3, 7 (p. A-12), 15 (p. 180), 16 (p. 66)
M4 Burster	0.5 lbs. (0.23 kg)	N/A	Used with M70	3, 15 (p. 180, 251)

Fills

Bomb, 115-pound, M70, M70A1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	31	14.1	N/A	N/A	Experimental	27 (p. 1)
CG	54.4	24.7	122	55.3	Experimental	28
CK	54.4	24.7	122	55.3	Experimental	28
H	57.1-60.7	25.9-27.5	116-128	52.6-58.1	In 1944, H was the only filler for the M70	3, 6 (p. 420), 8 (p. 1), 10 (p. 35), 14 (p. 676), 15 (p. 180), 16 (p. 27)
HD	60.0-60.6	27.2-27.4	128	58.1	M70A1	1 (p. 4-24, 4-25, B-1), 2 (p. 4-25), 7 (p. A-12), 12 (p. 15-2), 25 (10-1)
HN	N/A	N/A	N/A	N/A	Experimental	29
IM	N/A	N/A	N/A	N/A	-	6 (p. 423), 26 (p. 95)
L	N/A	N/A	N/A	N/A	-	15 (p. 180, 251), 16 (p. 8, 30)
NP	N/A	N/A	N/A	N/A	-	6 (p. 423), 26 (p. 95)
WP	N/A	N/A	N/A	N/A	-	6 (p. 423), 26 (p. 95)

Shipping/Packing

The M70 bomb was shipped loaded with closing plugs to seal the bomb and to protect the fuze threads. The M70A1 was protected during transport by shipping bands. Some bombs had lug protectors, which protected the suspension lugs. With shipping bands, the M70A1 weighed approximately 135 pounds and displaced 3.9 cubic feet. With lug protectors the M70A1 weighed approximately 133 pounds and displaced 2.1 cubic feet. The tail fin, burster, fuze, and arming wire were packed separately (3), (7 p. A-14), (15 p. 258), (25 p. 10-2).

Miscellaneous Information

A cluster of four M70s could be formed by using the Cluster Adapter M22 (6 p. 423).

Between 1943 and 1945, 722,968 M70 series bombs were procured to meet Navy and Air Force requirements. In 1943, 128,752 of these bombs were filled with L and as of 1946, no stocks remained on hand. Responsibility for the M70 series bombs was transferred to the Chemical Corps' jurisdiction in 1949 and 1950 with 425,438 M70 bombs on hand (354,356 identified as RF1, believed to be H-filled bombs, and 71,082 NRF2 believed to be empty casings). In 1949, there were no HD-filled M70A1 bombs on hand. During the Korean period, certain stocks were rehabilitated and renovated, 150,000 being transferred to the Navy. A 1955 reference indicates that HN-1 as a possible filler. Subsequently, the Air Force canceled all requirements for this munition which resulted in the M70 and M70Al Bombs being designated Standard-C and Standard-A Bu-Ord items respectively by the 1959 CCTC Item 3425. In 1963, the Navy determined that it had no further requirements for certain chemical munitions including the 58,639 M70 Bombs stored at Rocky Mountain Arsenal for which immediate disposal was authorized (11). It does not appear that the M70A1 was ever procured (11), (22 p. 47), (23), (24 p. 96).

Key Dates

Bomb, 115-pound, M70, M70A1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1942	OCM 19301 (M70 H-fill Standard)	21 (p. 48)
Standardized	1943	CCTC 881 (H-fill Standard; L-fill substitute Standard)	17 (p. 82)
Obsoleted	1945	CCTC 1461 (M70 L-fill)	18 (p. 37)
Standard Modernization	1958	CCTC 3408 (M70A1 HD-Fill to Standard Type and L-fill to Limited Standard for Bureau of Ordnance)	19 (p. 106)
Standard Modernization	1959	CCTC 3525 (H-fill to Standard-C for Bureau of Ordnance for M70	20 (p. 213)
Obsoleted	1963	CCTC 4139 (M70 H-fill and M70A1 HD-fill)	11

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

3. Technical Division. 1944. Catalogue of Standard Ordnance Items, Second Edition 1944, Volume III. Office Chief of Ordnance.

4. Graham, M., Gregg, A., & Kriete, B. 1944. Technical Division Memorandum Report, TDMR 902, Comparison of the 125-LB., Chemical Bomb, T2, and the 115-LB. Chemical Bomb, M70; and Addendum. Chemical Warfare Service.

5. Pine Bluff Arsenal. 1945. List of Manufacturing Expenditure Orders. U.S. Army.

6. Naval Sea Systems Command. 1969. Naval Sea Systems Command Ordnance Pamphlet, NAVSEA OP 1664, Change 1, U.S. Explosive Ordnance. U.S. Government Printing Office.

7. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

8. Hollingsworth, Henry L. 1943. Technical Division Memorandum Report, TDMR 626, 115-lb Chemical Bomb M70, ADB968653. Department of the Army.

9. Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. Department of the Army.

10. Chief of Ordnance. 1942. Technical Manual, TM 9-1984, Disposal of American and Allied Bombs and Fuzes. War Department.

11. Chemical Corps Technical Committee. 1963. CCTC Item # 4139 (AMCTC Item 1654), Obsoletion of Bombs, Gas, Persistent H & HD, l15-1b., M70 and M70A1. U.S. Army Materiel Command.

12. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.

13. Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Cancelled Fuzes, MIL-HDBK-146. Department of Defense.

14. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.
15. War Department. 1944. Technical Manual, TM 9-1980, Bombs for Aircraft. U.S. Government Printing Office.
16. Office of the Chief, Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office.
17. Chemical Corps Technical Committee. 1943. CCTC Item # 881, Classification of Fillings for Chemical Munitions. Department of the Army.
18. Chemical Corps Technical Committee. 1945. CCTC Item # 1461, Classification of Persistent Agent Fillings for Chemical Bombs. Chemical Warfare Service.
19. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
20. Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.
21. Ordnance Committee. 1942. Ordnance Committee Meeting, OCM Item # 19301, BOMB, CHEMICAL, 115-lb, M70 – Recommendation for Adoption as Standard for HS filling; BOMB, CHEMICAL, 100-LB, M47A2 – Recommendation for Temporary Emergency Loading with HS and Subsequent Restriction to WP and Incendiary Filling; BOMB, CHEMICAL, 100-lb, M47A1 – Recommendation for Restriction to WP and Incendiary Filling.
22. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.
23. Chemical Corps Technical Committee. 1946. CCTC Item # 1672, Cancellation of Experimental Type Bombs and Clusters. Department of the Army.
24. Chemical Corps Technical Committee. 1949. CCTC Item # 2000, Incorporation of Gas and Smoke Bombs in Chemical Corps Records. Department of the Army. June 15.
25. Bureau of Naval Weapons. 1960. NAVWEPS Ordnance Pamphlet, OP 2216, Aircraft Bombs, Fuzes and Associated Components. August. U.S. Government Printing Office.
26. David, J.P. 1944. United States Bombs and Fuzes: Pyrotechnics, Land Mines, Firing Devices. U.S. Navy Bomb Disposal School. 1 June.
27. Macintire, B.G. 1943. Dugway Proving Ground Memorandum Report, DPGMR No. 3, Preliminary Tests of HCN in M70 and M47A1 Bombs (January 1, 1943 to January 14, 1943). Chemical Warfare Service. January 26.
28. Headquarters, San Jose Project Division. 1946. San Jose Project Report Number 56, SJPR 56, Assessment of Single M78 and M70, CG and CK Filled Bombs Functioned Statically in Jungle. 27 November.
29. Peake, M. 1944. Office Chief of Chemical Warfare Service, Memorandum to Commanding Officer, Dugway Proving Ground Mobile CWS Unit, Bushnell, FL. Subject: Field Test of HN-1. 19 December.

6.10 Bomb, 125-pound, M113 (T3E2)

Figures

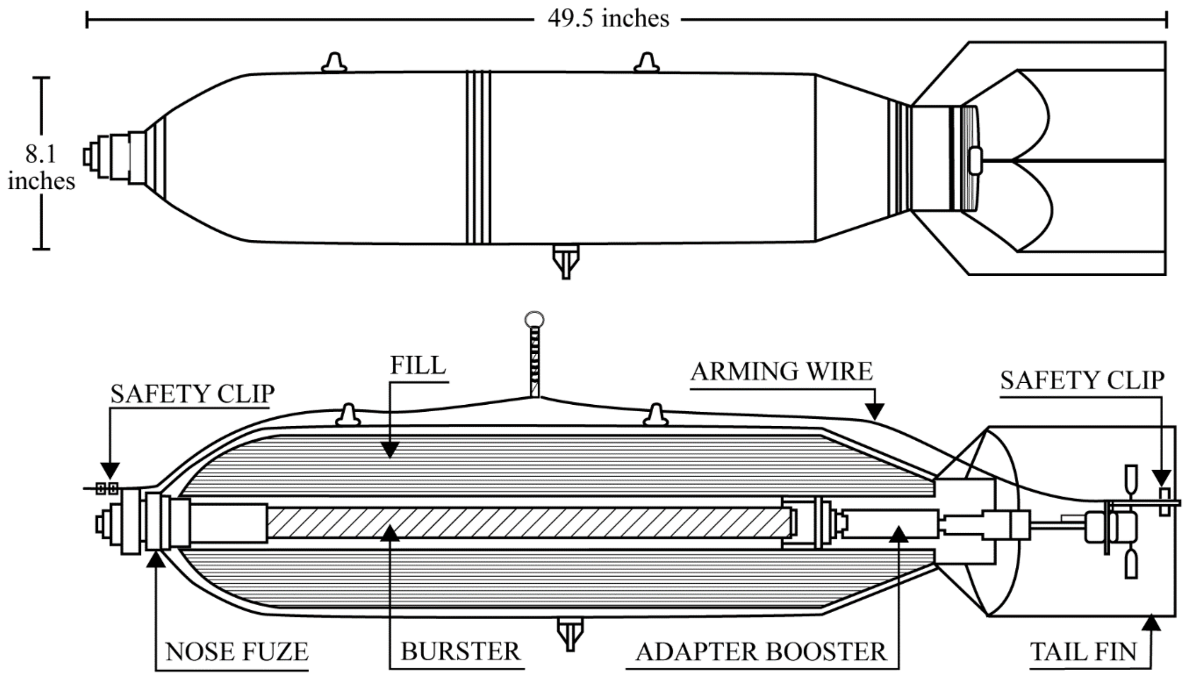

Figure 22: Bomb, 125-pound, M113 (T3E2) - Line Drawing

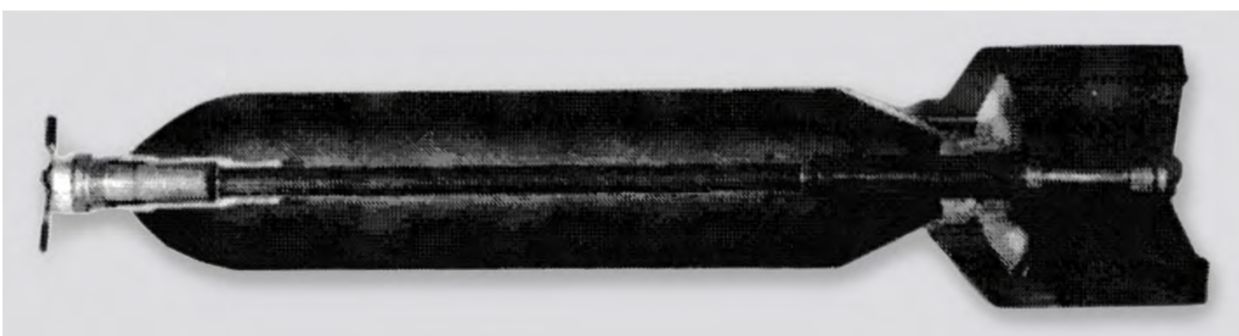

Figure 23: Bomb, 125-pound, T3E2 - Photograph, Cutaway View

Specifications

Bomb, 125-pound, M113 (T3E2) - Specifications and Other Data		**Citation**
Historical Name	Bomb, Gas, Persistent HD, 125-Pound, M113	1 (p. B1)
Developmental Information	T3E2	1 (p. B1), 5 (p. i)
Type	Bomb	1 (p. B1)
Size	125-pound	2 (p. 2)
Conflict	Cold War, WWII	1 (p. B1), 3
Service	Air Force, Navy	1 (p. B2)
Diameter	8 in. (20.32 cm)	1 (p. B1), 4 (p. 44), 5 (p. i)
Length	49.5 in. (125.73 cm)	1 (p. B1), 4 (p. 44), 5 (p. i)
Wall Thickness	0.19-0.25 in. (0.483-0.64 cm)	8 (p. 2)

Bomb, 125-pound, M113 (T3E2) - Specifications and Other Data		Citation
Other Engineering Data	The adapter-booster M119 was mounted in the internal threads of the rear closure extension. Used fin assembly M125A1 or M125, and arming wire M1A1.	1 (p. B2), 5
Construction Material	forged steel casing	1 (p. B1)
Drawing	P-74971	6 (p. 39)

General Use and Description

The T3E2 125-pound bomb was designed for persistent fills in low-altitude bombing and bombing over wooded areas. It was designed to replace the 115-pound Chemical Bomb M70. Development of this item resulted from the wartime shortage of the M70 and other types of mustard bombs and provided a munition suitable for both mustard and explosive fillings, as required (1 p. B2), (5 p. i - ii).

This bomb was round with an ogival nose and truncated conical rear section. The bomb body was cast or forged steel. Both double and single suspension lugs were welded to the body. The rear section tapered down to about four inches where a threaded extension was welded on to close the rear and provide mountings for both the tail fin and adapter-booster. A nose fuze seating cavity was welded in the nose. An adapter-booster seating cavity was press fitted to the rear closure extension. A burster well extended approximately two-thirds of body axial length between the nose fuze and adapter-booster cavities. Interior coating was phenolic varnish (3 p. 2, 3), (5 p. i - ii).

Explosive Train

Upon bomb release from the aircraft bomb station, arming wires (M1A1) were withdrawn from both fuzes, freeing arming vanes to rotate. Vane rotation in the air stream armed the fuzes. Both fuzes normally functioned on impact, the nose fuze acting faster. The nose fuze normally detonated the burster, but if the nose fuze failed, the tail fuze, through the adapter-booster charge, would set off the burster. The burster shattered the bomb and released the chemical agent (1 p. B2), (4 p. 45).

Fuzing

Bomb, 125-pound, M113 (T3E2) - Fuzing		
Fuze	**Notes**	**Citation**
AN-M100A2	Tail- impact non-delay arming vane type fuze	1 (p. B2), 4 (p. 44), 5 (p. i), 6 (p. 41), 9 (p. 114, 115)
AN-M103	Nose	9 (p. 114, 115)
AN-M103A1	Nose - impact instantaneous arming vane type	1 (p. B1), 4 (p. 44), 5 (p. i), 9 (p. 114, 115)
AN-M112A1	Tail- delay	1 (p. B2), 5 (p. i)
AN-M139A1	Nose	9 (p. 115)
AN-M140A1	Nose	9 (p. 115)
M160	Tail	1 (p. B2), 5 (p. i), 9 (p. 114, 115)
M163	Nose	5 (p. i), 6 (p. 41), 9 (p. 114, 115)
M164	Nose	9 (p. 114, 115)
M165	Nose	9 (p. 114, 115)

Booster, Adapter-Booster, or Burster

Bomb, 125-pound, M113 (T3E2) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M25 Burster	1 lbs. (0.45 kg)	Tetryl pellets	-	1 (p. B2), 6 (p. 3), 8 (p. WH 1104), 9 (p. 115)
M119 Adapter-booster	N/A	N/A	Used on T3E2 bomb	1 (p. B2), 7 (p. WH 1104), 9 (p. 114)
M125 Burster	N/A	N/A	Used with T3E2 bomb	1 (p. B3), 9 (p. 114)
T3E1 Adapter-booster	N/A	N/A	Used with T17 burster on T3E2 bomb	5 (p. i)
T17 Burster	N/A	N/A	Used with T3E1 adapter-booster	5 (p. i)

Fills

Bomb, 125-pound, M113 (T3E2) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	59.0	26.7	141	64.0	Experimental	5
H	55.5-60.1	25.2-27.3	135-151	61.2-68.6	T3E2	5 (p. 4), 8 (p. 3), 9 (p. 47)
HD	58.5-60.2	26.5-27.3	135-151	61.2-68.5	-	1 (p. B2), 2 (p. 2), 8 (p. 3, 12), 9 (p. 47)

Shipping/Packing

The M113 was packaged in shipping rings. The approximate weight was 148 pounds. The bomb was not shipped as a complete end item, components were shipped separately (1 p. B2), (9 p. 114).

Miscellaneous Information

An estimated 17,600 M113 bombs were procured, 17,332 were on hand when the bomb was standardized in 1949. Based on a 1953 review, 9,450 bomb casings on hand were dispositioned and, as of 1955, none remained in stock. A 1955 reference identifies HN-1 as a possible fill. The HE counterpart to this was designated the 150-pound T2 bomb and classified similarly (1 p. B1-B2), (5 p. i), (7 p. 43), (9 p. 47).

Key Dates

Bomb, 125-pound, M113 (T3E2) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Classified	1944	OCM 25172, 25488 (T3 as Limited Procurement Type)	10 (p. 7)
Standardized	1949	CCTC 1953 (HD-fill, Substitute Standard)	1 (p. B1), 6 (p. 41)
Obsoleted	1955	CCTC 3115	1 (p. B3)

Sources

1. Chemical Corps Technical Committee. 1955. CCTC Item # 3115, Obsoletion of Bomb, Gas, Persistent, HD, 125-lb., M113. Department of the Army.
2. Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. Department of the Army.
3. Graham, M., Gregg, A., & Kriete, B. 1944. Technical Division Memorandum Report, TDMR 902, Comparison of the 125-LB., Chemical Bomb, T2, and the 115-LB. Chemical Bomb, M70; and Addendum. Chemical Warfare Service.
4. Departments of the Army and Air Force. 1953. Technical Manual, TM 3-400/Technical Order, TO 39B-15C-1, Chemical Bombs and Clusters. Department of the Army.

5. Smith, D.E. 1949. Technical Command Report, TCR 18, Evaluation of 125-lb. Chemical Bomb T3E2. Technical Command.

6. Chemical Corps Technical Committee. 1949. CCTC Item # 1953, Standardization Bomb, Gas, Persistent; HD, 125-lb, M113 (T3E2). Department of the Army.

7. Chemical Corps Technical Committee. 1950. CCTC Item # 2155, Subject: Designation of Components of Bomb, Gas, Persistent; HD 125-lb., M113 (T3E2). Department of the Army.

8. Gregg, Arthur, & Kriete, Bertrand. 1946. Technical Division Memorandum Report, TDMR 1277, Preliminary Tests of the 125-LB Chemical Bomb T3. Chemical Corps.

9. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.

10. Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 25172, Bomb, GP, 150 lb., T2 and Bomb, Gas, Persistent (H), 125 lb., T3 – Approved as Limited Procurement Types. Ordnance Department.

6.11 Bomb, 125-pound, T2

Figures

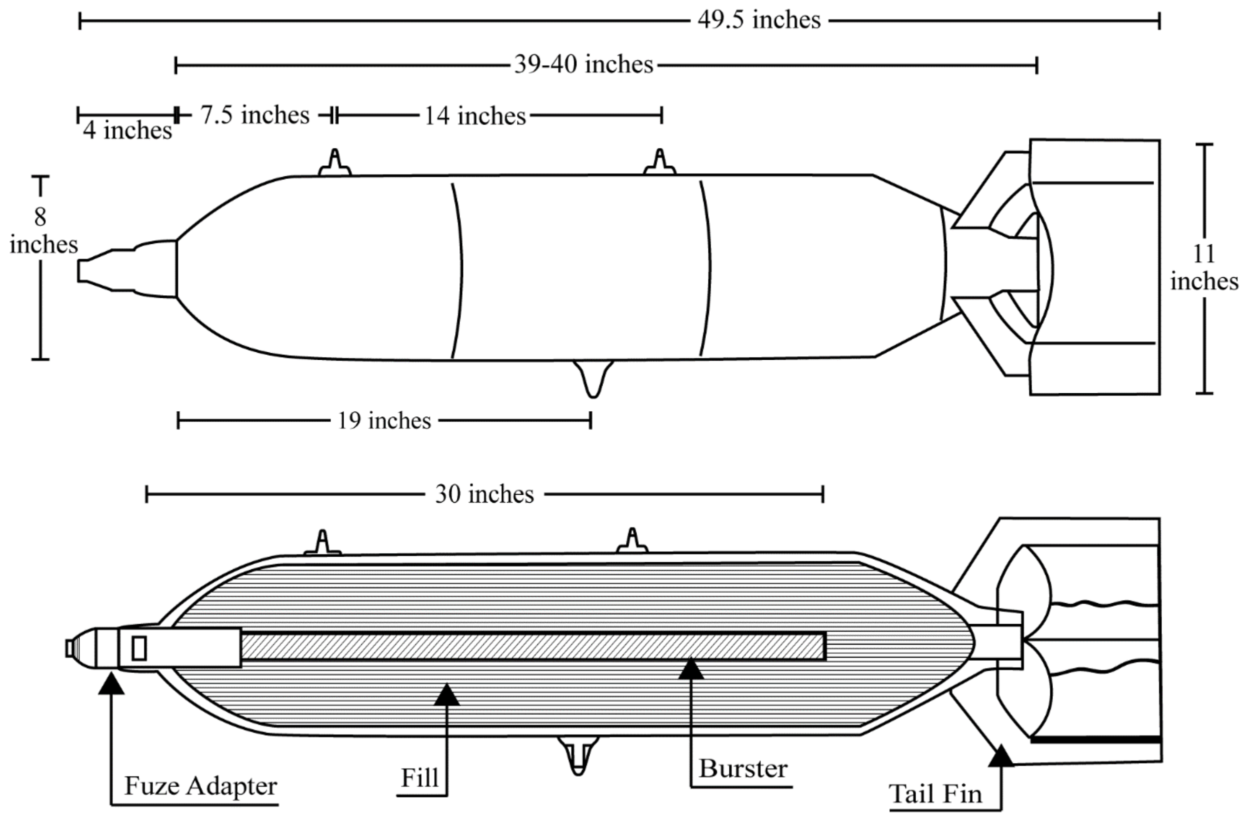

Figure 24: Bomb, 125-pound, T2 – Line Drawing

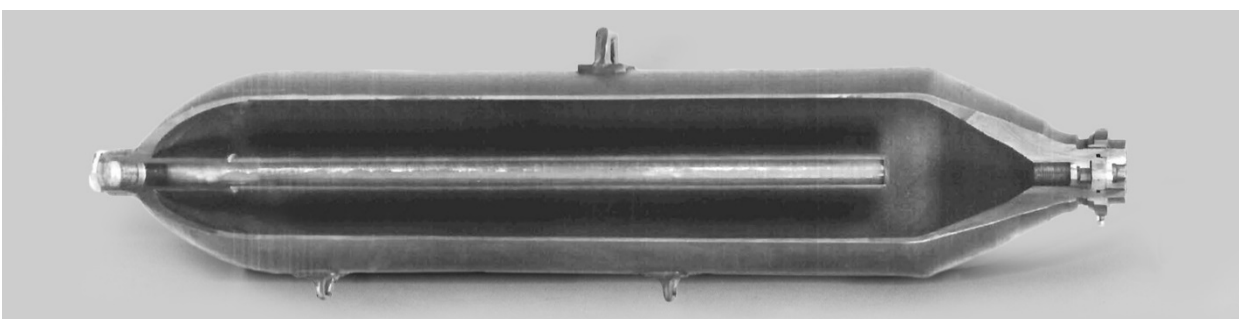

Figure 25: Bomb, 125-pound, T2 – Photograph, Cutaway View

Bomb, 125-pound, T2

Specifications

Bomb, 125-pound, T2 – Specifications and Other Data		Citation
Historical Name	125-lb. Chemical Bomb, T2	1 (p. 1)
Type	Bomb	1 (p. 1)
Size	125-pound	1 (p. 1)
Diameter	8 in. (20.3 cm)	1 (p. 3, 36, drawing)
Length	Burster well: 30-31 in. (76.2-78.7 cm) Body: 39-40 in. (99.0-101.6 cm) Overall: 49.5 in. (125.7 cm)	1 (p. 3, 36, drawing)
Width	Fin: 11 in. (27.9 cm)	1 (p. drawing)
Wall Thickness	0.125-0.244 in. (0.318-0.620 cm) Base of ogive: 0.256 in. (0.650 cm)	1 (p. 36)
Other Engineering Data	Weight, Empty: 72-75 lbs. (32.6-34 kg)	1 (p. 5, 10)
Construction Material	Steel	1 (p. 3)

General Use and Description

The 125-pound T2 was designed to replace the 115-pound M70 bomb (1 p. 3). The T2 consisted of a hot drawn tubular forged body. The 30-inch burster well was expanded in place in a reamed hole at the ogive of the bomb. The filling aperture in the tail of the bomb was closed by a 1.25-inch lower plug with tapered thread above which was a 1.75-inch straight thread plug bearing on a steel washer bearing in turn on a soft iron gasket, which rested on a circumferential shoulder above the lower plug. The burster well extended only to within six inches of the filling aperture to allow room for the insertion at a filling head. The complete assembly included the M110A1 fuze, the fin assembly for the 100-pound general purpose bomb, AN-M30, a burster of pelleted tetryl similar to the M10 burster but having a length of 30 inches instead of 36 inches and the standard arming wire assembly for the M70 bomb (1 p. 3).

Explosive Train

Available references did not provide this information.

Fuzing

Bomb, 125-pound, T2 – Fuzing		
Fuze	**Note**	**Citation**
M110A1	–	1 (p. 3)

Booster, Adapter-Booster, or Burster

Bomb, 125-pound, T2 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	Pelleted tetryl	Similar to M10 burster	1 (p. 3)

Fills

Bomb, 125-pound T2 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
H	58	26.3	138	62.6	1 (p. 5)

Shipping/Packing

Available references did not provide this information.

Bomb, 125-pound, T2

Key Dates

Available references did not provide this information.

Sources

1. Graham, M.; Gregg, A.; Kriete, B. 1944. Technical Division Memorandum Report, TDMR 902 Comparison of the 125-lb. Chemical Bomb, T2, and the 115-lb. Chemical Bomb, M70. November. Army Chemical Center.

6.12 Bomb, 500-pound, MK 94 Mod 0 (EX23, E110)

Figures

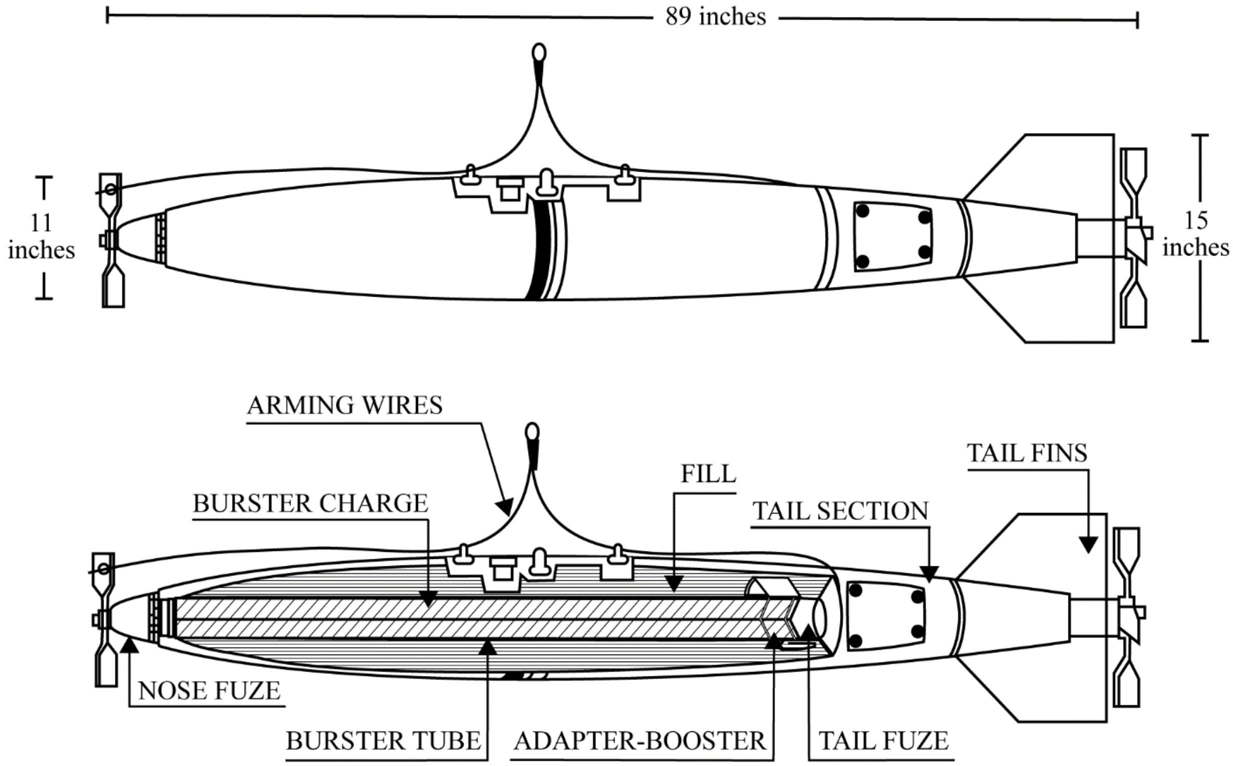

Figure 26: Bomb, 500-pound, MK 94 Mod 0 (EX23, E110) - Line Drawing

Figure 27: Bomb, 500-pound, MK 94 Mod 0 - Photograph

Specifications

Bomb, 500-pound, MK 94 Mod 0 (EX23, E110) - Specifications and Other Data		**Citation**
Historical Name	Bomb, Gas, Nonpersistent, 500-Pound, MK94 Mod 0	1 (p. 4-30, 4-31)
Developmental Information	EX23 (Navy) E110 (Army Chemical Corps)	1 (p. 4-31), 2 (p. 4-32)
Type	Bomb	1 (p. 4-30), 2 (p. 4-31), 3 (p. 1-7), 4 (p. 16), 5 (p. 4-3), 6 (p. 2-61)

Bomb, 500-pound, MK 94 Mod 0 (EX23, E110)

Bomb, 500-pound, MK 94 Mod 0 (EX23, E110) - Specifications and Other Data		Citation
Size	500-pound	2 (p. 4-31), 5 (p. 4-3), 6 (p. 2-61)
Service	Marine Corps, Navy	1 (p. 4-31), 2 (p. 4-31), 4 (p. 16), 7 (p. 8)
Diameter	11 in. (28 cm)	1 (p. 4-31), 3 (p. A-21), 5 (p. 4-3), 6 (p. 2-61)
Length	Fuzed: 89 in. (226 cm)	1 (p. 4-31), 2 (p. 4-32), 5 (p. 4-3), 6 (p. 2-61)
Width	Fin Span: 15 in. (38.1 cm)	2 (p. 2-61), 5 (p. 4-3), 6 (p. 2-61)
Wall Thickness	0.4 in. (1.02 cm)	6 (p. 2-61)
Other Engineering Data	Arming wire: M6A2, two required Weight, Empty: 278 lbs. (126 kg)	1 (p. 4-31), 2 (p. 4-32), 5 (p. 4-3), 6 (p. 2-61)
Construction Material	Steel	1 (p. 4-30), 2 (p. 4-32)
Drawing	1380220, 1380549, 1380977	2 (p. 4-32), 5 (p. 4-3)
NSN	1325-00-566-0324	7 (p. 30)

General Use and Description

The MK 94 Mod 0 bomb provided a toxic chemical offensive capability (1 p. 4-30), (2 p. 4-31).

The 500-pound nonpersistent GB bomb MK94 Mod 0 was essentially a MK 82 general purpose fin stabilized, low-drag bomb that had been modified for GB filling. The modification consisted largely in the elimination of electric-cable conduits from the low-drag bomb and adding a burster and a filling hole. The major components of the bomb were the body section, fin assembly, arming wire, nose fuze, long stem tail fuze, burster tube with charge, suspension, and hoisting lugs. The body was of steel construction. Two suspension lugs were spaced 14 inches apart, with a hoisting lug located at the center of gravity. The lugs were screwed into the length of the body cavity. The walls at the nose and the tail end of the welded bomb body were internally threaded to receive the burster retainer and the adapter-booster M115A1 respectively. The burster retainer was screwed into the nose after installation of the explosive burster. A nose fuze adapter was then screwed into the nose to accommodate the nose fuze. At the tail end of the body, there was a step of smaller diameter to retain the burster. An M115A1 adapter-booster was then screwed into the aft wall of the body to accommodate the tail fuze.

The filling hole was closed by installation of a steel ball as a primary seal, and a steel plate, resistance welded to the body, as the secondary seal (1 p. 4-30), (2 p. 4-31), (5 p. 4-3), (6 p. 2-61).

Explosive Train

When the bomb was released from the aircraft, the arming wires were withdrawn. This would permit both fuzes to arm. Both the nose fuze and the tail fuze would detonate upon impact. The nose fuze would set off the adapter-booster and the burster, which would explode the bomb and disperse the chemical agent. The tail fuze would act upon impact as back up to detonate the adapter-booster (5 p. 4-5, 4-6), (6 p. 2-61).

Fuzing

Bomb, 500-pound, MK 94 Mod 0 (EX23, E110) - Fuzing		
Fuze	**Notes**	**Citation**
AN-M101A2	Tail- impact (EX23)	9 (p. 4-10)
AN-M103A1	Nose	2 (p. 4-32), 4 (p. 16), 5 (p. 4-3), 6 (p. 2-61)
AN-M139A1	Nose	5 (p. 4-3), 6 (p. 2-61)
AN-M140A1	Nose	5 (p. 4-3), 6 (p. 2-61)
AN-M166E1	Nose- variable time	2 (p. 4-32), 5 (p. 4-3), 6 (p. 2-61), 9 (p. 4-10)
AN-M168	Nose- variable time	5 (p. 4-3), 6 (p. 2-61)
AN-M195	Tail- impact	2 (p. 4-32), 4 (p. 16), 5 (p. 4-3), 6 (p. 2-61)
M163	Nose	6 (p. 2-61)
M164	Nose	6 (p. 2-61)
M165	Nose	6 (p. 2-61)
M188	Nose- variable time	6 (p. 2-61)
M195	Tail – with M166E1 nose for airburst	2 (p. 4-32)
MK243	Nose	1 (p. 4-31), 2 (p. 4-32), 5 (p. 4-3), 6 (p. 2-61)

Booster, Adapter-Booster, or Burster

Bomb, 500-pound, MK 94 Mod 0 (EX23, E110) – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Burster not designated	16.1 lbs. (7.3 kg)	HBX-1	-	2 (p. 4-32), 6 (p. 2-61)
M115A1 Adapter-booster	N/A	N/A	-	1 (p. 4-31), 2 (p. 4-32), 5 (p. 4-3), 6 (p. 2-61)

Fills

Bomb, 500-pound, MK 94 Mod 0 (EX23, E110) – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	108-112	48.9-50.8	441-490	200-222	-	1 (p. 4-30, 4-31), 2 (p. 4-32), 3 (p. 1-7, A-21), 4 (p. 16), 5 (p. 4-3), 6 (p. 2-61), 8 (p. 65), 9 (p. 4-4)

Shipping/Packing

One bomb was shipped on a pallet with a weight of 414 pounds. Six pallets could be shipped in a container (3 p. 4-12), (5 p. 4-6), (7 p. 30).

Miscellaneous Information

The MK 96 Mod 0 was designated EX23 by Navy and E110 by Army Chemical Center during development. The bomb was released for production in 1958 (1 p. 4-31), (2 p. 4-32).

Key Dates

Bomb, 500-pound, MK 94 Mod 0 (EX23, E110) – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Developed	1953	Designated EX23 by Navy and E110 by Army Chemical Corps	2 (p. 4-32)
Production	1958	-	2 (p. 4-32)

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
3. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.
4. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
5. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
6. Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. U.S. Government Printing Office.
7. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
8. Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. Department of the Army.
9. Army Chemical Center. 1955. ORD 2509, Preliminary Manuscript, Naval Chemical Munitions, Chemical Corps Medical Laboratories. 14 April.

6.13 Bomb, 500-pound, MK 116 Mod 0, Weteye

Figures

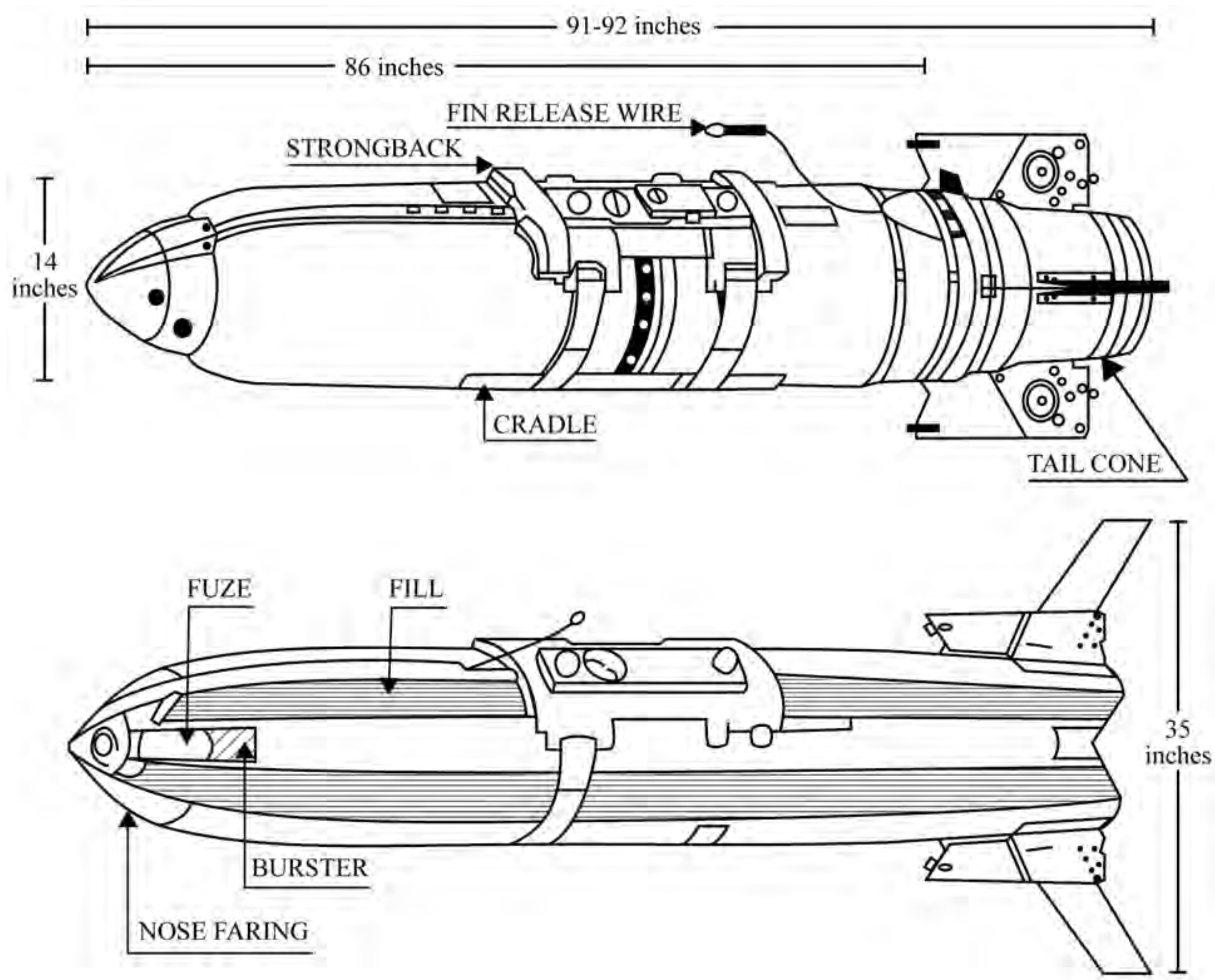

Figure 28: Bomb, 500-pound, MK 116 Mod 0, Weteye – Line Drawing

Figure 29: Bomb, 500-pound, MK 116 Mod 0, Weteye – Photograph

Bomb, 500-pound, MK 116 Mod 0, Weteye

Specifications

Bomb, 500-pound, MK 116 Mod 0, Weteye – Specifications and Other Data		Citation
Historical Name	Bomb, Chemical Agent, MK 116 MOD 0 (Weteye)	1 (p. 10-6)
Type	Bomb	2 (p. 4-26), 3 (p. 1-7)
Size	500-pound	2 (p. B-1)
Service	Marine Corps, Navy	4 (p. 1)
Diameter	14 in. (35.56 cm)	1 (p. 10-6), 2 (p. 4-27)
Length	With fins: 91-92 in. (231-235 cm) Body: 86 in. (218 cm)	1 (p. 10-6), 2 (p. 4-27), 4
Width	Fins: 35 in. (88.9 cm)	5 (p. 2-1, 7 (p. 2-1))
Wall Thickness	0.125-in. (0.3175 cm)	5 (p. 2.-1), 7 (p. 2-1)
Other Engineering Data	Weight, Empty: 176.5 lbs. (80.1 kg)	7 (p. 2-1)
Construction Material	Extruded aluminum alloy	4 (p. 2), 5 (p. 2-1)
Drawing	LD 270366	1 (p. 10-6)
NSN	1325-00-890-7937	1 (p. 10-6)

General Use and Description

The MK 116 Mod 0, “Weteye,” Chemical Bomb was a massive antipersonnel bomb that provided a toxic chemical offensive capability (2 p. 4-26).

The Weteye was capable of dispensing VX or GB chemical agents. The system was designed for maximum safety in shipboard handling and storage. The major components of the Weteye bomb were a nose fairing, forward bulkhead, aft bulkhead, and tail fin assembly. The extendible fin assembly, which was spring-loaded, was activated immediately after the bomb was released from the aircraft. Two suspension lugs supported by a heavy strong back made the weapon compatible with the MBR, Aero 7A, and Aero 20A bomb racks.

The torpedo-shaped bomb has a single-piece, extruded aluminum shell. A burster tube, 3-1/4 inches in diameter, extends the full length of the bomb and is open at each end. A tail fin/assembly, a suspension assembly, and a counterweight assembly are attached to the exterior of the bomb. This removable hardware weighs 103 pounds. With the hardware attached, the filled Weteye bomb weighs 524 pounds. The interior of the bomb is divided into three separate compartments. A perforated baffle separates the forward and middle compartments. The aft compartment of the Weteye bomb was only partially filled. The incomplete filling of the aft compartment provided a void space to accommodate agent expansion. After filling the bomb, the filling port was permanently sealed.

To provide a VX capability, the bomb was supplied with an M20 fuze, to give a low-burst capability of 20 to 60 feet. An M990C fuze provided high-burst capability of 120 to 160 feet. The bomb contained a central burster consisting of four burster charges (1 p. 10-6), (2 p. 4-26), (6 p. III-1).

Explosive Train

When the bomb was released from the aircraft, the arming wire was withdrawn, allowing the fuze to arm in the airstream. At the same time, the fin-release wire was withdrawn, activating the spring-tension extendible fins. Upon impact the fuze ignited the burster. The burster exploded the bomb and disseminated the chemical agent (1 p. 10-6).

Bomb, 500-pound, MK 116 Mod 0, Weteye

Fuzing

Bomb, 500-pound, MK 116 Mod 0, Weteye - Fuzing		
Fuze	**Notes**	**Citation**
M20	Nose- low-burst	2 (p. 4-27)
M904E2	Nose- mechanical	5 (p. 2-1)
M990C	Nose- high-burst	2 (p. 4-23)
M990D	Nose- electrical	5 (p. 2-1)

Booster, Adapter-Booster, or Burster

Bomb, 500-pound, MK 116 Mod 0, Weteye - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Booster	0.43 lbs. (0.20 kg)	Tetryl	-	1 (p. 10-6, 10-7)
Mk 5 Mod 0 - Burster	6 lbs. (2.72 kg)	Composition B	4 per bomb	5 (p. 2-2), 7 (2-2)
Burster	22 lbs. (9.98 kg)	Composition B	-	1 (p. 10-6, 10-7)
T45E1 - Adapter-booster	N/A	N/A	-	5 (p. 2-2), 7 (p. 2-2)

Fills

Bomb, 500-pound, MK 116 Mod 0, Weteye - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	347	157	562	254	-	1 (p. 10-6, 10-7), 3 (p. 1-7)
VX	285	129	500	227	Fill weight was estimated based on gross weight.	2 (p. 4-27)

Shipping/Packing

The shipping container weighed 327 pounds and was approximately 20 inches wide, 20 inches high and 103 inches long. The shipping container was a cylindrical steel shell that was surrounded by a rectangular frame. The top half of the container was secured by 20 bolts. The shipping container weighed approximately 851 pounds when holding the filled bomb (4), (6 p. III-1).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
3. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.
4. Task Force Public Affairs Office. 1981. Fact Sheet: Description of MK 116, Mod 0, Chemical Bombs (Weteye). U.S. Army.
5. Department of the Army. 1979. Supply Bulletin, SB 742-1325-94-20, Ammunition Inspection Procedures for Chemical Bomb Mark 116 MOD 0. U.S. Army.
6. Rocky Mountain Arsenal and Army Materials and Mechanics Research Center. 1979. Investigation of Leaking Weteye Bombs, Report of the Weteye Reassessment Inspection Task Group. U.S. Army.
7. Naval Air Systems Command 1967. NAVAIR 11-5a-6, Handbook, Safety, Unpacking, Inspection and Assembly, CHEMICAL BOMB MK 116 MOD 0. 15 November.

6.14 Bomb, 500-pound, BLU-80/B, Bigeye

Figures

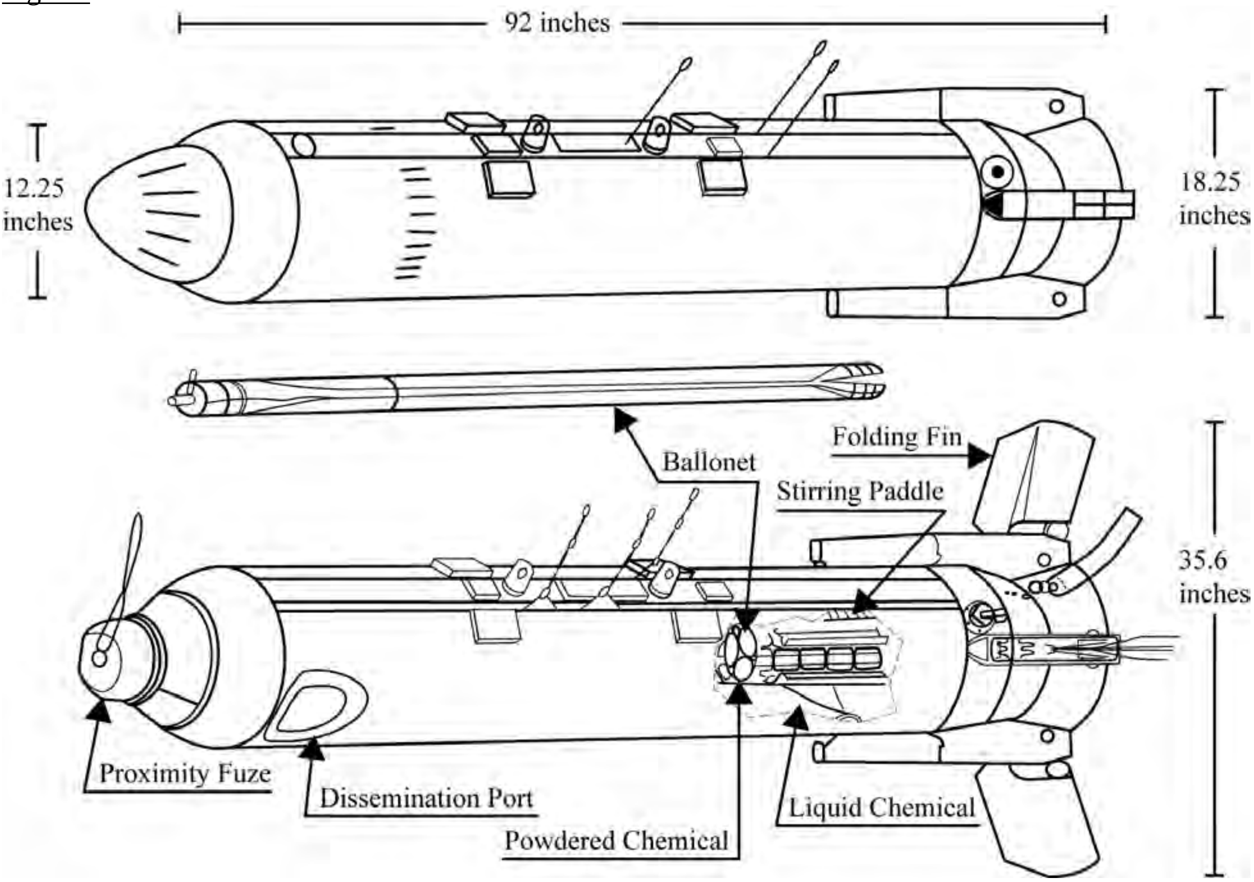

Figure 30: Bomb, 500-pound, BLU-80/B, Bigeye – Line Drawing

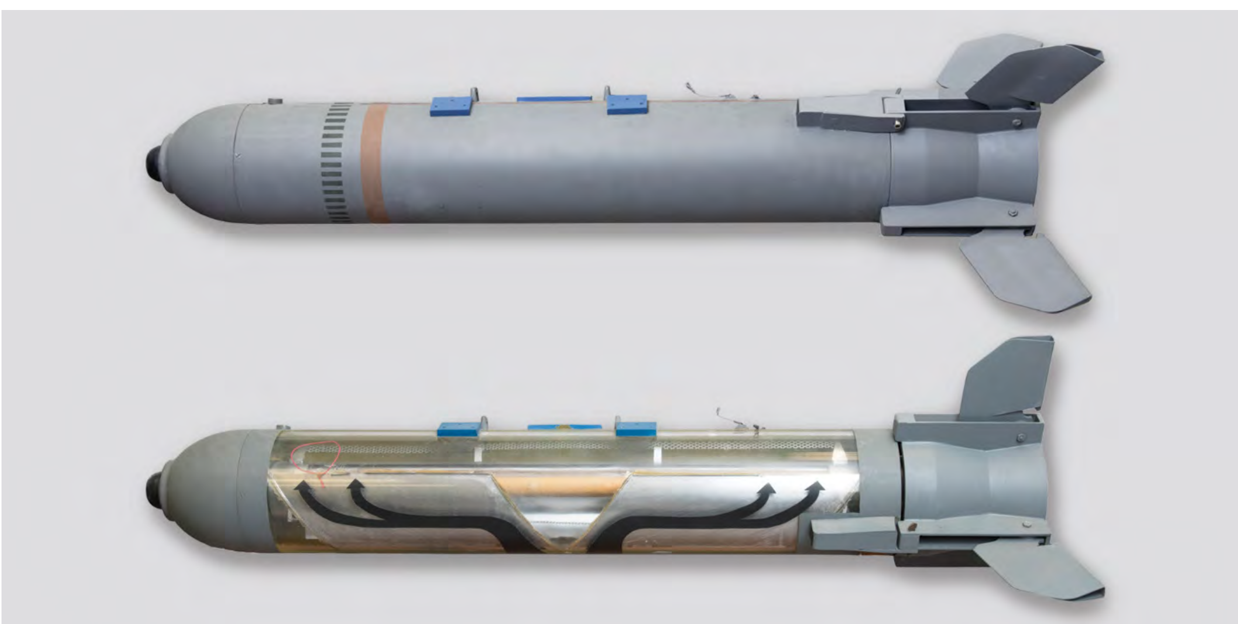

Figure 31: Bomb, 500-pound, BLU-80/B, Bigeye – Photographs (Models) Top: Exterior, Bottom: Cutaway View

Bomb, 500-pound, BLU-80/B, Bigeye

Specifications

Bomb, 500-pound, BLU-80/B, Bigeye – Specifications and Other Data		Citation
Historical Name	Bomb, Binary Chemical BLU-80/B (Bigeye)	1 (p. 1-6)
Type	Bomb	1 (p. 1-6)
Size	500-pound	2 (p. 134)
Conflict	Cold War	2 (p. 10)
Service	Army, Navy, Air Force	2 (p. 10), 3 (p. 3-1)
Diameter	Reactor section: 12.25 in. (31.11 cm)	1 (p. 1-6)
Length	With fuze cover: 92 in. (234 cm) Without fuze cover: 91 in. (231 cm)	1 (p. 1-6)
Width	Fin open: 35.6 in. (90.42 cm) Fin closed: 18.25 in. (46.35 cm)	1 (p. 1-6)
Wall Thickness	0.625 in. (1.5875 cm)	2 (p. 12)
Other Engineering Data	Detonator: MK 71 Lead: MK 9 Igniter: MK 133 Mod 0 Gas generator: BBU-18/B Ballonet: MXU-695/B Weight, Empty: 337-368 lbs. (153-167 kg) Weight, without ballonet: 523 lbs. (237 kg)	1 (p. 1-6, 1-11), 2 (p. 53 - 55)
NSN	1325-00-A01-4435 (Bomb without Ballonet) 1325-01-249-1815 (Ballonet, Cartridge Actuated)	1 (p. 1-6)
Drawing	15-12-303	2 (p. 107)

General Use and Description

The BLU-80/B bomb was an aircraft delivered binary chemical weapon that generated a persistent nerve agent (i.e., VX) from two relatively non-toxic chemicals, ethyl-2-diisopropylaminoethyl-methylphosphonite (QL) (liquid) and sulfur (NE) (solid powder). The BLU-80/B (Bigeye) Bomb consisted of four major sections: the airframe, bomb body (reactor), ballonet (MUX-695/B), and dissemination system.

The airframe consisted of the weapon outer skin, a strongback running the length of reactor, a nose fairing for aerodynamic streamlining, and cartridge actuated folding fins. The fins provided aerodynamic stability once the weapon was released from aircraft.

The reactor was a sealed vessel that contained liquid QL under a low-pressure atmosphere of inert gases. The reactor protected the liquid QL during shipment and storage and provided a space and mechanism for the mixing reaction to take place.

The ballonet was a narrow cylinder that contained solid NE and explosives. When actuated, NE was forced through the thin-walled tubes of the reactor chamber housing QL for formation of toxic nerve agent (i.e., VX).

The dissemination system consisted of a proximity nose fuze (dispenser proximity fuze FMU-140/B), a mild detonating fuze assembly, and four flexible linear-shaped charges for cutting open preformed ports.

The BLU-80/B never went into production (1 p. 1-4) (2 p. 7), (3 p. 3-1, 3-2).

Explosive Train

At the weapon release point, the pilot ejected the weapon. As the weapon fell from the aircraft, lanyards actuated the tail fins, which initiated a gas pressure generator and an explosive actuator cartridge (firing device). The cartridge provided gas pressure to shear fin retention pins and caused a positive ramming action to open each of the four fins.

The gas pressure generator drove a gas motor which rotated the NE loaded ballonet. Simultaneously, the ballonet impulse cartridge assembly was mechanically initiated providing an explosive gas pressure build up expanding the ballonet assembly and forcing solid NE into the reactor chamber where the NE reacted with QL forming VX.

A thermal battery provided for proximity sensor and fuze electronics. The proximity sensor prevented mechanical arming (explosive train alignment) until proper weapon speed was attained. A fuze provided a firing pulse to initiate the explosive train following the chemical mixing process and prior to ground impact. The fuze initiated the weapon explosive dissemination system. Upon initiation, preformed ports in the weapon skin were opened allowing agent to stream from weapon while traveling along flight trajectory (1 p. 1-5).

Fuzing

Bomb, 500-pound, BLU-80/B, Bigeye – Fuzing		
Fuze	**Note**	**Citation**
FMU-140/B	Proximity- 135 milligrams lead styphnate	1 (p. 1-11), 2 (p. 9)

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Bomb, 500-pound, BLU-80/B, Bigeye – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
VX	162-186	73.5-84.3	501-551	226-250	2 (p. 53 - 55)

Shipping/Packing

For safety reasons, the ballonet was shipped and stored separately from rest of weapon (1 p. 1-4). The BLU-80/B, without ballonet was shipped in Container, Shipping and Storage, CNU-396/E, which was 102.75 inches (260.98 centimeters) long, 35.01 inches (88.92 centimeters) wide, 23.25 inches (59.05 centimeters) high, and weighed 1,526 pounds (692 kilograms) with 2 QL filled and fuzed bombs. Two ballonets were shipped in Container, Shipping and Storage, CNU-388/E, which was 78.68 inches (199.84 centimeters) long, 16 inches (40.64 centimeters) wide, 10 inches (25.4 centimeters) high, and had a weight of 139 pounds (63.05 kilograms) (1 p. 1-6).

Key Dates

Available references did not provide this information.

Sources

1. Product Assurance Directorate. 1988. Special Surveillance Instructions 742-1325-94-304, Bomb, Binary Chemical BLU-80/B, w/o Ballonet (BIGEYE) and Ballonet, Cartridge Actuated MXU-695/B. U.S. Army Armament, Munitions and Chemical Command.
2. Jackson, A.; Gadde, K.; Goheen, J.; Semiating, W. 1987. CRDEC-TR-87042, Fill, Close, Load, Assemble, and Packout Technology for the 8-Inch, VX-2, XM736 Projectile and the Bigeye Bomb (BLU-80/B). Chemical Research, Development and Engineering Center and U.S. Army Armament Munitions Chemical Command.
3. Program Manager for Non-Stockpile Chemical Materiel. 1993. Survey and Analysis Report. U.S. Army Chemical Materiel Destruction Agency.

6.15 Bomb, 500-pound, EX38

Figures

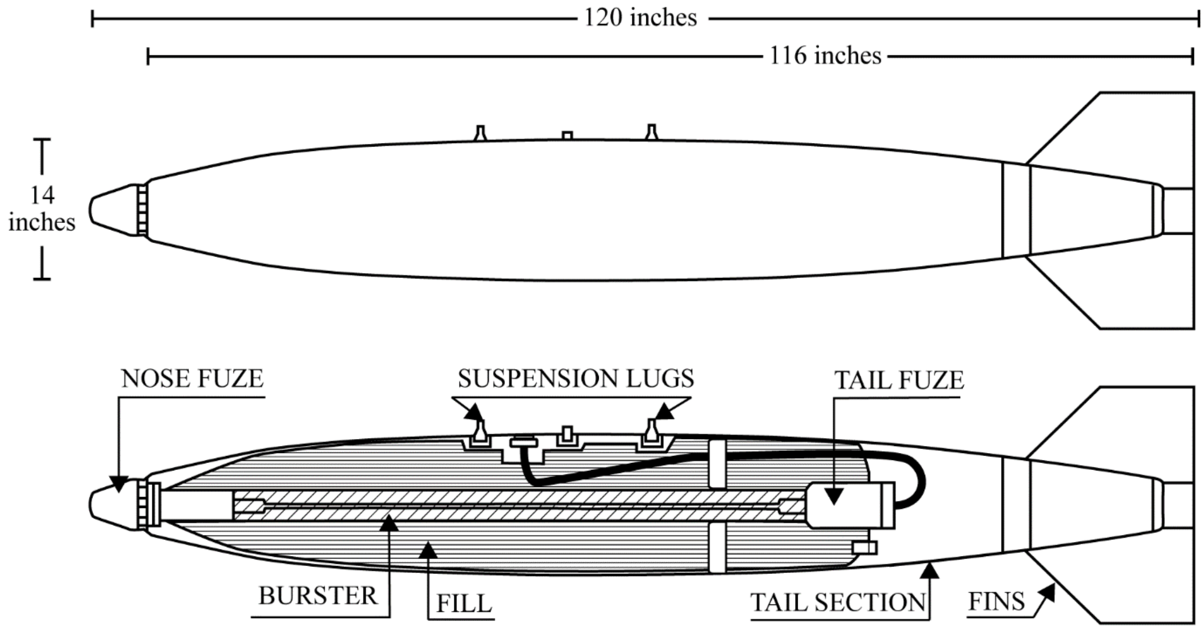

Figure 32: Bomb, 500-pound, EX38 - Line Drawing

Specifications

Bomb, 500-pound, EX38 - Specifications and Other Data		**Citation**
Historical Name	Bomb, Toxic, 500-Pound (VX-GB) EX38	1 (p. 4-27)
Type	Bomb	1 (p. 4-27)
Size	500-pound	1 (p. 4-27)
Conflict	Cold War	2
Service	Navy	1 (p. 4-28), 2 (p. 2 - 3)
Diameter	14 in. (35.56 cm)	1 (p. 4-28), 2 (p. 16)
Length	Body: 116 in. (295 cm) With fuze: 120 in. (305 cm)	1 (p. 4-28), 2 (p. 16)
Wall Thickness	0.103 in. (0.26162 cm)	1 (p. 4-28), 2 (p. 25)
Construction Material	Aluminum	1 (p. 4-28)
Drawing	CWLR-314-5-3370	1 (p. 4-28)
NSN	1325-00-566-0324	3 (p. 30)

General Use and Description

The EX38 was designed for carriage and release from carrier-based Naval aircraft to provide toxic chemical offensive capability by aircraft (1 p. 4-27), (2 p. 1).

The EX38 was suitable for carriage and release from high-speed, carrier-based Navy aircraft. This bomb was a low-drag design of ballistic stability and aimability with accommodations for standard fuzing of impact, variable time, and electrical fuzes. It met design requirements for airborne stores, and was compatible with existing handling and transport equipment, as well as military safety and storage. The system could be set to airburst at 20 to 60 feet altitude or 100 to 160 feet altitude. It could be used with Aero 7A and Aero 20A bomb racks and Aero 3A fuze charging system. Two suspension lugs were located 14 inches apart (1 p. 4-27 - 4-28).

Bomb, 500-pound, EX38

Explosive Train

Fuze would initiate explosive burster at selected altitude and disseminate chemical agent (1 p. 4-27, 4-28).

Fuzing

Bomb, 500-pound, EX38 - Fuzing		
Fuze	**Notes**	**Citation**
M20	Nose- variable time	1 (p. 4-28)
M904	Nose- mechanical time	1 (p. 4-28)
M905	Tail- mechanical time	1 (p. 4-28)
M913 (T768)	Electric fuze system	1 (p. 4-28)
M990	Tail- electric	1 (p. 4-28)

Booster, Adapter-Booster, or Burster

Bomb, 500-pound, EX38 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	N/A	Explosive burster; ground or air.	1 (p. 4-28)

Fills

Bomb, 500-pound, EX38 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	310-314	140-142	514-515	233-234	Alternate	1 (p. 4-28), 2 (p. 3)
VX	310-314	140-142	514-515	233-234	-	1 (p. 4-28), 2 (p. 3)

Shipping/Packing

The bomb had a shipping weight of 414 pounds and occupied 3.2 cubic feet (3 p. 30).

Miscellaneous Information

The EX38 was designed to replace the MK94 bomb (1 p. 4-28). The Navy decided to terminate the EX38 development program by 1962 and the efforts were redirected to the development of the Weteye bomb. The Weteye was similar in size, material, fill capacity, and agent (4 p. 26).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
2. Tarento, F.F. 1961. Final Report EX-38 500 LB. Chemical Bomb Development, Report 5412. EDO Corporation.
3. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
4. U.S. Army Chemical Research and Development Laboratory 1962. Quarterly Historical Report, 1 July to 30 September 1962. December.

6.16 Bomb, 500-pound, M78, AN-M78

Figures

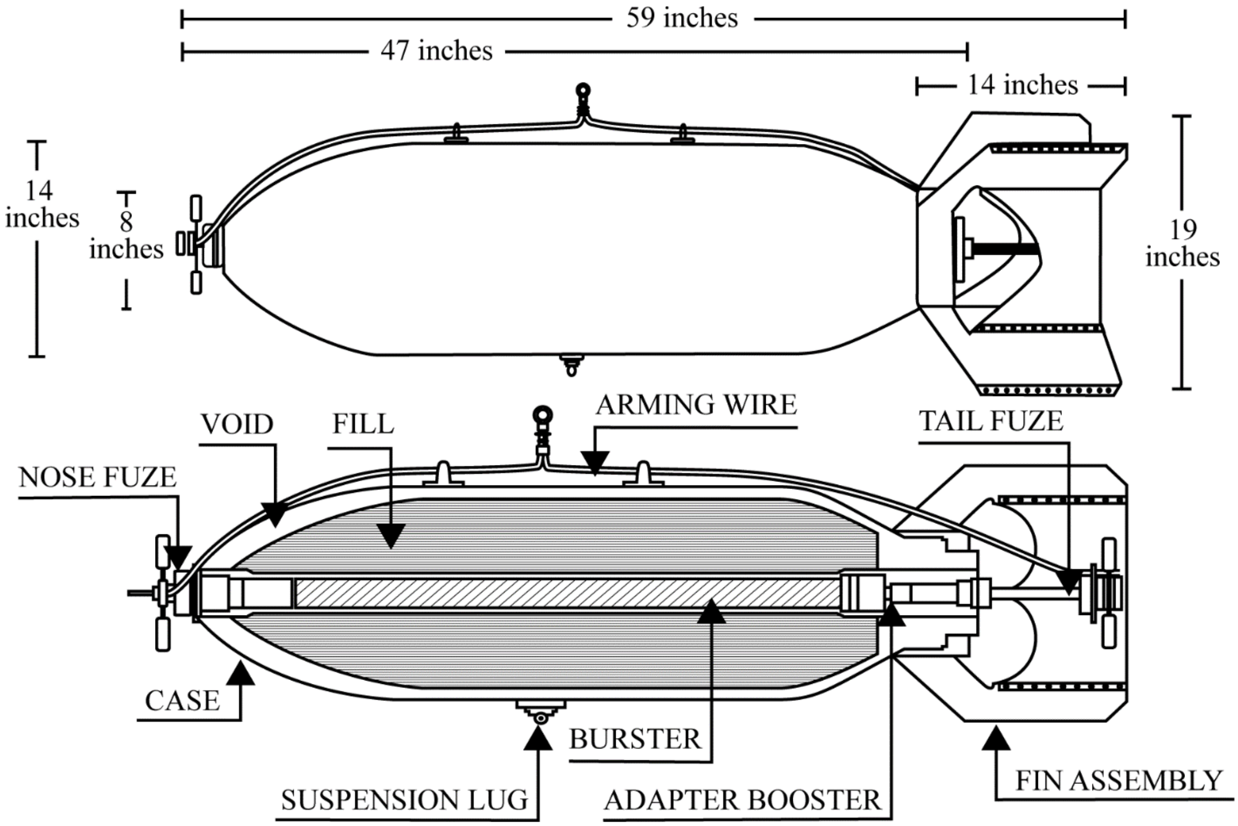

Figure 33: Bomb, 500-pound, M78, AN-M78 - Line Drawing

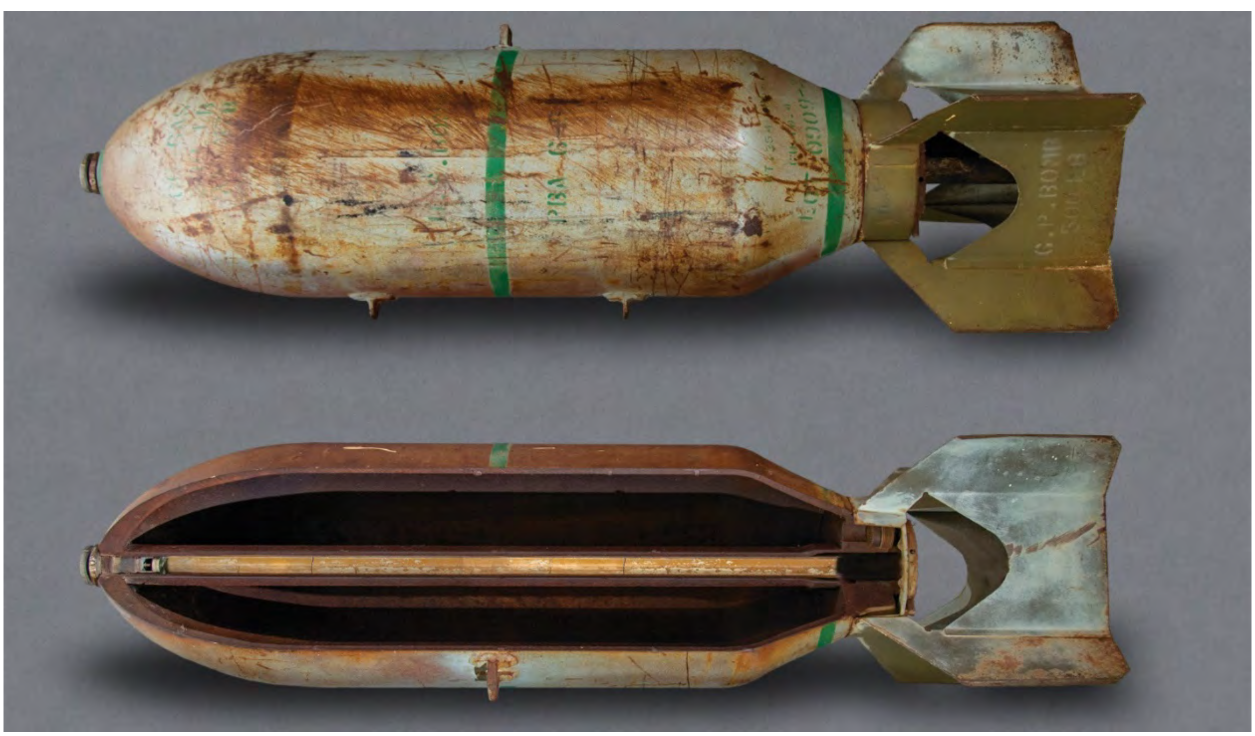

Figure 34: Bomb, 500-pound, M78 - Photograph, Top: Exterior, Bottom: Cutaway View

Bomb, 500-pound, M78, AN-M78

Specifications

Bomb, 500-pound, M78, AN-M78 - Specifications and Other Data		Citation
Historical Name	Bomb, Gas, Nonpersistent, CG & CK, 500-Pound, AN-M78 Bomb, Chemical, 500-lb., M78 (T3E1)	1 (p. A-15), 2 (p. 1), 3 (p. D3)
Developmental Information	T3E1	2 (p. 1), 3 (p. D1a)
Type	Bomb	1 (p. A-15), 4 (p. 46)
Size	500-pound	5 (p. 434)
Conflict	WWII	2, 3 (p. D2)
Service	Air Force, Army, Navy	1 (p. A-15), 3 (p. D2-D3)
Diameter	Narrowest point: 8 in. (20 cm) Widest point: 14 in. (36 cm)	1 (p. A-15), 3 (p. D2), 4 (p. 47), 5 (p. 434), 6 (p. 28)
Length	Overall: 59 in. (150 cm) Body: 47 in. (119 cm) Tail: 14 in. (36 cm)	1 (p. A-15), 3 (p. D2), 4 (p. 47), 5 (p. 434), 6 (p. 28)
Width	Tail/Fin: 19 in. (48 cm)	1 (p. A-15), 5 (p. 434)
Wall Thickness	0.3 in. (0.73 cm)	5 (p. 434)
Other Engineering Data	Fin Assembly Model: AN-M109A1, M109, or M128 Arming Wire: M5, M7, or AN-M7A1 Type E. Weight, Empty weight: 260 lbs. (117.9 kg)	1 (p. A-15, A-17), 3 (p. D2), 4 (p. 47)
Construction Material	One-piece cast steel	1 (p. A-15), 7
Drawing	82-0-115	1 (p. A-15)
FSN	1325-219-8568 (CG-fill) 1325-219-8581 (CK-fill)	3 (p. D3)

General Use and Description

The AN-M78 500-pound nonpersistent bomb was designed to provide a toxic chemical offensive capability using chemical agents (e.g., CG or CK) (8).

The complete device consisted of a bomb body, filling, a tail fin, a burster, an adapter-booster, a nose fuze, a tail fuze, and an arming wire. The body was one-piece cast steel construction with a tubular burster that extended the entire interior length of the bomb from the threaded fuze adapter in the nose to a threaded hole in the base plate welded to the tail end of the body. The burster was threaded internally at the nose to receive the nose fuze and at the rear to receive the Adapter-Booster M115. The base plug consisted of a special forging welded to the case, containing the Needle Valve M1. The rear section of the bomb tapered down to approximately an eight-inch diameter where a base plate was welded, closing the body. The tail was a standard box-type fin assembly secured to the bomb by a locking nut that threaded onto the base plug. Suspension was by two lugs seven inches on either side of the center of gravity, or by a single suspension lug 180 degrees removed at the center (1 p. A-15), (4 p. 47).

Explosive Train

Detonation of the fuze would set off the burster, which would explode the bomb and disperse the agent. The nose fuze normally detonated the burster but, in the event of malfunction, the tail fuze set off the burster through the adapter-booster charge (1 p. A-18).

Fuzing

Bomb, 500-pound, M78, AN-M78 - Fuzing		
Fuze	**Notes**	**Citation**
AN-M101A1	Tail- alternate	1 (p. A-17), 3 (p. D2), 4 (p. 47), 5 (p. 434), 9 (p. 182)
AN-M101A2	Tail- authorized alternative, with primer-detonator, M14, non-delay	1 (p. A-17), 3 (p. D2), 4 (p. 47), 5 (p. 434), 6 (p. 29), 9 (p. 182)
AN-M103	Nose- superquick, authorized alternative	1 (p. A-17), 3 (p. D2), 4 (p. 47), 5 (p. 424), 6 (p. 29), 8 (p. 15-5), 9 (p. 182)
AN-M103A1	Nose- authorized alternative	1 (p. A-15, A-17), 4 (p. 47), 5 (p. 434), 8 (p. 15-5)
AN-M139A1	Nose- authorized alternative	1 (p. A-15, A-17), 4 (p. 47), 5 (p. 434), 6 (p. 29), 8 (p. 15-5)
AN-M140A1	Nose- authorized alternative	1 (p. A-15, A-17), 4 (p. 47, 132), 5 (p. 434), 6 (p. 29), 8 (p. 15-5)
AN-M145A1	Nose - mechanical time (1.6 pound) Used with M117 adapter-booster	1 (p. A-17), 10 (p. 2-139, 2-140)
AN-M146A1	Nose- mechanical time Used with M117 adapter-booster	1 (p. A-17), 10 (p. 2-141, 2-142)
AN-M166	Nose- variable time	1 (p. A-15), 5 (p. 434)
M101A1	Tail- authorized alternative	1 (p. A-17), 3 (p. D2), 6 (p. 29)
M103	Nose	5 (p. 434), 9 (p. 182)
M124	Tail- may be used when required	9 (p. 182)
M127	Nose- Army only with M117 adapter-booster	5 (p. 434), 9 (p. 182)
M128	Nose- Navy only	5 (p. 434)
M133	Tail	9 (p. 182)
M135	Nose	5 (p. 434)
M135A1	Nose	5 (p. 434)
M136	Nose	4 (p. 47), 5 (p. 434)
M136A1	Nose	5 (p. 434)
M139	Nose	5 (p. 434)
M139A1	Nose	1 (A-15), 5 (p. 134)
M140	Nose	5 (p. 434)
M161	Tail- preferred	1 (p. A-17), 3 (p. D2), 4 (p. 47), 5 (p. 434), 6 (p. 29)
M163	Nose- preferred non-delay	1 (p. A-15, A-17), 5 (p. 434), 6 (p. 29), 8 (p. 15-5)
M164	Nose- authorized alternative	1 (p. A-17), 4 (p. 47, 132), 5 (p. 434), 6 (p. 29), 8 (p. 15-5)
M165	Nose- authorized alternative	1 (p. A-17), 4 (p. 132), 5 (p. 134), 6 (p. 29), 8 (p. 15-5)
M166	Nose- variable time	5 (p. 434)
M175	Tail	3 (p. D2)
T50E4	Nose- variable time	5 (p. 434)
T82	Nose- variable time	5 (p. 434)

Booster, Adapter-Booster, or Burster

Bomb, 500-pound, M78, AN-M78 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
AN-M15 Burster	N/A	N/A	-	1 (p. A-15), 3 (p. D2), 4 (p. 47), 5 (p. 434), 6 (p. 29), 9 (p. 182)
M115 Adapter-booster	N/A	N/A	-	1 (p. A-17), 3 (p. D2), 4 (p. 47), 5 (p. 434), 6 (p. 29), 8 (p. 15-5), 9 (p. 182)
M115A1 Adapter-booster	N/A	N/A	-	1 (p. A-17), 4 (p. 47), 6 (p. 29), 8 (p. 15-5), 9 (p. 182)
M117 Adapter-booster	N/A	N/A	Used with AN-M145A1 and AN-M146A fuzes for aerial burst	1 (p. A-17), 5 (p. 434), 8 (p. 15-5), 9 (p. 182)
M15	2.54 lbs. (1.15 kg)	Tetrytol	-	4 (p. 47), 5 (p. 434), 11 (p. 2)

Fills

Bomb, 500-pound, M78, AN-M78 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	100	45.3	383	173	Experimental	5 (p. 434), 12 (p. 43, 44)
CG	205	92.9	488-496	221-224	-	1 (p. A-15), 3 (p. D2), 4 (p. 47), 5 (p. 434), 8 (p. 15-5)
CK	165-176	74.8-79.8	448-467	203-211	-	1 (p. A-15), 3 (p. D2), 4 (p. 47), 5 (p. 434), 8 (p. 15-5)

Shipping/Packing

Shipping bands protected the AN-M78 bomb during shipping and storage. Shipping weight was approximately 472 pounds when CG-filled. The explosive components, arming wire, and fin assembly were packed separately (1 p. A-18).

Miscellaneous Information

The M78 bomb was a wartime item adapted from the AN-M64 General Purpose bomb to provide large munitions with substantial quantities of nonpersistent agent. During the immediate post-war years, the M78 was considered an asset in Air Force operational plans. The wartime bombs were upgraded with the AN-M128 fin assembly, M175 fuze, and M13 arming wire to improve accuracy with high-speed, high-altitude aircraft. Meanwhile, the development of the nonpersistent agent GB, and munitions for its delivery (i.e., MC-1, M34A1 cluster) reduced the need for the M78 bomb.

Between 1944 and 1945, 25,160 CG-filled, and 33,347 CK-filled AN-M78 bombs were procured. In 1949, there were 26,447 CK, and 6,660 CG AN-M78 bombs on hand. Also in 1949, it was reported that AC was never authorized as a filling for the AN-M78, the round is non-standard, and no stocks were on hand. When CK became a Limited Standard item in 1951, there were 27,179 CK-filled M78 bombs on hand. In 1963, there were 5,698 CG-filled and 28,475 CK-filled AN-M78 bombs on hand (3 p. D3 - D4), (13 p. 77), (14 p. 96).

Bomb, 500-pound, M78, AN-M78

Key Dates

Bomb, 500-pound, M78, AN-M78 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1943	CCTC 881 (CG and CK-fill, Standard)	15 (p. 82)
Canceled	1946	CCTC 1672 (AC as an experimental fill)	12 (p. 44)
Standardized	1944	OCM 23112, 25283 (M78 (T3E1)	2 (p. 1, 4), 3, 16, 20 (p. 160)
Standardized	1951	CCTC 2289 (M78 CK-fill Limited Standard)	17 (p. 76)
Standardized	1958	CCTC 3408 (CG-fill -Standard-Air Force and CK and AC-fill - Ltd Standard-Air Force)	18 (p. 106)
Standard Modernization	1959	CCTC 3524, 3525 (CK- and CG-fill Standard-C-Air Force)	19 (p. 213)
Obsoleted	1960	CCTC 3686 (AC obsoleted)	20
Obsoleted	1963	CCTC 4141 (AN-M78 CG- and CK-fill)	3 (p. D-6)

Sources

1. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

2. Sub-Committee on Bombs. 1944. Ordnance Committee Meeting, OCM Item # 23112, Bombs, Chemical, 500-lb., M78 (T3E1) and Burster, M15 - Standardization. Ordnance Committee.

3. Chemical Corps Technical Committee. 1963. CCTC Item # 4141, Subject: Obsoletion of Bombs, Gas, Nonpersistent CG & CK, 500-lb., AN-M78; & Bombs, Gas, Nonpersistent CG & CK, 1000-lb., AN-M79 (U). U.S. Army Materiel Command.

4. Departments of the Army and Air Force. 1953. Technical Manual, TM 3-400/Technical Order, TO 39B-15C-1, Chemical Bombs and Clusters. Department of the Army.

5. Naval Sea Systems Command. 1969. Naval Sea Systems Command Ordnance Pamphlet, NAVSEA OP 1664, Change 1, U.S. Explosive Ordnance. U.S. Government Printing Office.

6. Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. Department of the Army.

7. Henry, S.I., & Flood, L.W. 1947. Metallurgical Research Department Report, Corrosion Inspection of Chemical Bombs After Exposure to "CC" Gas, MS-4195-3. A.O. Smith Corporation.

8. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.

9. War Department. 1944. Technical Manual, TM 9-1980, Bombs for Aircraft. U.S. Government Printing Office.

10. Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Cancelled Fuzes, MIL-HDBK-146. Department of Defense.

11. Technical Staff, Dugway Proving Ground. 1944. Dugway Proving Ground Memorandum Report, DPGMR No. 18, 500-LB., 1000-LB., 2000-LB., and 4000-LB. Bombs Filled with Nonpersistent Agents. Chemical Warfare Service.

12. Chemical Corps Technical Committee. 1946. CCTC Item # 1672, Cancellation of Experimental Type Bombs and Clusters. Department of the Army

13. Chemical Corps Technical Committee. 1951. CCTC Item # 2289, Reclassification of Cyanogen Chloride, CK to Limited Standard Type. Department of the Army.

14. Chemical Corps Technical Committee. 1949. CCTC Item # 2000, Incorporation of Gas and Smoke Bombs in Chemical Corps Records. Department of the Army. June 15.

15. Chemical Corps Technical Committee. 1943. CCTC Item # 881, Classification of Fillings for Chemical Munitions. Department of the Army.

16. Chemical Corps Technical Committee. 1957. CCTC Item # 3286, Subject: Incorporation of Fin Assemblies, Bomb, AN-M128 & AN-M129; Fuzes, Bomb Tail, M175 & M176; & Arming Wire Assembly, M13 as Standard Components of the AN-M78 & AN-M79 500-lb. & 1000-lb. Gas Bombs. Department of the Army.
17. Ordnance Department. 1944. OTCM Item # 25283, Read for Record Before Ordnance Committee 28 Sept 1944, Memorandum For: Secretary, Ordnance Technical Committee, Subject: Bomb, Chemical, 500 lb., AN-M78 - Standardized by the Joint Aircraft Committee. September. Ordnance Committee.
18. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
19. Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.
20. Chemical Corps Technical Committee. 1960. CCTC Item # 3686, Obsoletion of Bomb, Gas, Nonpersistent AC, 1000-lb., AN-M79 & Quick-acting Hydrogen Cyanide, AC Quick-Acting Hydrogen Cyanide, AC. Department of the Army.

6.17 Bomb, 500-pound, T2

Figures

No images were found in available references.

Specifications

Bomb, 500-pound, T2 – Specifications and Other Data		Citation
Historical Name	Bomb, Chemical, 500 lb., CG, T2	1 (p. 3)
Type	Bomb	1 (p. 3), 2 (p. 2), 3 (p. II-2)
Size	500-pound	1 (p. 3), 2 (p. 2), 3 (p. II-2)
Conflict	WWII	1, 2, 3
Service	Army	3 (p. 1, II-2)
Other Engineering Data	Weight, Empty: 253-275 lbs. (115-125 kg)	2 (p. 2),
NSN	310140 (CG)	1 (p. 3)

General Use and Description

The T2 series of bombs is only slightly different from the T3 series, which includes the M78 and M79. The T2 bomb is an earlier version of the M78 and M79 bombs, the difference being that the valve and filling openings are on the side of the casing rather than in the tail (3 p. VI-31).

Explosive Train

The explosive train is assumed to be the same as that for the M78.

Fuzing

Bomb, 500-pound, T2 – Fuzing		
Fuze	**Notes**	**Citation**
M103	Nose- impact	2 (p. 2), 4 (p. 2)
ANM101	Tail	2 (p. 2), 4 (p. 2)

Booster, Adapter-Booster, or Burster

Bomb, 500-pound, T2 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M15 Burster	2.54 lbs. (1.15 kg)	Tetrytol	–	2 (p. 2)

Fills

Bomb, 500-pound, T2 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
AC	107	48.5	360	163	2 (p. 2)
CG	211-212	95.7-96.2	465-486	210-220	1 (p. 3), 2 (p. 2), 3 (p. II-2), 4 (p. 2)
CK	183	83	436	198	2 (p. 2)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not provide this information.

Sources

1. Control Division. 1946. Disposition of CWS-Owned Materiel. February 8. Chemical Warfare Service.
2. Technical Staff, Dugway Proving Ground. 1944. Dugway Proving Ground Memorandum Report, DPGMR No. 18, 500-LB., 1000-LB., 2000-LB., and 4000-LB. Bombs Filled with Nonpersistent Agents. Chemical Warfare Service.
3. Chemical Corps. 1948. Disposition of Chemical Corps Items. Department of the Army.
4. Technical Staff, Dugway Proving Ground. 1943. Dugway Proving Ground Memorandum Report, DPGMR 9, 500-LB. T2 Bombs filled with CG. Chemical Warfare Service. August.

6.18 Bomb, 750-pound, MC-1

Figures

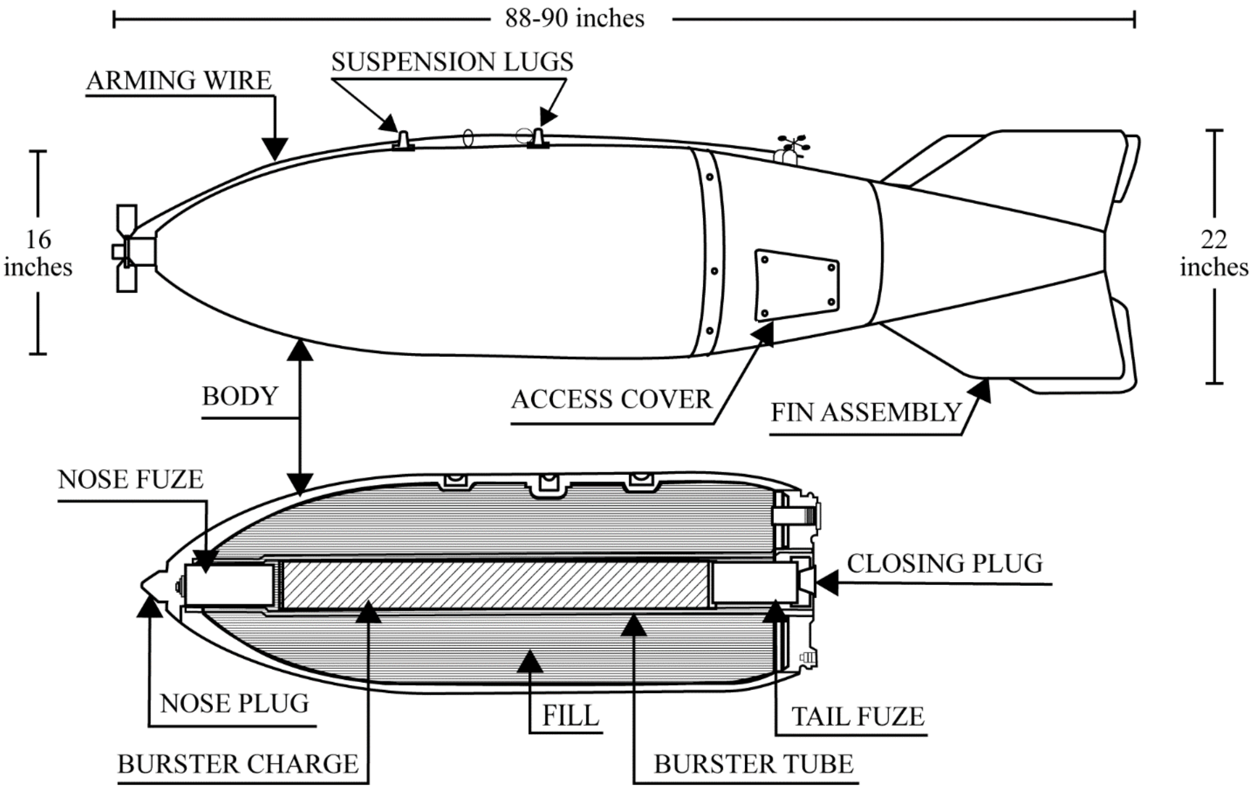

Figure 35: Bomb, 750-pound, MC-1 - Line Drawing

Figure 36: Bomb, 750-pound, MC-1 - Photograph

Specifications

Bomb, 750-pound, MC-1 - Specifications and Other Data		**Citation**
Historical Name	Bomb, Gas: Nonpersistent, GB, 750-Pound, MC-1	1 (p. 2-62), 6 (p. 16)
Type	Bomb	2 (p. 4-33), 3 (p. 4-32), 4 (p. 30)
Size	750-pound	2 (p. 4-34), 3 (p. 4-33), 4 (p. 30), 5 (p. 3)
Conflict	Cold War	6 (p. N1)
Service	Air Force	2 (p. 4-33), 3 (p. 4-32), 4 (p. 30), 5 (p. 3), 6 (p. N1), 7 (p. 16)

Bomb, 750-pound, MC-1

Bomb, 750-pound, MC-1 - Specifications and Other Data		Citation
Diameter	16 in. (40.64 cm)	1 (p. 2-62), 2 (p. 4-34), 3 (p. 4-32), 6 (p. N3)
Length	88-90 in. (224-229 cm)	1 (p. 2-62), 2 (p. 4-34), 3 (p. 4-33), 6 (p. N3)
Width	Fin span: 22 in. (56 cm)	1 (p. 2-62)
Wall Thickness	0.375 in. (0.95 cm)	6 (p. N3)
Other Engineering Data	Fin Assembly: M131 (T152E2)	2 (p. 4-34), 3 (p. 4-33)
Drawing	CMLC: 14-5-2735	2 (p. 4-34), 3 (p. 4-33)
NSN	1325-716-1444, 1325-554-1173	4 (p. 30)

General Use and Description

The MC-1 750-pound bomb was used to provide toxic chemical offensive capability. The bomb was designed for internal or external carriage on bomber and fighter-bomber aircraft utilizing single or double lug suspension for release at altitudes up to 60,000 feet, and air speeds up to 600 knots. It was a general-purpose bomb M117 modified to accommodate a liquid chemical filler and a burster (2 p. 4-33).

The MC-1 bomb was essentially a M117-GP demolition bomb modified for a liquid chemical filler and burster. The complete bomb consisted of a body, fin assembly, one arming wire, three suspension lugs (14 inches apart), a nose fuze, adapter-boosters, burster, filling agent, and a tail fuze, which included a tail fuze drive with a flex coupling that connected the drive to the tail fuze. The bomb body was round in a cross section with an ogival nose and truncated conical tail. A burster tube was welded to the body at the nose end and into a hole in the base plate at the rear. The burster tube was internally threaded at each end and was fitted with fuze wells. The burster was a tubular fiberboard container filled with Composition B and closed by metal end caps. It was installed in the burster tube when the bomb was assembled. For use with one or two lug suspensions on Air Force bomber and fighter-bomber type aircraft (2 p. 4-33), (3 p. 4-32), (6 p. N3 - N5).

Explosive Train

The bomb functions with either a nose fuze, tail fuze, or both. The fuzes armed when the bomb was released from the aircraft. When the bomb impacted, the fuzes functioned and detonated the adapter-boosters which in turn detonated the burster. The burster ruptured the bomb body and disseminated the filler (1 p. 2-63), (6 p. N2, N3).

Fuzing

Bomb, 750-pound, MC-1 - Fuzing		
Fuze	**Notes**	**Citation**
AN-M103A1	Nose	1 (p. 2-62)
AN-M139A1	Nose	1 (p. 2-62)
AN-M140A1	Nose	1 (p. 2-62)
M163	Nose	1 (p. 2-62)
M164	Nose	1 (p. 2-62)
M165	Nose	1 (p. 2-62)
M190	Tail	1 (p. 2-62)
M904 (T709E3)	Nose	2 (p. 4-34), 3 (p. 4-33)
M904E1	Nose	1 (p. 2-62)
M904E2	Nose	1 (p. 2-62)
M905 (T771E4)	Tail - with T25E6 tail fuze drive assembly and T40 flexible coupling	1 (p. 2-62), 3 (p. 4-33)

Booster, Adapter-Booster, or Burster

Bomb, 750-pound, MC-1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M126A1 (T45E1) Adapter-Booster	N/A	N/A	-	1 (p. 2-62)
M32	14.5 lbs. (6.58 kg)	Composition B	-	1 (p. 2-62, 2-63)
T45E1 Adapter-Booster	0.35 lbs. (0.16 cm)	Composition C-3	Nose	5 (p. 18)
T6E4 Adapter-Booster	0.453 lbs. (0.21 kg)	Composition C-3	Tail	1 (p. 2-62), 5 (p. 18)

Fills

Bomb, 750-pound, MC-1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	220	99.7	710-725	322-329	-	2 (p. 4-34), 3 (p. 4-33), 5 (p. 3), 8 (p. 1-7)

Shipping/Packing

The MC-1 was shipped without fuzing components, weighed 625 pounds, and displaced 4.6 cubic feet (4 p. 30).

Miscellaneous Information

This bomb replaced the M78 and M79 bombs (2 p. 4-34), (3 p. 4-33).

Key Dates

Bomb, 750-pound, MC-1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1959	CCTC 3524	4 (p. 30), 6 (p. N1)

Sources

1. Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. U.S. Government Printing Office.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
3. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
4. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
5. CW Branch. 1958. Dugway Proving Ground Report, DPGR 219, Final Development Testing of the MC-1 USAF 750-Pound Toxic Bomb (U). U.S. Army Chemical Corps Research and Development Command.
6. Chemical Corps Technical Committee. 1958. CCTC Item # 3524, Subject: Classification of Bomb, Gas, Nonpersistent GB, 750 lbs., MC-1 as Standard-A, USAF Type. Department of the Army.
7. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
8. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.

6.19 Bomb, 1,000-pound, M79, AN-M79 (T3E1)

Figures

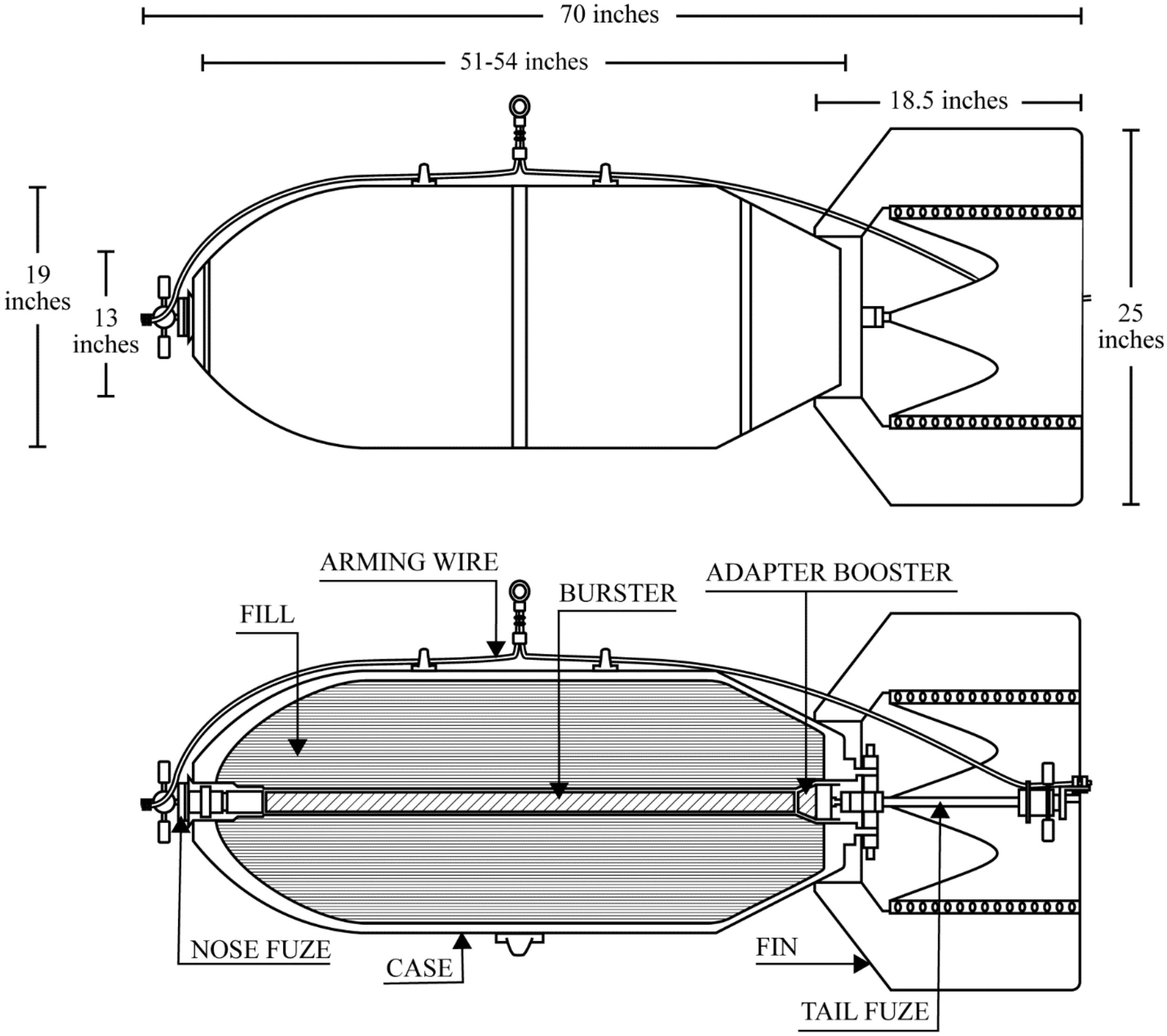

Figure 37: Bomb, 1,000-pound, M79, AN-M79 (T3E1) - Line Drawing

Figure 38: Bomb, 1,000-pound, AN-M79 - Photograph

Bomb, 1,000-pound, M79, AN-M79 (T3E1)

Specifications

Bomb, 1,000-pound, M79, AN-M79 (T3E1) - Specifications and Other Data		Citation
Historical Name	Bomb, Gas, Nonpersistent, CG, AC, or CK, 1,000-Pound, AN-M79	1 (p. 30), 2 (p. 1), 3 (p. 50), 4 (p. D1a)
Developmental Information	T3E1	4 (p. D1a), 5 (p. 1)
Type	Bomb	2 (p. 1), 6 (p. 10-8), 7 (p. 436)
Size	1,000-pound	2 (p. 1), 6 (p. 10-8), 7 (p. 434)
Conflict	WWII	4 (p. D2), 7
Service	Air Force, Army, Navy	4 (p. D3), 8 (p. I2)
Diameter	19 in. (48 cm) Tapers to 13 in. (33 cm)	2 (p. 1), 3 (p. 49 - 50), 4 (p. D2), 6 (p. 10-8), 7 (p. 434), 8 (p. I2), 9 (p. A-19), 10 (p. I2)
Length	Body: 51-54 in. (130-137 cm) Tail/Fin: 18.5 in. (47 cm) Overall: 70 in. (179 cm)	2 (p. 1), 3 (p. 49), 6 (p. 10-8), 7 (p. 434), 8 (p. I2), 9 (p. A-19), 4 (p. D2), 10 (p. 434)
Width	Tail/Fin: 25 in. (64 cm)	6 (p. 10-8), 7 (p. 434)
Wall Thickness	0.38 in. (0.96 cm)	7 (p. 434)
Other Engineering Data	Fin Assembly: AN-M64, AN-M65, AN-M109A1, AN-M113A1 or M113, AN-M128, AN-M129, M128, or M129 Weight, Empty: 485 lbs. (219.9 kg)	3 (p. 51), 4 (p. D2), 6 (p. 10-8), 8 (p. I2), 9 (p. A-19), 10 (p. I2, I4)
Construction Material	Forged or cast steel	2 (p. 1), 6 (p. 10-8), 7 (p. 434), 10 (p. 434)
Drawing	A2-0-98, 82-0-98, 82-3-416, 416A, 417, 4128, 419, 420, 82-14-46-46A	5 (p. 2), 6 (p. 10-8), 9 (A-19), 10 (p. I1)
FSN	1325-219-8569 (CG) 1325-219-8580 (AN-M79, AC-fill) 1325-219-8582 (CK)	4 (p. D3), 8 (p. I3)
Spec	MIL-B-13047A (AN-M79)	8 (p. I1), 10 (p. I1)

General Use and Description

Available references did not provide information on specific use.

The AN-M79 nonpersistent chemical agent bomb was an adaptation of the 1,000-pound AN-M65 general purpose bomb. It could be filled with AC, CG, or CK. It was round, with an ogival nose and truncated conical rear section. The bomb body was forged steel. Both double and single suspension lugs were welded to the body. The rear section tapered down to about 13 inches in diameter where a base plate was welded to close the body. The base plate had a filling hole, a hole for venting and sampling with a M1 needle valve, and a threaded center hole for an adapter-booster. A burster well was welded inside the base plate and extended to the bomb nose, where it was threaded to receive a fuze seat liner. The fuze seat liner in the bomb nose provided a seat for the fuze (1 p. 30), (3 p. 49 - 51), (6 p. 10-8), (7 p. 434), (9 p. A-19, A-21).

Explosive Train

Upon bomb release from aircraft bomb station, arming wires were withdrawn from both fuzes, freeing arming vanes to rotate. Vane rotation in the air stream armed the fuzes. The nose fuze normally detonated the burster, but if the nose fuze failed, the tail fuze, through the adapter-booster charge, would set off the burster. The burster shattered the bomb and released the agent (1 p. 30-31), (3 p. 51), (6 p. 10-8, 10-9), (7 p. 434, 436), (9 p. A-22).

Fuzing

Bomb, 1,000-pound, M79, AN-M79 (T3E1) - Fuzing		
Fuze	**Notes**	**Citation**
AN-M101A1	Tail	8 (p. I2)
AN-M102A1	Tail- alternate, with primer-detonator M14	3 (p. 51), 7 (p. 434), 11 (p. 183)
AN-M102A2	Tail- standard in 1945, with primer-detonator M14	2 (p. 2), 3 (p. 51), 4 (p. D2), 5 (p. 2), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19), 10 (p. I2, I4), 11 (p. 183)
AN-M103	Nose- alternate	3 (p. 50), 4 (p. D2), 5 (p. 2), 7 (p. 434), 10 (p. I2), 11 (p. 183)
AN-M103A1	Nose- arming vane type (standard in 1945)	2 (p. 2), 3 (p. 50), 4 (p. D2), 6 (p. 10-8), 7 (p. 434), 8 (p. 165), 9 (p. A-19), 10 (p. I2)
AN-M139A1	Nose- alternate	3 (p. 50), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19)
AN-M140A1	Nose- alternate	3 (p. 50), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19)
AN-M168	Nose- variable time, alternate	6 (p. 10-8), 9 (p. A-19)
AN-M184	Tail- alternate, required with M129 fins	6 (p. 10-8)
M103	Nose	7 (p. 434), 11 (p. 183)
M127	Nose- mechanical time (Army only with adapter-booster M117)	3 (p. 132), 7 (p. 434), 11 (p. 183)
M128	Nose- Navy only	7 (p. 434)
M135	Nose	7 (p. 434)
M135A1	Nose	7 (p. 434)
M136	Nose	7 (p. 434)
M136A1	Nose	7 (p. 434)
M139	Nose	7 (p. 434)
M139A1	Nose	7 (p. 434)
M140	Nose	7 (p. 434)
M140A1	Nose	7 (p. 434)
M162	Tail- preferred	3 (p. 51), 4 (p. D2), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19), 10 (p. I2, I4)
M163	Nose- preferred	3 (p. 50, 71), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19)
M164	Nose- alternate	3 (p. 50), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19)
M165	Nose- alternate	3 (p. 50), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19)
M166	Nose- variable time	7 (p. 434)
M175	Tail	10 (p. I2)
M176	Tail	4 (p. D2), 10 (p. I3)
T50E4	Nose- variable time	7 (p. 434)
T82	Nose- variable time	7 (p. 434)

Booster, Adapter-Booster, or Burster

Bomb, 1,000-pound, M79, AN-M79 (T3E1) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
AN-M15 Burster	N/A	N/A	-	8 (p. 165)
AN-M16 Burster	N/A	Tetrytol	Used with M1151A1 adapter-booster holder assembly	2 (p. 2), 3 (p. 50), 4 (p. D2), 6 (p. 10-8), 9 (p. A-19), 10 (p. I2), 11 (p. 183)
M16 Booster	4.45 lbs. (2.04 kg)	Tetrytol	Waterproof fiber tube	5 (p. 2, 3), 7 (p. 436), 9 (p. A-19)
M115 Adapter-booster	N/A	N/A	Mounted in the base plate threaded holder	3 (p. 50), 4 (p. D2), 5 (p. 2), 7 (p. 436), 8 (p. 165), 10 (p. I2), 11 (p. 183)
M115A1 Adapter-booster	N/A	N/A	Mounted in the base plate threaded holder	3 (p. 50), 4 (p. D2), 6 (p. 10-8), 7 (p. 436), 9 (p. A-19), 10 (p. I2), 11 (p. 183)
M117 Adapter-booster	N/A	N/A	-	3 (p. 132)

Bomb, 1,000-pound, M79, AN-M79 (T3E1)

Fills

Bomb, 1,000-pound, M79, AN-M79 (T3E1) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	185-200	83.9-90.7	707-728	320-330	-	1 (p. 30 - 32), 2 (p. 1), 3 (p. 50), 4 (p. D2), 6 (p. 10-8, 10-9), 7 (p. 434), 8 (p. 165), 9 (p. A-19), 11 (p. 183)
CG	404-417	183-189	926-987	420-447	-	1 (p. 30, 31), 2 (p. 1), 3 (p. 50), 4 (p. D2), 6 (p. 10-8), 7 (p. 434), 9 (p. A-19)
CK	315-351	142-159	860-884	390-401	-	1 (p. 30, 32), 2 (p. 1), 3 (p. 50), 4 (p. D2), 6 (p. 10-8), 9 (p. A-19)

Shipping/Packing

Shipping bands protected the bomb during shipping and storage. The bombs were shipped without fins, fuzes, or burster components. Shipping weight was approximately 710-719 pounds (322-326 kilograms) when AC-filled, 930-939 pounds (421.8-425.9 kilograms) when CG-filled, and 866-875 pounds (392.8-396.8 kilograms) when CK-filled (2 p. 2), (6 p. 10-9), (3 p. 52), (9 p. A-22).

Miscellaneous Information

The M79 bomb was a wartime item adapted from the AN-M65 general purpose bomb to provide large munitions with substantial quantities of nonpersistent agent. During the immediate post-war years, the M79 was considered an asset in Air Force operational plans. The wartime bombs were upgraded with the AN-M129 fin assembly, M176 fuze, and M13 arming wire to improve accuracy with high-speed, high-altitude aircraft. Meanwhile, the development of the nonpersistent agent GB, and munitions for its delivery (i.e., MC-1, M34A1 cluster) reduced the need for the M79 bomb.

Between 1944 and 1945, 63,578 CG-filled, and 55,851 CK-filled AN-M79 bombs were procured. In 1949, there were 26,819 CG, 33,361 CK, and no AC-filled M79 bombs on hand. When CK became a limited standard item in 1951, there were 33,297 CK-filled M79 bombs on hand. In 1960, it was reported that 4,979 AC-filled M79 bombs had been procured, but there were none on hand. In 1963 when the AN-M79 was obsoleted, there were 25,411 CG-filled, 35,165 CK-filled, and 5,268 empty AN-M79 bombs on hand (4 p. D3, D4), (8 p. I2), (10 p. I1), (12 p. 77), (13 p. 96).

Key Dates

Bomb, 1,000-pound, M79, AN-M79 (T3E1) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1943	CCTC 881 (CK and CG-fill Standard and AC as substitute Standard)	14 (p. 82)
Standardized	1944	OCM 22844 (AC-, CK-, and CG-fill)	5 (p. 5)
Standardized	1951	CCTC 2289 (M79 CK-fill Limited Standard)	12 (p. 76)
Standardized	1958	CCTC 3408 (CG-Fill – Standard-Air Force CK and AC-fill – Limited Standard – Air Force)	15 (p. 106)
Standard Modernization	1959	CCTC 3525 (CK and AC-fill Standard-C – Air Force)	16 (p. 213)
Obsoleted	1960	CCTC 3686 (AC-fill)	8 (p. I3)
Obsoleted	1963	CCTC 4141 (AN-M79 CK and CG-fill)	4 (p. D5, D6)

Sources

1. Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. Department of the Army.

2. War Department. 1945c. Technical Bulletin, TB CW 22, Nonpersistent Gas Bombs: Handling, Shipping, and Storage. Department of the Army.

3. Departments of the Army and Air Force. 1953. Technical Manual, TM 3-400/Technical Order, TO 39B-15C-1, Chemical Bombs and Clusters. Department of the Army.

4. Chemical Corps Technical Committee. 1963. CCTC Item # 4141, Subject: Obsoletion of Bombs, Gas, Nonpersistent CG & CK, 500-lb., AN-M78; & Bombs, Gas, Nonpersistent CG & CK, 1000-lb., AN-M79 (U). U.S. Army Materiel Command.

5. Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 22844, Bomb, Chemical, 1000-LB., M79 (T3E1), Burster M16, and Valve, Needle M1: - Standardization. Ordnance Department.

6. Bureau of Naval Weapons. 1960. NAVWEPS Ordnance Pamphlet, OP 2216, Aircraft Bombs, Fuzes and Associated Components. U.S. Government Printing Office.

7. Bureau of Ordnance. 1947. Ordnance Pamphlet, OP 1664 (Vol. 1), U.S. Explosive Ordnance. Department of the Navy.

8. Chemical Corps Technical Committee. 1960. CCTC Item # 3686, Obsoletion of Bomb, Gas, Nonpersistent AC, 1000-lb., AN-M79 & Quick-acting Hydrogen Cyanide, AC Quick-Acting Hydrogen Cyanide, AC. Department of the Army.

9. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command. 15 August.

10. Chemical Corps Technical Committee. 1957. CCTC Item # 3286, Subject: Incorporation of Fin Assemblies, Bomb, AN-M128 & AN-M129; Fuzes, Bomb Tail, M175 & M176; & Arming Wire Assembly, M13 as Standard Components of the AN-M78 & AN-M79 500-lb. & 1000-lb. Gas Bombs. Department of the Army.

11. War Department. 1944. Technical Manual, TM 9-1980, Bombs for Aircraft. U.S. Government Printing Office.

12. Chemical Corps Technical Committee. 1951. CCTC Item # 2289, Reclassification of Cyanogen Chloride, CK to Limited Standard Type. Department of the Army.

13. Chemical Corps Technical Committee. 1949. CCTC Item # 2000, Incorporation of Gas and Smoke Bombs in Chemical Corps Records. Department of the Army. June 15.

14. Chemical Corps Technical Committee. 1943. CCTC Item # 881, Classification of Fillings for Chemical Munitions. Department of the Army.

15. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.

16. Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.

6.20 Bomb, 1,000-pound, T1

Figures

No images were found in available references.

Specifications

Bomb, 1,000-pound, T1 – Specifications and Other Data		Citation
Historical Name	T1, 1,000-lb. bomb	1 (p. 2)
Type	Bomb	1 (p. 2), 2 (p. 1)
Size	1,000-pound	1 (p. 2), 2 (p. 1)
Service	Navy	1 (p. 1)
Other	Weight, Empty: 343 lbs. (156 kg)	1 (p. 2)

General Use and Description

Available references did not provide this information.

Explosive Train

The explosive force of the burster caused the filling to be dispersed mainly as liquid droplets (1).

Fuzing

Available references did not include information regarding fuzes for this item.

Booster, Adapter-Booster, or Burster

Bomb, 1,000-pound, T1 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M16 burster	4.29 lbs. (1.94 kg)	Tetrytol	–	1 (p. 2)
T2 burster	4.45 lbs. (2.02 kg)	Tetrytol	–	2 (p. 2)

Fills

Bomb, 1,000-pound, T1 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
AC	208-232	94.3-105.2	551-575	250-261	1 (p. 2), 2 (p. 2)
CG	428-452	194-205	771-795	350-361	1 (p. 2), 2 (p. 2)
CK	370-381	168-173	713-724	323-328	1 (p. 2), 2 (p. 1)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not provide this information.

Sources

1. Technical Staff, Dugway Proving Ground. 1944. Dugway Proving Ground Memorandum Report, DPGMR No. 18, 500-LB., 1000-LB., 2000-LB., and 4000-LB. Bombs Filled with Nonpersistent Agents. Chemical Warfare Service.
2. Dole, Malcolm and Nolan, Jake, Captain. 1944. Dugway Proving Ground Memorandum Report, DPGMR 15, Florida Forest Field Trials of Non-Persistent and Persistent Agents. Chemical Warfare Service.

6.21 Bomb, 1,000-pound, T2

Figures

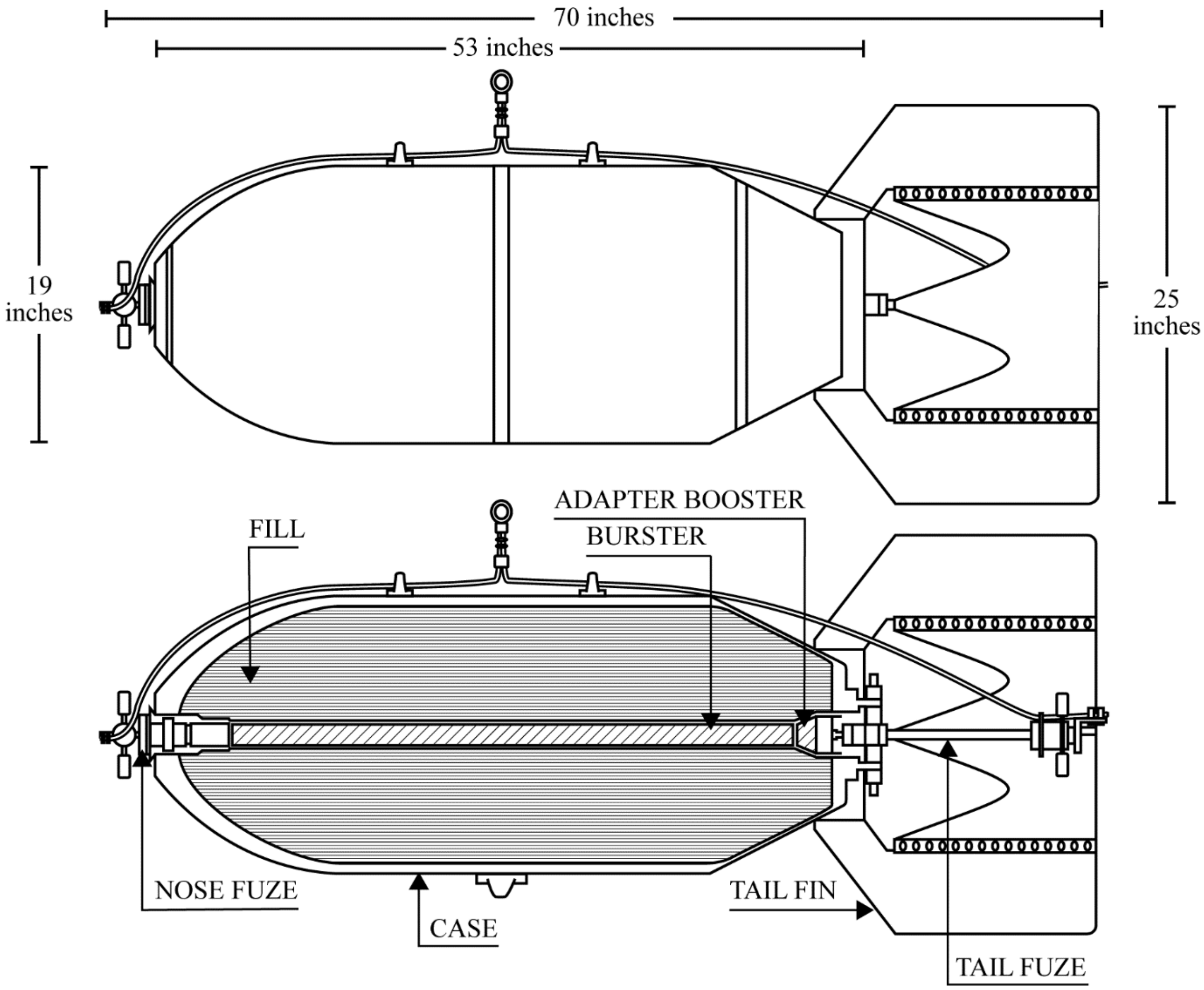

Figure 39: Bomb, 1,000-pound, T2 - Line Drawing

Figure 40: Bomb, 1,000-pound, T2 - Photograph

Bomb, 1,000-pound, T2

Specifications

Bomb, 1,000-pound, T2 - Specifications and Other Data		Citation
Historical Name	T2 1000-Pound Chemical Bomb	1 (p. 1)
Type	Bomb	1 (p. 1)
Size	1,000-pound	1 (p. 1)
Conflict	WWII	1 (p. 1)
Service	Navy	1
Diameter	19 in. (48 cm)	1 (p. 3)
Length	Overall: 70 in. (179 cm) Body: 53 in. (135 cm)	1 (p. 3)
Width	Fin: 25 in. (64 cm)	1 (p. 8)
Specification	196-131-239 (AC-fill) 196-131-240 (CG-fill)	5 (p. 4)
Other	Weight, Empty: 490 lbs. (222 kg)	1 (p. 6)
Drawing	395185	1 (p. 2)

General Use and Description

The 1,000-pound T2 chemical bomb was intended to be filled with various chemicals, principally nonpersistent toxic agents, which required large quantities to obtain concentrations that would be lethal to personnel (1 p. 1).

The T2 1000-pound chemical bomb was essentially an AN-M65 1,000-pound general purpose bomb modified for chemical filling. It had a bursting charge sufficient to break the body into a few large pieces and to disperse the filler, and it was adapted for both a nose and tail fuze. The modifications included two filling holes and a test hole in the side of the body, and a full-length burster well extending down the axis of the bomb. The filling holes were closed with 1.5-inch standard pipe plugs and the test hole was closed with a 0.5-inch standard pipe plug. The threads on the filling and test hole plugs were tinned with solder to insure a tight seal. The filling holes were located diametrically opposite the two double suspension lugs. The test hole was midway between the filling hole and the single suspension lug.

The burster well was a steel tube welded into the tail plug of the bomb and to the nose of the bomb. The tail plug was screwed into the bomb and welded. The box-type fin assembly was the same as was used with the AN-M65 1,000-pound general purpose bomb.

The AC loaded bombs were equipped with a special plug that contained a sampling valve, in place of the forward 1.5-inch plug in the side of the bomb. The valve was flush with the bomb surface. The T2 bomb differs from the M79 bomb mainly in the location and type of filling holes, in the method of assembling the full-length burster well, and in the adapter-booster (1 p. 1, 2, 5).

Explosive Train

Available references did not provide specific information on explosive train.

Bomb, 1,000-pound, T2

Fuzing

Bomb, 1,000-pound, T2 - Fuzing		
Fuze	**Notes**	**Citation**
AN-M102A1	Alternative	1 (p. 2), 3 (p. 2)
AN-M102A2	Tail	1 (p. 2)
AN-M103	Nose	1 (p. 2)
AN-MK 219 bomb fuze	Used with MK 219 fuze adapter and MK 4 auxiliary booster; alternate to AN-M103	1 (p. 2), 2 (p. 2-247)

Booster, Adapter-Booster, or Burster

Bomb, 1,000-pound, T2 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M102 Adapter-booster	N/A	N/A	-	1 (p. 2)
M16 Burster	4.29 lbs. (1.95 kg)	Tetrytol	-	3 (p. 2)
T2	4.45 lbs. (2.02 kg)	Cast tetrytol	Diameter: 1.75-in. (4.45 cm) Length: 41.97 in. (107 cm)	1 (p. 2)

Fills

Bomb, 1,000-pound, T2 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	208	94.3	707	320	-	1 (p. 6), 3 (p. 2)
CG	428	194	923	418	-	1 (p. 6), 3 (p. 2), 4 (p. II-2)
CK	370	167	860	390	Filled as CC	1 (p. 1)
DP (diphosgene)	N/A	N/A	N/A	N/A	-	1 (p. 1)
H	N/A	N/A	N/A	N/A	-	1 (p. 1), 4 (p. II-2)
L	N/A	N/A	N/A	N/A	-	1 (p. 1)

Shipping/Packing

The T2 bomb body, suspension lugs, and filling holes were protected during shipment by metal shipping bands. The tail fin assembly, fuzes, and arming wire assembly were shipped together in a crate, separately from the bomb body. The filled bomb was shipped from Naval ammunition depots with the high explosive burster, the adapter-booster, and the fuze seat liner installed, and with the shipping plugs screwed into the fuze cavities at both ends of the bomb (1 p. 1, 2, 4).

Miscellaneous Information

As of 1948, the bomb, chemical, 1,000 lb., T2 filled with AC, CG and H were listed as “unauthorized CML C Items” (4 p. II-2).

Key Dates

Bomb, 1,000-pound, T2 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1944	OCM Item 22844	5 (p. 4)

Sources

1. Bureau of Ordnance. 1943. Ordnance Pamphlet, OP 1030, Nonpersistent Gas Munitions. Department of the Navy.
2. Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Cancelled Fuzes, MIL-HDBK-146. Department of Defense.

3. Technical Staff, Dugway Proving Ground. 1944. Dugway Proving Ground Memorandum Report, DPGMR No. 18, 500-LB., 1000-LB., 2000-LB., and 4000-LB. Bombs Filled with Nonpersistent Agents. Chemical Warfare Service.

4. Office of the Chief Chemical Corps. 1946. Disposition of Chemical Corps Items, Department of the Army. U.S. Army.

5. Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 22844, Bomb, Chemical, 1000-LB., M79 (T3E1), Burster M16, and Valve, Needle M1: - Standardization. Ordnance Department.

6.22 Bomb, 1,000-pound, General Purpose, (y) E2C

Figures

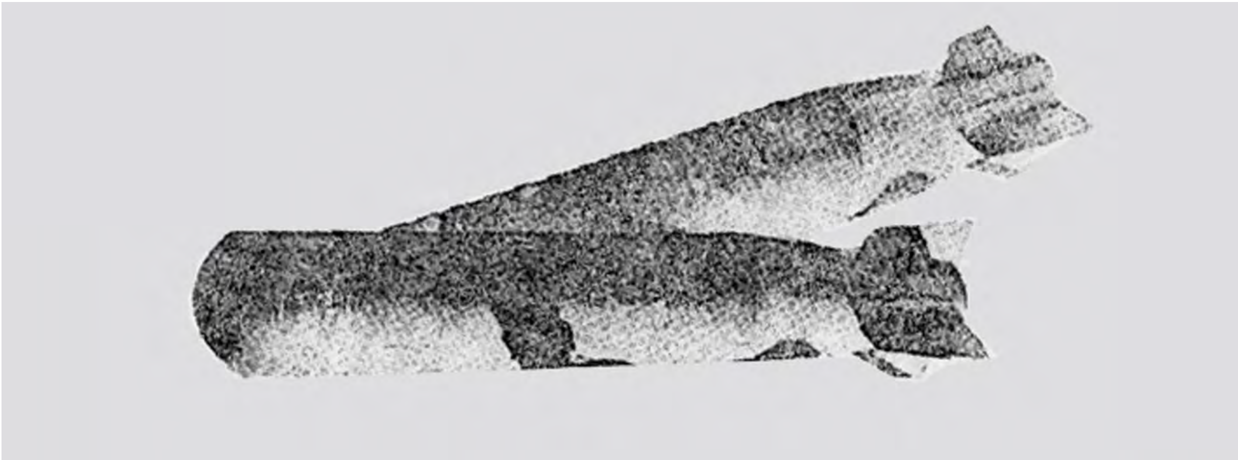

Figure 41: Bomb, 1,000-pound, General Purpose, (y) E2C - Photograph

Specifications

Bomb, 1,000-pound, General Purpose, (y) E2C - Specifications and Other Data		Citation
Historical Name	(y) E2C 1000 lb. Bomb, General Purpose	1 (Appendix A, page 63)
Type	Bomb	2
Size	1,000-pound	1 (Appendix A, page 63)
Conflict	Cold War	2
Diameter	17 in. (41.91 cm)	2
Length	100 in. (252.73 cm)	2

General Use and Description

The (y) E2C was a general purpose, persistent, chemical agent bomb designed for use with strategic bombing aircraft capable of flight at high speeds and high altitudes (2).

It was fuzed with a T765 variable time nose fuze set at the factory to function 62 feet above terrain. This bomb was a light-cased bomb utilizing a cast axial burster weighing 10 pounds (2).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Bomb, 1,000-pound, General Purpose, (y) E2C - Fuzing		
Fuze	**Note**	**Citation**
T765	Nose-variable time	2

Booster, Adapter-Booster, or Burster

Bomb, 1,000-pound, General Purpose, (y) E2C - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Cast aerial burster	10 lbs. (4.54 kg)	N/A	-	2

Bomb, 1,000-pound, General Purpose, (y) E2C

Fills

Bomb, 1,000-pound, General Purpose, (y) E2C - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
HD	522	236	858	389	-	2

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.

2. Dugway Proving Ground. 1953. Dugway Proving Ground Report, DPGR 124, Operational Evaluation of the Bomb (y) E2C, CW 12-52. AD896570. Department of the Army.

6.23 Bomb, 2,000-pound, T2

Figures

No images were found in available references.

Specifications

Bomb, 2,000-pound, T2 – Specifications and Other Data		**Citation**
Historical Name	Bomb, 2,000-lb. T2	1 (p. 2), 2 (p. 16)
Type	Bomb	1 (p. 2), 2 (p. 16)
Size	2,000-pound	1 (p. 2), 2 (p. 16)
Conflict	WWII	1 (p. 1)
Other	Weight, Empty: 1,028-1,053 lbs. (466-478 kg)	1 (p. 2), 2 (p. 16)

General Use and Description

There is only a slight difference between the M78 and M79 bombs and the T2 series of 2,000-pound bombs (1 p. 2).

Explosive Train

Available references did not provide this information.

Fuzing

Bomb, 2,000-pound, T2 – Fuzing		
Fuze	**Notes**	**Citation**
M103	Nose	1 (p. 2)
M102A1	Tail	1 (p. 2)

Booster, Adapter-Booster, or Burster

Bomb, 2,000-pound, T2 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M17 burster	5.98 lbs. (2.71 kg)	Tetrytol	–	1 (p. 2)

Fills

Bomb, 2,000-pound, T2 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Notes Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
AC	408	185	1,436	651	1 (p. 2)
CG	839	381	1,867	847	1 (p. 2)
CK	726	329	1,754	796	1 (p. 2)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not provide this information.

Sources

1. Technical Staff, Dugway Proving Ground. 1944. Dugway Proving Ground Memorandum Report, DPGMR No. 18, 500-LB., 1000-LB., 2000-LB., and 4000-LB. Bombs Filled with Nonpersistent Agents. Chemical Warfare Service.

2. National Defense Research Committee. Undated. 1940s Filling Data on Large Chemical Bombs, Table III, K. National Defense Research Committee REEL 457, p. 16.

7 Bomblet

Small (10-pound and less) bombs are called bomblets when loaded into clusters. The bodies of small chemical agent bombs are round in cross section while those of small incendiary bombs are hexagonal. When a group of bomblets are fastened together so that the group can be carried in, and released from, an aircraft in the same way as a single large bomb they are referred to as a cluster bomb. After release from the aircraft, the cluster separates, and the bomblets fall individually to the target (Departments of the Army and the Air Force, 1957 p. 3). A bomblet is a component part of a clustered munition (e.g., cluster bomb, missile warhead) designed to achieve wide area coverage (Carter, Jr., and Wilson 1957, 1) (Secretary of the Army, 1962, p. 15).

7.1 Bomblet, 2.5-inch, E139

Figures

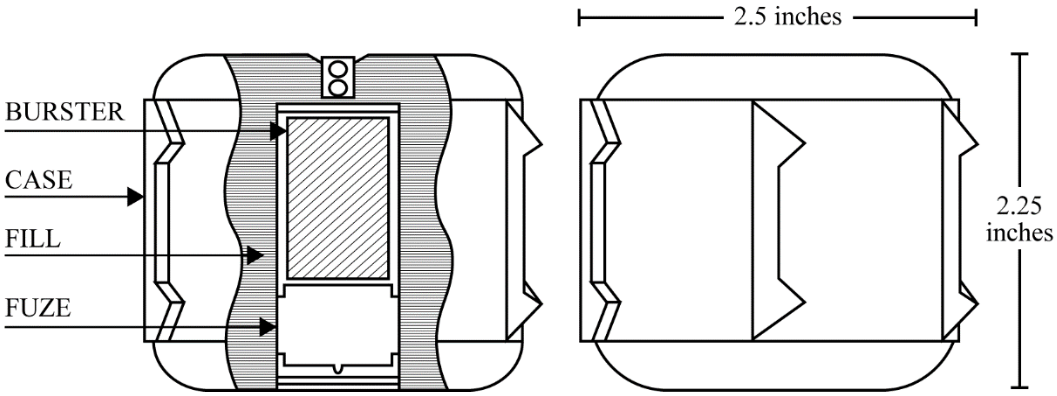

Figure 42: Bomblet, 2.5-inches, E139 - Line Drawing

Figure 43: Bomblet, 2.5-inches, E139 - Photograph - Right: Exterior; Left: Cutaway View

Specifications

Bomblet, 2.5-inches, E139 - Specifications and Other Data		**Citation**
Historical Name	E139, Bomblet	1 (p. 10-14)
Type	Bomblet	1 (p. 10-14)
Size	2.5-inches	2 (p. 15)
Conflict	Cold War	1, 3, 4
Service	Army	2, 4
Diameter	2.5 in. (6.35 cm)	1 (p. 10), 2 (p. 15)
Length	2.25 in. (5.72 cm)	1 (p. 10), 2 (p. 15), 4 (p. 7)
Wall Thickness	0.045 in. (0.11 cm)	1 (p. 10), 2 (p. 15)
Construction Material	Aluminum alloy	1 (p. 10), 2 (p. 15)

General Use and Description

The E139 was designed to provide long range offensive chemical capabilities (3 p. 7 - 8).

Bomblet, 2.5-inches, E139

The E139 bomblet was a self-dispersing cylindrical munition. It was constructed of two cylindrical cups, each made of approximately 0.045-inch thick aluminum alloy. These cups were Tig-welded together at their periphery. A 0.137-pound hard lead band was wrapped in a groove around the body midsection for rotational inertia effects. One end of the bomblet contained a filling opening that was sealed after filling by a pressed double-ball closure. The opposite end had an accessible burster well. The burster assembly consisted of a tetryl pellet (encased in polyethylene) that was 0.98-inch in diameter and 0.671-inch long, the M219E1 grenade fuze, and a steel compression spring, washer, and snap-ring retainer. A collar of 0.020-inch thick aluminum alloy, which had been extruded with six integral driving ribs, was pressed onto the cylindrical body. In flight these ribs induced the bomblet to spin about its longitudinal axis to arm the M219E1 fuze, as well as to create an aerodynamic lifting force on the bomblet for dispersion (1 p. 10, 14), (4 p. 7).

Explosive Train

The armed fuze functioned upon impact with the ground when a stab type firing pin initiated the detonator, thereby igniting a lead cup of Royal Demolition Explosive (RDX) which would disseminate the agent (1 p. 14), (4 p. 7).

Fuzing

Bomblet, 2.5-inches, E139 - Fuzing		
Fuze	**Note**	**Citation**
M219E1 grenade fuze	Grenade fuze	1 (p. 14), 4 (p. 7)

Booster, Adapter-Booster, or Burster

Bomblet, 2.5-inches, E139 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	0.0265 lbs. (0.012 kg)	Tetryl pellet	Burster	1 (p. 10)

Fills

Bomblet, 2.5-inches, E139 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	0.26	0.12	0.67	0.30	-	1 (p. 10), 4 (p. 7)

Shipping/Packing

Approximately 1,130 E139 bomblets were in six nylon fabric bags that were used for packaging and dispersing of the bomblets (4 p. 7).

Miscellaneous Information

Approximately 1,140 E139 bomblets were used in the E27 Warhead Section of the 1,000-pound Lance missile (2 p. 10).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bush, O.J. 1971. Edgewood Arsenal Technical Report, EATR 4476, Test and Evaluation of E27 Warhead Section (Lance) Safety Features Involving the Agent Hazard. U.S. Army Munitions Command.
2. Bush, O.J. 1972. Edgewood Arsenal Technical Report, EATR 4613, E27 Chemical Warhead Section Final Report (U). Department of the Army.
3. Michniewicz, Peter. 1971. Edgewood Arsenal Technical Report, EATR 4517, Final Flight Test Report of the E27 Warhead Section/ Lance Missile, O8L. Department of the Army.
4. Michniewicz, Peter. 1971. Edgewood Arsenal Technical Report, EATR 4529, Final Flight Test Report of the E27 Warhead Section/ Lance Missile, 12L. U.S. Army Munitions Command.

7.2 Bomblet, 4.25-inch, Cube, E123

Figures

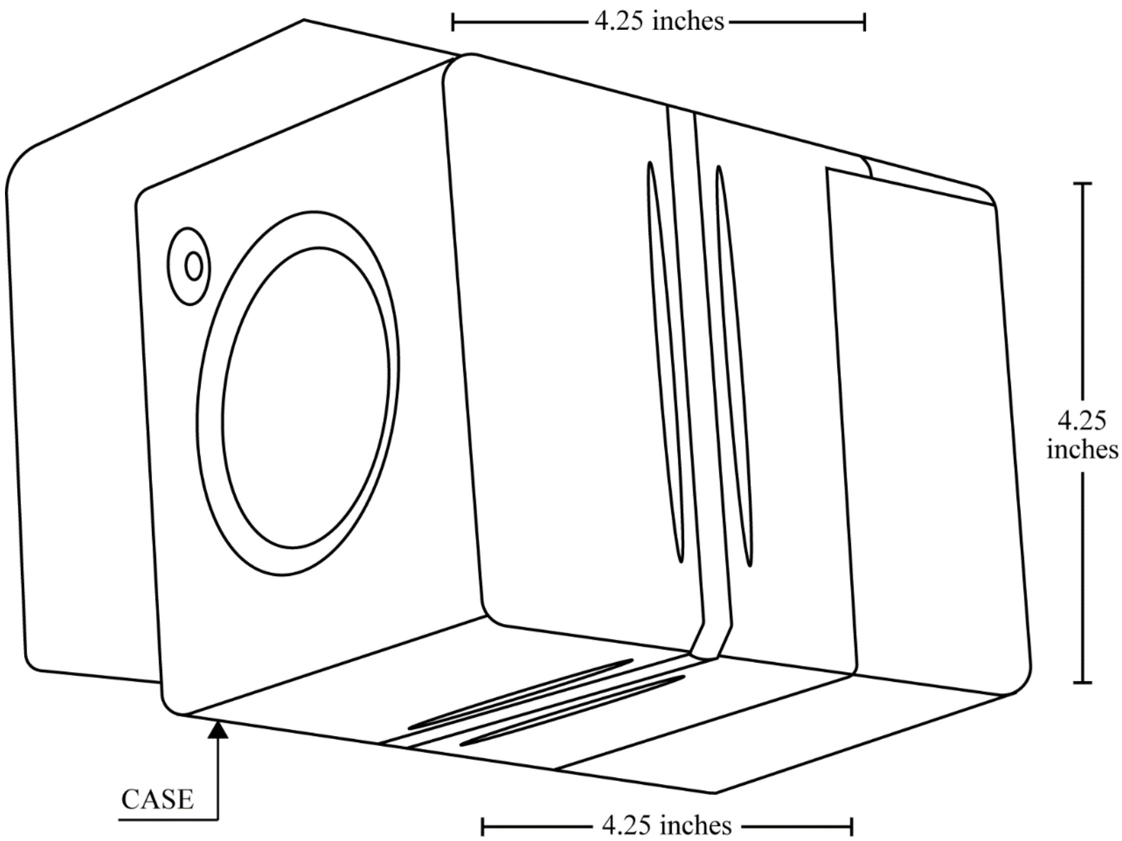

Figure 44: Bomblet, 4.25-inch, Cube, E123 - Line Drawing

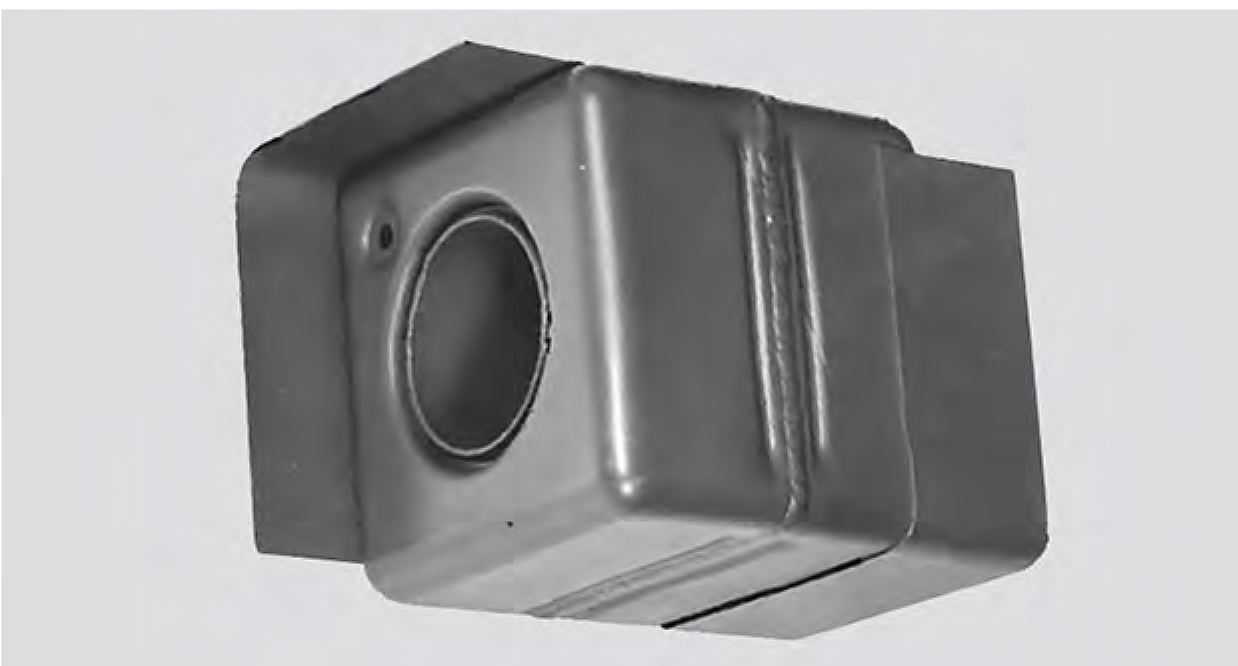

Figure 45: Bomblet, 4.25-inch, Cube, E123 - Photograph

Bomblet, 4.25-inch, Cube, E123

Specifications

Bomblet, 4.25-inch, Cube, E123 - Specifications and Other Data		Citation
Historical Name	E123 "Cube" Bomblet	1 (p. 1)
Type	Bomblet	1 (p. 1)
Size	4.25-inch	1 (p. 3)
Conflict	Cold War	1 (p. 1)
Service	Air Force	1 (p. 1)
Length	4.25 in. (10.79 cm)	1 (p. 3)
Width	4.25 in. (10.79 cm)	1 (p. 3)
Height	4.25 in. (10.79 cm)	1 (p. 3)

General Use and Description

The E123 cluster munition was designed to achieve wide area coverage of toxic agents (1 p. 1).

The E123 bomblet was cube shaped with walls 4.25 inches in length. It had a central burster well and a simple soldered closure. The bomblet was fitted with an internal stiffener plate located at the center of the bomblet and perpendicular to the burster well. The bomblet was equipped with one-inch fins. Subsequent bomblets were equipped with 0.5-inch fins, which were shown to result in better dispersion. Stiffener ribs were provided in the bomblet walls close to the seam formed in welding the bomblet body halves to the stiffener plate. The ribs served to minimize distortion of the bomblet walls by the heat of welding.

The fuze was a mechanical type, all-ways fuze that had a centrifugal arming system (1 p. 3 - 4).

Explosive Train

Upon release from the cluster adapter, aerodynamic forces would cause the bomb to spin. Centrifugal force would then arm the fuze. Upon impact the fuze would initiate, setting off the burster, which would spread the chemical agent filler (1 p. 4).

Fuzing

Bomblet, 4.25-inch, Cube, E123 - Fuzing		
Fuze	**Note**	**Citation**
Not designated	All-ways acting, mechanical	1 (p. 4)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Bomblet, 4.25-inch, Cube, E123 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.90	0.86	4.30	1.95	-	1 (p. 4)

Shipping/Packing

Available references did not provide this information.

Bomblet, 4.25-inch, Cube, E123

Miscellaneous Information

Used with the M30 adapter. Each adapter held 91 cubes. Total weight of agent in an adapter was 173 pounds (1 p. 4).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Carter, J, Jr., & Wilson, Billy. 1957. Munitions Development Division Technical Memorandum, Development of E123 "Cube" Bomblet (U). Munitions Development Division.

7.3 Bomblet, 4.5-inch, Spherical, M139 (E130R2)

Figures

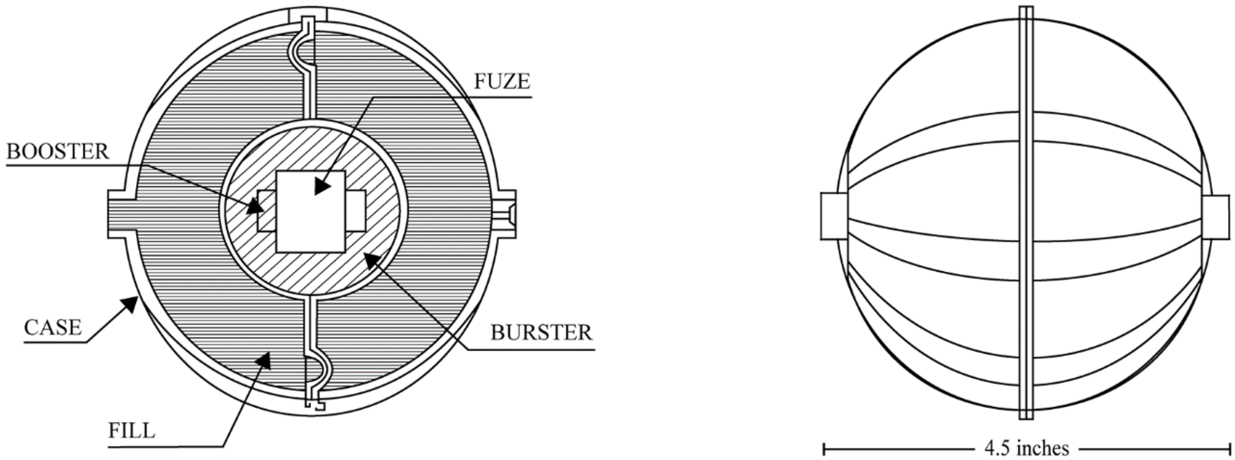

Figure 46: Bomblet, 4.5-inch, Spherical, M139 (E130R2) - Line Drawing

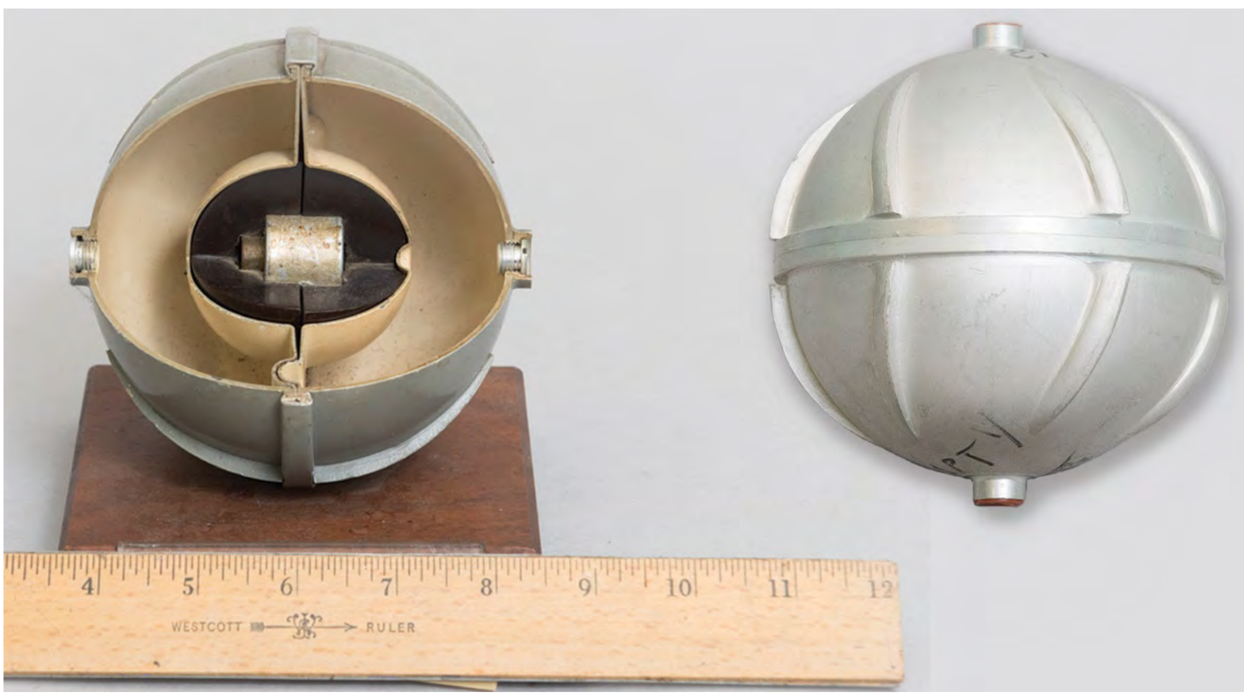

Figure 47: Bomblet, 4.5-inch, Spherical, M139 (E130R2) - Photograph - Left: Cutaway View, Right: Exterior

Bomblet, 4.5-inch, Spherical, M139 (E130R2)

Specifications

Bomblet, 4.5-inch, Spherical, M139 (E130R2) - Specifications and Other Data		Citation
Historical Name	Bomb, Nonpersistent Gas, Spherical, 4.5 Inch, M139 Bomblet, Spherical, 2.4-Pound (GB-VX) E130R2	1 (p. 4-5), 2
Developmental Information	E130R2	5
Type	Bomblet	1 (p. 4-5)
Size	4.5-inch	1 (p. 4-6), 2 (p. 3), 3 (p. 4-7)
Conflict	Cold War	1
Service	Army	2 (p. cover)
Diameter	4.5 in. (11.5 cm)	1 (p. 4-6), 3 (p. 4-6), 4 (p. 189)
Construction Material	Aluminum and steel	1 (p. 4-5)
Drawing	CMLC DRWG: 14-5-2768, C14-6-2768	1 (p. 4-6), 3 (p. 4-7)
NSN	1325-00-729-5261	6 (p. 30)

General Use and Description

The M139 self-dispersing bomblets were used in the Sergeant M212 and Honest John M190 warheads to provide a long-range chemical offensive capability (1 p. 4-5, 4-6), (3 p. 4-6, 4-7).

This bomblet had an aluminum outer shell with six aerodynamic ribs on the outer surface canted 12 degrees, which on release impart a high spin dispersing the bomb and arming the fuze. A spherically-shaped burster charge, located concentrically with the outer surface, was used for disseminating the fill. The bomblet was constructed in two halves to facilitate assembly of the fuze and burster charge. A steel ring clamped the two halves together. The inner shell was steel (1 p. 4-5, 4-6), (3 p. 4-6), (7 p. 518).

Explosive Train

The fuze was an all-ways acting impact type, which armed upon being rotated at a high-speed. Upon impact, the fuze functioned, setting off an RDX booster pellet mounted in the center of the burster. The booster caused the burster to function and spread the chemical agent (i.e., GB and VX) (1 p. 4-5), (5).

Fuzing

Bomblet, 4.5-inch, Spherical, M139 (E130R2) - Fuzing		
Fuze	**Note**	**Citation**
XM912 (M912)	Centrifugal arming, all-ways/impact, 1.07-in. (2.72 cm) long by 0.99-in. (5.05 cm) in diameter	1 (p. 4-6), 3 (p. 4-6), 4 (p. 189), 7 (p. 518)

Booster, Adapter-Booster, or Burster

Bomblet, 4.5-inch, Spherical, M139 (E130R2) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M45 (E20) Burster	0.15 lbs. (0.07 kg)	Composition B	Spherically shaped burster charge	5
M140 (E55) Auxiliary booster	N/A	RDX	-	7 (p. 518)

Bomblet, 4.5-inch, Spherical, M139 (E130R2)

Fills

Bomblet, 4.5-inch, Spherical, M139 (E130R2) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.30	0.58	2.14-2.5	0.97-1.13	-	1 (p. 4-6), 3 (p. 4-6 - 4-7), 4 (p. 189), 6 (p. 30)
VX	1.30	0.58	2.40	1.09	-	1 (p. 4-6)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The M139 was used with the XM50 warhead (368 bomblets), the Little John warhead E20 (368 bomblets), the Sergeant warhead E21 (330 bomblets), and the improved Honest John warhead E19R2 (1 p. 4-6), (3 p. 4-7), (4 p. 167, 169), (5).

Key Dates

Bomblet, 4.5-inch, Spherical, M139 (E130R2) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1964	Army Materiel Command Technical Committee (AMCTC) 2621 (Standard-A)	7 (p. 513)

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
2. Army - MU(EA). 1995. Military Specification, MIL-B-60073A(MU), Bomb, Nonpersistent Gas, Spherical, 4.5 Inch, M139; Filling and Assembly. Department of the Army.
3. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
4. School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. U.S. Army Missile and Munitions Center.
5. Stewart, F., & Wagner, P. 1962. CRDL Technical Memorandum 30-66, Development of Bomb, Nonpersistent Gas, Spherical, 4.5-inch, E130R2 (U). Directorate of Development, U.S. Army Chemical Research & Development Laboratories, Army Chemical Center.
6. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
7. Chemical Biological Subcommittee. 1964. AMCTC Item # 2621, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. U.S. Army Materiel Command.

7.4 Bomblet, 5.2-inch, Spherical, E118

Figures

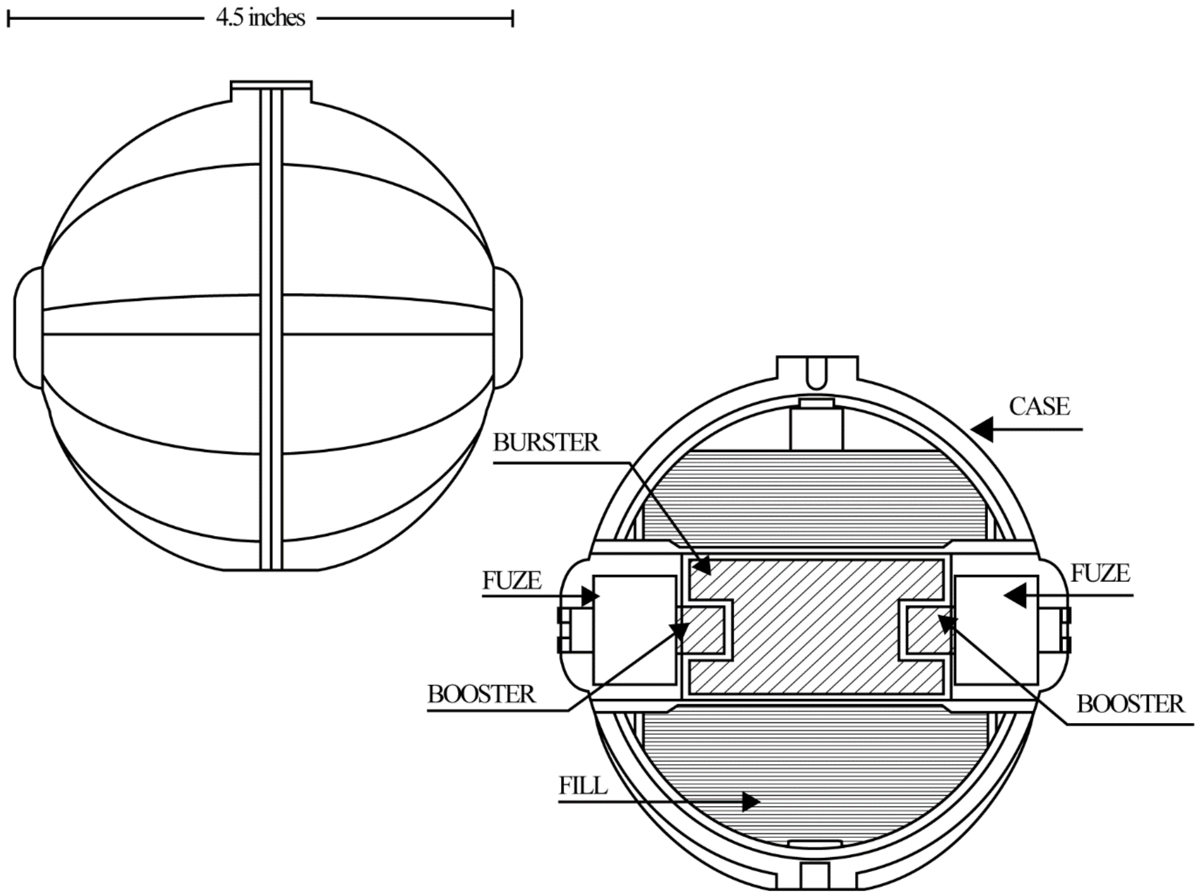

Figure 48: Bomblet, 5.2-inch, Spherical, E118 - Line Drawing

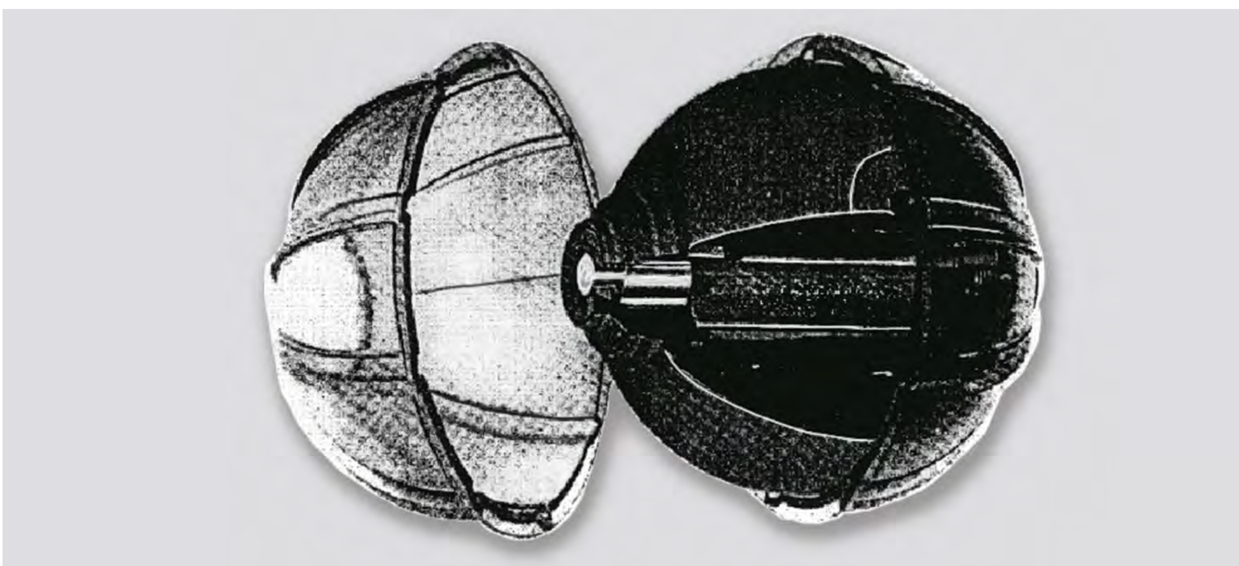

Figure 49: Bomblet, 5.2-inch, Spherical, E118

Bomblet, 5.2-inch, Spherical, E118

Specifications

Bomblet, 5.2-inch, Spherical, E118 - Specifications and Other Data		Citation
Historical Name	E118 5.2-Inch Bomb, Nonpersistent, Gas, Spherical	1 (p. 3, appendix A)
Type	Bomblet	1 (p. 3, appendix A)
Size	5.2-inch	4 (p. 8)
Conflict	Cold War	4 (p. 8)
Diameter	5.25 in. (13.32 cm)	2 (p. 12), 4 (p. 8)
Other Engineering Data	The E118 was replaced by the E130 spherical bomblet.	4 (p. 8)
Construction Material	Outer shell: plastic Inner shell: steel	2 (p. 12), 4 (p. 8)

General Use and Description

The E118 was developed during an effort to produce self-dispersing bomblets for use with high-speed missiles. The E118 is a nine-ribbed, 5.25-inch diameter spherical GB munition with a plastic outer shell and a steel inner shell (3 p. 6), (4 p. 8).

The final E118 Spherical Bomblet design employed a cylindrical burster between two T1027 centrifugally armed all-ways impact fuzes. The burster and fuzes were contained within a burster well which was located parallel and concentric with the axis of spin. Surrounding the burster well was an annular synthetic rubber tube which acted as a void control. The agent was contained between the synthetic tube and the spherical steel shell. Attached to the inner surface of the steel shell were four vanes or impellers to assist in rotating the liquid. Two hemispherically shaped plastic shells containing nine driving ribs were cemented over the spherical steel shell (4 p. 8).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Bomblet, 5.2-inch, Spherical, E118 - Fuzing		
Fuze	**Note**	**Citation**
T1027	All-ways impact fuze, two required	2 (p. 12), 4 (p. 8)

Booster, Adapter-Booster, or Burster

Bomblet, 5.2-inch, Spherical, E118 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	Composition C	Cylindrical burster situated between two T1027 fuzes. Weight range 0.33-0.41 lbs. (0.15-0.19 kg).	3 (p. 9), 4 (p. 8)

Fills

Bomblet, 5.2-inch, Spherical, E118 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.60	0.72	5.50	2.49	-	4 (p. 8)

Shipping/Packing

Available references did not provide this information.

Bomblet, 5.2-inch, Spherical, E118

Miscellaneous Information

The E118 was intended to replace the E54R6 for use in the interim cluster adapter for the Corporal missile. The optimum bomblet diameter was smaller and the establishment for the E130 requirement obsoleted the E118 (4 p. 2, 8).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.
2. Office of the Engineering Field Office. 1999. 1999 Main Munition Table. Army Chemical Center.
3. Pickett, E. 1958. CWL Technical Memorandum 33-7, A Series of Static Tests of GB-filled E118 and E130 Spherical Munitions When Equipped with Bursters of Various Configurations, AD221108. U.S. Army.
4. Wagner, P. 1958. CWL Technical Memorandum 30-35, Development of Bomb, Nonpersistent gas, Spherical, 4.5-inch, E130R1, AD356703. U.S. Army.

7.5 Bomblet, 3-pound, E91, E91R1

Figures

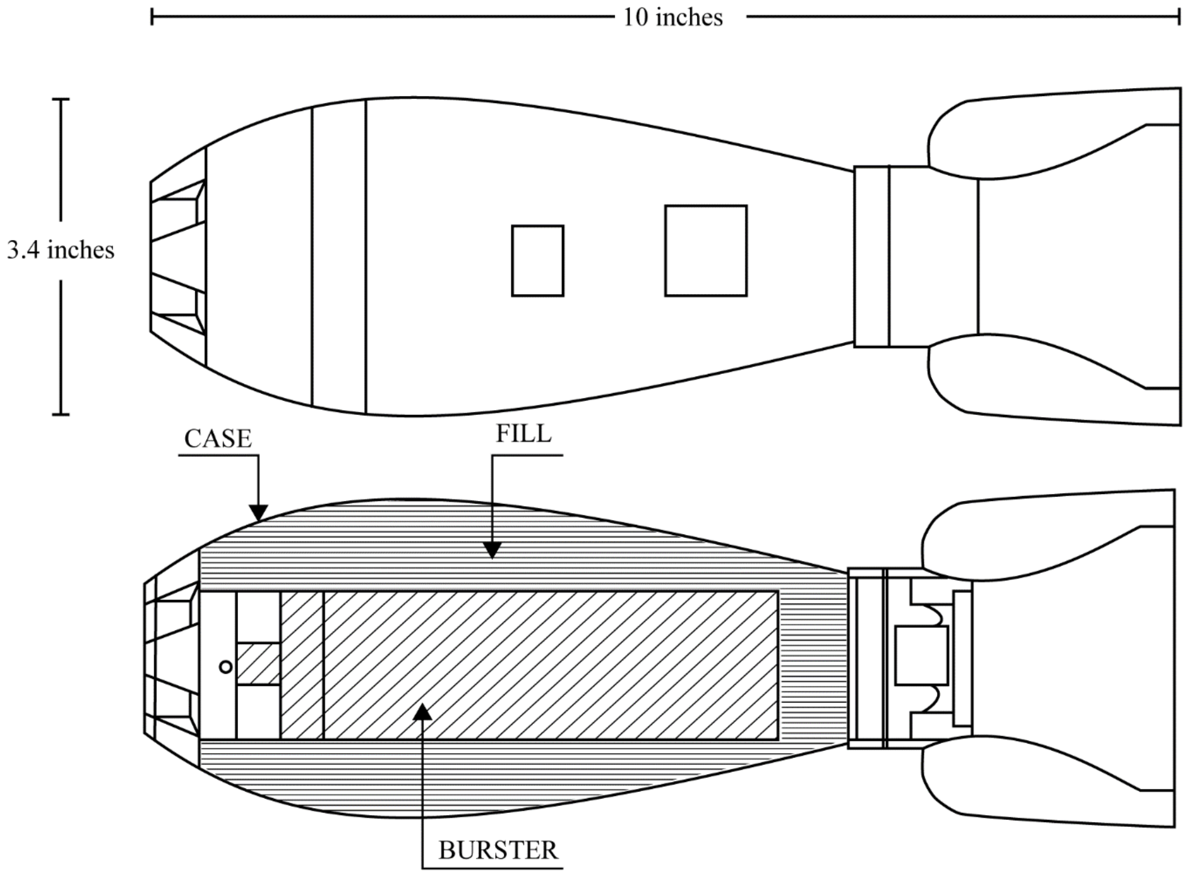

Figure 50: Bomblet, 3-pound, E91, E91R1 - Line Drawing

Figure 51: Bomblet, 3-pound, E91 - Photograph - Model

Bomblet, 3-pound, E91, E91R1

Specifications

Bomblet, 3-pound, E91, E91R1 - Specifications and Other Data		Citation
Historical Name	Bomb, Nonpersistent Gas, 3-Pound, E91R1	1 (p. 17)
Type	Bomblet	2 (p. 2)
Size	3-pound	1 (p. 17)
Conflict	Cold War	2 (p. 2)
Diameter	3.4 in. (8.64 cm)	1 (p. 17)
Length	10 in. (25.4 cm)	1 (p. 17)
Propellant	7 increments of 4.2-inch mortar propellant	2 (p. 2)

General Use and Description

Available references did not provide information on specific use.

The E91 bomblet had a vase-shape that resulted in a high drag, aerodynamically clean body. It was 10 inches long and 3.4 inches in diameter. The blunt nose and abrupt circular stabilizer added to the high drag and low terminal velocity. The bomb had an air-arming fuze and was designed for normal clustering in warheads.

The E91R1 3-pound bomb was a modified E91 bomb, which was designed for guided missile use. The tail consisted of four plastic fins protruding from a conical surface instead of the steel tail cup or plastic fluted assembly. The new tail assembly was designed to increase the surface area and thereby obtain static stability at subsonic speeds (1 p. 17, 18).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Bomblet, 3-pound, E91, E91R1 - Fuzing		
Fuze	**Notes**	**Citation**
E24R1	Modified for inverted mortar functioning	2 (p. 2)
E38	Nose - point detonating Weight: 0.70 lbs. (0.318 cm) Length: 1.75 in. (4.45 cm)	3 (p. 2-19, 2-20)

Booster, Adapter-Booster, or Burster

Bomblet, 3-pound, E91, E91R1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	0.24 lbs. (0.11 kg)	Composition B	Agent to burster ratio was 4.5 to 1.	3 (p. 2-20)

Fills

Bomblet, 3-pound, E91, E91R1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.08	0.48	3.00	1.36	The agent to burster ratio was 4.5 to 1.	2 (p. 2)

Shipping/Packing

Available references did not provide this information.

Bomblet, 3-pound, E91, E91R1

Miscellaneous Information

The E91 was used in the E118R1 Cluster, Nonpersistent Gas Bomb (750-pound) (1 p. 17).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.
2. Clay, J., & Stone, W. Jr. 1954. Dugway Proving Ground Trial Report, DPGTR 167. U.S. Army.
3. Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Cancelled Fuzes, MIL-HDBK-146. Department of Defense.

7.6 Bomblet, 3.4-pound, Spherical, M134 (E130R1)

Figures

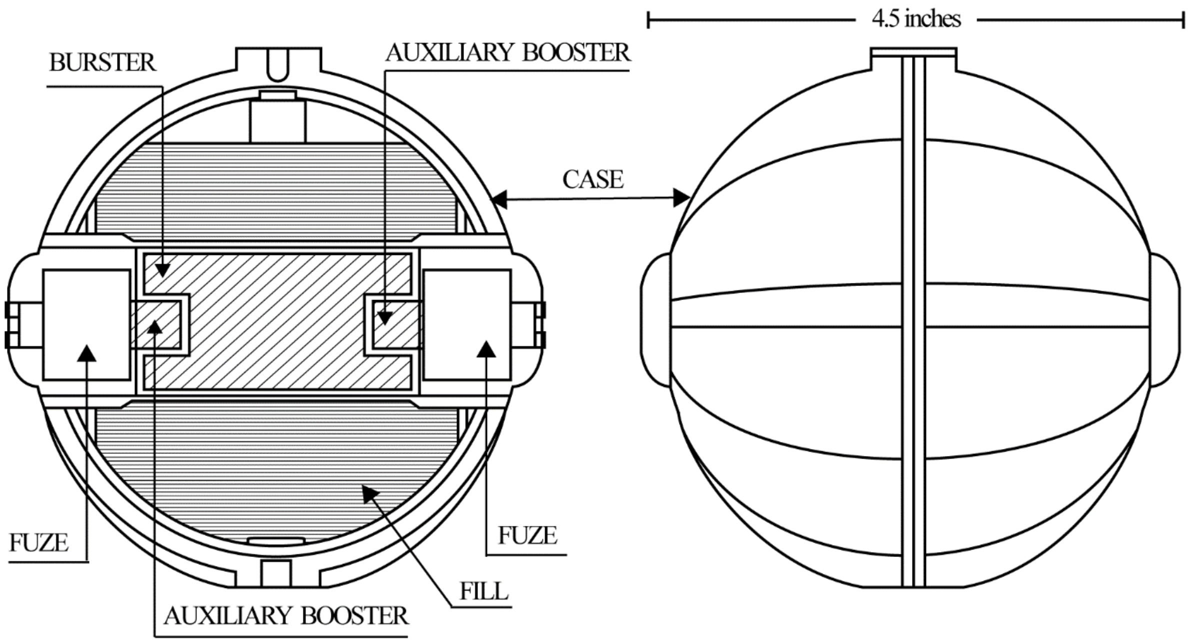

Figure 52: Bomblet, 3.4-pound, Spherical, M134 (E130R1) - Line Drawing

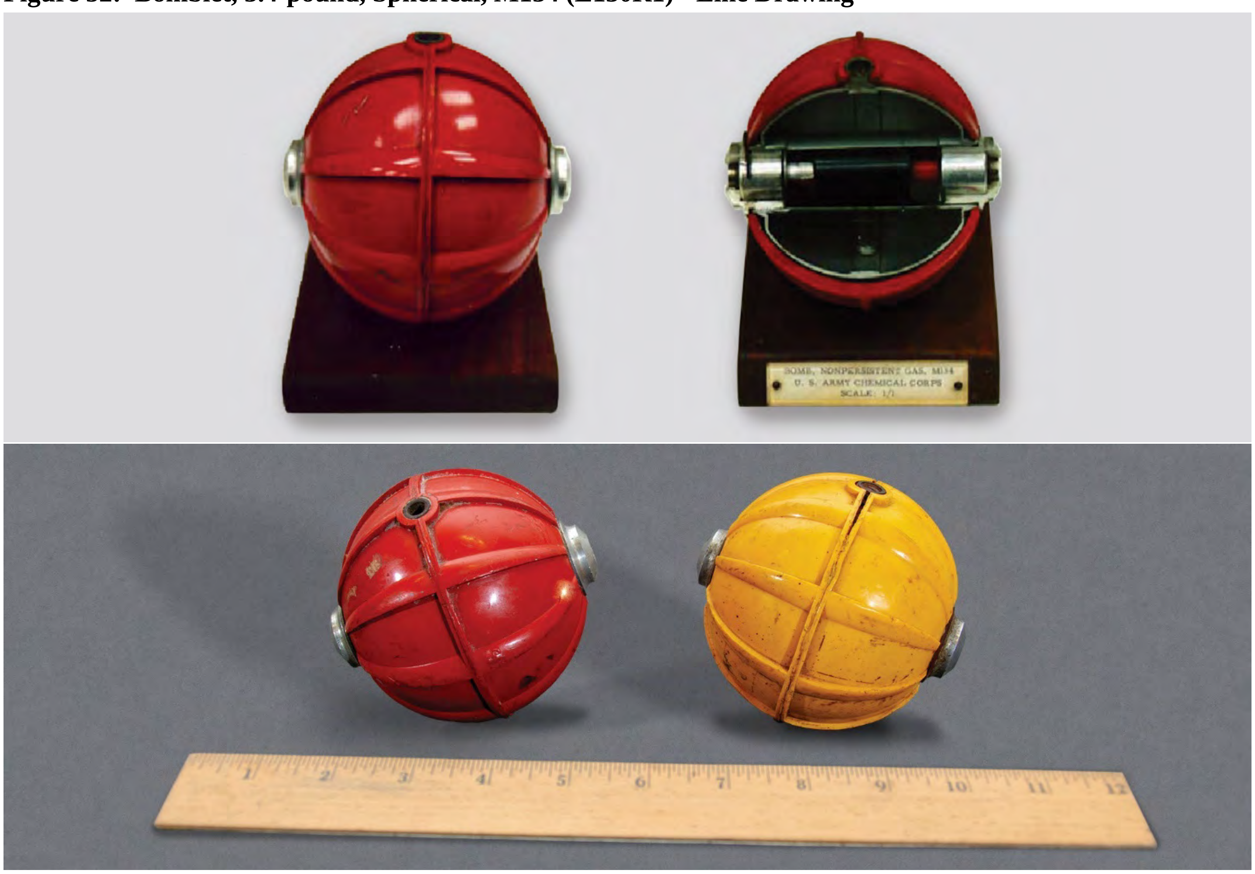

Figure 53: Bomblet, 3.4-pound, Spherical, M134 - Photograph Top: Cutaway, Bottom: Intact

Bomblet, 3.4-pound, Spherical, M134 (E130R1)

Specifications

Bomblet, 3.4-pound, Spherical, M134 (E130R1) - Specifications and Other Data		Citation
Historical Name	Bomblet, Spherical, Gas, Nonpersistent, 3.4-Pound, M134	1 (p. 4-10)
Developmental Information	E130R1 (with VX-fill)	1 (p. 4-11)
Type	Bomblet	2 (p. 4-11)
Size	3.4-pound	2 (p. 4-11)
Conflict	Cold War	1 (p. 4-10)
Service	Army, Navy	2 (p. 4-11)
Diameter	4.5 in. (11.43 cm)	1 (p. 4-11), 2 (p. 4-12)
Construction Material	Outer casing: plastic Inner shell: steel	1 (p. 4-10)
Drawing	CMLC C14-5-2573, C14-5-2572	1 (p. 4-11), 2 (p. 4-12)

General Use and Description

The M134 bomblet was designed to provide a long range toxic chemical offensive capability (1 p. 4-10), (2 p. 4-11).

This bomblet was a self-dispersing, spherically shaped, GB-filled munition. Dispersion was accomplished by aerodynamic forces generated by nine vanes on the outside surface of the bomblet. A filling void was maintained to permit thermal expansion due to temperature changes (1 p. 4-10), (2 p. 4-11).

Explosive Train

A cylindrically shaped burster charge was located on, and concentric with, the spin axis of the bomblet. At each end of the burster charge was a tetryl booster charge and an all-ways centrifugal fuze. The fuze functioned on impact and detonated the burster. The internal pressures produced ruptured the bomblet casing and disseminated the fill (1 p. 4-11), (2 p. 4-11).

Fuzing

Bomblet, 3.4-pound, Spherical, M134 (E130R1) - Fuzing		
Fuze	**Note**	**Citation**
M911	Centrifugal arming- all-ways acting/impact, two used, auxiliary booster M135	1 (p. 4-11), 2 (p. 4-12)

Booster, Adapter-Booster, or Burster

Bomblet, 3.4-pound, Spherical, M134 (E130R1) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M135 Burster	N/A	N/A	Auxiliary	2 (p. 4-12)
M33	0.18 lbs. (0.08 kg)	N/A	-	1 (p. 4-11)

Fills

Bomblet, 3.4-pound, Spherical, M134 (E130R1) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.10	0.49	3.40	1.54	-	1 (p. 4-11), 2 (p. 4-11)
VX	N/A	N/A	N/A	N/A	Experimental	2 (p. 4-12)

Shipping/Packing

Available references did not provide this information.

Bomblet, 3.4-pound, Spherical, M134 (E130R1)

Miscellaneous Information

The M134 bomblet was used with the Honest John M79 (E19R1) 762-mm Warhead (356 bomblets) (1 p. 4-11), (2 p. 4-12), (3 p. 516).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
3. Chemical Corps Technical Committee. 1962. CCTC Item # 4080, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. Department of the Army.

7.7 Bomblet, 6-pound, E104, E104R1

Figures

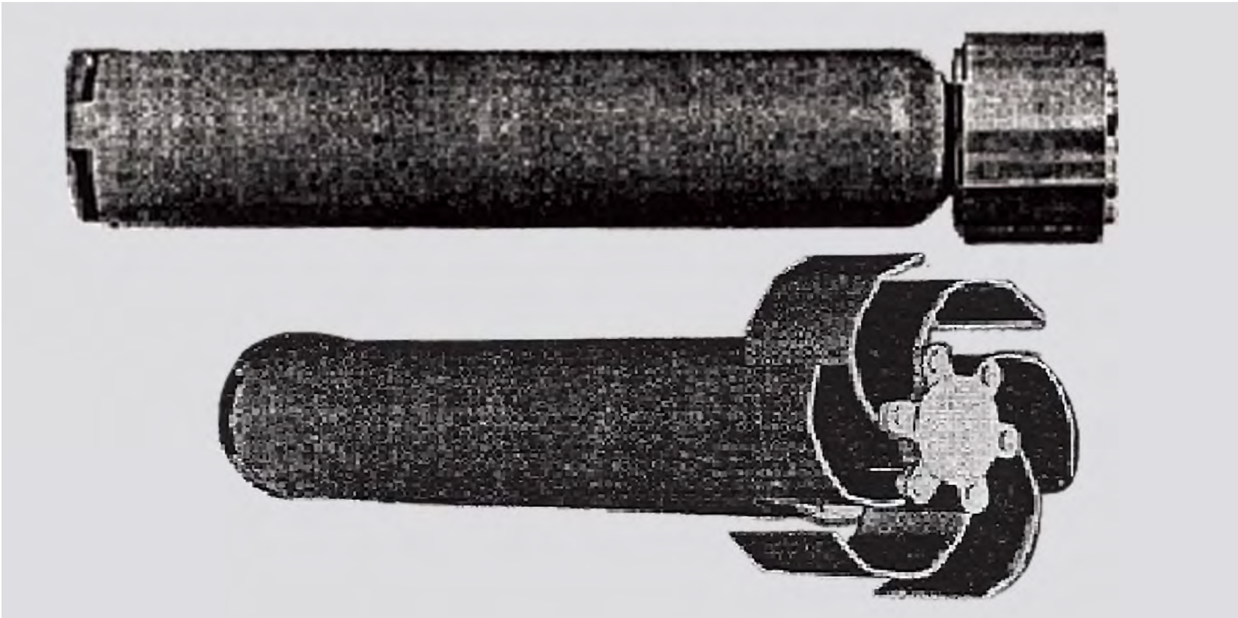

Figure 54: Bomblet, 6-pound, E104, E104R1 - Photograph

Specifications

Bomblet, 6-pound, E104, E104R1 - Specifications and Other Data		Citation
Historical Name	E104, E104R1, 6-Pound Bomb, Non-Persistent, Gas	1 (p. 23, 25, Appendix A)
Type	Bomblet	2 (p. 1)
Size	6-pound	1 (p. 23, 25, Appendix A), 2 (p. 2), 3 (p. 5)
Diameter	2.75 in. (6.98 cm)	2 (p. 2), 3 (p. 5)
Length	13.9-14.7 in. (35.6-37.3 cm)	1 (p. 23, 25, Appendix A), 2 (p. 2), 3 (p. 5)

General Use and Description

The E104 was a line of development of a GB bomb suitable for clustering and dispersion from a 750-pound multipurpose cluster adapter. These are designed for carriage and dispersion from high-speed aircraft at medium and high altitudes (2 p. 1), (4 p. 1).

The E104 was a nonpersistent bomb that weighed approximately 6.1 pounds. The bomblet utilized a central burster and an air-arming, out-of-line detonator, impact fuze. The cylindrical bomb was stabilized by a fin consisting of three collapsible wrap-around blades. The E104R1 bomblet was the same as the basic E104 except it has six collapsible wrap-around blades (1 p. 23, 25, Appendix A), (2 p. 2).

The E104R1 bomb was closed by a primary and secondary seal. The secondary seal consisted of a tapered steel plug with a 1/16-inch, thick aluminum jacket. The aluminum jacket seats on a shoulder in the fill hole expanding the aluminum against the wall of the fill hole. The primary seal was a projection-welded welsh plug (3 p. 5).

Explosive Train

The bomblet with the E40 and E41R1 fuzes was armed by an air-driven arming vane. Both contain out of-line detonators, the alignment of which provides an arming delay. In both fuze types, the alignment of the detonators must be accomplished before they can be fired. Nose impact fired the E40 fuze by driving the extended striker into the detonator. The E41R1 had a cocked firing pin released by inertial forces (2 p. 2, 3).

Fuzing

Bomblet, 6-pound, E104, E104R1 - Fuzing		
Fuze	**Notes**	**Citation**
E24R1	-	4 (p. 12)
E40	Nose - air-arming Nose- point detonating for E104R1 Weight: 0.80 lbs. (0.363 kg) Length: 1.75 in. (4.45 cm)	2 (p. 2), 5 (p. 2-21, 2-22)
E41R1	Nose- air-arming	2 (p. 2)
Not designated	Impact	1 (p. 23, 25, Appendix A)

Booster, Adapter-Booster, or Burster

Bomblet, 6-pound, E104, E104R1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	0.35 lbs. (0.19 kg)	Tetryl	Axial burster	4 (p. 12)

Fills

Bomblet, 6-pound, E104, E104R1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.90	0.86	6.05-7.95	2.74-3.61	-	1 (p. 24, 26, Appendix A), 2 (p. 2)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The E104R1 was used in the following clusters:

- Cluster, Chemical E130R1, the cluster contained 60 E104R1 bombs.
- Cluster, Chemical E130R3, the cluster contained 76 E104R1 bombs.
- Cluster, Chemical E136R1, the cluster contained 60 E104R1 bombs.
- Cluster, Chemical E136 and E136R3, the cluster contained 76 E104R1 bombs (1 p. 23, 24, Appendix A), 2 (p. 1).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.

2. Kelgard, Philip, E. 1956. Air Force Armament Center Test Report, AFAC-TR-56-21, Medium and High Altitude Functioning and Dispersion Tests of the E136R3 and E136R4 Type Clusters. United States Air Force.
3. Mayhew, Harry E., Jr. 1955. Plants Division Memorandum Report, Evaluation of High-Speed Filling Line Equipment for the E54R6 Bomb. Chemical Corps.
4. Shaw, D. 1956. Chemical and Biological Laboratories Report, CRLR 539, Special Report, A Series of Dynamic Tests of Single E104R1 GB-filled Bomblets with an Agent/Burster Ratio of 5/1 Fired from an Inverted Mortar, AD 094267. Chemical Corps.
5. Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Cancelled Fuzes, MIL-HDBK-146. Department of Defense.

7.8 Bomblet, 6-pound, E105

Figures

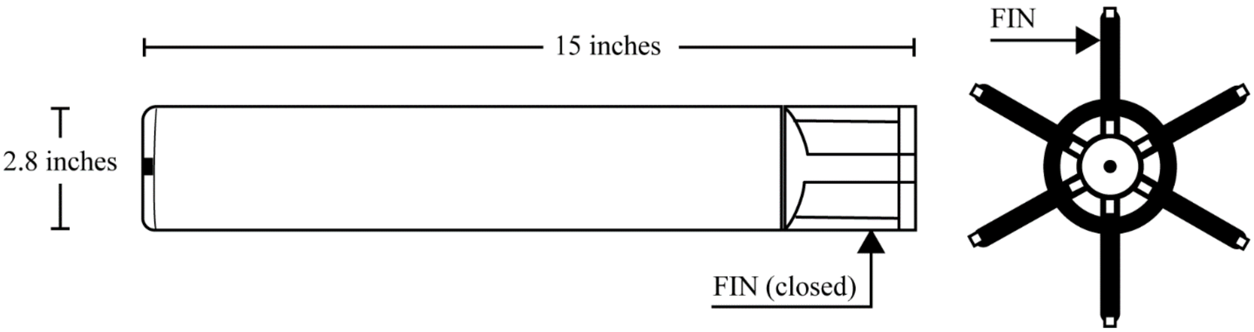

Figure 55: Bomblet, 6-pound, E105 - Line Drawing

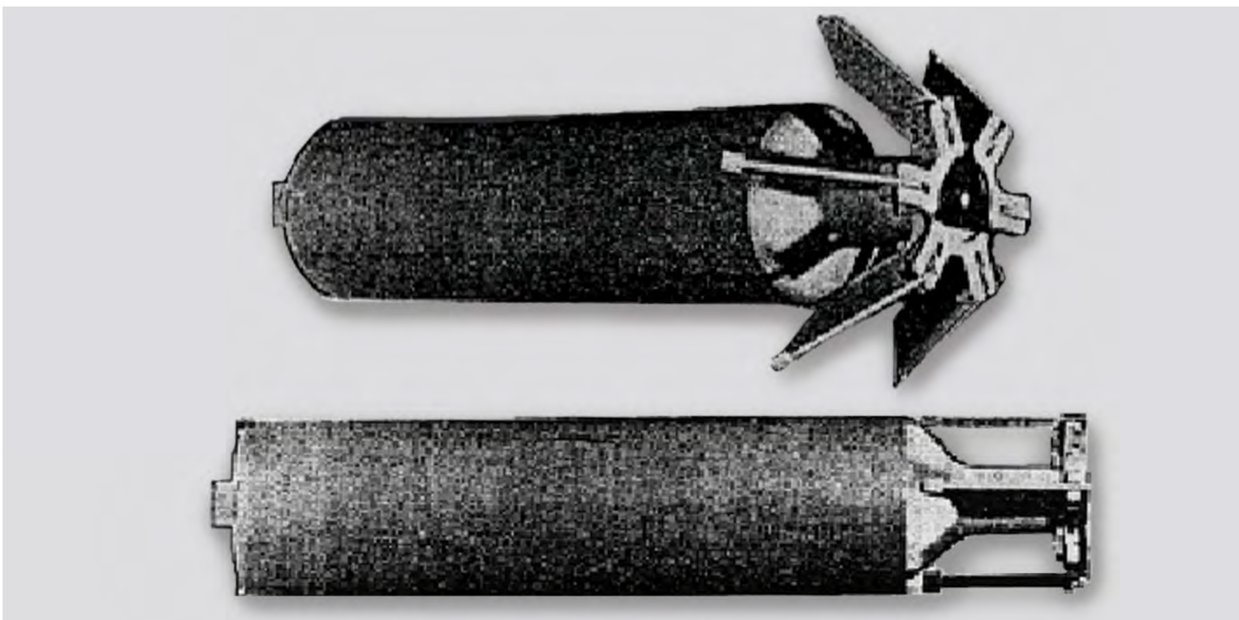

Figure 56: Bomblet, 6-pound, E105 - Photograph

Specifications

Bomblet, 6-pound, E105 - Specifications and Other Data		**Citation**
Historical Name	E105 6-Pound Bomb, Nonpersistent, Gas	1 (p. 27, Appendix A)
Type	Bomblet	1 (p. 27, Appendix A), 2 (p. 2)
Size	6-pound	1 (p. 27, Appendix A)
Diameter	2.8 in. (7.11 cm)	1 (p. 27, Appendix A)
Length	15 in. (38 cm)	1 (p. 27, Appendix A)

General Use and Description

Available references did not provide information on specific use.

The E105 was a nonpersistent chemical agent bomb. It weighed approximately 6.1 pounds. This bomb utilized a central burster and an air-arming impact fuze with an out-of-line detonator. The bomb was stabilized by means of a six-bladed collapsible fin. When the bomb was clustered, the blades were packed with their long dimensions parallel to the axis of the bomb. When opening they rotated to a position wherein the long dimensions were normal to the longitudinal axis of the bomb (1 p. 27, Appendix A).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Bomblet, 6-pound, E105 - Fuzing		
Fuze	**Notes**	**Citation**
E24R1	Modified for inverted mortar functioning	2 (p. 2)
Not designated	Impact	1 (p. 27, Appendix A)

Booster, Adapter-Booster, or Burster

Bomblet, 6-pound, E105 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Burster not designated	0.36 lbs. (0.16 kg)	Tetrytol	-	2 (p. 2)

Fills

Bomblet, 6-pound, E105 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.80-1.90	0.81-0.86	6.10	2.76	-	1 (p. 28, Appendix A),2 (p. 2)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The E105 was to be used in the Cluster, Chemical 750-pound GB E135, which contained 60 E105 bombs (1 p. 27, Appendix A), (2 (p. 2).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.

2. Dugway Proving Ground. 1954. Dugway Proving Ground Trial Report, DPGTR 131. Technical Library.

7.9 Bomblet, 6-pound, M69 (E1), AN-M69, AN-M69A1, M69X

Figures

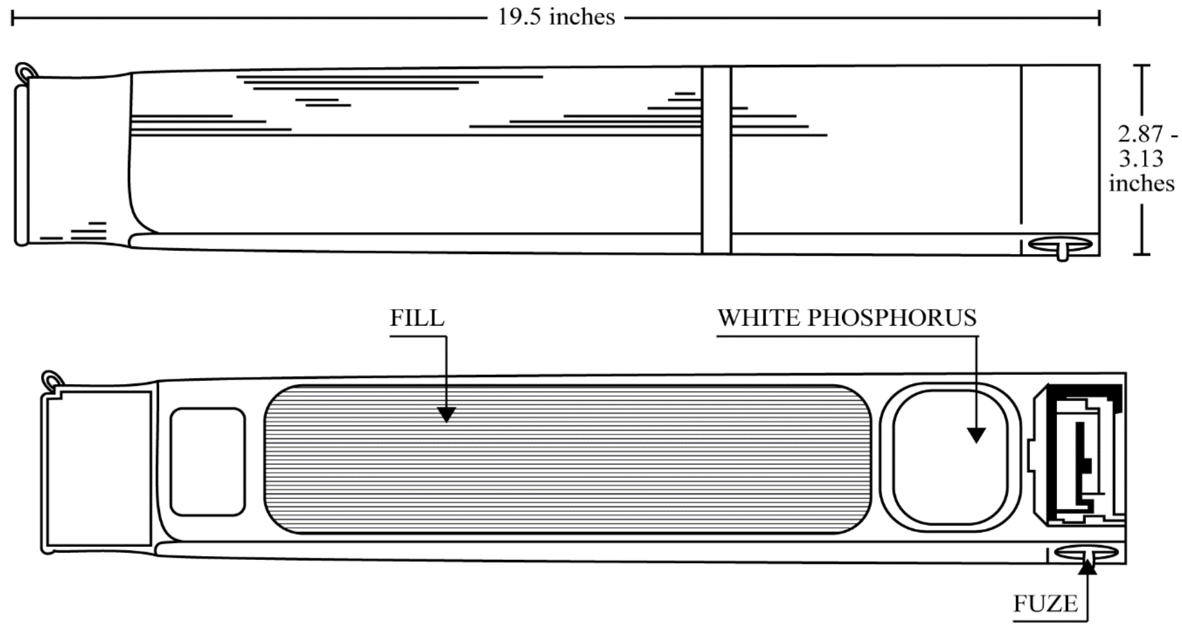

Figure 57: Bomblet, 6-pound, M69 (E1), AN-M69, AN-M69A1, M69X - Line Drawing

Figure 58: Bomblet, 6-pound, M69 (E1), AN-M69, AN-M69A1, M69X - Photograph

Specifications

Bomblet, 6-pound, M69 Series (E1) (M56), AN-M69 Series - Specifications and Other Data		Citation
Historical Name	6-Pound Chemical Bomb, E1 (M69)	1 (p. x)
Developmental Information	E1, M56	1 (p. 2), 6 (p. 40)
Type	Bomblet	1 (p. 1), 2 (p. 29), 3 (p. 11)
Size	6-pound	1 (p. 1), 4 (p. 36)
Conflict	Post WWII	4 (p. 36, 37)
Service	Air Force, Army, Navy	4 (p. 36, 37), 5 (p. 13, 14)
Diameter	2.87-3.13 in. (7.21-7.96 cm)	1 (p. 2), 2 (p. 11)
Length	19.5 inches (49.53 cm)	1 (p. 2), 2 (p. 11), 5 (p. 13, 14)
Wall Thickness	AN-M69: 0.418 in. (1.0617 cm)	4 (p. 37)
Other Engineering Data	The M69 was used in the M19 cluster.	1 (p. 1), 3 (p. 31)
Construction Material	Body: cold-rolled steel	2 (p. 11), 4 (p. 37)
Propellant	70 grams EC smokeless propellant powder	1 (p. 2), 2 (p. 31)
Spec/PD No	MIL-B-11643 (AN-M69)	5 (p. 13)
Drawing	C14-5-229 (ANM69)	5 (p. 13)
FSN	1325-142-0652 (AN-M69, IM-filled) 1325-142-0653 (AN-M69)	5 (p. 13)

Bomblet, 6-pound, M69 Series (E1) (M56), AN-M69 Series

General Use and Description

The E1, later designated M69, was developed to establish new methods of disseminating chemical agents. The M69 incendiary was initially developed as the Bomb, Incendiary, Oil, 6-1b. [pound], M56 but another item (a large demolition bomb) was also designated M56 and to avoid confusion the M56 was redesignated Bomb, Incendiary, Oil, 6-lb., M69 (1 p. x), (6 p. 41).

The bomb body was a hexagonal case with a nose cup welded to the forward end. The nose cup, fuze and powder charges were sealed off from the rest of the case by an impact diaphragm.

During development, both a 5-pound chemical bomb E1, and a 6-pound chemical bomb E1 were tested. The diaphragm on the 5-pound E1 was 0.025 inches thick. The diaphragm on the 6-pound E1 was 0.008 inches thick.

The body is of a rounded hexagonal shape with the fuze in the side near the blunt end. The tail consists of gauze streamers about 4.5-inches in length (1 p. 1, 3), (4 p. 37).

Explosive Train

The spring-loaded safety plunger ejected from of the fuze upon release from the cluster, arming the fuze. On impact, the striker overcame its spring and detonated the primer cap, which ignited a lead-coated spitter fuze. The spitter fuze burned from three to five seconds and ignited the booster charge, which in turn ignited the ejector charge. The combustion blew off the tail cup and ejected the filler. The M69 differs from the AN-M69X chiefly in that it does not carry an explosive charge. Fragments of the M69X filler burn from 8 to 20 minutes after ejection from the bomb case (2 p. 32, 32), (3 p. 11-12), 5 (p. 13, 14), (7 p. 719-720).

Fuzing

Bomblet, 6-pound, M69 Series (E1) (M69), AN-M69 Series - Fuzing		
Fuze	**Notes**	**Citation**
M1	Inertia type impact bomb	3 (p. 57), 4 (p. 37), 5 (p. 13)
M2 (E18R1)	Inertia type impact bomb	4 (p. 37), 5 (p. 14), 10 (p. 41)
Modified E1 charge	Inertia type impact bomb fuze booster with 0.5-gram EC propellant powder	1 (p. 2)

Booster, Adapter-Booster, or Burster

Bomblet, 6-pound, M69 Series (E1) (M69), AN-M69 Series - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	0.003 lb. (0.001 kg)	Black powder/EC (smokeless powder)	Booster charge. Gross weight range: 1 gram/0.5 grams.	1 (p. 4, 5)

Bomblet, 6-pound, M69 Series (E1) (M56), AN-M69 Series

Fills

Bomblet, 6-pound, M69 Series (E1) (M69), AN-M69 Series - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
HS	3.31-4.25	1.50-1.92	N/A	N/A	-	1 (p. 2, 3)
IM (incendiary oil)	2.20-2.60	1.00-1.18	6.10-7.20	2.76-3.27	M69X and AN-M69A1	5 (p. 14), 7 (p. 719, 720)
L	N/A	N/A	N/A	N/A	Experimental in M67	11 (p. 1, 2)
MR	5.00	2.26	N/A	N/A	-	1 (p. 2, 3)
NP	2.00-2.10	0.91-0.95	5.50-6.10	2.50-2.77	AN-M69, AN-M69A1 and AN-M69X	2 (p. 30, 32), 5 (p. 13, 14), 7 (p. 720, 721)

Shipping/Packing

This bomb was normally packed in M19 clusters. There were 14 AN-M69 bombs per M12 100-pound cluster and 38 AN-M69 and AN-M69A1 bombs per M19 500-pound cluster (2 p. 31), (5 p. 13-14).

Key Dates

Bomblet, 6-pound, M69 Series (E1) (M69), AN-M69 Series - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1942	Chemical Corps Technical Committee (CCTC) 529 (M56 [AN-M69] Incendiary)	8 (p. 4)
Standardized	1944	AN-M69 (Substitute Standard)	9 (p. 16)
Standardized	1945	CCTC 1268, 1306 (M69X Incendiary), NP-fill Standard, IM-fill Substitute Standard)	9 (p. 21, 22)
Classified	1952	CCTC 2479 (AN-M69A1, Incendiary - Standard)	10 (p. 45, 46)
Standardized	1954	CCTC 2930 (AN-M69 IM-filled – Limited Standard – Air Force)	12 (p. 1)
Obsoleted	1968	AMCTC 6418 (AN-M69 IM-filled)	13 (p. 54b)

Sources

1. Hollingsworth, Henry L., & Denues, Art 1st Lt. 1944. Technical Division Memorandum Report, TDMR 542, Functioning of M67 and M69 Bombs, HS Filled, Project B4.7, B6.7-2. Chemical Warfare Service.

2. Departments of the Army and Air Force. 1953. Technical Manual, TM 3-400/Technical Order, TO 39B-15C-1, Chemical Bombs and Clusters. Department of the Army.

3. Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. Department of the Army.

4. Chief of Ordnance. 1942. Technical Manual, TM 9-1984, Disposal of American and Allied Bombs and Fuzes. War Department.

5. Army Chemical Center. 1957. Reclassifications, obsoletions, and related actions which have occurred since publication of EP 79, Chemical Corps Equipment Data Sheets. U.S. Army Chemical Corps Engineering Command.

6. Chemical Warfare Technical Committee. 1944. CWTC Item # 998, Standardization of Bomb, Fuze, M1. Chemical Warfare Service.

7. Gual, A. and Finklestein, Leo. 1952. Chemical Research and Development Laboratories, History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 – 31 December 1945). Volume 18, Part V, Incendiaries. Project 4-72-05-005. AD0224098. Army Chemical Center. Army Chemical Center.

8. Chemical Warfare Technical Committee. 1942. CWTC Item # 529, Standardization of 6-lb. Oil Incendiary Bomb and 500-lb. Cluster Adapter. Chemical Warfare Service.

9. Chemical Warfare Technical Committee. 1945. CWTC Item # 1268, Standardization of Bomb, Incendiary, Oil 6-lb., M69X. Chemical Warfare Service.

10. Chemical Warfare Technical Committee. 1952. CWTC Item # 2479, Classification of Fuze, Bomb, M2 (E18Rl); Bomb, Incendiary, Oil, 6-lb AN-M69Al; and Cluster, Aimable, Incendiary Bomb, 500-1b M19Al as Standard Types. Chemical Warfare Service.

11. Chemical Warfare Service 1943. F.C. Boston, Cannon & Ammunition Section Memorandum to Chief, Munitions Development Division, Subject: Static Tests of Chemical Bombs, M67, Filled with (a) Frozen M1, (b) Unfrozen M1, Using E.C. Propellant Powder as Booster and Ejection Charges, March 12.

12. Chemical Corps Technical Committee. 1954. CCTC Item # 2930, Items Type-Classified by the Air Force (Read for Record). Department of the Army.

13. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.

7.10 Bomblet, 8-pound, BLU-30/B23

Figures

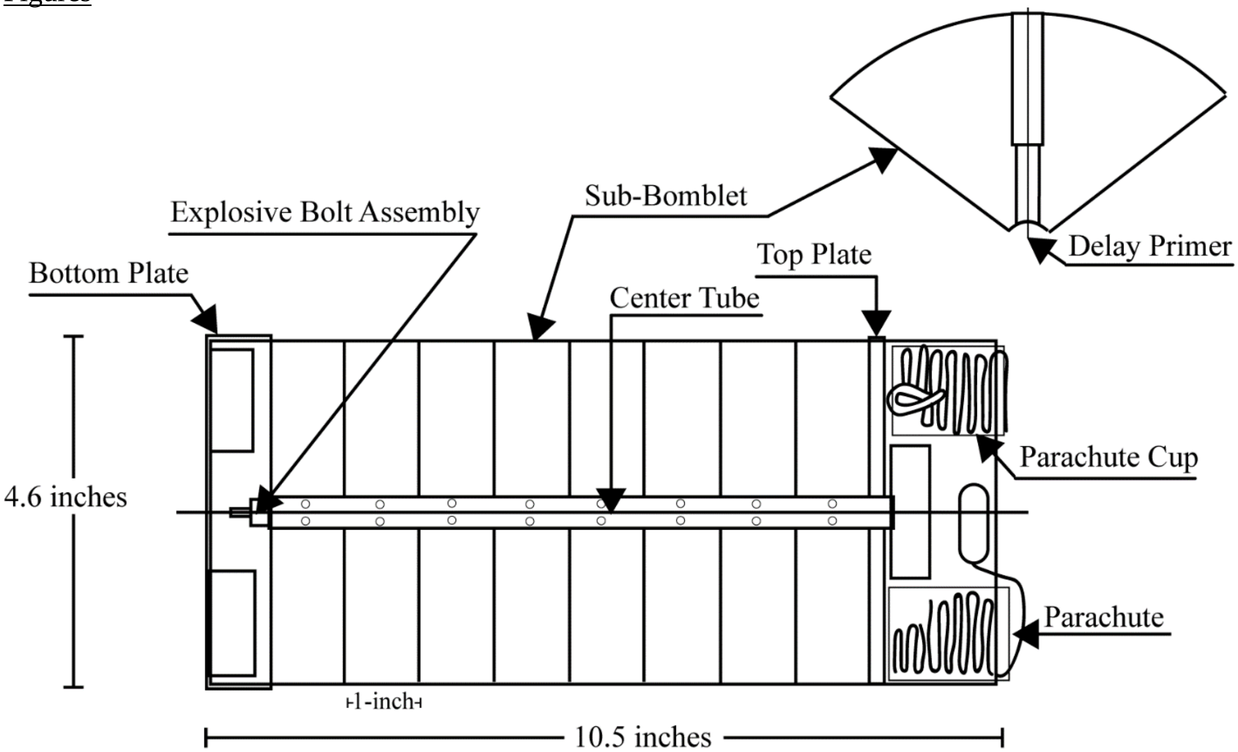

Figure 59: Bomblet, 8-pound, BLU-30/B23 – Line Drawing

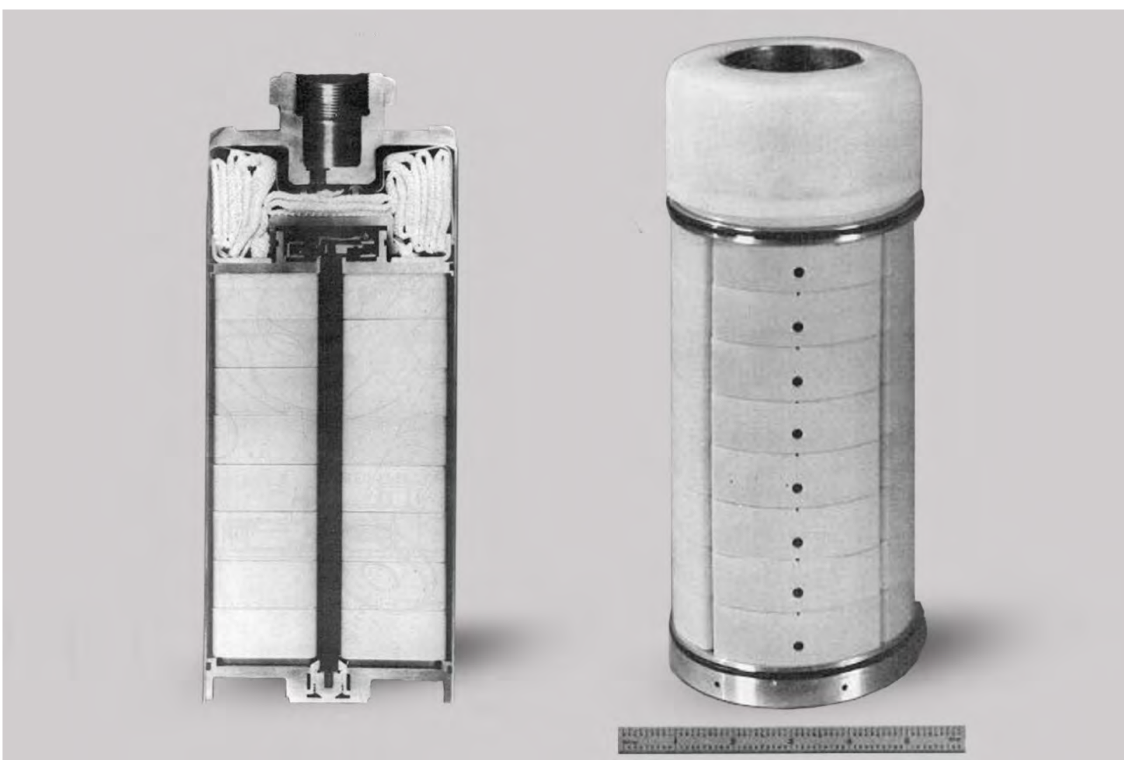

Figure 60: Bomblet, 8-pound, BLU-30/B23 – Photograph Left: Cutaway, Right: Intact

Specifications

Bomblet, 8-pound, BLU-30/B23 – Specifications and Other Data		Citation
Historical Name	BLU-30/B23 Bomblet Cluster	1 (p. 6)
Type	Bomblet Cluster	1 (p. 2, 13)
Size	8-pound	1 (p. 13)
Service	Air Force	1 (p. iii)
Diameter	4.6 in. (11.7 cm)	1 (p. 1, 13)
Height	10.5 in. (26.7 cm)	1 (p. 1, 13)
Other Engineering Data	Parachute: 18-in. (45.7 cm) cruciform Sub-bomblet: FMU-65/B (32 per bomblet cluster)	1 (p. 1, 13)

General Use and Description

The BLU-30/B23 bomblet cluster was designed for delivery by a tactical fighter aircraft from the SUU-13/A dispenser. Each bomblet carried 32 thermal generating sub-bomblets. It was designed to effectively and efficiently disseminate nonlethal agents CS and BZ over large geographical areas (1 p. 1, 6).

The thermal sub-bomblet design was quarter segment of a 4.6-inch circle one-inch in height. The sub-bomblet consisted of a cup and cover. After the sub-bomblet cup was filled with the agent-pyrotechnic mix, the cover was sealed in place with adhesive, and the modified FMU-65/B fuze was installed. The body shape is such that the sub-bomblets positively interlock with each other when in the cluster. Each sub-bomblet contained 40 grams of agent/pyrotechnic mix (1 p. 5, 7, 13, 18).

Explosive Train

The bomblet was designed to function as follows: Between 0. 1 and 0. 2 seconds after a proper release from a SUU-13/A Dispenser, the parachute would deploy with sufficient force exerted on the parachute-fuze ring to fail the two arming screws. At 0. 45 seconds from release, a modified BLU-4 timer initiated a Pyrocore element contained within the center tube of the cluster. The Pyrocore flame front, as it moved down the center tube, acted as an ignitor for a heat-initiated delay primer for each of the 32 sub-bomblets. When the flame front reached the bottom of the center tube, it initiated an explosive bolt, the action of which telescoped the top and bottom plates of the bomblet, enabling the sub-bomblets to be released. Seven seconds after the delay primer of each sub-bomblet is initiated, the flash output of the primer would initiate the agent-pyrotechnic payload, which, in turn, thermally generated an agent cloud for 10 to 20 seconds (1 p. 1, 3, 22).

In a later design, once the bomblets are free of the cluster, the spring-loaded arming pin of each FMU-65/B fuze retracts initiating a one second sub-bomblet arming cycle. After fuze arming and on impact with the ground, in later design, the omni-directionally sensitive fuze ignited the sub-bomblet (1 p. 21, 22).

Fuzing

Bomblet, 8-pound, BLU-30/B23 – Fuzing		
Fuze	**Notes**	**Citation**
BLU-4	Modified for 0.45-second delay airburst	1 (p. 1)
FMU-65/B (Modified)	Impact initiated, omnidirectionally sensitive fuze for sub-bomblets	1 (p. 6, 18)

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Bomblet, 8-pound, BLU-30/B23 – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BZ	1.57	0.71	8.00	3.63	0.049 lbs. per sub-bomblet	1 (p. 1, 3, 5, 6, 13)
CS	1.12	0.51	7.50	3.40	0.035 lbs. per sub-bomblet	1 (p. 3, 5, 6, 13, 114-124)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not provide this information.

Miscellaneous

The BZ-pyrotechnic mix consisted of 55% BZ with the remainder of the mix composed of a binder, potassium chlorate, and sulfur. The CS-pyrotechnic mix consisted of 40% CS with the remainder of the mix composed of a binder, potassium chlorate, and sugar. The binder for each mix contained polyethylene glycols polymerized with toluene diisocynate (1 p. 114).

Sources

1. Spurback, K. 1968. Technical Report AFATL-TR-68-87, BLU-30/B (Nonhazardous) Bomblet. Air Force Armament Laboratory.

7.11 Bomblet, 10-pound, E29 (G8), E29R1

Figures

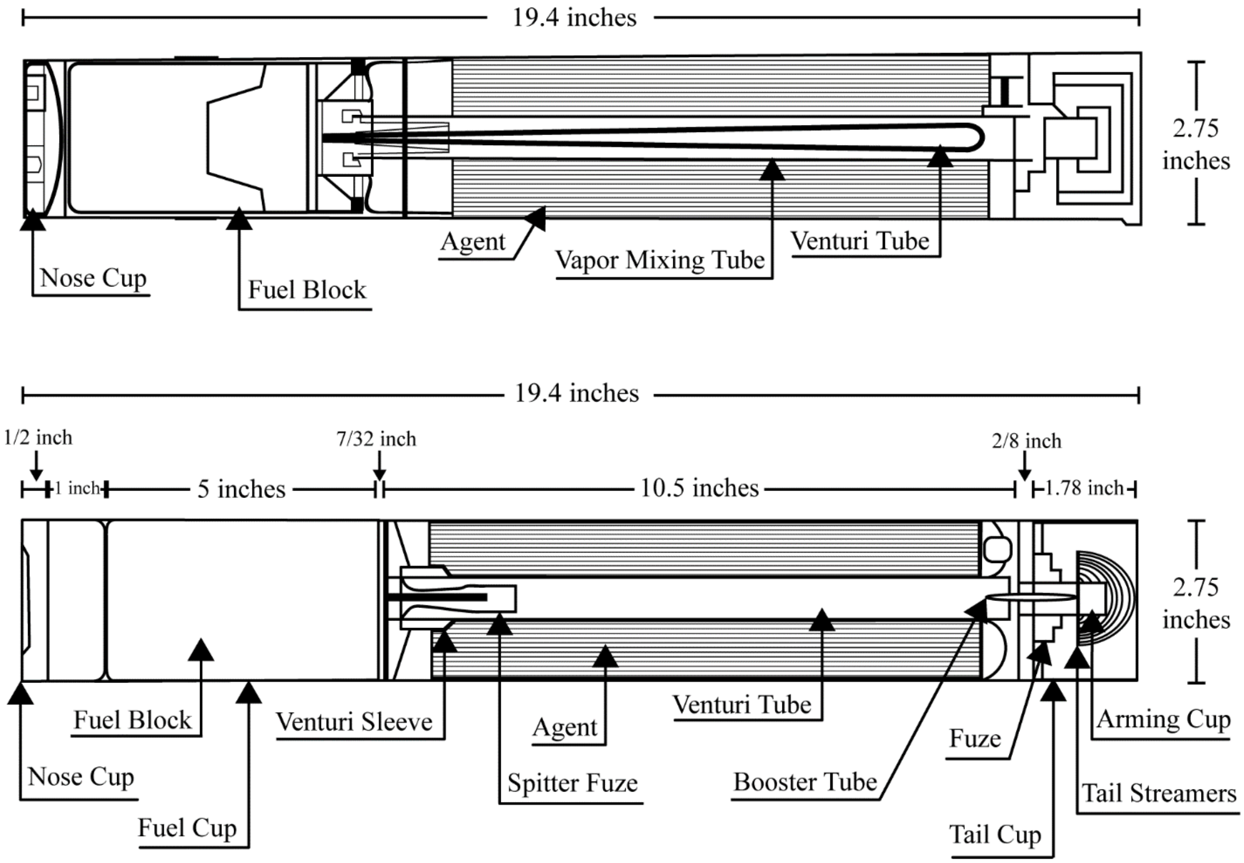

Figure 61: Bomblet, 10-pound, E29, E29R1 – Line Drawing, Top: E29R1, Bottom: E29

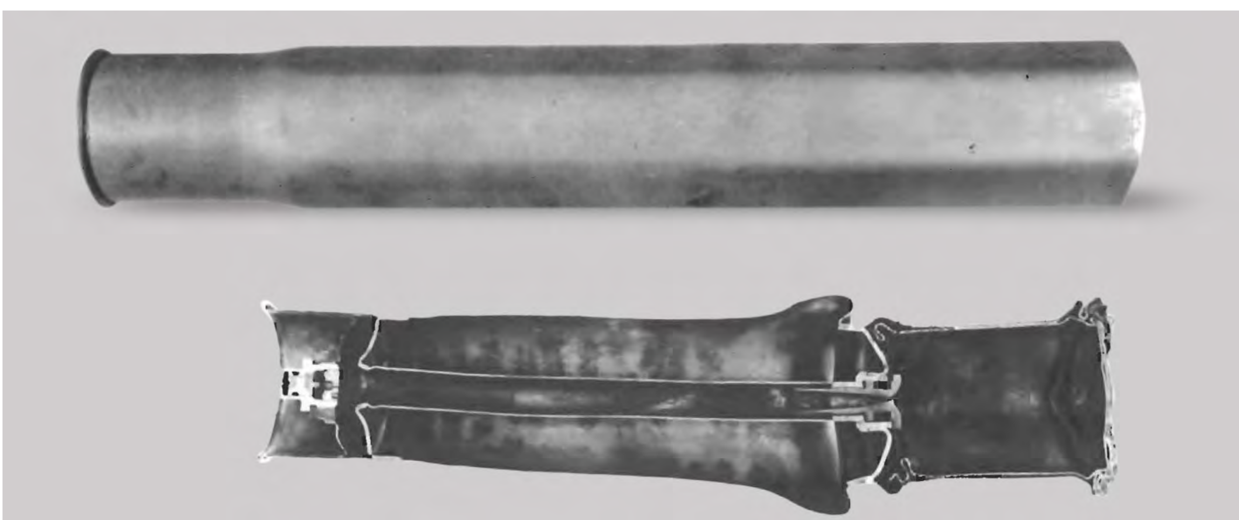

Figure 62: Bomblet, 10-pound, E29 – Photograph, Top: E29 Exterior, Bottom: E29 Cutaway View (after drop test)

Figure 63: Bomblet, 10-pound, E29R1 – Photograph

Specifications

Bomblet, 10-pound, E29 (G8), E29R1 – Specifications and Other Data		Citation
Historical Name	Bomb, Thermal Generator, 10-lb., E29 10-lb Thermal Generator Bomb E29 and E29R1	1 (p. 1), 2 (p. i, 1), 3 (p. i)
Developmental Information	G8	4 (p. Table IV)
Type	Bomb	1 (p. 1), 2 (p. 1)
Size	10-pound	1 (p. 1), 2 (p. 1)
Service	Air Force	3 (p. 2, 9)
Diameter	2.75 in. (6.7 cm) E29R1 with fins open: 5.75 in. (14.6 cm)	2 (p. 5), 3 (p. iv), 4 (p. 5), 7 (p. 4-60)
Length	19.4 in. (49.2 cm) Cloth streamer: 40-60 in. (102-152 cm) Nose, E29: 1.5 in. (3.81 cm) Nose, E29R1: 0.75 in. (01.91 cm)	2 (p. 5, 6), 3 (p. iv), 4 (p. 5, 10, 31, 47)
Width	Cloth streamer: 2-3 in. (5.08-7.62 cm)	2 (p. 6), 4 (p. 10, 31, 47)
Wall Thickness	E29R1: 0.0478 in. (0.121412 cm)	4 (p. 35)
Other Engineering Data	Fuel block: ammonium nitrate charcoal type Primer: M29 percussion cap Cluster adapter: M4 (quick opening)	2 (p. 6), 4 (p. 11)
Drawing	E29R1, telescoping tail: AS-CB-14 E29R1, cloth tail: AS-CB-36	4 (p. 2, 3)

General Use and Description

The E29 (originally designated G8) and the E29R1 bombs were developed to provide a small chemical bomb that would produce a high concentration of mustard vapor, in a relatively short period of time, by the thermal generator principle (2 p. 1), (3 p. 1). The thermal generator principle employed in the E29 and E29R1 was the same as that originally employed in candles and smoke pots (3 p. 8). The bombs were designed to be carried in standard cluster adapters developed for the AN-M69 bomb (2 p. 3).

The E29 Bomb is of hexagonal cross section with dimensions similar to the AN-M69 bomb. A fuel block in the nose of the bomb maintained a flow of gas through the venturi producing a flow of agent vapor from the concentrically placed agent compartment (4 p. 47).

The E29R1 Bomb is similar to the E29 except that pop-out metal tails are replaced the cloth streamer used on the E29 for stabilization and a round body is employed instead of the hexagonal type (4 p. 47 - 48). The E29R1 was composed of two pieces, the main body of the bomb and the cloth streamer or telescoping metal tail unit, which screwed into the body (4, p. 5, 12), (7 p. 4-60). The cloth streamer tail used on the E29 and early versions of the E29R1 consisted of three streamers and three shroud lines. The metal telescoping tail on the E29R1 consisted of a telescoping cup and a telescoping hub with three folding vanes (2 p. 6). A spring clip on the tail is ejected on release of the bomb allowing the cover plate to pull out the streamers in flight. On impact, the bomb penetrates the ground and stands upright (7 p. 4-61).

The body consisted of an impact nose, a fuel compartment, an agent compartment, and a venturi vaporizer that passed through the center of the agent compartment. The agent compartment was separated from the fuel compartment by a steel cup that also housed the venturi vaporizer (4 p. 6). The pressed fuel block consisted of two layers plus a starting layer in which an ammonium nitrate charcoal type of fuel was used. The total weight of fuel was one pound (4 p. 1, 7 - 8), (7, p. 4-60).

The vaporizer consisted of a venturi and a vapor-mixing tube. The venturi included a rounded inlet, a short straight section at the venturi throat and a diverging section. It was screwed into a venturi sleeve brazed into the agent compartment bottom. There were two shoulders on the venturi that sat against the venturi sleeve. These seats were sealed with copper clad asbestos gaskets. The venturi sleeve contained eight liquid feed holes, which allowed the agent to flow into the annular space between the venturi gaskets. The main feed hole in the venturi throat was sealed with a low melting solder. In operation, the burning fuel block melted the solder and allowed the agent to feed into the venturi throat (4 p. 6).

Explosive Train

The fuze for use with the cloth streamer tail was an inertia impact fuze with an arming pin which was pulled out by the cloth streamer after the bomb left the cluster. The primer ignited the booster tube mounted in the fuze base. The fuze for use with the spin stabilizing tail was a centrifugal arming fuze with centrifugally operated arming pins that were forced out by the spin of the bomb. The primer ignited a booster tube mounted in the fuze base (4 p. 10). In operation, the fuze primer ignited the booster tube. This flash ignited the quickmatch, which burned down the vapor-mixing tube and ignited the starting layer of the fuel block (2 p. 5).

Fuzing

Bomblet, 10-pound, E29 (G8), E29R1 – Fuzing		
Fuze	**Notes**	**Citation**
N34	Navy fuze, modified	4 (p. 32)
E10 fuze assembly	–	2 (p. 21)
Not designated	Tail: inertia impact (cloth streamer tail)	2 (p. 6), 4 (p. 10)
Not designated	Tail: centrifugal (telescoping metal tail)	2 (p. 6), 4 (p. 12, 79)

Booster, Adapter-Booster, or Burster

Bomblet, Cluster, 10-pound, E29 (G8), E29R1 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Booster- not designated	N/A	Potassium perchlorate and aluminum	–	4 (p. 32)
M29 primer and booster tube	N/A	N/A	–	4 (p. 80)

Fills

Bomblet, 10-pound, E29 (G8), E29R1 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
H	N/A	N/A	N/A	N/A	2 (p. 12), 5 (p. 1)
HD	2.3	1.04	8.3	3.76	2 (p. 12), 4 (p. 1), 7 (p. 4-62)

Miscellaneous Information

In several tests of the E29, the fill was oleum, butyl carbitol or orthodichlorobenzene. In tests of the E29R1, the fill was arochlor, butyl carbitol, methyl salicylate, or orthodichlorobenzene methyl salicylate mixture (4 p. 36, 43, 49).

In 1947, work on the 10-pound Thermal Generator Bomb was terminated since it was considered doubtful that the requirement for this type of munition continued. The work was terminated in favor of an explosive type munition represented by the E5R8 bomb prototype (6 p. 48). As of early 1946, fewer than 5,000 of these bombs were produced (4 p. 3).

Shipping/Packing

Available resources did not provide this information.

Key Dates

Bomblet, 10-pound, E29 (G8), E29R1 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1944	CCTC 1009	2 (p. 3), 8
Canceled	1948	CCTC 1835 E29R1	3 (p. 2), 6 (p. 48)

Sources

1. Loftin, J.C., Captain. 1944. Technical Command Informal Report, TCIR 162 Bomb, Thermal Generator – 10 lb., E29 Functioning Test. July. Chemical Warfare Service.
2. Smith, D.E. 1948. Technical Command Report, TCR 9 Development and Testing of 10-lb. Thermal Generator Bombs E29 and E29R1 for Dispersing Mustard. October. Chemical Corps Technical Command.
3. Berlin, A.S. and Kline, S.Q. 1948. Technical Command Report, TCR 12 Preliminary Investigation of 10-lb. Bomb for Persistent Agents. November. Technical Command.
4. Comings, E.W. 1946. Office of Scientific Research, OSRD No. 6574, Development of a Thermal Generator Bomb for Dispersing Concentrated Mustard Aerosol. February. National Defense Research Committee.
5. Kribben, B.D., Captain. 1945. E29R1 Thermal Generator Bomb. November. Chemical Warfare Service.
6. Chemical Corps. 1947. Chemical Corps Technical Committee CCTC 1835 Termination of Project B6.7-3 (4-04-15-03), 10-lb. Chemical Bomb, Thermal Generator. October. Department of the Army.
7. EDO Corporation 1948. Survey of Aircraft Spray Equipment and Practice for Vesicants, Report No 2401. 31 August.
8. Chemical Corps. 1944. Chemical Corps Technical Committee CCTC 1009 Military Requirement and Military Characteristics for a Thermal Generator Type Bomb for Mustard Vapor. Department of the Army.

7.12 Bomblet, 10-pound, E49 Series

Figures

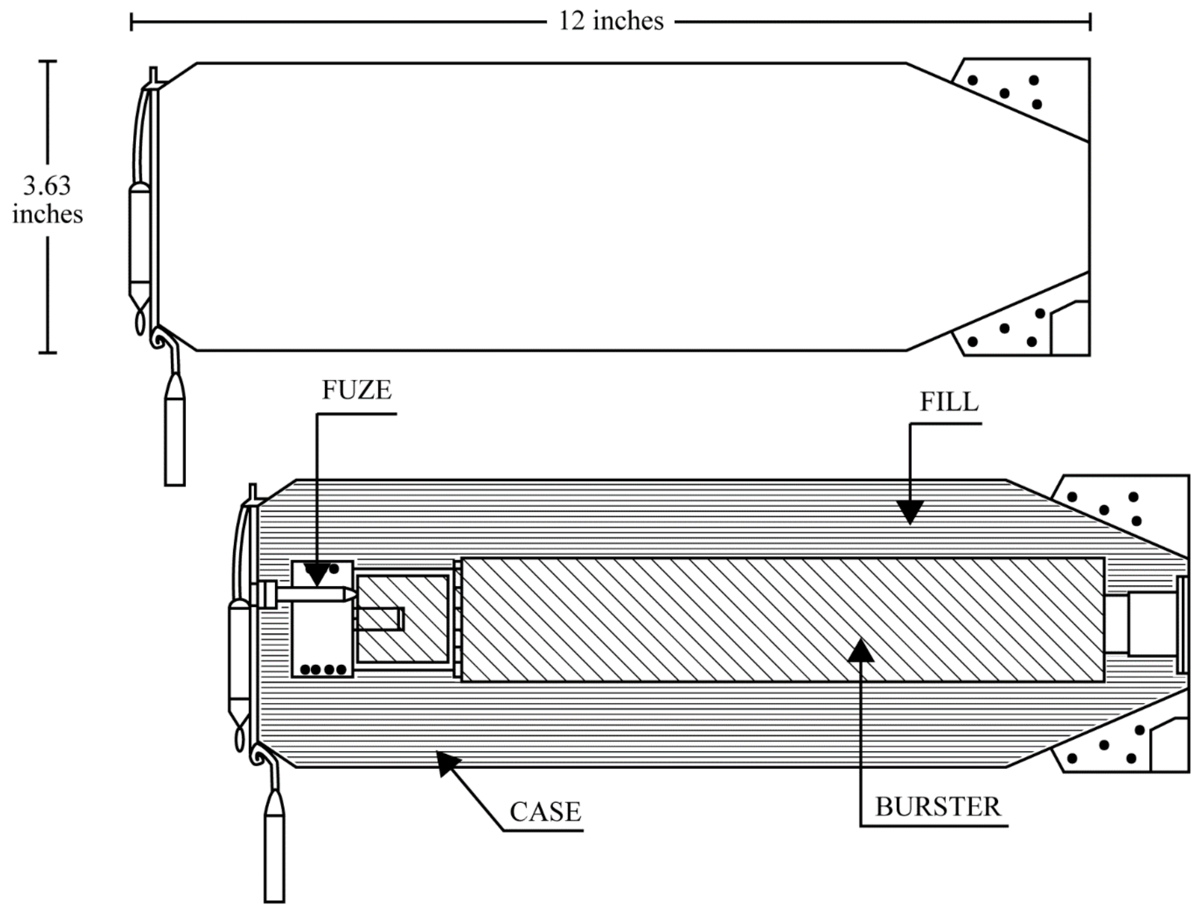

Figure 64: Bomblet, 10-pound, E49 - Line Drawing

Figure 65: Bomblet, 10-pound, E49 - Photograph Top: Recovered, Bottom: Intact

Bomblet, 10-pound, E49 Series

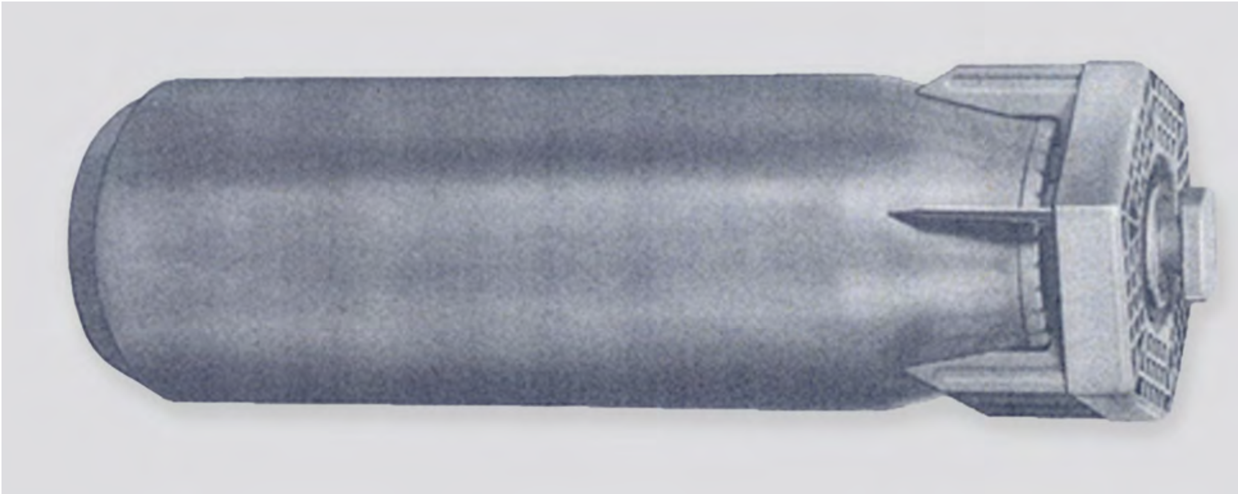

Figure 66: Bomblet, 10-pound, E49R2 - Image

Specifications

Bomblet, 10-pound, E49 - Specifications and Other Data		Citation
Historical Name	Bomb, Chemical, 10-Pound, E49	1 (p. 39, Appendix A)
Type	Bomblet	2, 3 (p. 15), 4 (p. 15)
Size	10-pound	1 (p. 39, Appendix A), 2, 3 (p. 15)
Conflict	Post WWII	1 (p. 39, Appendix A)
Service	Air Force	2
Diameter	3.63 in. (9.22 cm)	1 (p. 39, Appendix A), 5 (p. i)
Length	12 in. (30.48 cm)	1 (p. 39, Appendix A), 5 (p. i)
Other Engineering Data	The E49 was used in the E100 1,000-pound cluster. The E49 bomblets held in the E47 cluster adapter formed the MX-771 warhead	1 (p. 39, Appendix A), (3 p. 5, 15)
Drawing	314-5-3067	-

General Use and Description

The E49 was designed as a small clusterable bomb for the employment of persistent chemical agents. The design was intended to overcome issues identified with the E5 series, EK-series and E29 bombs (5 p. i).

The E49 10-pound bomb was referred to as the "Child Bomb", so named because the bomb was small, and the components could be grouped together to form a large cluster bomb. Child bombs were named solely for the size of the bomb, not for its intended purpose. The E49 was a stabilized small tail ejection type bomb for persistent agents with overall dimensions suitable for efficient stowage in 1,000-pound clusters. The bomb weighed approximately 10 pounds when filled with mustard (1 p. 39, Appendix A), (5 p. i).

Explosive Train

Early design envisioned an impact type fuze with adequate safety features to prevent instantaneous arming of the bombs after released from the cluster. The fuze T729E1 was recommended for consideration (5 p. 13).

Fuzing

Available references did not include information regarding fuzes for this item.

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Bomblet, 10-pound, E49 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GA	N/A	N/A	N/A	N/A	E49R2	4 (p. 13)
HS	3.20	1.45	10.0	4.53	-	1 (p. 39, 40, Appendix A)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The E49-series bombs were developed as part of Army Chemical Corps Project 4-04-15-10. A cluster of 55 E49 bomblets were held in the E47 cluster adapter to form the MX-771 gas warhead (3 p. 5, 15). The E49R1 was designed for use in the E100 and E100R1 1,000-pound cluster bomb. There were 76 E49R1 bombs arranged in four banks of 19 bombs in each cluster (1 p. 39 - 40, Appendix A), (2), (5 p. 13).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.
2. Office of the Engineering Field Office. 1951. Report of Status and Progress on Air Force Projects at Army Chemical Center, MD. Army Chemical Center. 1 May.
3. Office of the Engineering Field Office. 1999. 1999 Main Munition Table. Army Chemical Center.
4. Milly, George H. 1950. Technical Command Informal Report, TCIR 566, Report of Field Tests of G Agents at Dugway Proving Ground During Summer 1949. Technical Command.
5. Berlin, A.S., & Kline, S.Q. 1948. Technical Command Report, TCR 12, Preliminary Investigation of 10-lb. Bomb for Persistent Agents. Technical Command.

7.13 Bomblet, 10-pound, Ejection Airburst, EK-Series

Figures

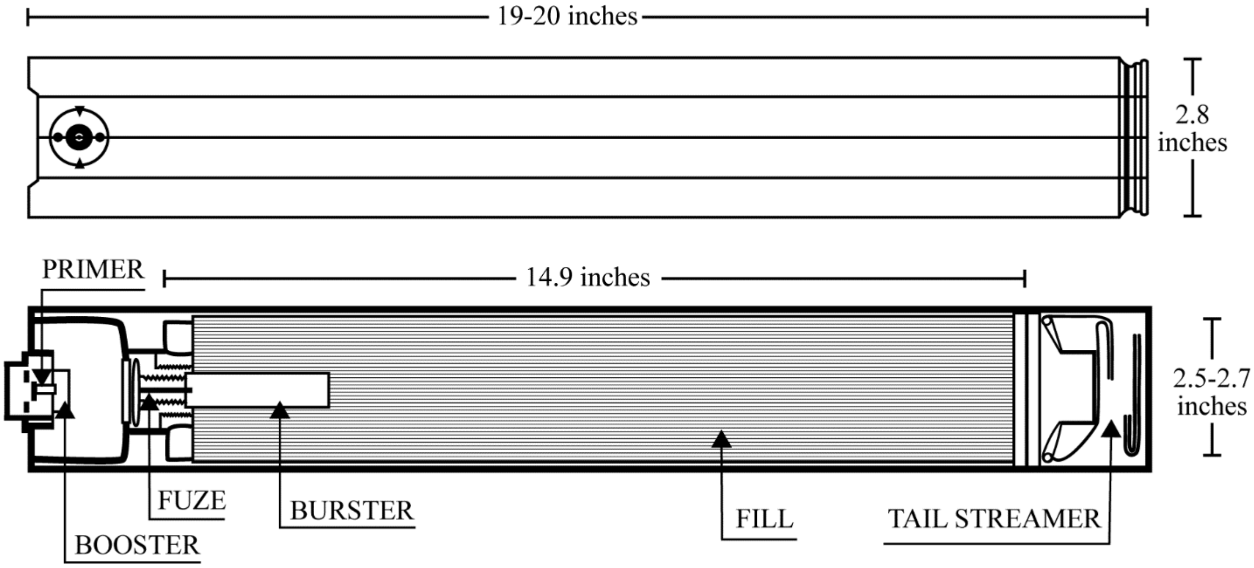

Figure 67: Bomblet, 10-pound, Ejection Airburst, EK-2 - Line Drawing

Figure 68: Bomblet, 10-pound, Ejection Airburst, EK-1 - Photograph - Cutaway View

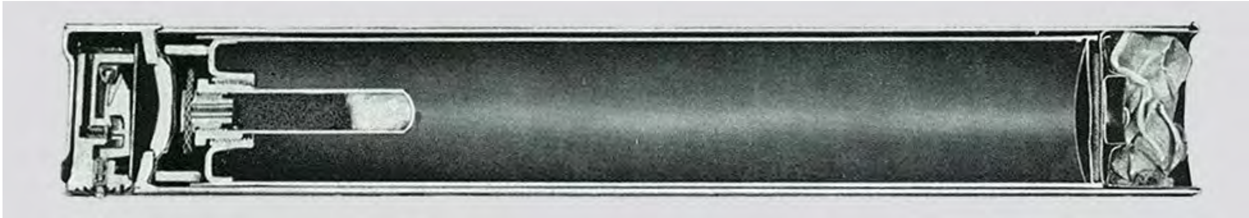

Figure 69: Bomblet, 10-pound, EK-3 - Photograph - Cutaway View

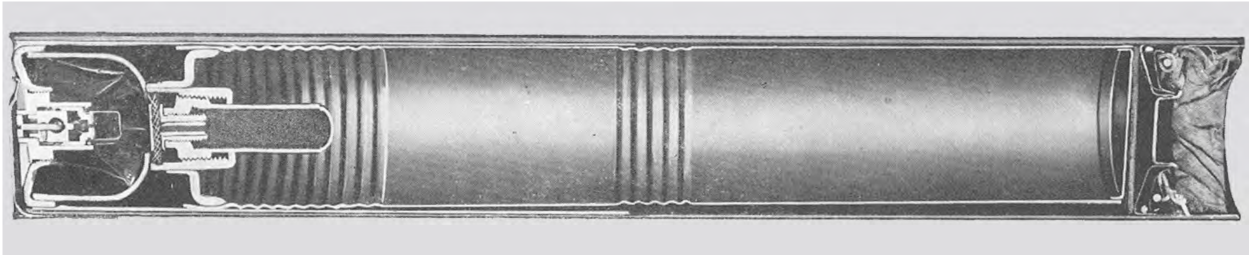

Figure 70: Bomblet, 10-pound, EK-4 - Photograph - Cutaway View

Bomblet, 10-pound, EK Series

Specifications

Bomblet, 10-pound, Ejection Airburst, EK-Series - Specifications and Other Data		Citation
Historical Name	Vesicant Spray Bomb, EK-1, EK-2, EK-3, EK-4	1 (p. 5), 4
Developmental Information	EK-1, EK-2, EK-3	1 (p. 1, 4)
Type	Bomblet	1, 2 (p. 1), 3 (p. 8)
Size	10-pound	3 (p. i)
Conflict	Post WWII	1 (p. 3a, 4, 5)
Diameter	Inner Case, Round: 2.56-2.75 in. (6.50-6.98 cm) Outer Case, Round: 2.8 in. (7.1 cm) Burster: 0.75 in. (1.9 cm)	1 (p. 7, 8, drawings), 3 (p. iv), 4
Length	Inner case, Round: 14.9 in. (37.78 cm) Outer case, Round: 19-20 in. (48.3-51 cm) Sleeve: 9.5 in. (24.13 cm) Burster: 2 in. (5.08 cm) Streamers: 40 in. (102 cm)	1 (p. 7, 8, drawings), 3 (p. iv), 4
Wall Thickness	Inner: 20-gauge (0.04 in.) steel tubing Outer: 18-gauge (0.05 in.) steel tubing	1 (p. 7, 8)
Other Engineering Data	The EK-1 was a modified M69 case. The EK-3 was developed from an AN-M69 case. The EK-2 and EK-3 were designed for use with the M4 or E22R2 adapter.	1 (p. 1, 2, 4, 10), 2 (p. 1)
Construction Material	Steel tubing	1 (p. 7, 8)
Propellant	A-4 black powder packed 10.5 grams in a nitrocellulose container. Two containers per bomb.	1 (p. 10, 16), 4 (p. 2)

General Use and Description

These bomblets were designed to meet the needs for a base ejection airburst bomb for the dispersal of liquid agents (1 p. 1, 3), (2 p. 1).

The EK-1 bomblet was developed from a modified hexagonal M69 bomb case to give improved dispersion of H by adding an inner canister, which was ejected upon impact, and burst at a height of 100 to 250 feet. The design of the EK-1 bomb was modified to increase the strength of the inner case and to facilitate its commercial manufacture. This model was designated EK-3 (1, p. 4). A need to strengthen the unit was established. A round bomblet was developed to increase strength and ease manufacturing; it was designated EK-2 (1 p. 1).

The delay fuze used in the EK-1 bomb consisted of a holder and a short length of safety fuze, held in place by means of two screws and half-washers. A piece of Navy No. 1 quick match was fastened to both ends of the fuze, and the ends were covered with a mixture of collodion and Type II fuze powder.

The main outward difference between the designs were a hexagonal or a round casing. The EK-2 round bomb was developed because of its greater strength and ease of manufacture. The first round model was designated EK-2 and was constructed by hand and tested by firing the bomb from a mortar and by dropping them from an airplane. The EK-2 used an inertia type fuze, which was made safe by inserting an arming pin between two steel balls and the firing pin.

Improvement of the EK-3 bomb required that the entire unit be strengthened. This fuze went through several modifications until it resulted in the fuze used in the EK-4 bomb. These models showed improvement over the EK-3 bomb and the development was continued until functioning was acceptable. This model was designated EK-4.

The EK-4 consists of an inner case made from 2-$^{9}/_{16}$ inches outer diameter, 20-gauge, steel tubing. A stamped cup containing an impact collar and the filling hole is copper brazed in the nose of the case. The tail cup is also copper brazed in place. This cup has a circular groove stamped in it so that the thickness of the remaining metal is slightly less than half of the wall thickness of the case. The groove weakens the cup to ensure that it would blow open at this point. A compressed black powder train was initially used as the delay fuze for the EK-4 but later, a short length of lead covered spitter fuze was substituted for the loose powder and was pressed into the holder. The ends of the powder train were exposed, and one end was coated with a booster mixture. The outer case has a stamped nose cup containing the threaded hole where the fuze is copper brazed in place. A dome-shaped diaphragm absorbs some of the impact of the inner case and provides a chamber for the powder bags. Four oval shaped powder bags are used to eject the inner case.

A stamped nose plate replaced the flat nose plate so the assembly could be copper brazed. The tail cup was soft soldered in place, so that tail ejection of the agent would occur.

A compressed black powder train was initially used as a fuze for the EK-3 but later, a short length of lead covered spitter fuze was substituted for the loose powder and was pressed into the holder. The ends of the powder train were exposed, and one end was coated with a booster mixture.

It was apparent from impact tests that the EK-1 and EK-3 were not suitable due to the inner case deformation upon impact. Subsequently, a round bomblet was decided upon (1 p. 1, 2), (3 p. iii, iv), (4 p. 1, 2).

Explosive Train

Upon impact, the impact fuze initiated the ejection charge. The ejection charge consisted of smokeless ball powder, plus either 0.5 grams of Type II black powder or two inches of Navy No. 1 quick match. The inner case was ejected 125 to 450 feet above the ground. When the delay fuze burned down, the burster was initiated, which spread the agent (1 p. 8), (2 p. 1).

Fuzing

Bomblet, 10-pound, Ejection Airburst, EK-Series - Fuzing		
Fuze	**Notes**	**Citation**
M1	-	3 (p. iii), 4 (p. 2)
Not designated	Inner case-delay	1 (p. 8, 9), 2 (p. 1)
Not designated	Outer case-impact	1 (p. 8, 9, 10), 2 (p. 1)

Booster, Adapter-Booster, or Burster

Bomblet, 10-pound, Ejection Airburst, EK-Series - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	0.02 lb. (0.009 cm)	Smokeless ball powder Type II black powder	Smokeless ball powder (8.5 grams), plus either Type II black powder (0.5 grams) or of Navy No. 1 quick match (2 inches)	1 (p. 8)

Fills

Bomblet, 10-pound, Ejection Airburst, EK-Series - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
H	3.18	1.44	N/A	N/A	Filler was dyed with 0.5% Oil Red dye.	1 (p. 5), 2 (p. i), 3 (p. 8), 4 (p. 2)
HD	EK-1: 3.37 EK-2: 2.67 EK:4: 2.80	EK-1: 1.52 EK-2: 1.21 EK-4: 1.27	EK-1: 8.85 EK-4: 8.40	EK-1: 4.01 EK-4: 3.81	Filler was dyed with 0.5% Oil Red dye.	1 (p. 2, 11, 16), 2 (p. I, 1, 4)
HV/HDV	3.18	1.44	N/A	N/A	Experimental fill dyed with 0.5% Oil Red dye. EK-4	1 (p. 5), 2 (p. i), 4 (p. 2)
HV	2.80	1.27	N/A	N/A	Filler was dyed with 0.5% Oil Red dye.	1 (p. 11)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The EK-3 was used with 100-pound quick opening cluster (M4-adapter-14 bomblets) or 500-pound aimable cluster (E22R2 adapter- 38 bomblets) (1 p. 4), (2 p. 1),

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Kallal, R.J., & Davis, R.W., & Johnstone, H.F. 1945. Office of Scientific Research and Development, OSRD No. 6300, Development of a Small Base Ejection Air-Burst Bomb for Dispersing Liquid Agents. Office of Scientific Research and Development.
2. Technical Staff 9769 (TSU) CWS Mobile Unit. 1946. Mobile Unit Memorandum Report, MR #5, The Tactical Usefulness of the EK3 and EK4 Bombs. Filled HD and HDV, as Compared with Ground Functioning Munitions, Namely the E5 and M47A2 Bombs. Chemical Warfare Service.
3. Berlin, A.S., & Kline, S.Q. 1948. Technical Command Report, TCR 12, Preliminary Investigation of 10-lb. Bomb for Persistent Agents. Technical Command.
4. Stockhardt, Jay S., Captain. 1945. Technical Command Informal Report, TCIR 302, Vesicant Spray Bomb, EK-3 Filling and Clustering. Chemical Warfare Service.

7.14 Bomblet, 10-pound, M67

Figures

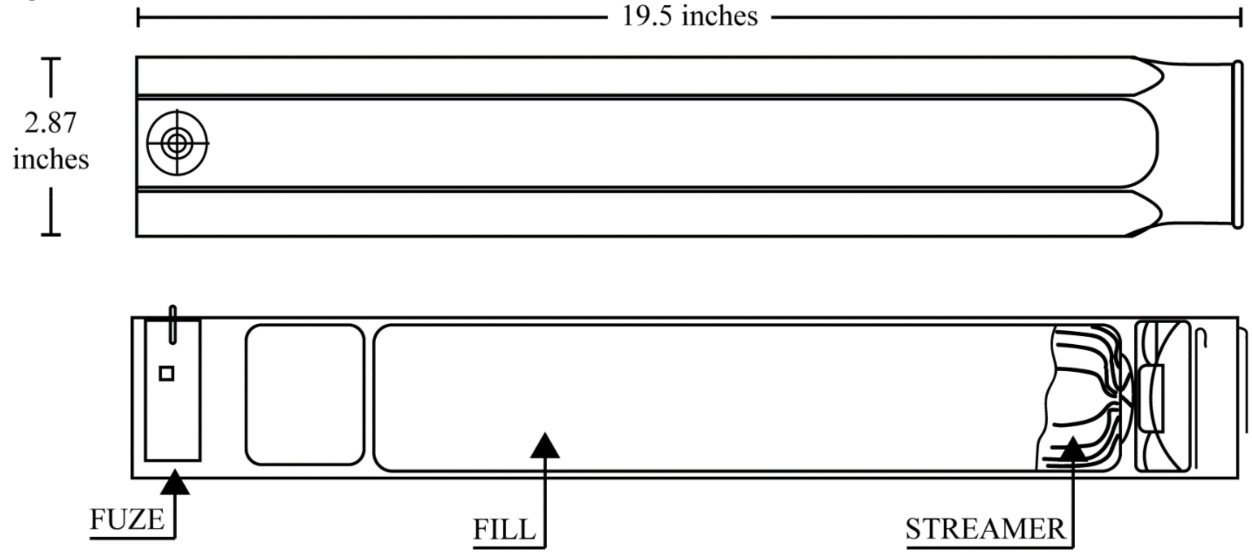

Figure 71: Bomblet, 10-pound, M67 - Line Drawing

Figure 72: Bomblet, 10-pound, M67 - Photograph - Intact

Specifications

Bomblet, 10-pound, M67 - Specifications and Other Data		**Citation**
Historical Name	10-lb. Chemical Bomb, M67 Bomb, Smoke, 10-lb, AN-M67	1 (p. 2), 4 (p. 19)
Type	Bomblet	1 (p. 2)
Size	10-pound	1 (p. 2)
Service	Navy	2 (p. 2)
Length	19.5 in. (49.5 cm)	3 (p. iii)
Width	2.87 in. (7.29 cm)	3 (p. iii)
Other Engineering Data	Used in 100-pound M14 and M15 clusters, and the 500-pound M16 cluster	2 (p. II-4, IV-2)
Construction Material	Steel	3 (p. iii)
Specification	CWS 196-131-111	1 (p. 2)

Bomblet, 10-pound, M67

General Use and Description

The M67 consists of a hexagonal steel shell with two compartments. A small chamber at the nose houses a M1 fuze and the ejection charges. A larger chamber contains the fill (3 p. iii).

Explosive Train

Available references did not provide specific information on the explosive train.

Fuzing

Bomblet, 10-pound, M67 - Fuzing		
Fuze	**Note**	**Citation**
M1	-	3 (p. iii)

Booster, Adapter-Booster, or Burster

Bomblet, 10-pound, M67 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Booster	0.5 gram	EC Powder	-	4 (p. 5)

Fills

Bomblet, 10-pound, M67 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	2	0.91	N/A	N/A	Experimental	4 (p. 2, 9), 5 (p. 2)
HS	4.25	1.93	N/A	N/A	-	4 (p. 2, 9), 5 (p. 2)
WP	N/A	N/A	N/A	N/A	-	1, 5 (p. 1)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not provide this information.

Sources

1. Mitchel, C. T. 1943. Technical Division Memorandum Report, TDMR 756, Development of Bomb, Chemical, 10-LB., E5. Chemical Warfare Center.

2. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office.

3. Berlin, A.S., & Kline, S.Q. 1948. Technical Command Report, TCR 12, Preliminary Investigation of 10-lb. Bomb for Persistent Agents. Technical Command.

4. Hollingsworth, Henry L., & Denues, Art 1st Lt. 1944. Technical Division Memorandum Report, TDMR 542, Functioning of M67 and M69 Bombs, HS Filled, Project B4.7, B6.7-2. Chemical Warfare Service.

5. Kriete, Bertrand and Gregg, Arthur. 1946. Technical Division Memorandum Report, TDMR 1193, Improved Ejection Charge and Dispersion Data of the 10-lb. Chemical Bomb, E5R8 H Filled. Chemical Warfare Service. 26 February.

7.15 Bomblet, 10-pound, M74 (E5), M74A1

Figures

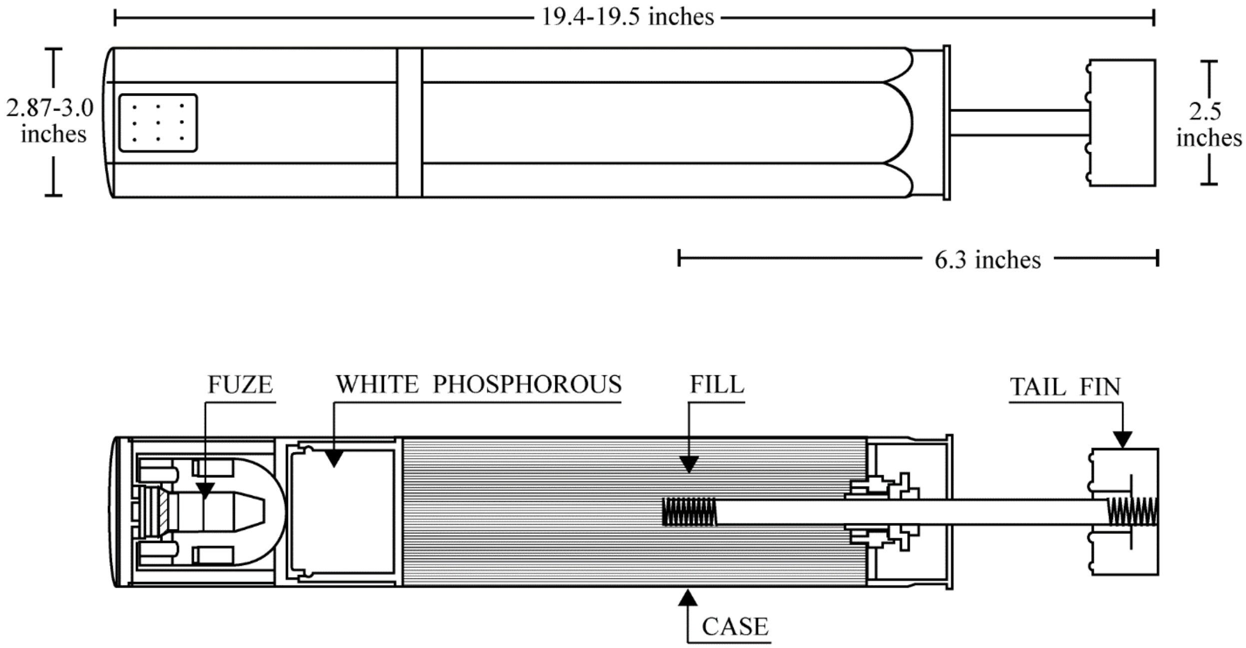

Figure 73: Bomblet, 10-pound, M74 (E5), M74A1 - Line Drawing

Figure 74: Bomblet, 10-pound, M74 (E5), M74A1 - Photograph - Top: Intact, Bottom: Cutaway View

Bomblet, 10-pound, M74 (E5), M74A1

Specifications

Bomblet, 10-pound, M74 (E5), M74A1 - Specifications and Other Data		Citation
Historical Name	Bomb, Chemical, 10-LB., E5	1 (p. cover)
Developmental Information	E5 E5R8 (H-fill)	1 (p. 1), 2 (p. 417)
Type	Bomblet	2 (p. 416), 3 (p. 4-16)
Size	10-pound	3 (p. 4-16)
Conflict	Cold War, WWII	3 (p. 4-16), 4 (p. 1)
Service	Air Force, Navy	2 (p. 416), 3 (p. 4-16)
Diameter	Body: 2.87-3.0 in. (7.29-7.62 cm) across flats	3 (p. 4-16), 5 (p. 416)
Length	Body: 19.4-19.5 in. (49.28-49.53 cm) Tail: 6.3 in. (16 cm)	2 (p. 416), 3 (p. 4-16), 6 (p. 2-39)
Width	Tail: 2.5 in. (6.35 cm)	2 (p. 416), 6 (p. 2-39)
Wall Thickness	0.027 in. (0.068 cm)	1 (p. 7)
Other Engineering Data	The M74 was used in clusters E29, E48 and E61. The M74A1 was used with the M35 cluster.	2 (p. 417, 418), 3 (p. 4-17), 6 (p. 2-40) 20 (p. 33-35, 134)
Construction Material	Sheet steel	2 (p. 416)
Specification	CWS 196-131-181 (WP-filled) CWS 196-131-182 (IM- or NP-filled) CWS 196-131-184 (H-filled)	1 (p. 27)
Drawing	Assembly, E5: C14-5-352 (WP-filled) Assembly, E5: C14-5-378 (Oil-filled) Assembly, E5: C14-5-465 (H-filled)	1 (p. 11)

General Use and Description

The M74 (E5) was designed to provide a chemical offensive capability. Initially, the E5 was designed to meet the requirement for laying smoke screens in support of ground troops (3 p. 4-16), (13 p. 1).

It was a 10-pound tail ejection type incendiary bomb of the same size and shape as the AN-M69 six-pound oil incendiary. The bomb was hexagonal in shape. However, the tail end of the case was reduced to a cylindrical cross section. It had a telescope type tail that was ejected under spring pressure when the bomb was released from the cluster. The M3 all-ways acting fuze screwed into the nose along the long axis of the bomb. A sheet steel, leak proof casing extended the entire length of the bomb. A nose cup fit into the front of the casing. It had a dome that housed the fuze.

In bombs filled with oil and incendiary mixture (PT or PT1) or NP, a small container, located immediately behind the dome, was filled with WP to aid in ignition and produce smoke. The PT1 or NP was enclosed in a cheesecloth sack. In bombs filled with WP, the filling was enclosed in impregnated paper tubes inside the casing.

A tail cup fit inside the rear end of the casing. A threaded hub inside this cup retained a well extending five inches into the body of the bomb. This well held the tail sleeve of the fin when the tail was compressed for clustering (3 p. 4-16), (5 p. 416), (7 p. 1), (13 p. 1).

Explosive Train

When the bombs were released, the arming pin was forced out by its spring, permitting the safety pin to enter the cavity in the striker. Impact forced the striker and sleeve together, which would pierce the percussion primer that would initiate the delay charge (magnesium black powder) and, subsequently, the fuze powder in the booster cup. A small container, located immediately behind the dome of the nose cup, was filled with WP to aid ignition of the incendiary composition, and produce smoke (2 p. 417), (3 p. 4-16), (5 p. 416), (6 p. 2-39).

Fuzing

Bomblet, 10-pound, M74 (E5), M74A1 - Fuzing		
Fuze	**Notes**	**Citation**
M142	All-ways acting	2 (p. 416), 7 (p. 2)
M142A1	Screwed into the nose cup	2 (p. 416), 6 (p. 2-39), 7 (p. 1)
M197	Used with M74A1	3 (p. 4-17), 6 (p. 2-39)
M3	-	2 (p. 416)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Bomblet, 10-pound, M74 (E5), M74A1 – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
H	N/A	N/A	N/A	N/A	Experimental, H was used in development of the E5R8.	1 (p. 11, 27), 2 (p. 417)
HT	N/A	N/A	N/A	N/A	Experimental	1 (p. 25)
L	N/A	N/A	N/A	N/A	Experimental	1 (p. 25)
NP	1.80	0.81	7.50	3.40	-	2 (p. 416), 4 (p. 22), 8 (p. 716 – 719)
PT	2.75	1.24	8.50	3.85	Filled as PT-1 with a 6-ounce WP ignition charge.	2 (p. 416), 3 (p. 4-17), 4 (p. 22), 6 (p. 2-39), 8 (p. 716, 719)
WP	N/A	N/A	N/A	N/A	The E5 bomb with a WP filling was rejected.	1 (p. 27), 2 (p. 417)

Shipping/Packing

The bombs were normally assembled in clusters and the clusters were packed in suitable containers (8 p. 719).

Miscellaneous Information

The M74A1 was identical to the M74, except M74A1 had an M197 fuze instead of the M142A1 and was used with the M35 cluster rather than the M31 cluster.

The M74 (NP, PT-1) and E5 (IM) were used in cluster E29 with adapter E6R2. M74 bomblets were used in clusters E48 and E61 with adapter M23, cluster M20A1 with adapter M33A1, Cluster M31 (PT-1) with adapter M25. The E5 (H) was used in cluster M34, and the E54 cluster (H-simulant). There were 38 bombs in each cluster (2 p. 417, 418), (3 p. 4-17), (6 p. 2-40) (20 p. 33-35, 134).

This bomb was ultimately replaced by the EK-series of bombs which were round, stronger, and easier to manufacture (14 p. 4-58).

Bomblet, 10-pound, M74 (E5), M74A1

Key Dates

Bomblet, 10-pound, M74 (E5), M74A1 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Procured	1943	CCTC 697, 740 E5 Limited Procurement	9 (p. 26). 13 (p. 2)
Standardized	1944	CCTC 1157 M74 PT1 standard and NP-fill substitute standard	10 (p. 1)
Obsoleted	1948	CCTC 1866 M74 Specification for IM- or NP-fill Canceled	11 (p. 132)
Canceled	1948	CCTC 1830 Cancellation of Classification of Bomb, Chemical, E5 as Limited Procurement Type	9 (p. 28)
Standardized	1954	CCTC 2930 (NP or PT1-filled – Standard – Air Force)	15 (p. 1)
Standardized	1958	CCTC 3408 M74A1 (PT1-filled – Standard – Air Force and M74 PT1-filled – Limited Standard – Air Force)	12 (p. 105, 106)

Sources

1. Mitchel, C.T. 1943. Technical Division Memorandum Report, TDMR 756, Development of Bomb, Chemical, 10-LB., E5. Chemical Warfare Center.

2. Bureau of Ordnance. 1947. Ordnance Pamphlet, OP 1664, U.S. Explosive Ordnance. Department of the Navy.

3. Naval Ordnance Laboratory. 1963. NAVWEPS [Bureau of Naval Weapons] Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

4. Willke, L.G. 1946. Technical Division Memorandum Report, TDMR 1244, Development of Explosive Incendiary Bombs E5X and E5XR2. Chemical Warfare Service.

5. Naval Sea Systems Command. 1969. Naval Sea Systems Command Ordnance Pamphlet, NAVSEA OP 1664, Change 1, U.S. Explosive Ordnance. U.S. Government Printing Office.

6. Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. U.S. Government Printing Office

7. Chemical Warfare Technical Committee. 1945. CWTC Item # 1329, Standardization of Fuze, Bomb, M142A1. Chemical Warfare Service

8. Gual, A. and Finklestein, Leo. 1952. Chemical Research and Development Laboratories, History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 – 31 December 1945). Volume 18, Part V, Incendiaries. Project 4-72-05-005. AD0224098. Army Chemical Center. Army Chemical Center

9. Chemical Corps Technical Committee. 1948. CCTC Item # 1830, Cancellation of Inactive Limited Procurement and Service Test Items. Chemical Warfare Service.

10. Chemical Warfare Technical Committee. 1944. CWTC Item # 1050, Standardization of Bomb, Chemical, 10-lb. (PT1, M74; Bomb, Chemical, 10-lb. (NP), M74). Chemical Warfare Service.

11. Chemical Corps Technical Committee. 1948. CCTC Item # 1866, Specification Changes. Chemical Warfare Service.

12. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.

13. Chemical Corps Technical Committee. 1943. CCTC Item # 697, Classification of E5 Chemical Bomb. Chemical Warfare Service.

18. EDO Corporation 1948. Survey of Aircraft Spray Equipment and Practice for Vesicants, Report No 2401. 31 August.

19. Chemical Corps Technical Committee. 1954. CCTC Item # 2930, Items Type-Classified by the Air Force (Read for Record). Department of the Army.

20. Departments of the Army and Air Force. 1953. Technical Manual, TM 3-400/Technical Order, TO 39B-15C-1, Chemical Bombs and Clusters. April. Department of the Army.

7.16 Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8)

Figures

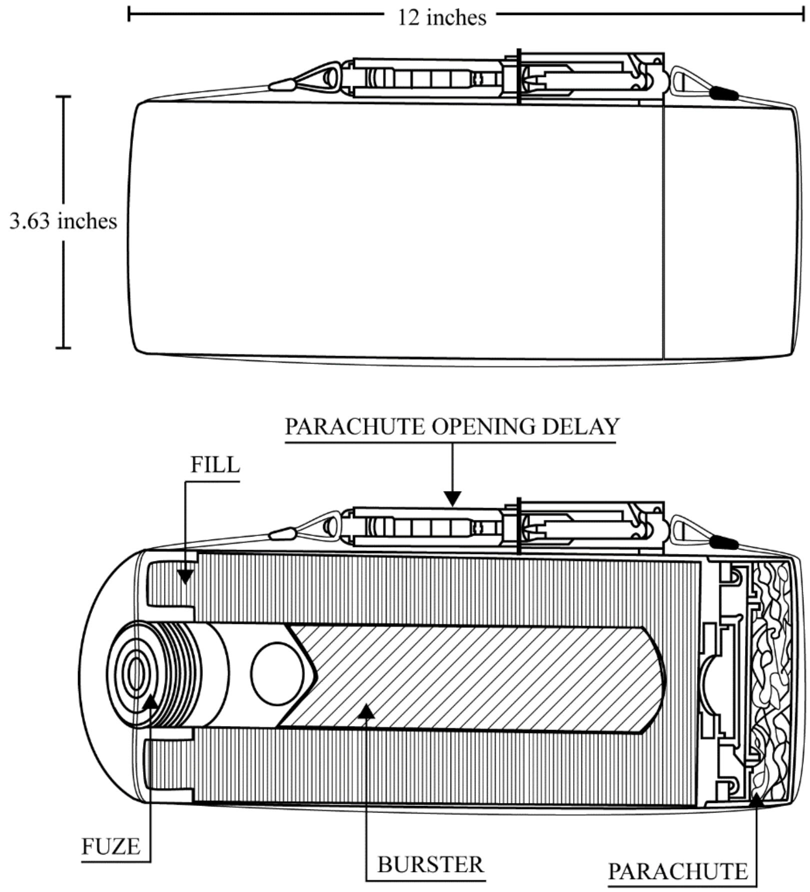

Figure 75: Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8) – Line Drawing

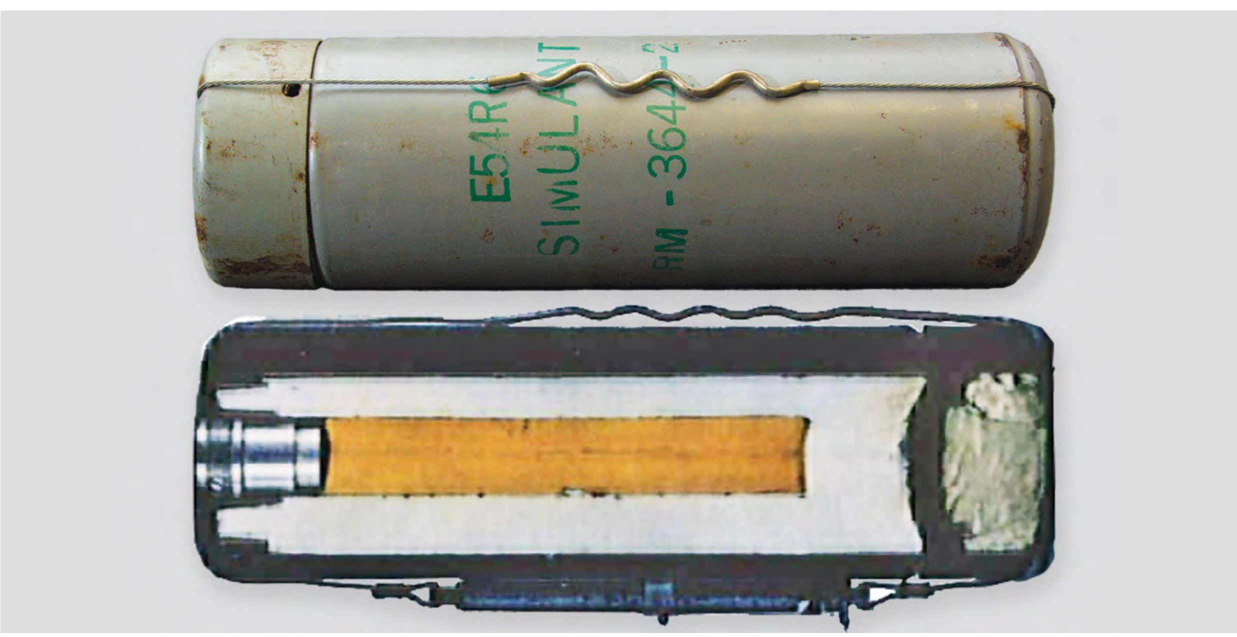

Figure 76: Bomblet, 10-pound, M125 (E54R6) – Photograph Top: E54R6, Bottom: M125 Cutaway

Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8)

Specifications

Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8) – Specifications and Other Data		Citation
Historical Name	Bomb, Gas: Nonpersistent, GB, 10-Pound, M125A1 and M125	1 (p. 2-57), 2 (p. 25), 3 (p. 7)
Developmental Information	E54R6: M125 E54R8: M125A1	4 (p. 4-20), 5 (p. 4-19), 6 (p. 66)
Type	Bomblet	5 (p. 4-18)
Size	10-pound	1 (p. 2-57), 2 (p. 25), 3 (p. 7)
Conflict	Cold War	2 (p. 3)
Service	Air Force	3 (p. 7), 4 (p. 4-19), 5 (p. 4-18)
Diameter	M125A1: 3.63 in. (9.22 cm) Parachute: 14 in. (35.56 cm)	1 (p. 2-57), 2 (p. 25), 4 (p. 4-20), 5 (p. 4-19)
Length	12 in. (30.48 cm)	1 (p. 2-57), 2 (p. 25), 4 (p. 4-20), 5 (p. 4-19)
Other Engineering Data	Used with the M34 cluster	(2 p. 26)
Construction Material	Sheet steel	2 (p. 25), 4 (p. 4-20)
Drawing	M125: D14-5-1372	6 (p. 66), 7 (p. K6)

General Use and Description

The M125 10-pound bomb was designed to provide toxic chemical offensive capability (4 p. 4-19), (5 p. 4-18).

The M125 was nearly identical to the M125A1 except that the M125 used the parachute-opening delay M1 instead of the M1A1 delay. The M125 also differed from the M125A1 in that a spring-loaded lock pin, which was restrained by the arming bar, held the firing pin in the delay instead of a detent (part of an external arming bar).

The body of the M125A1 was a sheet steel cylinder with a burster well and fuze at the front end, and a parachute at the rear. The cloth parachute opened to a diameter of 14 inches and was packed in the tail of the bomb. The parachute was packed under a metal tail cap which was held in place by a stranded steel cable attached to the bomb parachute-opening delay. The parachute-opening delay M1A1 was fastened to the outside of the bomb. The delay was held on the bomb by a stranded steel cable, which was wrapped around the long axis of the bomb and fastened at each end of the delay (1 p. 2-57 – 2-59), (2 p. 25, 26), (4 p. 4-19), (5 p. 4-18).

Explosive Train

The M125 bombs were arranged in the cluster so that the arming bars on all parachute-opening delays were depressed by contact with other bombs in the cluster. When the bomb was released from the cluster, the arming bar would spring away from the parachute-opening delay, and the firing pin in the delay would fire the primer. The primer ignited the delay charge, which would burn for three to seven seconds, then set off the explosive charge in the parachute-opening delay. The explosion would break the stranded steel cable, freeing the tail cup and removing restraint from the fuze arming ring. The parachute opened and abruptly slowed the descent of the bomb. The rapid deceleration caused the arming ring to fall from the fuze, thus arming the fuze. When the bomb impacted, the fuze initiated the burster, which ruptured the body and released the bomb filler (1 p. 2-59), (2 p. 26), (4 p. 4-19), (5 p. 4-18).

Fuzing

Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8) – Fuzing		
Fuze	**Note**	**Citation**
M196	Point detonating, containing an ordnance MM15A2 detonator. It was used with M1A1 Parachute Arming Assembly.	4 (p. 4-20), 5 (p. 4-19), 6 (p. 67)

Booster, Adapter-Booster, or Burster

Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8) – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M31 (E12R1)	0.55 lbs. (0.25 kg)	Tetryl	The M31 had a 1.337-1.44-in. diameter and was 7.0-7.5 in. long.	1 (p. 2-57), 6 (p. 67), 7 (p. K6)

Fills

Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8) – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	2.60	1.17	8.50	3.85	-	1 (p. 2-57), 2 (p. 25), 4 (p. 4-20), 5 (p. 4-19)

Shipping/Packing

The bomblets were shipped as part of the M34 bomb cluster (2 p. 26).

Miscellaneous Information

The bomblets were used with cluster assembly M34 and M34A1 (1 p. 2-57) (2 p. 25) (4 p. 4-19) (5 p. 4-18).

A total of 362,000-400,000 (Type A) and 2,488,000 (Type B) M125 bomb bodies were produced. The Type B was the preferred type (6 p. 66-67), (7 p. K6).

Key Dates

Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8) – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1954	CCTC 2947 (M125 Limited Standard, M125A1 Standard)	7 (p. K19)
Standardized	1958	CCTC 3408 (M125A1 GB-fill-Limited Standard-Air Force)	9 (p. 107)
Standard Modernization	1959	CCTC 3525 (GB-fill Standard-C-Air Force)	8 (p. 210, 213)
Obsoleted	1969	AMCTC 7028 (M125A1 and M125)	6 (p. 65)

Sources

1. Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. U.S. Government Printing Office.

2. Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. Department of the Army.

3. Chemical Corps. 1952. Quarterly Historical Report, 1 April – 30 June 1952. Chemical and Radiological Laboratories.

4. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

5. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

6. Chemical-Biological-Nuclear Subcommittee. 1969. AMCTC Item # 7028, Reclassification of Clusters, Gas Bomb, Nonpersistent GB, 1000-lb., M34 & M34A1 from Standard-A and Standard-C USAF-Types to Obsolete Types. U.S. Army Materiel Command.

7. Chemical Corps Technical Committee. 1954. CCTC Item # 2947, Classification of Clusters, Gas Bomb, GB, 1000-lb., M34 (E101R3) & M34A1 (E101R5) as Limited Standard and Standard Types, Respectively. Department of the Army.

8. Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.

9. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.

7.17 Bomblet, 10-pound, M138 (E135)

Figures

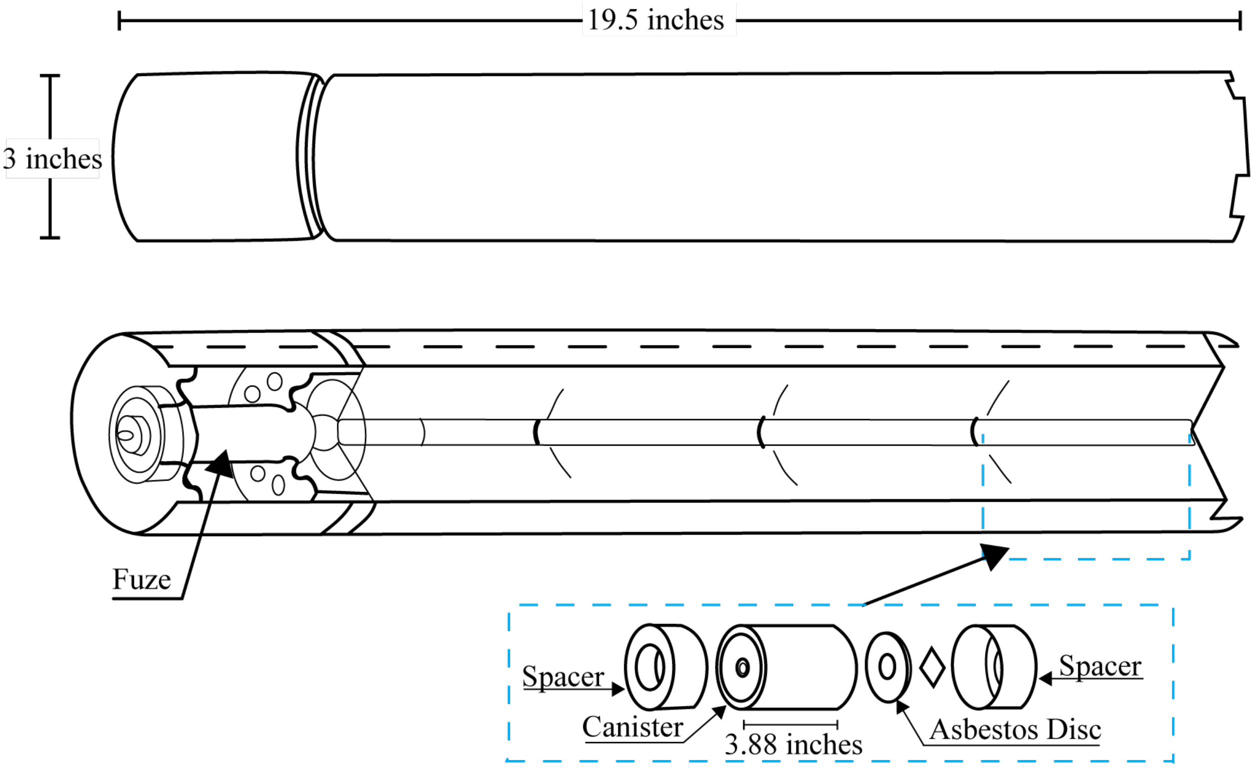

Figure 77: Bomblet, 10-pound, M138 – Line Drawing

Figure 78: Bomblet, 10-pound, M138 – Photograph

Specifications

Bomblet, 10-pound, M138 (E135) – Specifications and Other Data		Citation
Historical Name	M138 Thermal Generator Bomblet	1 (p. 13)
Developmental Information	E135: M138 bomblet E47: M7 Canister	1 (p. 15), 7 (p. 2)
Type	Bomblet	1 (p. 8), 2 (p. 2-3), 3 (p. A-1)
Size	10-pound	3 (p. A-1), 4 (p. 1-5), 5 (p. 3), 6 (p. 11)
Conflict	Cold War	-
Service	Air Force, Army	1 (p. 7), 7 (p. 2)
Diameter	3 in. (7.62 cm) Canister: 2.75 in. (6.99 cm)	1 (p. 13 – 15), 3 (p. A-1), 5 (p. 3), 6 (p. 11), 8 (p. D-4), 3 (p. A-1)

Bomblet, 10-pound, M138 (E135)

Bomblet, 10-pound, M138 (E135) – Specifications and Other Data		**Citation**
Length	Bomblet: 19.5 in. (49.5 cm) Canister: 3.88 in. (9.84 cm)	1 (p. 13), 3 (p. A-1, Figure A-3), 5 (p. 3), 6 (p. 11), 8 (p. D-4, F-1)
Other Engineering Data	Cluster adapter: M30 Canister: M7 (4 per bomblet)	3 (p. A-1), 4 (p. 1-5), 5 (p. 6), 6 (p. 11), 9 (p. 5)
Construction Material	Tubular steel	4 (p. 1-5), 5 (p. 3), 8 (p. F-1),
Drawing	C14-5-2312	5 (p. 3)

General Use and Description

The M138 bomblet was a thin-walled, unstabilized thermal-generation munition consisting of four M7 canisters nested in a tubular steel bomb casing. The M7 (E47) canister was 2.75 inches in diameter and 3.88 inches long. Each canister was filled with 0.75 pound of a 50/50 mixture of agent-pyrotechnic mixture with a total payload of three pounds, of which 1.5 pounds was BZ. An M105A1 or M150A2 fuze, a direct-arming pin type fuze, was screwed into one end of each bomblet. Spacers between the M30 adapter compartments held the arming pin in the depressed position (1, p. 15), (2, p. 2-3), (3, p. A-1) (4, p. 1-5), (5, p. 3), (6, p. 11).

M138 bomblets were used in the M43 / Cluster Bomb Unit (CBU)-5/B Cluster Bomb (57 bomblets) (see section 8.3), the M44 Cluster Bomb (42 bomblets) (see 8.1), and the E157 Cluster Bomb (21 bomblets) with the M30 cluster adapter. Upon removal from the cluster, the M138 bomblet becomes armed (2, p. 2-3, 4-4) (7, p. 2), (8 p. D-3).

Explosive Train

When the cluster (e.g., M43, CBU-5/B, or E157) opened, the M138 bombs fell individually to the target. Each of the four M7 canisters in the M138 bomblet has a cylindrical hole through the center coated with starter mix. The M150A2 fuzes became armed as soon as the M138 bombs separated from the spacers in the adapter. When the M138 bomb struck the target, the fuze was initiated and ignited the BZ-pyrotechnic mixture in the M7 canisters. Particles of BZ incapacitating agent were then released into the air (3 p. A-1), (4 p. 1-5).

Fuzing

Bomblet, 10-pound, M138 (E135) – Fuzing		
Fuze	**Note**	**Citation**
M150A1	All-ways, impact	1 (p. 15)
M150A2	All-ways, impact with M208 or M308 delay element	3 (p. A-1), 4 (p. 1-5), 6 (p. 11), 7 (p. 23), 8 (p. F-1)

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for the M138 bomblet.

Fills

Bomblet, 10-pound, M138 (E135) – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BZ	1.5	0.68	10	4.54	Combined fill weight of four M7 canisters.	1 (p. 15), 2 (p. 2-3), 5 (p. 3), 6 (p. 11),8 (p. F-1)

Shipping/Packing

Available references did not provide this information specifically for the M138 bomblet.

Bomblet, 10-pound, M138 (E135)

Key Dates

Available references did not provide this information.

Sources

1. Chemical Branch. 1964. Dugway Proving Ground Trial Record, DPGTR 394, Engineering Test of USAF Cluster, Aimable, 750-lb, Incapacitating, BZ, CBU-5/B (Dissemination Phase), 656B. U.S. Army Test and Evaluation Command.
2. Deseret Test Center. 1972. Technical Report, Joint CB Technical Data Source Book, Volume II, Riot Control and Incapacitating Agents, Part III: Agent BZ.
3. Trott, B.D. 1982. Engineering and Technical Support of Agent BZ Disposal, ARO Scientific Services Program TCN-81-220, Test Report for Agent BZ, Detonation Tests. Battelle Columbus Laboratories.
4. Department of the Army. 1982. Technical Manual, TM 43-0001-26-2, Army Equipment Data Sheets, Chemical Weapons and Munitions. U.S. Government Printing Office.
5. Process Engineering Division. 1976. Work Plan, Demilitarization and Disposal BZ Agent and BZ Munitions at Pine Bluff Arsenal. Department of the Army.
6. Chemical Systems Laboratory. 1978. Proposal for Demilitarization of Incapacitating Agent BZ and Munitions. Aberdeen Proving Ground.
7. Yeager, Kurt, 2nd Lt. 1963. Test of M-43 Cluster Bomb, Aerospace Internal Data Report No. 63-28. Air Proving Ground Center.
8. U.S. Army Toxic and Hazardous Materials Agency. 1980. Public Affairs Plan, Laboratory-Scale Incineration/Detonation Tests Involving Incapacitating BZ Agent & Munitions. Department of the Army.
9. Test and Evaluation Command. 1964. Dugway Proving Ground Trial Report, DPGTR 384, Hazard Classification Test for Storage, Handling, and Disposal of M43 Bomb Cluster, BZ-Filled, 750-lb, and M44 Generator Cluster, BZ-Filled, 175-lb, USATECOM Project No. 5-3-0130-01. Dugway Proving Ground: U.S. Army.

7.18 Bomblet, BLU-19/B23

Figures

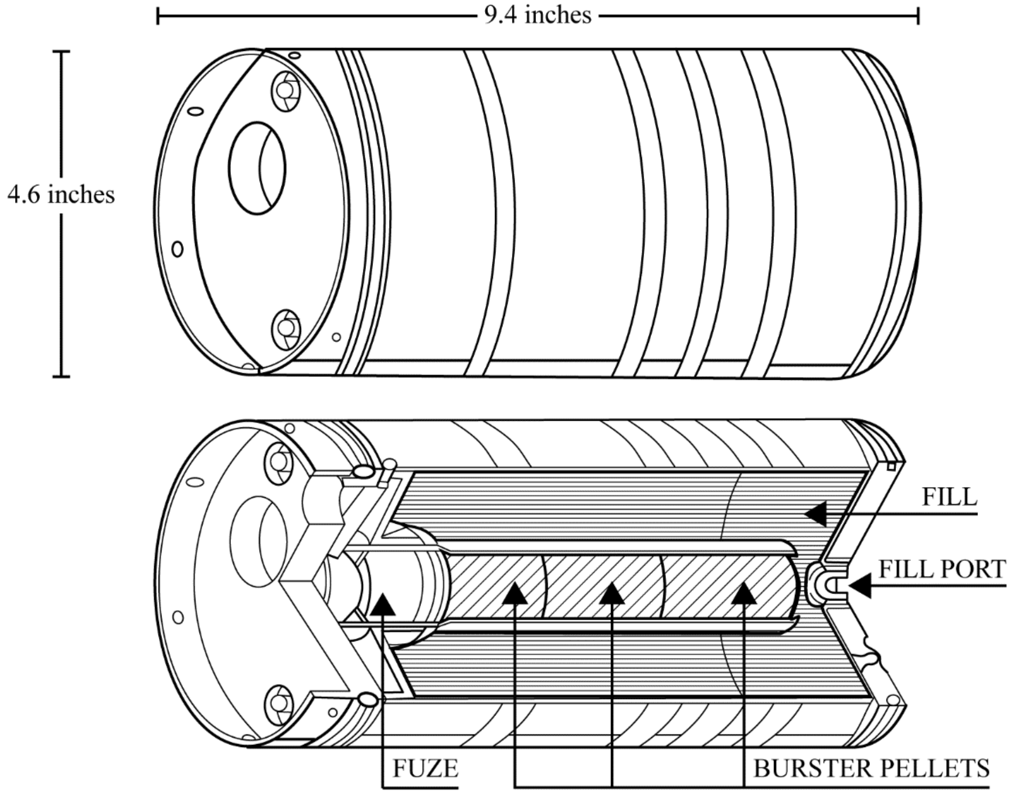

Figure 79: Bomblet, BLU-19/B23 - Line Drawing

Figure 80: Bomblet, BLU-19/B23 - Photograph - Cutaway View (showing FMU-50/B Fuze, Burster Pellets, and Simulant Fill)

Bomblet, BLU-19/B23

Specifications

Bomblet, BLU-19/B23 - Specifications and Other Data		Citation
Historical Name	BLU-19/ B23 Bomblet	1 (p. 9, Appendix A)
Type	Bomblet	2 (p. 2)
Service	Air Force	1 (p. 11, Appendix A), 2 (p. 5)
Diameter	4.6 in. (11.68 cm)	1 (p. 11, Appendix A), 2 (p. 2)
Length	9.44-9.77 in. (23.97-24.82 cm)	1 (p. 9, Appendix A), 2 (p. 2)
Wall Thickness	0.05 in. (0.127 cm)	2 (p. 2)
Construction Material	Steel plate	2 (p. 2)

General Use and Description

The SUU-13/A dispenser-BLU-19/B23 bomblet weapon system was designed to provide a capability of delivering appropriate concentrations of agent by high-performance aircraft (2 p. 2 - 5).

The BLU-19/ B23 was a cylindrical, thin-walled, unstabilized munition. The bomblet, made of steel plate, was fabricated in four basic parts: 1) an outer shell, 2) a centrally-placed agent load, 3) a central burster composed of plastic bonded RDX, and 4) a modified M551 fuze. The BLU-19/B23 bomblet is designed to be ejected from the SUU-13/A dispenser, which holds 40 bomblets (1 p. 9, 10, Appendix A), (2 p. 2 - 5).

Explosive Train

The BLU-19/ B23 was equipped with a modified M551 fuze with bore rider arming mechanism that fully armed the bomblet 0.5 second after ejection from the SUU-13/A dispenser. The firing train was initiated by impact in any direction when the fuze was armed. Impact in any orientation caused one or more striking weights to drive the firing pin initiating the primer and burster which aerosolized the agent fill (1 p. 9 - 10, Appendix A), (2 p. 5).

Fuzing

Bomblet, BLU-19/B23 - Fuzing		
Fuze	**Note**	**Citation**
M551	Modified fuze with bore rider arming mechanism	2 (p. 3, 4)

Booster, Adapter-Booster, or Burster

Bomblet, BLU-19/B23 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	0.3 lbs. (0.14 kg)	Plastic bonded RDX	Central burst	2 (p. 3)
Not designated	0.63 lbs. (0.29 kg)	Plastic bonded RDX	Central burst	1 (p. 10, Appendix A)

Fills

Bomblet, BLU-19/B23 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	3.70-4.40	1.68-2.00	8.40-9.70	3.81-4.40	-	1 (p. 10, Appendix A), 2 (p. 2)

Shipping/Packing

Available references did not provide this information.

Bomblet, BLU-19/B23

Miscellaneous Information

The BLU-19/ B23 bomblets were used in the SUU-13/A dispenser. The dispenser was equipped with 40 tubes each loaded with a single bomblet (1 p. 10, Appendix A) (2 p, 5).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.

2. Taylor, W., & Stone, H. 1965. Dugway Proving Ground Report, DPGR C440, Final Report of Engineering Design Test of the USAF Bomblet, Nonpersistent Agent, USATECOM Project 5-4-0005-01. USATECOM.

7.19 Bomblet, Chemical, BLU 50/B, BLU-39/B23

Figures

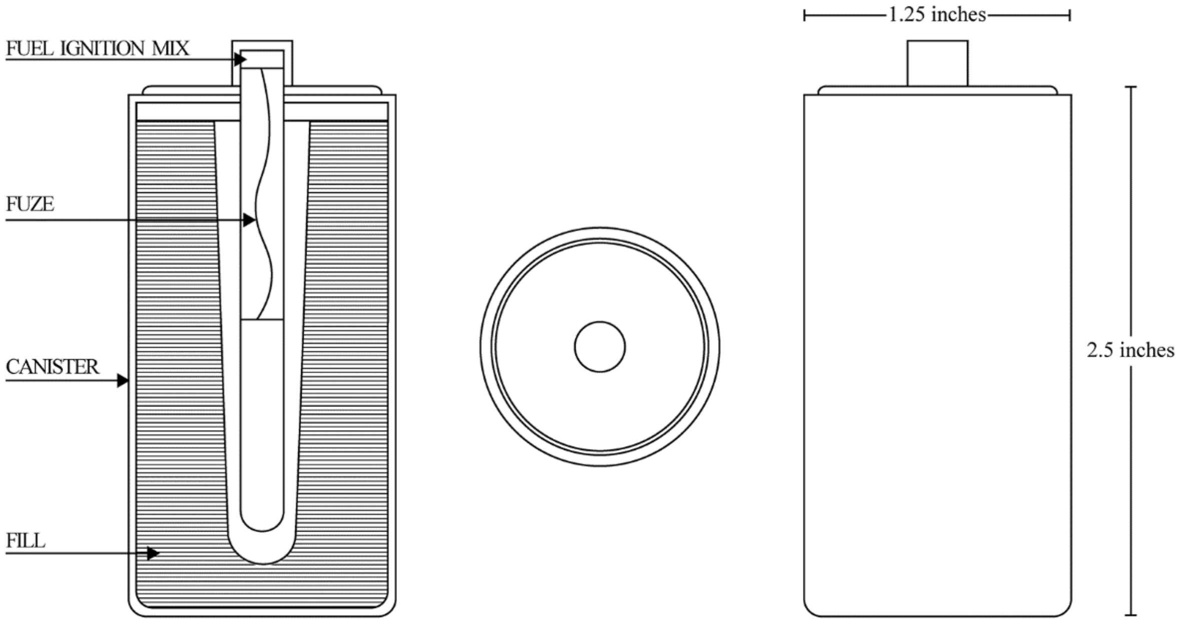

Figure 81: Bomblet, Chemical, BLU 50/B, BLU-39/B23 - Line Drawing

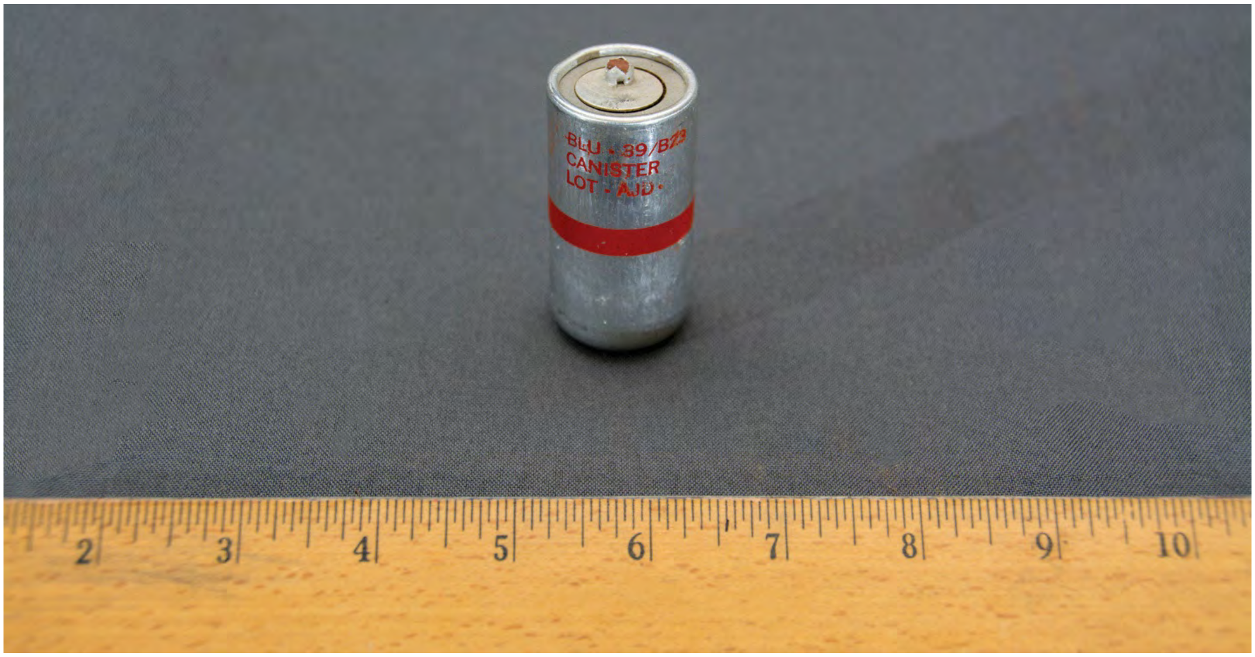

Figure 82: Bomblet, Chemical, BLU 39/B23 - Photograph (same form factor as BLU 50/B)

Bomblet, Chemical, BLU 50/B, BLU-39/B23

Specifications

Bomblet, Chemical, BLU 50/B, BLU-39/B23 - Specifications and Other Data		Citation
Historical Name	BLU 50/B Bomblet, BLU-39/B23	1 (p. 1)
Type	Bomblet	1 (p. 1), 2 (p. 2-4)
Service	Air Force, Army	2 (p. v)
Diameter	1.25 in. (3.18 cm)	3 (p. 1-181)
Length	2.5 in. (6.35 cm)	3 (p. 1-181)

General Use and Description

Available references did not provide information on specific use.

The BLU 50/B bomblet was identical in design to the BLU 39/B bomblet; the only difference was the chemical agent fill. The bomblet was approximately the size of a D cell battery. The outer shell was composed of ABS (acrylonitrile-butadiene-styrene) plastic and was held in place by plastic end plates. The bomb contained a central ignition tube, which ignited the contents of the canister.

After expulsion from the cluster, the bomblet had a 5 to 6 second pyrotechnic delay fuze that activated the BZ-pyrotechnic mix (55% BZ, 20.25% potassium chlorate, 7.95% percent sulfur, 6.0% percent sodium bicarbonate and 10.8% 233 resin) and separated the fuze from the top of the BLU-50/B. This exposed a small orifice in a rubber disk through which BZ was expelled, causing the bomb to skitter on the ground, and into the air, after initial impact with the ground. The BLU-50/B disseminated BZ for approximately 17 seconds (1 p. 2), (3 p. 1-181).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Bomblet, Chemical, BLU 50/B, BLU-39/B23 - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Pyrotechnic delay fuze	3 (p. 1-182)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Bomblet, Chemical, BLU 50/B, BLU-39/B23 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BZ	0.07	0.03	0.13	0.05	-	1 (p. 1), 2 (p. 2-4), 3 (p. 1-182)
CS	0.07	0.03	0.13	0.06	BLU-39/B	3 (p. 1-182)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The BLU-50/B was designed to be ejected from the SUU-13/A dispenser. The combination of BLU-50/Bs and the dispenser was designated the CBR-16A/A dispenser system. Each canister in the SUU-13/A contained 32 BLU-50/B bomblets. There were up to 1,280 BLU-50/B bomblets in the CBU-16A/A dispenser (1 p. 5), (2 p. 2-4).

The BLU-50/B was identical in design to the BLU-39/B bomblet (CBU30/A) except for the fill (1 p. 5), (2 p. 2-4).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Department of the Army. 1967. Dugway Proving Ground Letter Report, DPGLR C765, Limited Feasibility Test of the BLU-50/B Bomblet, USATECOM Project No. 5-7-5005-01 (U). USATECOM.

2. Deseret Test Center. 1972. Joint [Chemical- Biological] CB Technical Data Source Book (U), Volume II, Riot Control and Incapacitating Agents (U), Part Three: Agent BZ (U). U.S. Army.

3. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.

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8 Bomb Cluster, Generator, and Dispenser

A dispenser, or cluster bomb, is a bomb that is designed to dispense smaller bombs, or bomblets, to cover a wider area than a single large (greater than 100-pound) bomb.

8.1 Bomb, 175-pound, Cluster, Generator, M44 (E154)

Figures

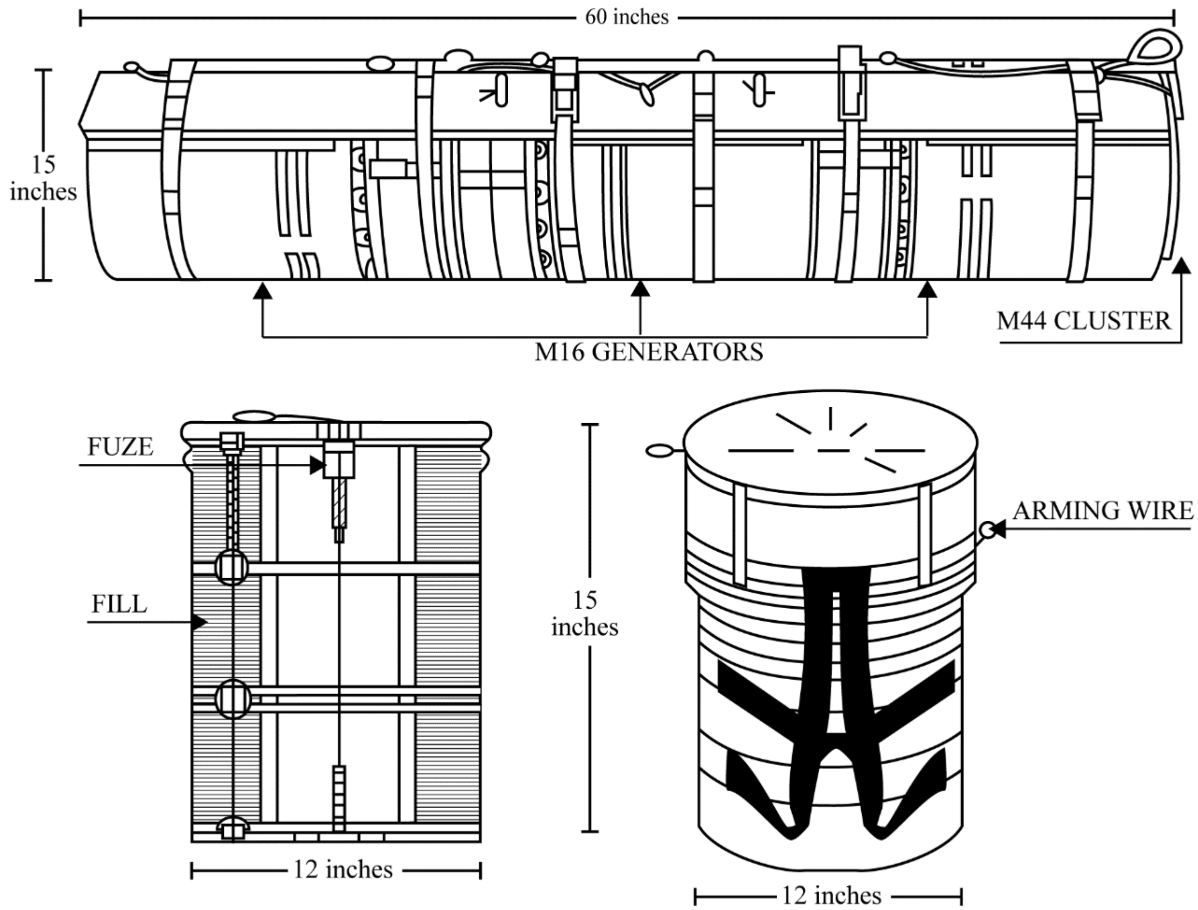

Figure 83: Bomb, 175-pound, Cluster, Generator, M44 (E154) - Line Drawing

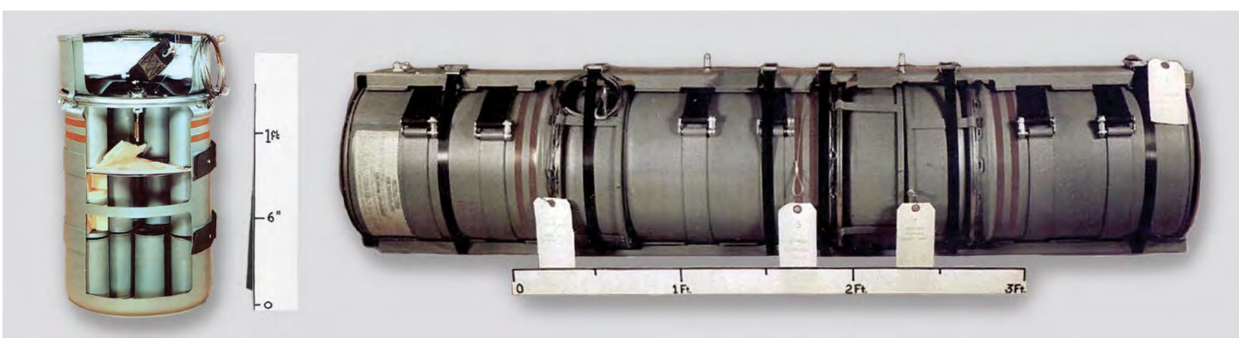

Figure 84: Bomb, 175-pound, Cluster, Generator, M44 (E154) – Photograph, Left: M16 Generator, Right: M44 Cluster

Specifications

Bomb, 175-pound, Cluster, Generator, M44 (E154) - Specifications and Other Data		Citation
Historical Name	Cluster, Generator, Incapacitating BZ, 175-Pound, M44	1 (p. 52)
Developmental Information	E154	1 (p. 52)

Bomb, 175-pound, Cluster, M44 (E154)

Bomb, 175-pound, Cluster, Generator, M44 (E154) - Specifications and Other Data		**Citation**
Type	Bomb	2 (p. 3)
Size	175-pound	3 (p. 4-47a)
Conflict	Cold War	4 (p. 52)
Service	Air Force, Army	3 (p. 4-47a), 5 (p. cover), 6 (p. 8)
Diameter	15.0-16.16 in. (38.1-41.04 cm) M16 Generator: 12 in. (30.48 cm)	3 (p. 4-47b), 5 (p. 1-7), 7 (p. 3-17)
Length	60 in. (152.4 cm)	3 (p. 4-47b), 5 (p. 1-8), 7 (p. 3-17)
Width	15 in. (38.1 cm)	5 (p. 1-8), 7 (p. 3-17)
Height	15 in. (38.1 cm)	5 (p. 1-8), 7 (p. 3-17)
Other Engineering Data	Parachute: M9 Parachute container: 1 M16 Canister: M6 (42 per M16 generator) Cluster Adapter: M39 Arming wire: M92	3 (p. 4-47b), 5 (p. 1-8), 6 (p. 8), 7 (p. 3-17)
Construction Material	Canister M6: cylindrical sheet metal Cluster and generator casings: Low carbon steel	8 (p. 6-1)
Drawing	LM 31-21-11, D336-1-207	5 (p. 1-8), 6 (p. 8)
NSN	1325-00-857-0610	5 (p. 1-8), 6 (p. 8)

General Use and Description

The M44 175-pound generator cluster was designed for aerial delivery of M16 50-pound incapacitating BZ generators on selected targets to temporarily incapacitate exposed personnel by slowing mental and physical activity, causing disorientation and hallucinations (3 p. 4-47a), (5 p. 1-7), (6 p. 8), (7 p. 3-17).

The M44 175-pound incapacitating BZ generator cluster consisted of three M16 50-pound incapacitating BZ generators clustered in an M39 generator cluster adapter. The cluster was mounted externally on wing racks and dropped as a cluster, or it could be disassembled and the M16 generators dropped singly. Also, the M16 generator could be used as a ground emplacement.

Each cluster was tagged to simplify the instructions contained on instruction decals for cluster airdrop, individual airdrop, or ground emplacement.

The M16 50-pound incapacitating BZ generator consisted of 42 each M6 incapacitating BZ canisters, arranged in 14-canister tiers, packaged in a pail and fuzed with an M220 fuze. The M16 pail is 12 inches in diameter, 15 inches high and has 14 holes in the top and bottom. An M9 parachute-and-container cluster was released by the fixture on the wing rack causing the branches of the arming wire to pull out of the buckles of the cluster adapter. The steel strapping separates, and the M16 BZ generators fell from the cluster. Canister M6 was a cylindrical sheet metal container approximately 2.5 inches in diameter and 4.5 inches high. Each canister was filled with a solid mixture of BZ. Each M6 canister is filled with 0.625 pounds of 50/50 agent-pyrotechnic mixture (pyromix) (3 p. 4-47a, 4-47b), (5 p. 1-17, 1-18), (6 p. 8), (7 p. 3-17), (8 p. 6-7), (9 p. 2-3), (10 p. 2).

Explosive Train

As the M16 BZ generators fell, the arming wire on the generator pulled free and the parachute separated from the generator. As the parachute opened, the cover of the M220 fuze was pulled from the fuze body, permitting the striker pin to strike the primer, which ignited the first-fire and delay pellets in the delay housing. The delay elements burned for 10-14 seconds; then ignition of the generator was caused by the ignition mixture igniting the igniter pads (3 p. 4-47a, 4-47b), (5 p. 1-7, 1-8), (6 p. 8), (7 p. 3-17).

Fuzing

Bomb, 175-pound, Cluster, Generator, M44 (E154) - Fuzing		
Fuze	**Note**	**Citation**
M220	Generator - delay fuze	3 (p. 4-47b), 5 (p. 1-8), 7 (p. 3-17)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Canister	Agent	Fill Weight per Canister		Canister per Generator/ Generators per Cluster	Fill Weight per Cluster		Citation
		lbs.	kg		lbs.	kg	
M6	BZ	0.3125	0.1417	42 / 3	39	18	5 (p. 1-7), 7 (p. 3-17), 9 (p. 2-3, 4-4)

Shipping/Packing

They were packed complete on a wooden skid enclosed in plywood. The skid weighed 250 pounds and occupied 11 cubic feet (5 p. 1-8), (6 p. 8).

Miscellaneous Information

As of 1982, there were 973 each M44 Generator clusters in the inventory (8 p. 3-1).

Key Dates

Bomb, 175-pound, Cluster, Generator, M44 (E154) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1962	CCTC 3960 (Standard-B)	11 (p. 13, 28)

Sources

1. Chemical Corps Technical Committee. 1955. Chemical Corps Book of Standards, 1955. Department of the Army.
2. Test and Evaluation Command. 1964. Dugway Proving Ground Trial Report, DPGTR 384, Hazard Classification Test for Storage, Handling, and Disposal of M43 Bomb Cluster, BZ-Filled, 750-lb, and M44 Generator Cluster, BZ-Filled, 175-lb, USATECOM Project No. 5-3-0130-01. U.S. Army.
3. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
4. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.
5. Department of the Army. 1982. Technical Manual, TM 43-0001-26-2, Army Equipment Data Sheets, Chemical Weapons and Munitions. U.S. Government Printing Office.
6. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.
7. Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. U.S. Government Printing Office.
8. Battelle, Columbus Laboratories. 1982. BZ Desk Reference, Contract DAAK 11-81-C-0080, CBRNIAC-CB-018474, Revised March 22. U.S. Army.

9. Deseret Test Center. 1972. Joint [Chemical- Biological] CB Technical Data Source Book (U), Volume II, Riot Control and Incapacitating Agents (U), Part Three: Agent BZ (U). U.S. Army.

10. Department of the Army. 1962. Technical Bulletin, TB CML 117, Cluster, Generator, Incapacitating BZ, 175-lb, M44. U.S. Army.

11. Chemical Corps Technical Committee. 1962. CCTC Item # 3960, Classification of Cluster, Bomb, Incapacitating BZ, 750-lb., M43 (E153); Cluster Generator, Incapacitating BZ, 175-lb, M44 ([E]154); and Incapacitating Agent, BZ as Standard-B Types. Department of the Army.

8.2 Dispenser, 750-pound, Universal Bomb, MK 15 Mod 0, Sadeye

Figures

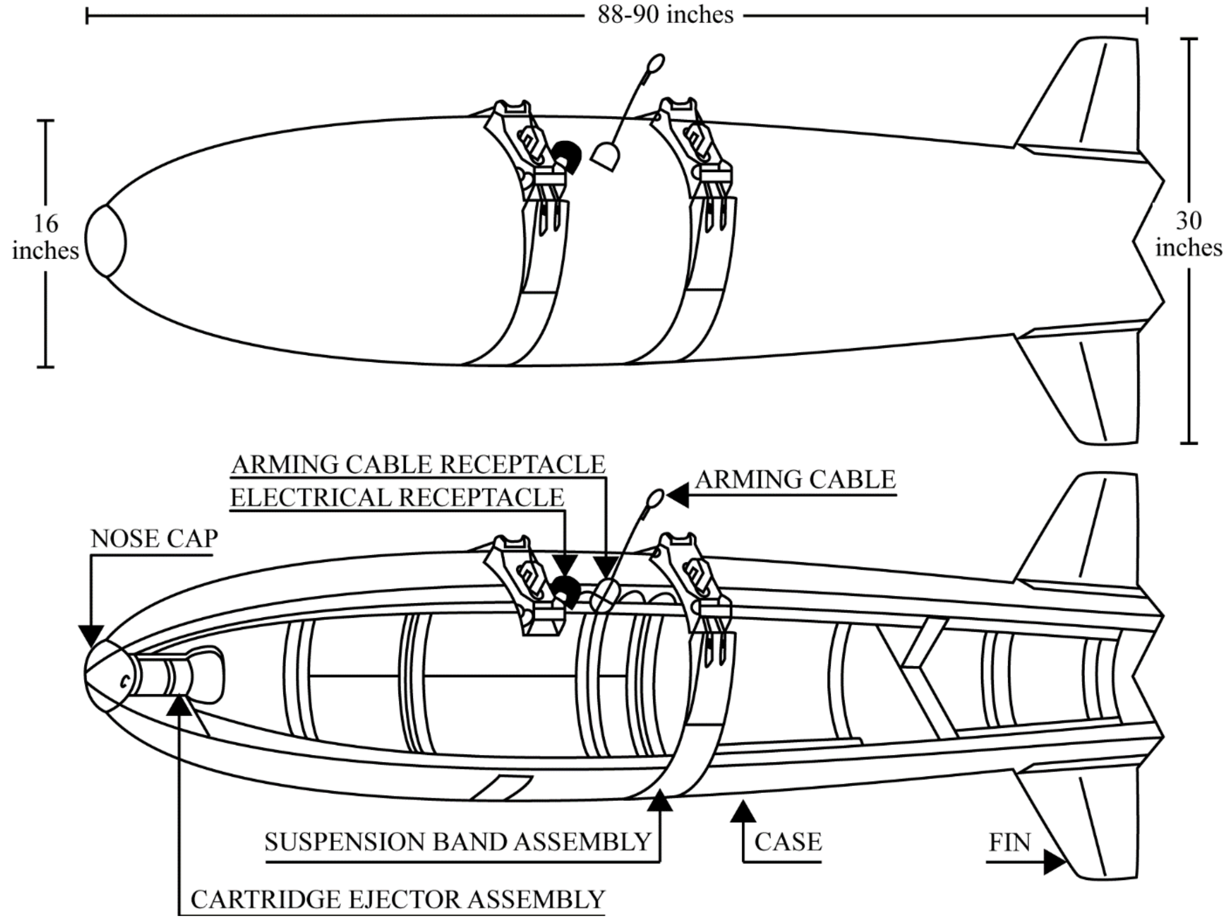

Figure 85: Dispenser, 750-pound, Universal Bomb, MK 15 Mod 0, Sadeye - Line Drawing

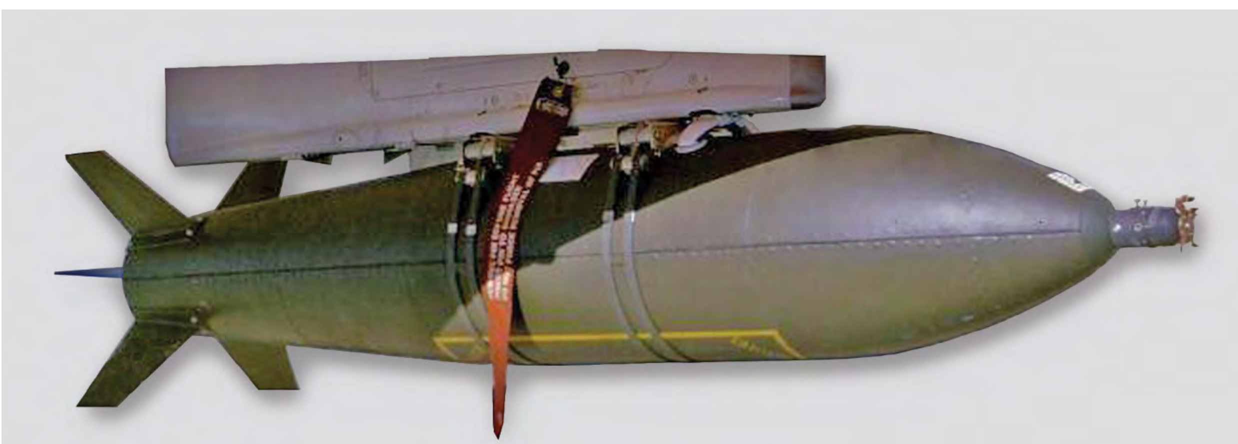

Figure 86: Dispenser, 750-pound, Universal Bomb, MK 15 Mod 0, Sadeye - Photograph, attached to aircraft

Dispenser, 750-pound, Universal Bomb, MK 15 Mod 0, Sadeye

Specifications

Dispenser, 750-pound, Universal Bomb, MK 15 Mod 0, Sadeye - Specifications and Other Data		Citation
Historical Name	Sadeye (Dispenser, Universal Bomb)	1 (p. 4-27a)
Type	Dispenser	1 (p. 4-27a)
Size	750-pound	1 (p. 4-27b)
Diameter	16 in. (40.64 cm)	1 (p. 4-27b), 2 (p. 1-1)
Length	88-90 in. (223.52-228.6 cm)	1 (p. 4-27b), 2 (p. 1-1)
Width	Wings: 30 in. (76.2 cm)	2 (p. 1-1)
Other Engineering Data	Weight, Empty: 150 lbs. (68.0 kg) Weight, Total: 750 lbs. (340 kg)	1 (p. 4-27b), 2 (p. 1-1)
Construction Material	The skin of the dispenser was low carbon steel. The fins were cast aluminum.	2 (p. 2-1), 3 (p. 2-1)

General Use and Description

The MK 15 Mod 0 “Sadeye” weapons system was used for delivery of small, tactical devices and bomblets by high-performance aircraft, equipped with single and multiple-carriage bomb racks; to include a toxic and biological offensive capability. The two halves of the dispenser were locked together by a nose locking ring and an end plate screwed to the aft end (1 p. 4-27a), (2 p. 1-1).

The Sadeye was a low-drag, dispenser that could be delivered by all modern, high-performance aircraft, equipped with single and multiple-carriage bomb racks. The weapon consisted of a semi-monocoque, skin-stressed container in longitudinal half sections, which separated for dispersion of the payload. Two suspension bands, approximately 32.5 and 45 inches from the forward end, encircle the two halves. Midway between the two suspension bands is the hoisting lug receptacle. An aircraft locking mechanism; the burster charge, and the switching unit (safe separation and firing timer) were housed in the ogive fuze well. The two halves of the dispenser were locked together by a nose locking ring and an end plate screwed to the aft end (1 p. 4-27a), (2 p. 1-1, 2-1), (3 p. 2-1).

The dispenser, when loaded with approximately 2,100 M40 bomblets, weighed about 750 pounds and was designated the Cluster Bomb Mk 15 Mod 0 (3 p. 2-1).

Explosive Train

Upon release, the suspension bands open automatically and drop free of the dispenser body. Simultaneously, the arming wire is withdrawn, initiating the fuze time-delay cycle. When the fuze functions, the fuze booster was ignited and the fuze and nose locking ring were blown forward, which would unlock the forward end of the dispenser, the two halves would be forced apart by the air dispensing the contents (2 p. 3-1), (3 p. 3-1).

Fuzing

Dispenser, 750-pound, Universal Bomb, MK 15 Mod 0, Sadeye - Fuzing		
Fuze	**Note**	**Citation**
M907	Nose- air-armed, airburst, mechanical time	2 (p. 2-1), 3 (p. 2-1)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Fill agent and weight were dependent on the bomblet used.

Shipping/Packing

The dispenser and fins were shipped in a MK 320 MOD 0 shipping and storage container (2 p. 2-3). The empty container weighs about 350 pounds; with a MK 15 Mod 0 cluster bomb, the total weight is approximately 1,100 pounds. The fuze and arming vane were packed in a disposable wooden crate (3 p. 2-4).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Naval Ordnance Test Station. 1964. NOTS-TP-3431-Revision 1, Cluster Bomb Mark 15 MOD 0 (Sadeye Weapon System), Description and Operation (A Preliminary Manual), AD361203. Bureau of Naval Weapons.
3. Chief of the Bureau of Naval Weapons. 1964. NAVWEPS Ordnance Pamphlet, OP 3345, First Revision, Cluster Bomb Mark 15 Mod 0 (Sadeye Antipersonnel Weapon System), Description and Operation (U). Department of the Navy. 15 December.

8.3 Bomb, 750-pound, Cluster, CBU-5/B (M43)

Figures

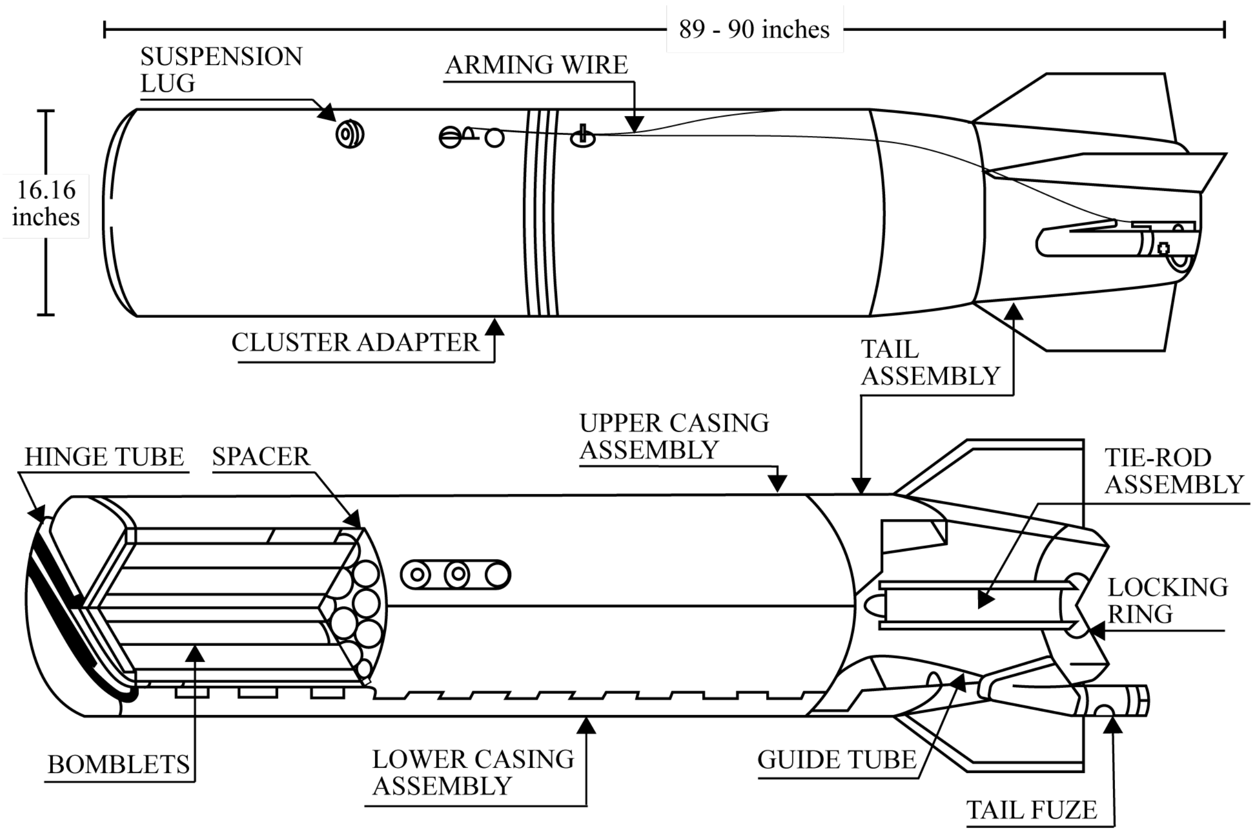

Figure 87: Bomb, 750-pound, Cluster, CBU-5/B (M43) - Line Drawing

Figure 88: Bomb, 750-pound, Cluster, CBU-5/B (M43) - Photograph, Top: Model, Bottom: Cluster

Specifications

Bomb, 750-pound, Cluster, M43, CBU-5/B - Specifications and Other Data		Citation
Historical Name	Cluster, Chemical, Bomb, 750 pounds, CBU-5/B (M-43)	1 (p. 2)
Developmental Information	E153: M43 cluster E135: M138 Bomblet	2 (p. 4-47)
Type	Bomb	2 (p. 4-46)
Size	750-pound	3 (p. 7), 4 (p. 4), 5 (p. 7)
Conflict	Cold War	5 (p. 7_)
Service	Air Force, Army, Navy	2 (p. iv, 4-47), 3 (p. 7), 5 (p. 7), 6 (p. 17)
Diameter	16.0-16.16 in. (40.64-41.04 cm)	2 (p. 4-47), 7 (p. 1-6), 8 (p. 3-14)
Length	With tail fin: 89-90 in. (226.06-228.6 cm)	2 (p. 4-47), 7 (p. 1-6), 8 (p. 3-14)
Other Engineering Data	Generator: M16 (3 each) Cluster adapter: M30, M39 Tail Assembly: M14 or E12R2 Alternate Tail: E12R2 Arming wire: M23	2 (p. 4-47), 4 (p. 5)
Construction Material	Cluster and submunition casings: low carbon steel	9 (p. 6-1)
Specifications	M43: 196-131-780A	3 (p. 7)
Drawing	M43 Cluster: D14-23-1468 Bomb: D14-5-2309 DL 14-23-1467	2 (p. 4-47), 7 (p. 1-6)
NSN	Complete: 1325-00-857-0611 Without fuze, fin, and wire: 1325-00-857-0024	7 (p. 1-6)

General Use and Description

The CBU-5/B was designed to provide the capability for air delivery of incapacitating chemical agents (2, p. 4-46). The CBU-5/B cluster is essentially an M43 cluster bomb modified for external carriage on high-performance aircraft. The modification consisted of adding an ogive nose, strengthening the tailfin assembly, and replacing the external arming wire by an internal arming wire (2 p. 4-46), (10 p. 2-3).

The CBU-5/B Cluster and M43 consisted of an M30 cluster adapter filled with 57 M138 BZ-filled bombs. The cluster adapter consisted of upper and lower casing assemblies; during the clustering procedure, these were mated and sealed with an internal gasket. Nineteen bombs were clustered in each of three longitudinal compartments inside the casing; the clustered bombs were separated by spacers during assembly of the cluster. Two suspension lugs were screwed into the two outer threaded holes in the upper casing assembly.

The M138 BZ bomb was a thermal generator munition consisting of four M7 canisters, each with 0.37 pounds of BZ in a 50/50 pyrotechnic mixture, nested in a tubular steel bomb casing, which had been crimped to hold the canister in place. The canisters that contained BZ agent were aligned within the casing. Each bomb was fuzed with an E8R8 bomb fuze, which was screwed into the end of the bomb. This was an all-ways impact fuze of the direct-arming pin type. The arming pin was depressed, and the safety wire withdrawn during clustering; the pin was held in the depressed position by the spacers within the cluster.

Bomb, 750-pound, Cluster, M43, CBU-5/B

A complete round consisted of an M14 tail assembly, two M152A1 tail fuzes, an M23 arming wire, an M43 bomb cluster, and suspension lugs (2 p. 4-46, 4-47), (7 p. 1-5, 1-16), (10 p. 2-3).

Explosive Train

When the cluster M43 was released from the aircraft, the arming wire assembly M23 would be withdrawn, the arming vanes of the fuze would rotate in the airstream, and the fuzes would be armed. After the preset time, one or both fuzes would function and detonate the burster, which would break the straps holding the cluster together. When the cluster opened the bomblets would fall individually to the target where they would function as designed (7 p. 1-5), (9 p. 6-2).

Fuzing

Bomb, 750-pound, Cluster, M43, CBU-5/B - Fuzing		
Fuze	**Notes**	**Citation**
M152A1	Tail- two each, delay arming, combination mechanical time and impact	2 (p. 4-47), 7 (p. 1-6), 8 (p. 3-14)
M908	2 each	8 (p. 3-14)
M909	Tail	7 (p. 1-6)

Booster, Adapter-Booster, or Burster

Bomb, 750-pound, Cluster, M43, CBU-5/B - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Detonating Cord	0.16 lbs. (0.07 kg)	pentaerythritol tetranitrate (PETN)	-	8 (p. 3-14), 9 (p. 6-2)

Fills

Bomblet	Agent	Fill Weight per Bomblet		Bomblets per Cluster	Cluster Gross Weight		Cross-Reference	Citation
		lbs.	kg		lbs.	kg	Section (Page #)	
M138	BZ	1.5	0.68	57	800	643	7.17 (p. 164)	2 (p. 4-46, 4-47), 3 (p. 7), 4 (p. 4 - 5), 6 (p. 17), 7 (p. 1-6), 8 (p. 3-14), 10 (p. 2-3)

Shipping/Packing

The bombs were packed one per crate. Each crate weighed 900 pounds (3 p. 7).

Miscellaneous Information

As of 1982, there were 518 each M43 bomb clusters in the inventory (9 p. 3-1).

Key Dates

Bomb, 750-pound, Cluster, CBU-5/B (M43) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1962	CCTC 3960, 3978 (Standard-B)	2 (p. 4-47), 11 (p. 23, 28)

Sources

1. Yeager, Kurt E. 1963. Test of M-43 Cluster Bomb, Aerospace Internal Data Report No. 63-28. Department of the Air Force.

2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

3. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.

4. Test and Evaluation Command. 1964. Dugway Proving Ground Trial Report, DPGTR 384, Hazard Classification Test for Storage, Handling, and Disposal of M43 Bomb Cluster, BZ-Filled, 750-lb, and M44 Generator Cluster, BZ-Filled, 175-lb, USATECOM Project No. 5-3-0130-01. U.S. Army.

5. Chemical Branch. 1964. Dugway Proving Ground Trial Record, DPGTR 394, Engineering Test of USAF [U.S. Air Force] Cluster, Aimable, 750-lb, Incapacitating, BZ, CBU-5/B (Dissemination Phase), 656B (U). APGC (PGKK) Eglin AFB.

6. Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. Department of the Army.

7. Department of the Army. 1982. Technical Manual, TM 43-0001-26-2, Army Equipment Data Sheets, Chemical Weapons and Munitions. U.S. Government Printing Office.

8. Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. U.S. Government Printing Office.

9. Battelle, Columbus Laboratories. 1982. BZ Desk Reference, Contract DAAK 11-81-C-0080, CBRNIAC-CB-018474, Revised March 22. U.S. Army.

10. Deseret Test Center. 1972. Joint [Chemical- Biological] CB Technical Data Source Book (U), Volume II, Riot Control and Incapacitating Agents (U), Part Three: Agent BZ (U). U.S. Army.

11. Chemical Corps Technical Committee. 1962. CCTC Item # 3960, Classification of Cluster, Bomb, Incapacitating BZ, 750-lb., M43 (E153); Cluster Generator, Incapacitating BZ, 175-lb, M44 ([E]154); and Incapacitating Agent, BZ as Standard-B Types. Department of the Army.

8.4 Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5)

Figures

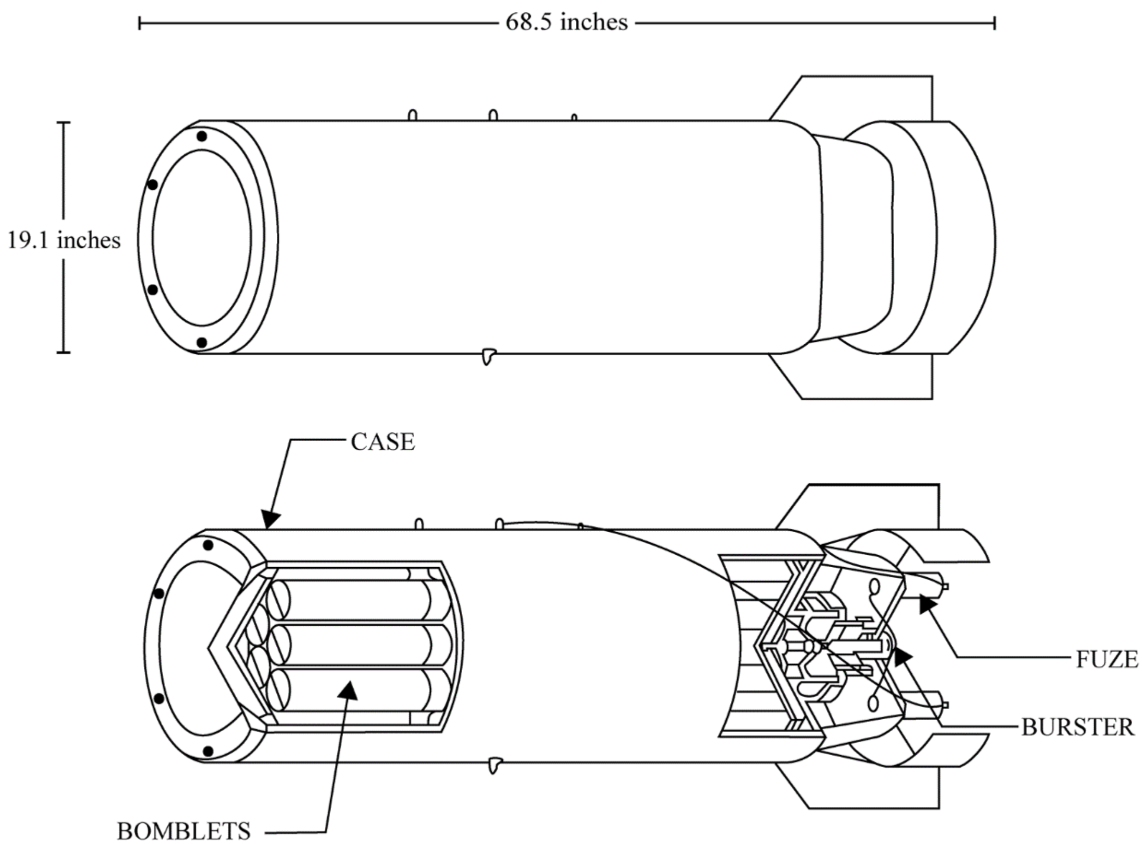

Figure 89: Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5) - Line Drawing

Figure 90: Bomb, 1,000-pound, Cluster, M34 - Photograph

Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5)

Specifications

Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5) - Specifications and Other Data		**Citation**
Historical Name	Cluster, Gas Bomb, Nonpersistent GB, 1000-Pound, M34 and M34A1	1 (p. 59)
Developmental Information	E101R3: M34 E101R5: M34A1	1 (p. 62)
Type	Bomb	2 (p. 4-50), 3 (p. 3-12)
Size	1,000-pound	4 (p. 4-49), 5 (p. 50), 6 (p. 5)
Service	Air Force	2 (p. 4-50), 4 (p. 4-49)
Diameter	19.1 in. (48.6 cm)	2 (p. 4-51), 3 (p. 3-13)
Length	68.5 in. (174 cm)	2 (p. 4-51), 3 (p. 3-13)
Wall Thickness	0.25 in. (0.63 cm)	1 (p. 66)
Other Engineering Data	The M34 used Fin Assembly M13, cluster adapter M29, and M22 Type B Arming Wire.	1 (p. 66), 2 (p. 4-51), 3 (p. 3-13), 4 (p. 4-50)
Construction Material	Steel	4 (p. 4-50)
Propellant	Cartridge, Cluster, Ejection Cartridges, M3 (4 required)	2 (p. 4-51), 3 (p. 3-13), 4 (p. 68)
Specifications	C14-23-1080 (M34) D14-23-1533 (M34A1)	1 (p. 69)

General Use and Description

The M34 and M34A1 GB 1,000-pound cluster bomb provided toxic chemical offensive capability (2 p. 4-50), (4 p. 4-49).

The M34A1 bomb cluster consisted of cluster adapter M29 filled with 76 M125A1 nonpersistent chemical agent bombs and fitted with four M3 cluster-ejection cartridges, two fuzes, and an arming wire. The M125A1 were loaded into cluster adapter M29 in four bundles of 19 bombs each. The bombs were arranged in the bundles in such a way that the arming bar on each bomb was depressed by an adjacent bomb. M34 was identical to the M34A1 except that the M34 used M125 bombs (1 p. 68), (2 p. 4-50), (3 p. 3-13), (4 p. 4-49, 4-50).

Explosive Train

When the cluster was released from an aircraft, the arming wire was withdrawn, the fuze arming vanes rotated in the airstream, and the fuzes armed. After the preset time had elapsed, one or both fuzes functioned and detonated the burster. Concussion from the explosion of the burster depressed the diaphragm in the striker assemblies, driving the points of the strikers into the primers in the cluster-ejection cartridges, exploding the cartridges. Gases released by the cartridges passed through the gas chamber, through vent holes in the chamber, and into the space between the adapter casing base and the pressure plate. Pressure developed by the gases forced the pressure plate toward the nose of the cluster and caused the stud attached to the pressure plate to pull out of the split nut. Continued expansion of the gases freed the nose assembly and forced the framework out of the casing. As each cluster buckle cleared the casing, the buckle opened. After all buckles opened, the adapter framework fell apart, allowing the bombs to fall individually to the target (2 p. 4-50), (3 p. 3-13), (4 p. 4-49).

Fuzing

Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5) - Fuzing		
Fuze	**Notes**	**Citation**
M152	Tail- mechanical time and impact with arming vane and pin, two required	2 (p. 4-51), 5 (p. 50, 92)
M152A1	Tail- mechanical time, two required	2 (p. 4-51), 3 (p. 3-13), 4 (p. 4-50), 5 (p. 50, 92)
M15A1	Tail- mechanical time and Impact with arming vane and pin	4 (p. 4-50)
M908	2 required	3 (p. 3-13)

Booster, Adapter-Booster, or Burster

Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	N/A	Component of M29 cluster adapter in tail fin.	4 (p. 4-50)
Not designated	N/A	Detonating cord	-	3 (p. 3-12, 3-13)

Fills

Bomblet	Agent	Fill Weight per Bomblet		Bomblets per Cluster	Fill Weight per Cluster		Cluster Gross Weight		Cross-Reference	Citation
		lbs.	kg		lbs.	kg	lbs.	kg	Section (Page #)	
M125A1	GB	2.60	1.17	76	198	89.8	1,130	512	7.16 (p. 161)	2 (p. 4-50), 3 (p. 3-13), 4 (p. 4-50)

Shipping/Packing

The M34 bomb cluster was packed in a shipping guard without the tailfin, arming wire, and fuzing components. The packed cluster weighed approximately 1,300 pounds and displaced 20.1 cubic feet. The tail fin stud, nut washer, lock washer, cartridge holders, striker assemblies and tail fin are packed in a separate crate (5 p. 51 - 53).

Miscellaneous Information

Between 1953 and 1954, the Air Force procured at total of 23,700 each M34 and M34A1 clusters including 2,700 in unserviceable condition (i.e., condition “0”). There were 9,676 each M34 clusters and 11,445 each M34A1 clusters in storage at Rocky Mountain Arsenal in 1969. These obsolete munitions were initially proposed for “burial at sea” but were not disposed of in this manner after review by the National Academy of Sciences (1 p. 32 - 63).

Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5)

Key Dates

Bomb, 1,000-pound, Cluster, M34 (E101R3), M34A1 (E101R5) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1949	CCTC 1993 (G-agent Cluster)	7
Classified	1953	CCTC 2673	7 (p. K2, K18)
Type Classified	1954	CCTC 2947 (M34A1 Standard – Air Force, M34 Limited Standard – Air Force)	7 (p. K18, K19)
Standardized	1958	CCTC 3408 (M34A1 Standard - Air Force, M34 Ltd Standard - Air Force)	8 (p. 108)
Standard Modernization	1959	CCTC 3525 (Standard-C Air Force)	9 (p. 213)
Obsoleted	1969	Army Materiel Command Technical Committee (AMCTC) 7028 and 7125 (M34 and M34A1)	10 (p. 54c)

Sources

1. Chemical-Biological-Nuclear Subcommittee. 1969. AMCTC Item # 7028, Reclassification of Clusters, Gas Bomb, Nonpersistent GB, 1000-lb., M34 & M34A1 from Standard-A and Standard-C USAF-Types to Obsolete Types. U.S. Army Materiel Command.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
3. Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. U.S. Government Printing Office.
4. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
5. Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. Department of the Army.
6. Chemical Corps. 1953. Dugway Proving Ground Report, DPGR 137, Assessment of a CW Cluster: assessment of the cluster, nonpersistent gas bomb, 1000-lb, E101R3, CW 7-53. U.S. Army.
7. Chemical Corps Technical Committee. 1954. CCTC Item # 2947, Classification of Clusters, Gas Bomb, GB, 1000-lb., M34 (E101R3) & M34A1 (E101R5) as Limited Standard and Standard Types, Respectively. Department of the Army.
8. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
9. Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.
10. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.

8.5 Dispenser, 900-pound, Bomb, XMC-1

Figures

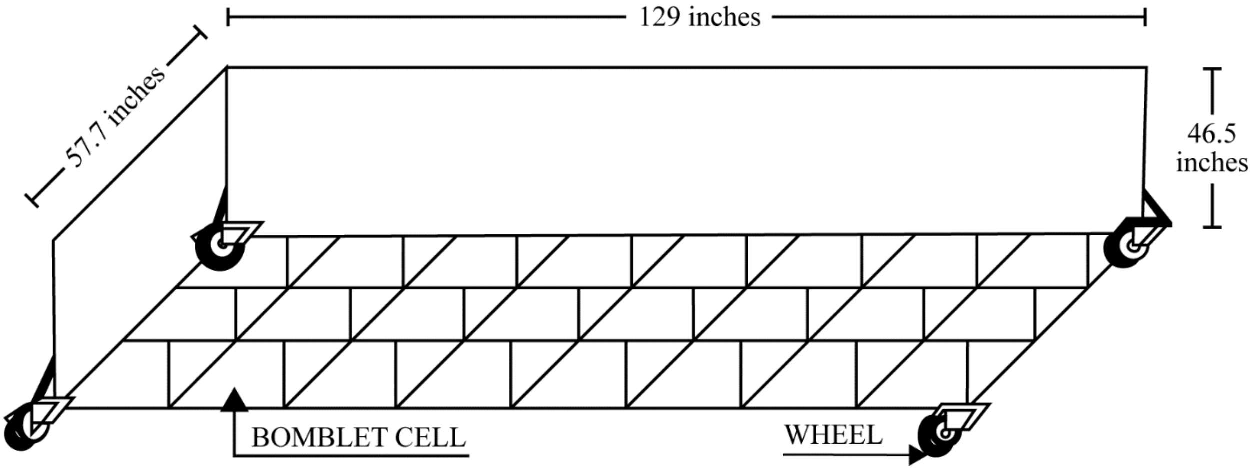

Figure 91: Dispenser, 900-pound, Bomb, XMC-1 - Line Drawing

Specifications

Dispenser, 900-pound, Bomb, XMC-1 - Specifications and Other Data		Citation
Historical Name	Dispenser, Bomb, 900-Pound, XMC-1	1 (p. 4-47)
Type	Dispenser	1 (p. 4-48)
Size	900-pound	1 (p. 4-47)
Conflict	Cold War	1
Service	Air Force, Navy	1 (p. 4-47), 2 (p. 4-48)
Length	129 in. (328 cm)	1 (p. 4-49), 2 (p. 4-49)
Width	57.7 in. (146.56 cm)	1 (p. 4-49), 2 (p. 4-49)
Height	46.5 in. (118.11 cm)	1 (p. 4-49), 2 (p. 4-49)
Other Engineering Data	Used with E120R1, E120R2, E132 cube, E134, and Flettner bomblets. Weight, Empty: 910 lbs. (413 kg) 24 cells in dispenser	1 (p. 4-49), 2 (p. 4-49)

General Use and Description

The XMC-1 provided large area coverage for biological and chemical weapons (1 p. 4-47), (2 p. 4-48).

This dispenser was composed of 24 cells, each 15.54 inches square. A single suspension lug at the top of the dispenser above the center of gravity engaged the U-2 shackle on the aircraft. To release the cells, a rotary solenoid was activated allowing the cell door and cartons to fall free. Final models were planned to have electric heaters to maintain a constant temperature control. There was a fiberglass or steel carton closure with timer and opening mechanism (1 p. 4-47), (2 p. 4-48).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Dispenser, 900-pound, Bomb, XMC-1 - Fuzing		
Fuze	**Note**	**Citation**
Not designated	One dispersion per cell to initiate package separation after a timed release. The fuze subsystem consisted of a control group, dispersion unit, and bomb fuze, all connected to the aircraft power supply.	1 (p. 4-49)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Bomblet	Agent	Fill Weight per Bomblet		Bomblets per Carton / Cell / Dispenser	Fill Weight per Dispenser		Gross Weight		Cross-Reference	Citation
		lbs.	kg		lbs.	kg	lbs.	kg	Section (Page #)	
E120R1 / E120R2	BW	N/A	N/A	27 / 81 / 1,944	N/A	N/A	7,000-10,000	3,175-4,536	N/A	1 (p. 4-4, 4-49)
E132	GB	70	31.7	1 / 3 / 72	5,040	2,286	7,000-10,000	3,175-4,536	6.6 (p. 48)	2 (p. 4-48, 4-49)
M134 / E134	GB	1.1	0.49	64 / 192 / 4,608	5,069	2,299	7,000-10,000	3,175-4,536	7.6 (p. 128)	1 (p. 4-49), 2 (p. 4-49)
E134	VX	N/A	N/A	64 / 192 / 4,608	N/A	N/A	7,000-10,000	3,175-4,536	7.6 (p. 128)	1 (p. 4-12), 2 (p. 4-49)
Flettner	BW	2.1	0.95	176 / 176 / 4,224	8,870	4,023	7,000-10,000	3,175-4,536	N/A	1 (p. 4-49)

Notes:
BW - biological weapon

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

Various biological and chemical weapons were used in the XMC-1; see bomblet details for agent fills.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

8.6 Dispenser, 1,000-pound, Universal Bomb, MK 4 Mod 0, Gladeye

Figures

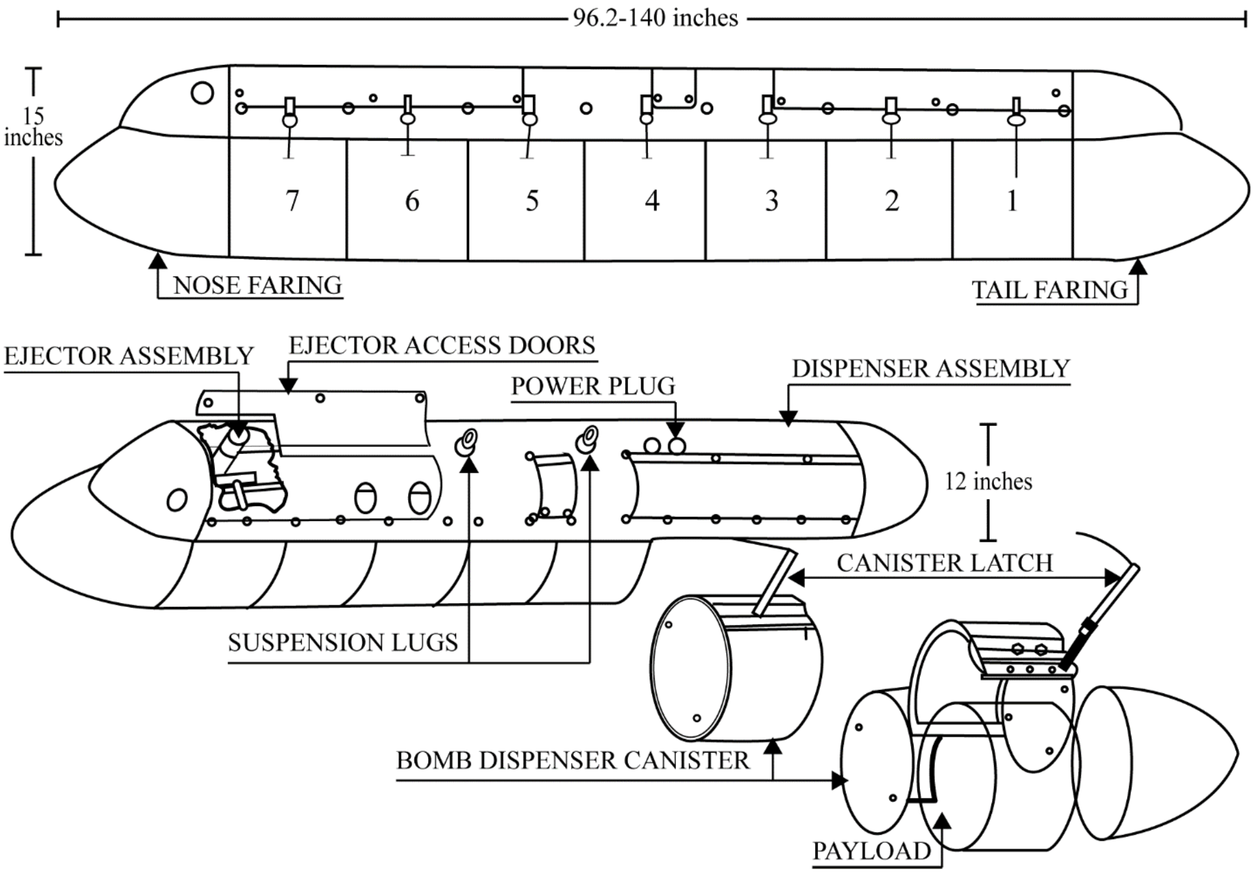

Figure 92: Dispenser, 1,000-pound, Universal Bomb, MK 4 Mod 0, Gladeye - Line Drawing

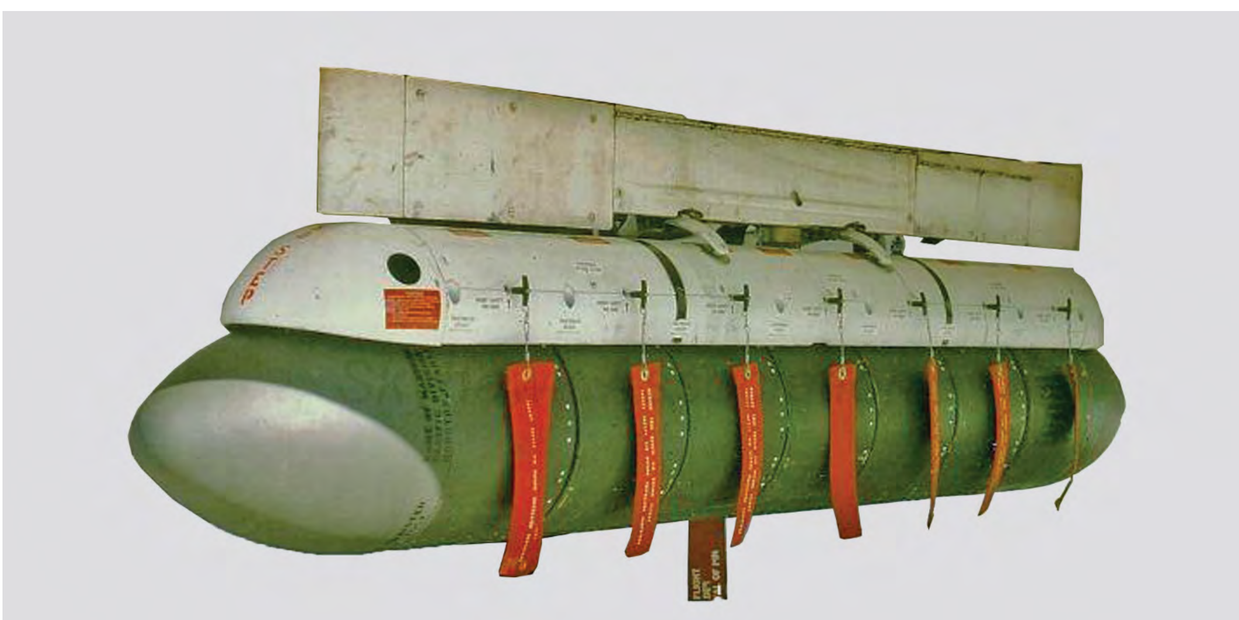

Figure 93: Dispenser, 1,000-pound, Universal Bomb, MK 4 Mod 0, Gladeye - Photograph, attached to aircraft

Dispenser, 1,000-pound, Universal Bomb, MK 4 Mod 0, Gladeye

Specifications

Dispenser, 1,000-pound, Universal Bomb, MK 4 Mod 0, Gladeye - Specifications and Other Data		**Citation**
Historical Name	Gladeye (Dispenser, Universal Bomb, MK 4 Mod 0)	1 (p. 4-27c)
Type	Dispenser	1 (p. 4-27c)
Size	1,000-pound	1 (p. 4-27c)
Service	Air Force, Army, Marine Corps, Navy	1 (p. iv), 2 (p. 1), 3 (p. 1-1)
Diameter	15 inches (38.1 cm)	1 (p. 4-27d)
Length	96.2-140 in. (244-355 cm)	1 (p. 4-27d), 3 (p. 2-2)
Width	12.2 in. (30.48 cm)	3 (p. 2-2)
Other Engineering Data	Gross weight of dispenser and canisters: 1,000 pounds. Empty weight: Universal Bomb, MK 4 Mod 0 183 lbs. (83 kg) Canister MK 2 Mod 0 12.0 lbs. (5.4 kg) Canister MK 2 Mod 1 12.2 lbs. (5.5 kg) Canister MK 3 Mod 0 18.0 lbs. (8.2 kg)	1 (p. 4-27d), 3 (p. 2-2, 3-1, 4-1)
Drawing	MK 4 Mod 0 Canister: 1567967	3 (p. 2-2)

General Use and Description

The Gladeye was a free-fall-general purpose dispenser designed for delivery of small, tactical devices; to include a toxic chemical and biological offensive capability (1 p. 4-27c), (3 p. 1-1).

Gladeye was a modular dispenser that consisted of a special rack or hardback fitted with seven round canisters (Bomb Dispenser Canister MK 2 Mod 0 and Mod 1 or Bomb Dispenser Canisters MK 3 Mod 0) plus an aerodynamic nose and tail fairing, and the dispenser assembly (Bomb Dispenser Mk. 4 Mod 0) to which the canisters are attached, and which incorporates the rack adapter. Bomb Dispenser Canister MK 2 (Mod 0 and Mod 1) was used to carry air-arming munitions or inert articles (e.g., chaff, leaflets). Bomb Dispenser Canister MK 3 Mod 0 is a general purpose container designed to disperse payloads requiring separation from the aircraft. Each canister was ejected separately either at pilot option or at any of three preselected intervals. These intervals were obtained using an intervalometer within the strongback (1 p. 4-27c), (2 p. 1).

The Bomb Dispenser Canister MK 2 (Mod 0 and Mod 1) were operated with a lanyard. The Bomb Dispenser Canister MK 3 (Mod 0) was actuated using a MK 35 time-delay cartridge. The individual canisters are 10.7 inches in length and 14.0 inches in diameter (3 p. 3-1, 4-1).

Each canister acted as a self-contained shipping container for the munitions. The system was mounted on any Aero 7A or Aero 20A rack and connected electrically to the rocket firing circuit of the aircraft. If it became necessary to jettison the loaded Gladeye weapon over friendly territory, the entire assembly including the strongback could be dropped. The canisters would not open, and the munitions load would not arm. The Bomb Dispenser Canister loaded gross weight varied from 32 to 195 pounds total weight depending on the payload used (1 p. 4-27c), (2 p. 1, 3).

Explosive Train

Each canister assembly was actuated by two Bomb Ejection Cartridges MK 2 Mod 1 that were wired to provide a sympathetic, redundant ignition system. The canister retaining hooks were released by a gas-operated shear (2 p. 1).

The MK 3 operation occurred as follows: The collet of the MK 4 dispenser ejector-latching device closes as the main piston moves downward. As the latching device was released and the canister ejected, the lanyard pin pulled free, releasing the firing pins. The firing pins, then under spring power, fired the MK

35 time-delay cartridges generating pressure, which forced the cartridges to open the canister along the parting line. This sheared the roll pins and opened the canister (3 p. 4-1).

Fuzing

Available references did not include information regarding fuzes for this item.

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Munition	Agent	Fill Weight per Munition		Munitions per Canister	Fill Weight per Canister		Dispenser Gross Weight		Cross-Reference	Citation
		lbs.	kg		lbs.	kg	lbs.	kg	Section (Page #)	
M15 grenade	WP	1.94	0.87	Round: 44 Oval: 58	85.4 112*	38.7 50.8*	1,000	454	NA	1 (p. 4-27d)
E61R4 bomblet	biological	1.4	0.63	Round: 64 Oval: 81	89.6 113*	40.6 51.2*	1,000	454	NA	1 (p. 4-27d)
E130R2 bomblet	GB	1.30	0.58	Round: 14 Oval: 16	33.6 38.4*	15.2 17.8*	1,000	454	7.3 (p. 120)	1 (p. 4-27d)
E134 bomblet	biological	1.0	0.45	Round: 26 Oval: 32	26 32	11.8 14.5	1,000	454	NA	1 (p. 4-27d)
M74A1 bomblet	PT1	2.75	1.24	Round: 12*	102*	46.2*	1,000	454	7.15 (p. 157)	1 (p. 4-27d)
M125A1 bomblet	GB	2.60	1.17	Round: 27*	299*	135*	1,000	454	7.16 (p. 159)	1 (p. 4-27d)
M134 bomblet	GB	1.0	0.49	Round: 12 Oval: 16	40.8 54.4	18.5 24.7	1,000	454	7.6 (p. 128)	1 (p. 4-27d)

Notes:
* Utilized a double length canister (1 p. 4-27d)

Shipping/Packing

Each canister acts as a self-contained shipping container for the munitions (1 p. 4-27c). Seven canisters, one load for the MK 4 dispenser, were shipped in one container. The assembled, empty canisters are ready for loading which would be done prior to issue. The shipping container includes the canisters, with one end plate in place (3 p. 4-1).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Glendenning, Dennis E. (Weapons Development Department). 1963. NAVWEPS Report 8439, Aircraft Qualification Information Package Gladeye Weapon System (Bomb Dispenser MK 4 Mod 0 and Bomb Dispenser Canister MK 2 Mod 0). U.S. Naval Ordnance Test Station.
3. Naval Ordnance Test Station 1965. NOTS-TP-3315 Rev 1, Universal Weapons Dispenser Mark 4 Mod 0 with Bomb Dispenser Canisters Mark 2 and Mark 3, Description and Operation (A preliminary Manual). March.

8.7 Dispenser, SUU-13

Figures

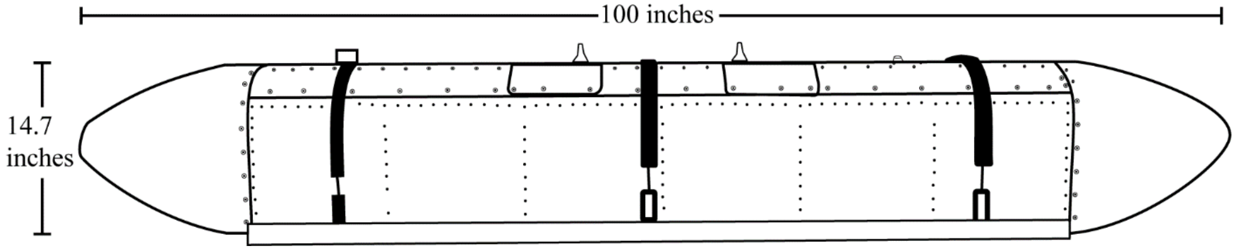

Figure 94: Dispenser, SUU-13 - Line Drawing

Figure 95: Dispenser, SUU-13/A - Photograph

Specifications

Dispenser, SUU-13 - Specifications and Other Data		Citation
Historical Name	SUU-13/A Dispenser	1 (p. 2)
Type	Dispenser	1 (p. 2), 2 (p. 1), 3 (p. 16)
Conflict	Cold War	2, 4
Service	Air Force, Army	1, 2 (p. 1), 3 (p. 16)
Diameter	Tube: 4.8 in. (12.19 cm)	1 (p. 3)
Length	Dispenser: 90.4 in. (229.61 cm) Tube: 11.3 in. (28.7 cm)	1 (p. 2, 3)
Width	Dispenser: 14.7 in. (37.34 cm)	1 (p. 2)
Height	Dispenser: 13.7 in. (34.80 cm)	1 (p. 2, 3)
Other Engineering Data	Weight, Empty: without tubes: 115 lbs. (52.2 kg), with tubes: 186 lbs. (84.4 kg) Loaded: 1,280 BLU-39/B23 bomblets: 382 lbs. (173 kg)	1 (p. 2)

General Use and Description

The SUU-13/A dispenser was part of an CBU system which changed its designation based on the munitions payload. The SUU-13/A, as part of the CBU-30/A munition, disseminated riot control agent (CS). Each SUU-13/A dispenser had 40 tubes with 40 CDU-9/B canisters, each of which contained 32 BLU-50/B or 32 BLU-39/B23 bomblets. A fully loaded dispenser could carry 1,280 bomblets. The SUU-13/A could also be loaded with 40 BLU-19/B23 bomblets (1 p. 2), (2), (4 p. 2-4).

The carrier was externally suspended from tactical aircraft by means of standard 14-inch (3556-millimeter) lugs. The dispenser was equipped with an intervalometer that was preset to permit a specific bomblet discharge rate. The concept of employment was to discharge bomblets simultaneously from several dispensers attached to low flying aircraft (1 p. 2, 3), (4 p. 6-6), (5 p. 10, Appendix A).

Explosive Train

The bomblets were discharged in a preset firing order by initiation of a squib at the head of each tube. This action produced a gas pressure, which would permit the expanding gas to force the bomblet out of the tube in a direction perpendicular to the line of flight (5 p. 10, Appendix A).

Fuzing

Dispenser, SUU-13/A - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Impact	3 (p. 16)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Dispenser, SUU-13/A - Fill Types and Weights										
Bomblet	**Agent**	**Fill Weight per Bomblet**		**Bomblets per Dispenser**	**Fill Weight per Dispenser**		**Cluster Gross Weight**		**Cross-Reference**	**Citation**
		lbs.	**kg**		**lbs.**	**kg**	**lbs.**	**kg**	**Section (Page #)**	
BLU-50/B	BZ	0.05-0.07	0.02-0.03	1,280	62.7-89.6	28.4-40.6	352-	894	7.19 (p. 170)	2 (p. 2), 3 (p. 16), 4 (p. 2-4), 6 (p. 16)
BLU-39/B23	CS	0.07	0.03	1,280	89.6	40.6	382	970	7.19 (p. 170)	1 (p. 2), 2 (p. 2)
BLU-19/B	GB	3.7-4.4	1.68-2.00	40	148-176	376-447	334-362	460-531	7.18 (p. 167)	2 (p. 2), 5 (p. 10. Appendix A), 7 (p. 5)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Maxwell, E.C., Jr. 1968. APGC-TR-68-6, First Article Test of the CBU-30/A Munition (SUU-13/A Dispenser with BLU-39/B23 Bombs). U.S. Air Force.

2. Campbell, D., & Seigh, J. 1964. CRDL Technical Memorandum 83-8, A Theoretical Study of the Area Coverage Potentials of the SUU-7A/A. SUU-13/A, and SUU-14/A Dispenser Systems (U). Chemical Research and Development Laboratories.

3. Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. Department of the Army.

4. Deseret Test Center. 1972. Joint [Chemical- Biological] CB Technical Data Source Book (U), Volume II, Riot Control and Incapacitating Agents (U), Part Three: Agent BZ (U). U.S. Army.

5. SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. U.S. Army.

6. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

7. Taylor, W., & Stone, H. 1965. Dugway Proving Ground Report, DPGR C440, Final Report of Engineering Design Test of the USAF Bomblet, Nonpersistent Agent, USATECOM Project 5-4-0005-01. USATECOM.

9 Chemical Agent Identification Set

CAIS are military training aids containing small quantities of various chemical agents and or other chemicals. CAIS fall into several categories: “Instructional” sets containing agent in bottles for use in classes to familiarize Soldiers with the odor of the various agents (commonly known as “sniff sets”); “Detonation” sets containing agent in ampoules for use in field instruction concerning identification of agents and use of protective gear; “Toxic Gas” kits containing larger quantities of neat agent for use in decontamination training; and “Identification” sets for use with detection equipment training.

All CAIS are to be handled as CWM until definitive assessment identifies the specific contents. As provided for in a 2007 memorandum from the Deputy Under Secretary of the Army for Environment, Safety, and Occupational Health, CAIS determined to contain only industrial chemicals (e.g., CG) or small quantities of dilute blister agents (e.g., H or L) can be managed as hazardous waste. CAIS K941, Toxic Gas Set M1; and CAIS K942, Toxic Gas Set M2/E11 are forms of CAIS always considered to be CWM because they contain neat agent. All CAIS containing a nerve agent at any concentration are considered CWM.

9.1 CAIS, Gas Identification Set, Instructional, K955, M1

Figures

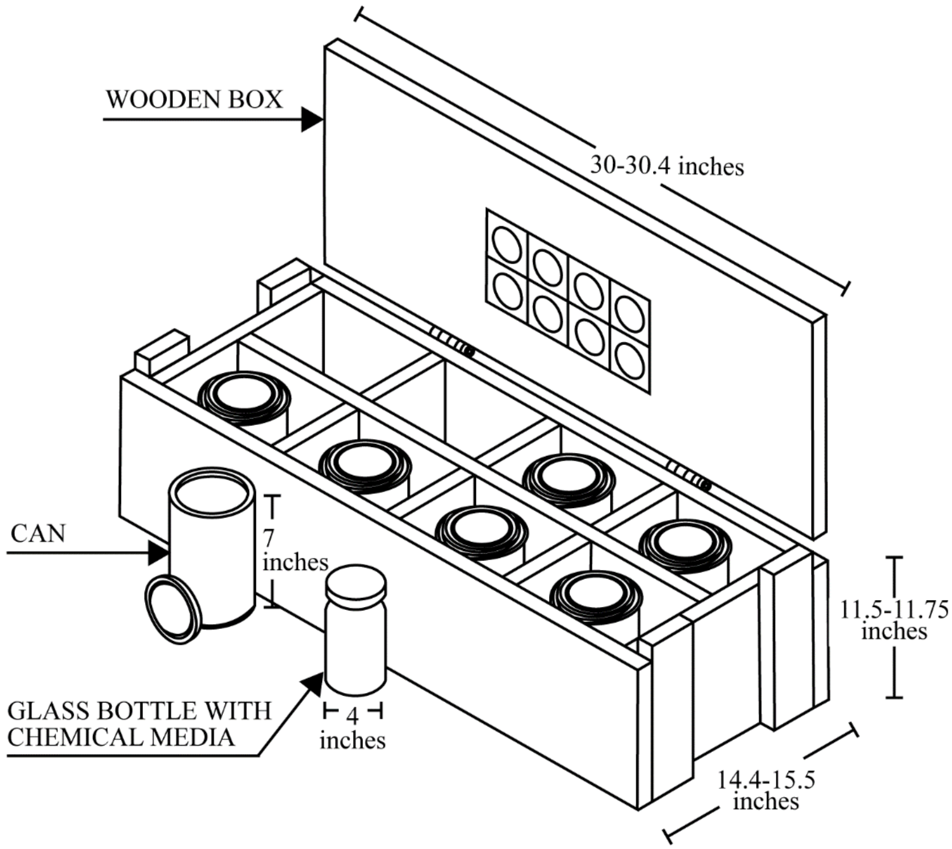

Figure 96: CAIS, Gas Identification Set, Instructional, K955, M1 - Line Drawing

Figure 97: CAIS, Gas Identification Set, Instructional, K955, M1 - Photograph - Left: K955 Components in Box, Right: Glass Bottle

CAIS, Gas Identification Set, Instructional, K955, M1

Specifications

CAIS, Gas Identification Set, Instructional, K955, M1 - Specifications and Other Data		**Citation**
Historical Name	Gas Identification, Instructional, M1	1 (p. 27), 8
Type	CAIS	1 (p. 27)
Conflict	WWII	1 (p. 27)
Diameter	Metal can: 4 in. (10.16 cm)	1 (p. 27)
Length	Wood box: 14.4-15.5 in. (36.56-39.4 cm)	1 (p. 27), 2 (p. 2)
Width	Wood box: 30-30.4 in. (76.2-77.15 cm)	1 (p. 27), 2 (p. 2)
Height	Wood box: 11.5-11.75 in. (29.21-29.85 cm) Metal can: 7 in. (17.78 cm)	1 (p. 27), 2 (p. 2)
Specification	MIL-S-10333, 94-54-25B	3 (p. 15-17), 4
NSN	1365-00-025-3273	1 (p. 27), 3 (p. 15-17)
FSN	1365-368-6154	1 (p. 27), 3 (p. 58)

General Use and Description

These sets were used indoors to train military personnel to identify chemical agent odors (3 p. 15-13), (12 p. 1).

This set was often called a "Sniff Set." It consisted of actual agents and simulants in individual four-ounce glass bottles with glass stoppers ground to make an airtight fit. Each bottle was approximately two inches in diameter and 4.88 inches in height and etched on the side with the agent brevity code. Each K955 CAIS contained seven glass bottles with agent. Of the seven bottles, one bottle contained 25 mL (0.85 fluid ounces) of L/M-1 adsorbed on 3 ounces of activated carbon, one bottle contained 25 mL (0.85 fluid ounces) of PS adsorbed on 3 ounces of activated carbon, and two bottles contained 25 mL (0.85 fluid ounces) of HS adsorbed on 3 ounces of activated carbon, one contained 3 grams of triphosgene (a simulant for CG), one contained 15 grams of CN, and one with 15 grams of DM. Through at least 1940, the sets were issued with eight bottles including two with CG, and one each with PS, CN, HS, L, DA and DM. DA was later dropped from the set (1 p. 27), (2 p. 2).

Since the MI Set was originally a nonexpendable item, provision was made for replacement of sample bottles in which the agent concentration had diminished due to evaporation. Replacement was accomplished by means of the Set, Sample Replacement, for Gas Identification Set, Instructional, MI (4 p. 56), (11 p. 49), (12 p. 2).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, Gas Identification Set, Instructional, K955, M1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG simulant	0.01	0.006	0.01*	0.00*	The bottle contained solid triphosgene, which off-gases CG. The early set contained two bottles of CG.	1 (p. 27), 2 (p. 2), 3 (p. 15-13), 12 (p. 1)
CN	0.03	0.015	0.03*	0.01*	CN agent used as fill.	1 (p. 27), 2 (p. 2), 3 (p. 15-13)
DA	N/A	N/A	N/A	N/A	DA was included in the sets prior to 1935.	12 (p. 1)
DM	0.03	0.015	0.03*	0.01*	DM was in a cloth bag.	1 (p. 27), 2 (p. 2), 3 (p. 15-13)
HS	0.07	0.03	0.14*	0.06*	Bottles may be marked as H or HS.	1 (p. 27), 2 (p. 2), 3 (p. 15-13)
L	0.10	0.04	0.10*	0.04*	Could be labeled "M-1", L absorbed by activated charcoal.	1 (p. 27), 2 (p. 2), 3 (p. 15-13), 12 (p. 1)
PS	0.09	0.04	0.09	0.04	PS absorbed by activated charcoal.	1 (p. 27), 2 (p. 2), 3 (p. 15-13)

Notes:
* Weight is per bottle.

Shipping/Packing

These sets were packed in a hinged, covered wood box resembling a footlocker and measuring 30 inches wide, 15.5 inches long and 11 inches high. The inside of the box was divided into eight sections. Seven of the sections contained sealed metal cans in sawdust and the eighth held instructions. The cans were four inches in diameter and seven inches high and had a paint can-type lid. Inside each can was one round bottle with a large screw top or glass stopper which was usually wax coated and sawdust or similar absorbent cushioning material. Each metal can was surrounded in the wood box by one-inch of wood pulp or similar cushioning material. The complete M1 kit weighed 71 pounds (1 p. 27), (2 p. 2), (3 p. 15-17), (11), (12 p. 1-2).

Miscellaneous Information

These bottles are frequently found loose in WWII disposal/burial sites. Their contents are easily identified by the letter and number code etched into the side of the glass bottle. Older sets use the code "M-1" for lewisite, while newer sets use the code “L.”

In 1934, the DA in the M1 set was replaced with a second bottle of HS. Sets prior to 1936 contained phosgene adsorbed on charcoal. It was found that these bottles did not retain a phosgene odor and excessive pressures built up in the bottles. Subsequently, CG bottles contained a coating of solid triphosgene, which off-gases CG.

Between 1941 and 1943, 25,395 sets were procured (1 p. 27), (4 p. 59), (13 p. 1), (14).

CAIS, Gas Identification Set, Instructional, K955, M1

Key Dates

CAIS, Gas Identification Set, Instructional, K955, M1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Type Classified	1927	CCTC 1927-21	5 (p. 2)
Adopted	1928	CCTC 1928-02-02	6 (p. 1, 2)
Standardized	1935	CCTC 1935-23	7 (p. 19)
Standardized	1944	CCTC 1291 (M1 - Reclassified Limited Standard)	4 (p. 1)
Standardized	1944	CCTC 1183 (Limited Standard)	11 (p. 48)
Canceled	1955	CCTC 3010 (Army Requirement)	8 (p. 127)
Standard Modernization	1959	CCTC 3525 (Standard-B-Bureau of Ordnance)	10 (p. 214)
Obsoleted	1970	AMCTC 8234 (M1)	4 (p. 59)

Sources

1. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.
2. Department of the Navy. 1945. Ordnance Pamphlet, OP 1447, Gas Identification Sets. Department of the Navy.
3. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
4. Chemical-Biological-Nuclear-Subcommittee. 1971. AMCTC Item # 8234, Reclassification of War Gas Identification Set, Instructional: Nondetonation, MI from Standard-B BuOrd Type to Obsolete Type. U.S. Army Materiel Command.
5. Chemical Corps Technical Committee. 1927. CCTC Item # 1927-21, Adoption as to Type - (b) Chemical Warfare Service Sniffing Set. U.S. Army Materiel Command.
6. Chemical Corps Technical Committee. 1928. CCTC Item # 1928-2-2, Adoption as to Type (b) Chemical Warfare Service Gas Service Sniffing Set. U.S. Army Materiel Command.
7. Chemical Corps Technical Committee. 1935. CCTC Item # 1935-23, Set, Gas Identification, Instructional – Recommendation of Classification and Basis of Issue. U.S. Army Materiel Command.
8. Chemical Corps Technical Committee. 1955. CCTC Item # 3010, Cancellation of Army Requirements for Sets, Gas Identification, Instructional, MI & M2 (Sniff Sets). U.S. Army Materiel Command.
9. Chemical Corps Technical Committee. 1956. CCTC Item # 3188, Reduction of Chemical Corps Items in the Supply System. U.S. Army Materiel Command.
10. Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.
11. Chemical Corps Technical Committee. 1944. CCTC Item # 1183, Standardization of Kit, Gas Identification, Instructional, M2. October 26.
12. Chemical Warfare School 1940. Pamphlet No 4, Instructions for Using Gas Identification Sets. Edgewood Arsenal. April.
13. Macy, R. and T. P. Dawson 1936. Edgewood Arsenal Technical Report, EATR 222, Instructional Gas Identification Set MI, Part I Replacement of Phosgene by Triphosgene, Part II Preparation of Triphosgene, Project D 4.4-1. War Department. March 31.
14. War Department 1935. Index Card 400.171/75, HS (Replacement of Sample of DA in Gas Identification Sets with HS). April.

9.2 CAIS, Gas Identification Set, Instructional, M2

Figures

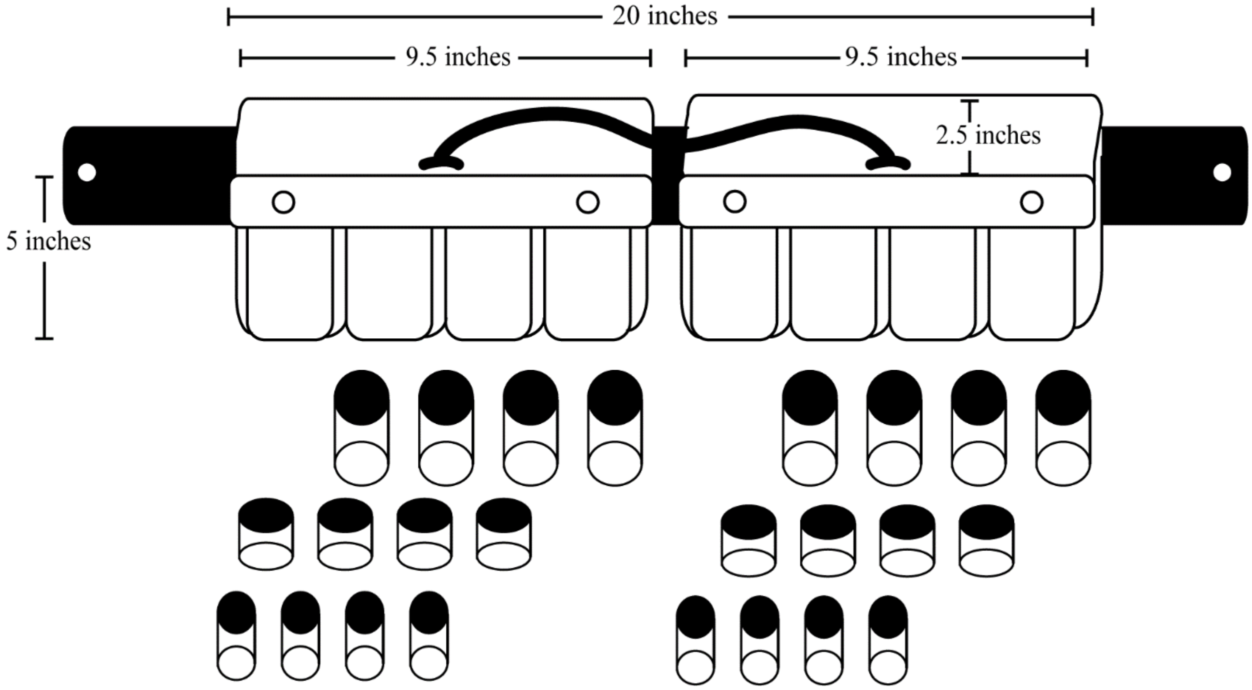

Figure 98: CAIS, Gas Identification Set, Instructional, M2 - Line Drawing

Figure 99: CAIS, Gas Identification Set, Instructional, M2 - Photograph

CAIS, Gas Identification Set, Instructional, M2

Specifications

CAIS, Gas Identification Set, Instructional, M2 - Specifications and Other Data		**Citation**
Historical Name	Kit, Gas Identification, Instructional, M2; and War Gas Identification Set, Instructional, M2	1 (p. 48), 2 (p. 99), 7 (p. 195)
Developmental Information	E6	1 (p. 52)
Type	CAIS	1, 2, 3, 4, 5, 6
Conflict	WWII	1, 2, 3, 4
Diameter	Bottles: 1.5-to 1.63-in. (3.81 to 4.13 cm)	1 (p. 50), 6 (p. 57)
Length	Carrier folded: 9.5 in. (24.13 cm) Carrier extended: 20 in. (50.8 cm)	1 (p. 50), 3 (p. 2)
Width	Carrier folded: 5 in. (12.7 cm) Carrier extended: 2.25 in. (5.71 cm)	1 (p. 50), 3 (p. 2)
Height	Carrier: 5 in. (12.7 cm) Bottles: 3.5 in. (8.89 cm)	1 (p. 50), 3 (p. 2, 3), 6 (p. 57)
Spec/PD No	97-54-396, MIL-S-13894	3 (p. 3), 5 (p. 1), 7 (p. 195)
CWS Drawing	Agents: C18-8-20 Assembly: B18-8-28 Carrier: C18-8-37 Jars: C18-8-22 Manufacture: C18-8-21	5 (p. 1 - 3)

General Use and Description

The M2 was developed to provide a compact instructional gas identification set for use by small groups (3, p. 1). The M2 sets were commonly called “sniff sets,” and were used for the classroom training exercises in the identification of chemical agents by their characteristic odor (4 p. 127).

The set consisted of agents and simulants in eight individual two-ounce, wide-mouth opaque glass bottles. The bottles were opaque to facilitate instruction in agent identification by odor alone (3 p. 3). Each of these bottles had molded plastic adapters and screw caps with rubber gaskets to assure a tight seal. Rubber gaskets were used to provide seals between the bottles and adapters and also between the adapters and screw caps. The bottle number was molded on the side of the bottle and on the bottle cap.

- Bottle #1 contained 15 mL (19.5 grams [g] assuming a liquid density of 1.27 g/mL) of H adsorbed on 50 mL of activated charcoal.
- Bottle #2 contained 15 mL (19.5 g assuming a liquid density of 1.27 g/mL) of HD adsorbed on 50 mL of charcoal carbon.
- Bottle #3 contained 15 mL (28.35 g assuming a liquid density of 1.89 g/mL) of L adsorbed on 50 mL of activated charcoal.
- Bottle #4 contained 15 mL (25.35 g assuming a liquid density of 1.69 g/mL) of PS adsorbed on 50 mL of activated charcoal.
- Bottle #5 contained 5 g of triphosgene (a simulant for CG).
- Bottle #6 contained 15 g of CN.
- Bottle #7 contained 19.2 g of sodium cyanide, a simulant for AC, mixed with 15.8 g of silica gel.
- Bottle #8 contained 10 g of DA mixed with 35 mL of activated charcoal (1 p. 50), (3 p. 3, 4), (5 p. 2, 3), (6 p. 57).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, Gas Identification Set, Instructional, M2 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC simulant	0.0423	0.0192	N/A	N/A	Bottle #7 contained sodium cyanide, a simulant for AC, mixed with 15.8 g of silica gel	1, 4 (p. 4), 6 (p. 3)
CG simulant	0.011	0.005	N/A	N/A	Bottle #5 contained solid triphosgene, which off-gases CG. Weight is per bottle.	1, 4 (p. 4), 6 (p. 3)
CN	0.033	0.015	N/A	N/A	Bottle #6	1, 4 (p. 4), 6 (p. 3)
DA	0.022	0.01	N/A	N/A	Bottle #8 contained DA mixed with 35 mL of activated charcoal.	1, 4 (p. 4), 6 (p. 3)
H	0.043	0.0195	N/A	N/A	Bottle #1 contained H adsorbed on 50 mL of activated charcoal	1, 4 (p. 4), 6 (p. 3)
HD	0.043	0.0195	N/A	N/A	Bottle #2 contained HD adsorbed on 50 mL of activated charcoal	1, 4 (p. 4), 6 (p. 3)
L	0.0626	0.0284	N/A	N/A	Bottle #3 contained L adsorbed on 50 mL of activated charcoal	1, 4 (p. 4), 6 (p. 3)
PS	0.056	0.0254	N/A	N/A	Bottle #4 contained PS adsorbed on 50 mL of activated charcoal	1, 4 (p. 4), 6 (p. 3)

Shipping/Packing

The bottles were packed in fiber containers and placed in pockets in a canvas carrier with waist strap so that it could be worn by an instructor. The canvas carrier measured 20 by 2.25 by 5 inches. The total weight of the kit was between 4.4 and 4.7 pounds (1 p. 50), (3 p. 2, 4), (6 p. 57).

To protect the agent bottles against breakage protective tubes of vulcanized fiber were inserted in each compartment of the carrier for the bottles to be placed in. Covers of the same material slip-fit over the tubes and contacted the plastic closures of the bottles so that the bottles could not move freely within the protective shield. The tubes were two inches in diameter and three and a half inches deep and allowed easy removal of the bottles. The vulcanized fiber tubes were resistant to mildew. The tubes and covers were numbered to correspond to the agent bottles. The agent code symbols appeared only on the inside of the cover (3 p. 3).

Miscellaneous Information

The kit was designated E6 during development. Before being designated M2, the E6 was improved by enlarging the bottle opening, increasing the concentration and amount of agent in each bottle, and replacing rubber gaskets with neoprene (1 p. 51).

At the time of obsoletion of the set in 1956, no M2 sets were on hand (7 p. 195).

Key Dates

CAIS, Gas Identification Set, Instructional, M2 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1944	CCTC Items 1183, 1291 (Standard)	1, 2, 6 (p. 55)
Cancellation	1955	CCTC Item 3010 (Army Requirements)	4, 6 (p. 55)
Other	1955	CCTC 3136 (Redesignated War Gas Identification Set, Instructional, M2)	7 (p. 195)
Obsoleted	1956	CCTC Item 3188	6 (p. 57), 7 (p. 158)

Sources

1. Chemical Corps Technical Committee. 1944. CCTC Item 1183, Standardization of Kit, Gas Identification, Instructional, M2. Department of the Army.
2. Chemical Corps Technical Committee. 1944. CCTC Item 1291, Standardization of Kit, Gas Identification, Instructional, M2. Department of the Army.
3. Scherr, H. 1945. Technical Division Memorandum Report, TDMR 1090, Set, Gas Identification, Instructional, M2, Project E 7a-1, Job 7. Chemical Warfare Service.
4. Chemical Corps Technical Committee. 1955. CCTC Item 3010, Cancellation of Army Requirements for Sets, Gas Identification, Instructional, M1 and M2. Department of the Army.
5. U.S. Army. 1945. U.S. Army Specification No. 97-54-396, Set, Gas Identification, Instructional, M3. Chemical Warfare Service.
6. U.S. Army Materiel Command. 1970. AMCTC Item 8234, Reclassification of War Gas Identification Set, Instructional: Nondetonation, MI from Standard-B BuOrd Type to Obsolete Type.
7. Chemical Corps Technical Committee. 1956. CCTC Item # 3188, Reduction of Chemical Corps Items in the Supply System. 27 January.

9.3 CAIS, Replacement Set, Gas Identification, Instructional, Navy X Sets

Figures

Figure 100: CAIS Replacement Set, Gas Identification, Instructional, Navy X Replacement Sets - Photograph

Specifications

CAIS, Replacement Set, Gas Identification, Instructional, Navy X Sets - Specifications and Other Data		Citation
Historical Name	Navy X Sets, Replacement Set, Gas Identification, Instructional, (Navy) and Set, Sample Replacement, for Gas Identification Set, Instructional, MI	1 (p. 31), 4 (p. 61)
Type	CAIS	1 (p. 31)
Conflict	WWII, Korea	1 (p. 31)
Service	Navy	1 (p. 31)
Diameter	Can: 4 in. (10.16 cm)	1 (p. 31)
Length	Wooden box: 16 in. (40.64 cm)	2 (p. 5)
Width	Wooden box: 7.5 in. (19.05 cm)	2 (p. 5)
Height	Wooden box: 11.75 in. (29.84 cm) Can: 7 in. (17.78 cm)	2 (p. 5)
Specifications	CWS 197-54-99A	3 (p. 94-95)
NSN	X302: 1365-038-5138 X545: 1365-608-5322 X546: 1365-608-5323 X547: 1365-608-5324 X548: 1365-608-5325 X549: 1365-608-5326 X550: 1365-608-5327 X551: 1365-608-5328 X552: 1365-608-5329	1 (p. 31)

General Use and Description

These replacements for sets used by military to train Soldiers to identify chemical agents on the field. The replacement materials for the K955 evolved as the agents and training requirements changed. The MI (K955) Set was originally a nonexpendable item, and provision was made for replacement of sample bottles in which the agent concentration had diminished due to evaporation. Replacement was accomplished by means of the "Set, Sample Replacement, for Gas Identification Set, Instructional, MI" which consisted of two component bottles in a shipping box (4 p. 56).

There were several other configurations for the replacement kits as well. These include nine different types of replacement CAIS used by the Navy to replace components of the K955 CAIS and the Navy's supplemental set which included HN.

The X302 contained one bottle with 25 mL (0.85 fluid ounces) of HN1, and one 25 mL (0.85 fluid ounces) bottle of HN3 absorbed in three ounces of activated charcoal.

The sample replacement sets X545 through X552 contained two bottles with either a total of 1.7 fluid ounces of liquid agent absorbed in activated charcoal or solid agent (1 p. 31).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, Replacement Set, Gas Identification, Instructional, Navy X Sets - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight***		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	0.01	0.00	0.01	0.01	Triphosgene CG simulant used with set X545.	1 (p. 31)
CN	0.03	0.01	0.07	0.03	Set X546	1 (p. 31)
DM	0.03	0.01	0.07	0.03	Set X549	1 (p. 31)
HN-1	0.06	0.02	0.12	0.05	Used in X302 and X550. HN-1 absorbed in 3 ounces of activated charcoal.	1 (p. 31), 2 (p. 5)
HN-3	0.07	0.03	0.14	0.06	Used in X302 and X551. HN-3 absorbed in 3 ounces of activated charcoal.	1 (p. 31), 2 (p. 5)
HS	0.07	0.03	0.14	0.06	Set X547	1 (p. 31)
L	0.10	0.04	0.21	0.09	Set X548	1 (p. 31)
PS	0.09	0.04	0.19	0.08	Set X552	1 (p. 31)

Notes:
* Weight is per bottle.

Shipping/Packing

Each X-Set was packaged in a wooden box with a hinged cover. The replacement consisted of two component bottles in a shipping box 16.625 x 11.75 x 8.5 inches in size and weight of 23 pounds. Each box was divided into two sections. Each section contained a can with a paint can-type lid packed with sawdust. Each can contained one round bottle with a large screw top or glass stopper, which was usually wax coated. Requisitioners of new agent bottles returned the exhausted bottles in the nonexpendable shipping box (1, p. 31), (2 p. 5), (4 p. 56).

Miscellaneous

There replacement sets were used between WWII and the Korean Conflict (1, p. 31). During the period 1943-45 a total of 30,874 of the M1 Replacement Sets was procured and incorporated into the supply system. In 1946, there were 39 complete units on hand with 384 component bottles available. The replacement set was classified as a Limited Standard article in 1946 and since the replacement set was determined to be most accurately defined as a spare part, which precluded its standardization (3 p. 94) (4 p. 56, 59).

Key Dates

CAIS, Replacement Set, Gas Identification, Instructional, Navy X Sets - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Classified	1946	CCTC 1683 (MI Replacement reclassified as a spare part)	3 (p. 95)
Obsoleted	1971	AMCTC 8234 (M1)	4 (p. 59)

Sources

1. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.

2. Department of the Navy. 1945. Ordnance Pamphlet, OP 1447, Gas Identification Sets. Department of the Navy.

3. Chemical Corps Technical Committee. 1946. CCTC Item # 1683 Cancellation of Miscellaneous Experimental Items. Department of the Navy.

4. Chemical-Biological-Nuclear-Subcommittee. 1971. AMCTC Item # 8234, Reclassification of War Gas Identification Set, Instructional: Nondetonation, MI from Standard-B BuOrd Type to Obsolete Type. U.S. Army Materiel Command.

9.4 CAIS, Toxic Gas Set, K941, M1

Figures

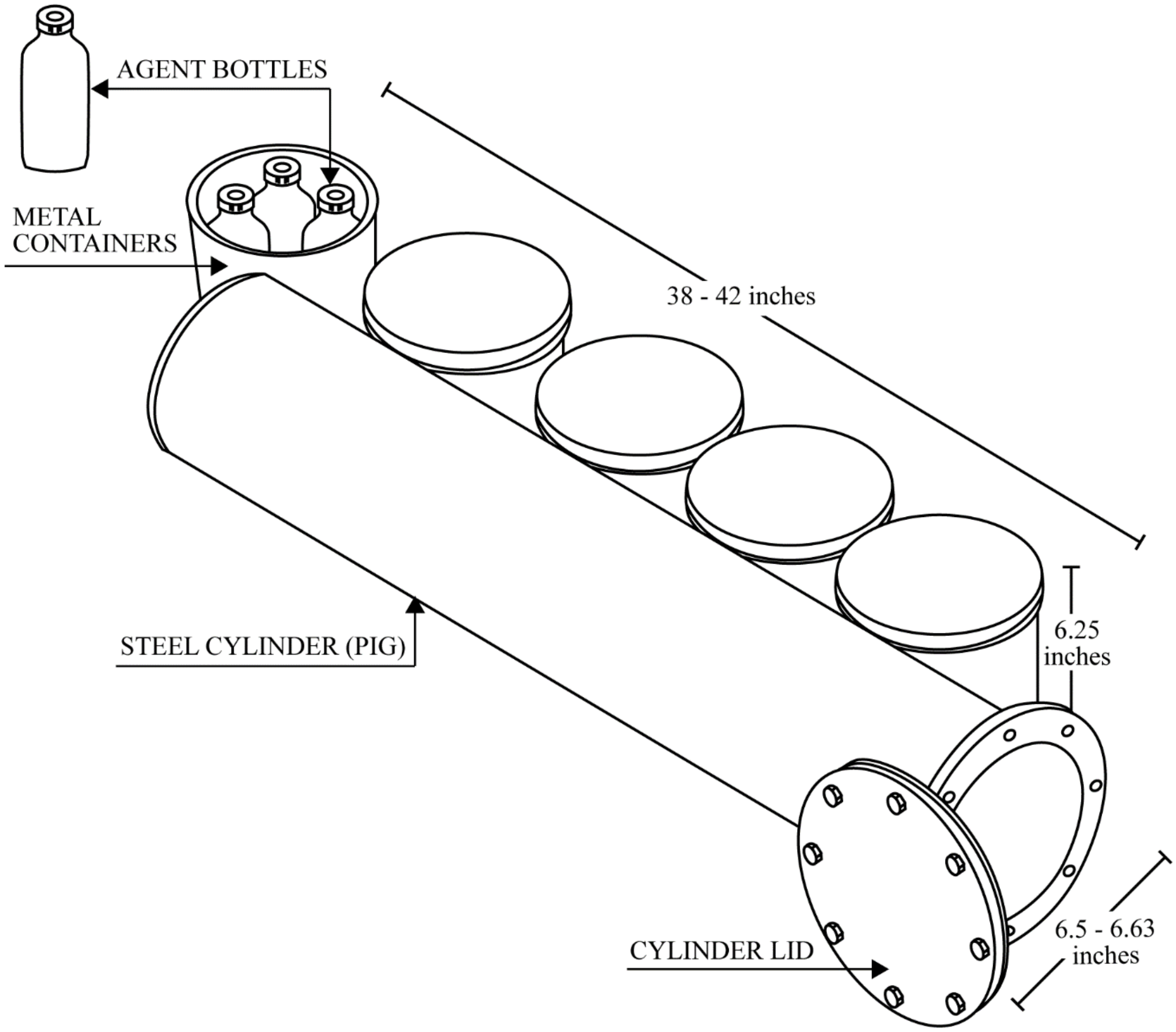

Figure 101: CAIS, Toxic Gas Set, K941, M1 - Line Drawing

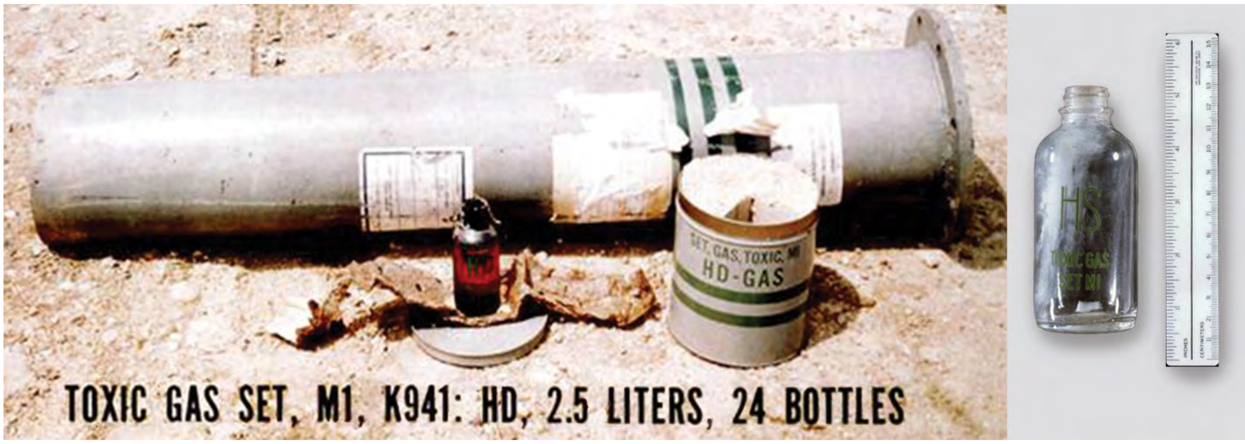

Figure 102: CAIS, Toxic Gas Set, K941, M1 - Photograph, Left: Toxic Gas Set, M1, K941, Right: Bottle

CAIS, Toxic Gas Set, K941, M1

Specifications

CAIS, Toxic Gas Set, K941, M1 - Specifications and Other Data		**Citation**
Historical Name	Set, Gas, Toxic: HD, M1, and Toxic Gas Set: HD, M1	1 (p. 5), 2 (p. 120), 8 (p. 17)
Type	CAIS	1 (p. 5)
Conflict	Cold War, WWII	1 (p. 5)
Service	Air Force, Army, Navy	3 (p. 253, 255), 4 (p. 15-27)
Diameter	PIG: 6.5 – 6.62 in. (16.5 – 16.8 cm) Can: 6.5-6.63 in. (16.5-16.8 cm)	3 (p. 253), 4 (p. 15-27)
Length	PIG: 38-42 in. (96.52-106.68 cm)	3 (p. 253), 4 (p. 15-27)
Height	Can: 6.25 in. (15.9 cm)	1 (p. 5)
Wall Thickness	PIG: 0.145 in. (0.368 cm)	9
Specification	MIL-S-10333, 97-54-254	3 (p. 253), 4 (p. 15-27), 7, 10
Drawing	D18-58-2	3 (p. 253)
NSN	1365-00-219-8574	1 (p. 5), 3 (p. 253), 4 (p. 15-27)
FSN	1365-219-8574, 6910-219-8574	1 (p. 5), 5 (p. 209)

General Use and Description

The K941 sets allowed the military to use mustard agent for general training purposes. The M1 set was used in field exercises to contaminate areas for training in detection, decontamination, and protective measures (1 p. 5), (2), (3 p. 253), (4 p. 15-27).

In 1942, the initial Set, Gas, Toxic, M1 consisted of 32 four-ounce screw cap glass bottles, each containing 4 fluid ounces (150.2 grams assuming a liquid density of 1.27 grams/milliliter) of H for a total of 128 fluid ounces (3.79 liters or 4.81 kilograms) per set. The bottles were packed into seven fiber containers. Six of the containers contained five bottles while the seventh contained two bottles and three wooden dummies. The containers were put into a steel shipping cylinder that was 5-7/8 inches in diameter, approximately 38 inches long, and 0.145-inch thick. The open end of this container was closed by a flanged end cover, which was secured by eight bolts (9).

By 1944, the K941 CAIS specification was revised, and the set contained 24 screw cap, glass bottles, each contained 3.5 fluid ounces of mustard (H and HS) or HD (133.5 grams assuming a liquid density of 1.27 grams/milliliter) for a total of 84 fluid ounces (2.48 liters or 3.16 kilograms) per set. Each bottle was wrapped in brown wax-paper.

Four bottles were packed in a one-half inch layer of sawdust within another container (initially a fiberboard container and later a sealed metal can). The E8 kit had sealed metal cans, 6.25 inches high and had a removable roll-type key on the bottom (i.e., the keys were like those found on cans of fish or meat). Six of these fiberboard or metal cans were fit into a steel shipping cylinder that was 6-5/8 inches in diameter, approximately 38 inches long, and 0.145-inch thick. The open end of this container was closed by a flanged end cover, which was secured by eight bolts tightened over a 1/8-inch-thick lead gasket.

The bottles were round and had a small screw top. Heat resistant paint on the bottles indicates “H,” “HS,” “HD,” or “Toxic Gas Set, M1” (2), (3 p. 253), (4 p. 15-27), (7), (10)

Whenever encountered, individual bottles or complete CAIS K941 are considered CWM (1 p. 5).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, Toxic Gas Set, K941, M1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
H	0.29	0.13	6.96	3.16	Weight is per bottle (24 bottles per set).	3 (p. 253), 4 (p. 15-27), 5 (p. 209)
HD	0.29	0.13	6.96	3.16	Weight is per bottle. (24 bottles per set).	1 (p. 5), 3 (p. 253), 4 (p. 15-27)

Shipping/Packing

The sets were packed in a steel cylinder that weighed 83 pounds and occupied 2.1 cubic feet.

The steel shipping container was airtight and would stand 250 pounds per square inch (psi) internal pressure when bolted tight. The nuts were hexagonal and could be removed with a standard 1 ¼-inch wrench.

Two interlocking pieces of corrugated fiberboard and a fiberboard liner were placed into each of the six inner containers. The six containers were packed in a steel shipping cylinder (i.e., PIG). The cylinder was sealed with a steel cover that was bolted over a lead gasket (3 p. 253), (4 p. 15-27), (7).

Miscellaneous Information

In 1947, correspondence indicates that the drawings for the kit would be revised to specify that the filling be HD in lieu of H. Since H was a substitute standard filing for HD, no change in designation was necessary (11).

During WWII, 23,001 M1 toxic gas sets were procured with an additional 3,531 sets procured between 1949 and 1952. As of 1971, the Army reportedly had 46 sets on hand (2 p. 125).

In former WWII training areas, K941 shipping containers (also called PIGS) or loose K941 bottles are frequently found buried. Loose bottles should be handled carefully by field personnel during recovery using appropriate protective measures as the plastic/Bakelite tops on these bottles are prone to leak (1 p. 5), (2 p. 123, 125).

Key Dates

CAIS, Toxic Gas Set, K941, M1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1942	CCTC 567, 617	3 (p. 253), 8, 9
Standardized	1942	CCTC 567, 617	3 (p. 253), 8, 9
Standardized	1955	CCTC 3125 (Limited Standard)	2 (p. 122)
Standardized	1956	CCTC 3242 (Limited Standard)	3 (p. 253)
Standard Modernization	1958	CCTC 3408 (Standard-B)	3 (p. 253), 6 (p. 117)
Other	1971	AMCTC 8441 (Revised nomenclature)	8 (p. 17)
Obsoleted	1971	AMCTC 8515	2 (p. 120)

Sources

1. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.

2. Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8515, Reclassification of Toxic Gas Sets: M1 and M2 from Standard-B and Standard-A Types to Obsolete Types. U.S. Army Materiel Command.

3. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.

4. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.

5. Department of the Army. 1961. Technical Manual, TM 3-500, Chemical Corps Equipment Data Sheets. U.S. Government Printing Office.

6. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.

7. Department of Defense 1950. Military Specification, MIL-S-10333 (CmlC), Set, Gas, Toxic, M1. 31 May.

8. Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8441 (CBN Item #4862), Revised Nomenclatures for War Gas Identification Set, Instructional: Detonation, MI & AN-MlA1, and Toxic Gas Set: HD, M1 & M2. U.S. Army Materiel Command. 30 March.

9. Chemical Corps Technical Committee. 1942. CCTC Item # 567, Subcommittee Report – Standardization of Set, Gas, Toxic, M1, Military Requirement and Military Characteristic. Department of the Army.

10. U.S. Army. 1944. Specification 97-54-254, Set, Gas, Toxic, M1. 2 September.

11. Technical Command 1947. John A. MacLaughlin, Commanding Officer, Memorandum to R & E Division, Army Chemical Center, Subject: Modification of Set, Gas, Toxic, M1. October 24.

9.5 CAIS, Toxic Gas Set, K942, M2 (E11)

Figures

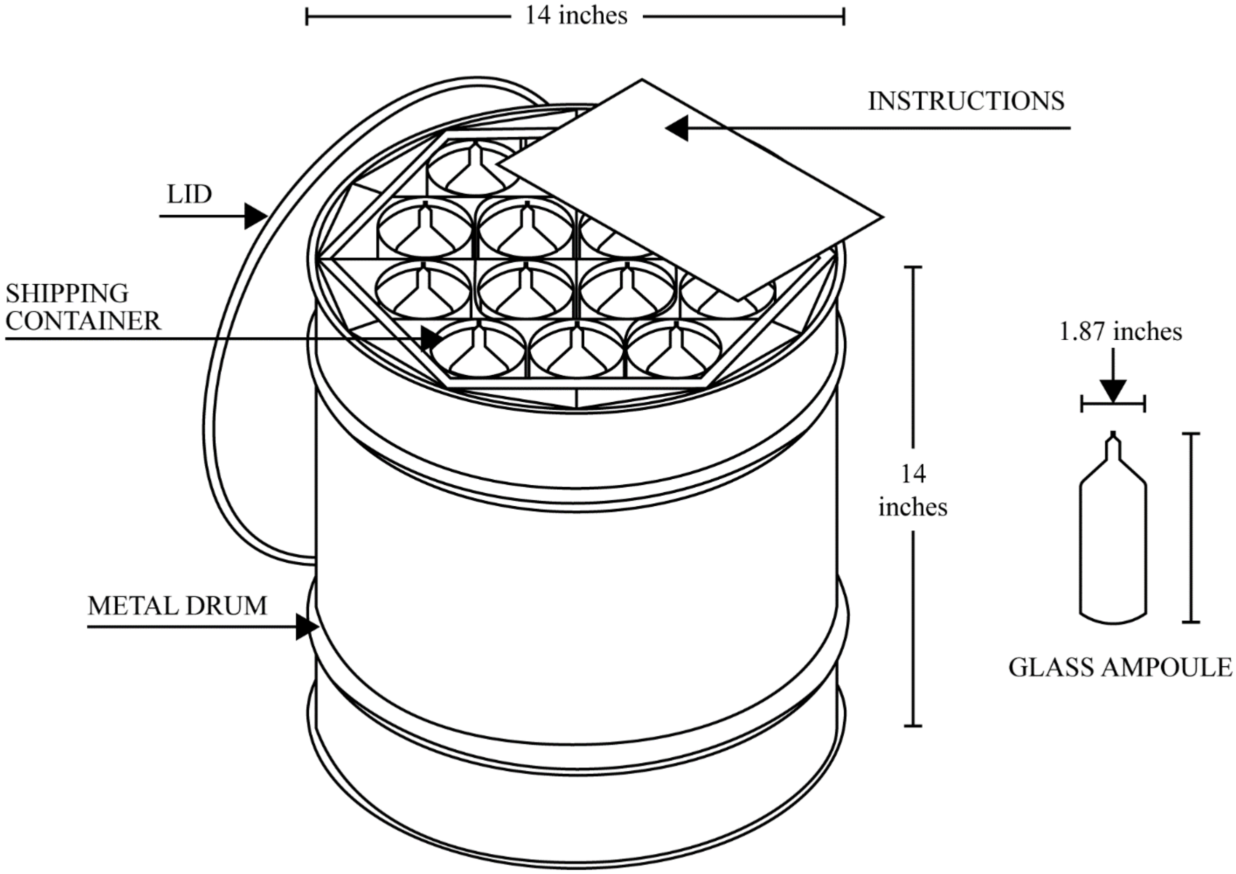

Figure 103: CAIS, Training Toxic Gas Set, M2 - Line Drawing

Figure 104: CAIS, Toxic Gas Set, K942, M2 (E11) - Photograph – 1) E11 Drum, Closed 2) E11 Drum, Open 3) M2, K942 Drum Open 4) K942 Toxic Gas Set Can with Contents

Specifications

CAIS, Toxic Gas Set, K942, M2 (E11) - Specifications and Other Data		Citation
Historical Name	Set, Gas, Toxic: HD, M2 and Toxic Gas Set: HD, M2	1 (p. 9), 4, 7
Development Markings	E11	1 (p. 13)
Type	CAIS	1 (p. 9)
Conflict	Other	1 (p. 9)
Service	Army, Navy	2 (p. 15-29), 3 (p. 254)
Diameter	Ampoule: 1.87 in. (4.76 cm) Drum: 14 in. (35.56 cm)	1 (p. 9-10), 2 (p. 15-29), 3 (p. 254)
Length	Ampoule: 4.62 in. (11.74 cm) Drum: 14 in. (35.56 cm)	1 (p. 9, 10), 2 (p. 15-29), 3 (p. 254)
Height	Drum: 14 in. (35.56 cm)	1 (p. 10), 2 (p. 15-29), 3 (p. 254)
Wall Thickness	Drum: 0.0375 in. (0.0953 cm)	3 (p. 254), 4 (p. 124, 126)
Specification	MIL-S-51058	3 (p. 254)
Drawing	C18-58-31	3 (p. 254)
NSN	1365-00-563-4146	2 (p. 15-29)
FSN	1365-563-4146	1 (p. 9), 3 (p. 254)

General Use and Description

The K942 sets were used by military to provide small quantities of mustard to train Soldiers in field decontamination. The contents of the glass vials could be dispersed by throwing the vials or through use of a blasting cap.

The M2 gas set was used to familiarize trainees with HD. Small quantities of HD were used to contaminate designated training areas. Personnel were trained in recognizing the effects of HD and the proper decontamination procedures (1 p. 9), (2 p. 15-29), (3 p. 254), (6 p. 30 - 32).

The K942 CAIS contained 28 heat-sealed ampoules, each containing 3.8-4.0 fluid ounces of mustard (H, HD, or HS) for a total of 106.4 fluid ounces. Assuming a liquid density of 1.27 grams/mL, each ampoule contained 142.7 grams of H.

Each ampoule was packed in its own can, 28 cans were packed in a steel drum. Ampoules were flame sealed at the neck to produce a leak proof container for the mustard. Each ampoule was stored in a hermetically sealed metal tear strip container made of tinplate. These containers were approximately 2.63 inches in diameter and 6.25 inches long. The ampoules were protected from movement and breakage by foam rubber disks at the ends and a corrugated fiberboard lining.

Whenever encountered, individual ampoules or complete CAIS K942 are considered CWM (1 p. 9), (2 p. 15-29), (3 p. 254) (4).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, Toxic Gas Set, K942, M2 (E11) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight***		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
H	0.25-0.31	0.11-0.14	40.0	18.14	3.8 fluid ounces / 112 mL per ampoule with 28 ampoules per set.	1 (p. 9), 3 (p. 254), 4 (p. 124)
HD	0.31	0.14	40.0	18.14	3.8 fluid ounces / 112 mL per ampoule with 28 ampoules per set.	1 (p. 9), 2 (p. 15-29), 3 (p. 254), 4 (p. 124)

Notes:
* Gross weight is for the set as packed in a steel drum.

Shipping/Packing

The 28 cans containing the heat-sealed vials forming the kit were packed in a cold rolled carbon steel drum that was 14 inches in diameter, 14 inches high, and 0.0375 inches thick in two layers. There were 14 cans per layer. The cans were separated into individual compartments by fiberboard packaging. The drum was sealed by a bolted ring closure cover seated on a rubber gasket. Shipping weight of the kit was approximately 40 pounds (1 p. 9), (3 p. 254), (4 p. 124, 126).

Miscellaneous Information

The M1 set had some leakage during shipping. The M2 set had a drum-type metal shipping container and improved interior packing. This was to replace the M1 set shipping containers and agent tube packing that were considered unreliable. The flame sealed ampoules of mustard in the M2 set could withstand H/HD pressures at up to 150 degrees F, indefinitely (4 p. 123, 124), (6 p. 10).

It is reported that 20 M2 toxic gas sets were procured in 1953 and none remained on hand as of 1971. The M2 Toxic Gas Set was no longer in use by the Navy by 1985 (2 p. 15-29), (4 p. 125).

Key Dates

CAIS, Toxic Gas Set, K942, M2 (E11) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1942	CCTC 617	3 (p. 254)
Standardized	1956	CCTC 3242 (Standard)	3 (p. 254), 4 (p. 122)
Standard Modernization	1958	CCTC 3408 (Standard-A)	3 (p. 254), 5 (p. 116)
Other	1971	AMCTC 8441 (Revised nomenclature)	7 (p. 17)
Obsoleted	1971	AMCTC 8515	4 (p. 120)

Sources

1. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.

2. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.

3. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.

4. Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8515, Reclassification of Toxic Gas Sets: M1 and M2 from Standard-B and Standard-A Types to Obsolete Types. U.S. Army Materiel Command.

5. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.

6. Dugway Proving Ground. 1957. Dugway Proving Ground Report, DPGR 169, Tests of E11 Toxic Gas Set, CCB 3-55. 16 April. [DTIC AD127834]

7. Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8441 (CBN Item #4862), Revised Nomenclatures for War Gas Identification Set, Instructional: Detonation, MI & AN-MlAl, and Toxic Gas Set: HD, M1 & M2. U.S. Army Materiel Command. 30 March.

9.6 CAIS, Training Set, Chemical Agent Identification, K945, M72, CAITS

Figures

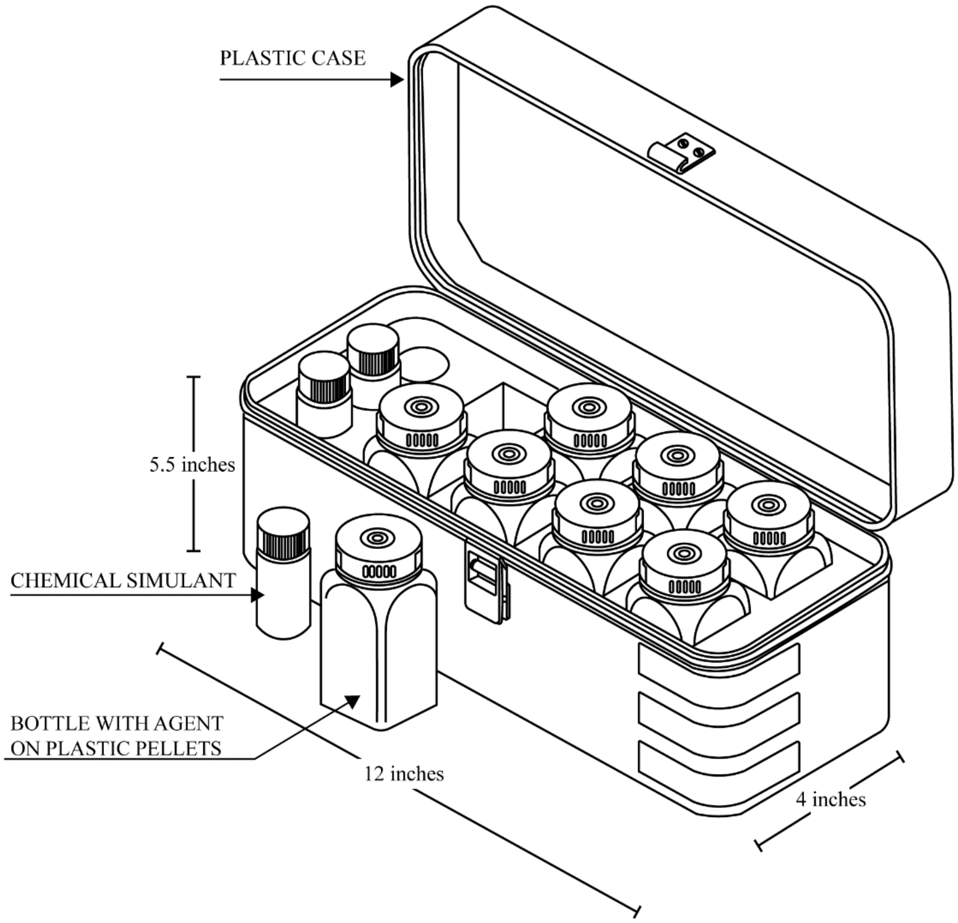

Figure 105: CAIS, Chemical Agent Identification Training Set, M72 - Line Drawing

Figure 106: Chemical Agent Identification Training Set, M72 - Photograph - Open Tackle Box, Vial, Bottle

CAIS, Training Set, Chemical Agent Identification, K945, M72, CAITS

Specifications

CAIS, Training Set, Chemical Agent Identification, K945, M72, CAITS - Specifications and Other Data		Citation
Historical Name	Training Set, Chemical Agent Identification, M72	1 (p. 15), 4 (p. 11)
Developmental Information	XM72 (E18)	3 (p. 15-31), 4 (p. 11)
Type	CAIS	1 (p. 15), 4 (p. 11)
Conflict	Cold War	1 (p. 15), 4 (p. 11)
Service	Army, Marine Corps, Navy	2 (p. 138)
Diameter	Bottle, Round: 1.75 in. (4.45 cm) Vial: 1.1 in. (2.79 cm)	4 (p. 13)
Length	Carrying case: 4 in. (10.16 cm)	1 (p. 15), 3 (p. 15-31)
Width	Carrying case: 12 in. (30.48 cm) Bottle, Square: 1.64 in. (4.17 cm)	1 (p. 15), 3 (p. 15-31), 7
Height	Carrying case: 5.5 in. (13.97 cm) Bottle, Round: 3.125 in. (7.94 cm) Bottle, Square: 3.34 in. (8.48 cm) Vial: 2.88 in. (7.32 cm)	1 (p. 15), 3 (p. 15-31), 4 (p. 13), 7
Specification	MIL-T-51321	3 (p. 15-31)
NSN	1365-00-051-1807	3 (p. 15-31)
FSN	1365-051-1807	1 (p. 15)

General Use and Description

The M72 Chemical Agent Identification Test Set (CAITS) was a training device intended for use by qualified instructors to demonstrate color changes associated with chemical detectors, such as detector tubes, tickets, and paper (3 p. 15-31), (7 p. 1).

The M72 CAITS contained eight, plastic-coated, amber glass two-ounce bottles, and three plastic-coated, one-ounce, clear glass vials inserted in a molded plastic cushioning material. Each kit contained four bottles of nerve agent GB (3 mL agent [3.27 g assuming a liquid density of 1.09 g/mL] in 15 g of polystyrene pellets), one of L (3 mL agent [5.67 g assuming a liquid density of 1.89 g/mL] in 15 g of polystyrene pellets), one of triphosgene (solid chemical that breakdowns to off-gases CG, 5 g), one of potassium cyanide (KCN) (5 g and 1 to 2 mL water), and one of HD (1 mL agent in 15 g Plexiglass pellets). The K945 CAITS also had three plastic-coated, one-ounce, clear glass vials (1.1 inches in diameter and 2.88 inches high) with screw caps containing simulant chemical agent in liquid form. The eight 2-ounce bottles in the set were originally round (1.75 inches in diameter by 3.125 inches) but specifications were later changed to be square bottles (3.34 inches in height and 1.64 inches wide).

The square bottles and three round vials were enclosed in a plastic carrying case measuring 12 by 5.5 by 4 inches and weighing about three pounds. This case was a gray, nylon "tackle box" type with alternate corners marked with three green bands (1, p. 15), (2 p. 136), (3, p. 15-31), (4), (5), (7 p. 3).

When encountered, individual bottles or complete CAIS K945 are considered CWM (1 p. 15), (3 p. 15-31), (5 p. 4).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, Training Set, Chemical Agent Identification, K945, M72, CAITS - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	0.01	0.00	0.01*	0.00*	Triphosgene was used as a simulant for CG. The set contained one bottle of triphosgene.	1 (p. 15), 3 (p. 15-31), 4 (p. 13)
GB	0.01	0.00	0.03*	0.01*	There were four bottles of GB per set.	1 (p. 15), 3 (p. 15-31)
HD	0.01	0.00	0.01*	0.00*	The set contained one bottle of H.	1 (p. 15), 3 (p. 15-31), 4 (p. 13)
L	0.01	0.00	0.01*	0.00*	The set contained one bottle of L.	1 (p. 15), 3 (p. 15-31), 4 (p. 13)
V-G	0.01	0.00	0.04	0.02	Agent GF (3 mL) in 12 grams of polystyrene pellets. In XM72 kit. There were four bottles per set. Only in replacement bottles.	4 (p. 13)
Simulant-AC	0.01	0.00	0.01*	0.00*	KCN was used as a simulant of AC. The set contained one bottle.	1 (p. 15), 3 (p. 15-31), 4 (p. 13)
Simulant-G	0.05	0.02	0.05	0.02	13.5 mL hexylene glycol & 6.5 mL 2-methoxyethanol. Weight is per vial.	4 (p. 13)
Simulant-H	0.05	0.02	0.05	0.02	20 mL isoamylsalicylate. Weight is per vial.	3 (p. 15-31), 4 (p. 13)
Simulant-V	0.05	0.02	0.05	0.02	20 mL saturated solution of N-methylglucamine in tetrahydrofurfuryl alcohol & diethylene glycol. Weight is per vial.	4 (p. 13)
* Weight is per bottle.						

Shipping/Packing

The M72 CAITS plastic carrying case was sealed in two-layer laminated plastic bags that were packed in a fiberboard box that was in turn packed into a wooden box sealed with metal straps. The box with the M72 CAITS was packaged one per metal drum. The filled drum weighed approximately 15 pounds (1 p. 15), (3 p. 15-31), (4), (5).

Miscellaneous Information

As of 1967, there were 25 M72 kits on hand (4 p. 15). Between 1968 and 1969, a small number of K945 were produced at Edgewood Arsenal, MD. Kits were shipped to Tooele Army Deport, UT (514 kits) and Umatilla Army Depot, OR (1,000 kits) for storage in addition to kits at Edgewood Arsenal (448 kits). Laws passed in 1969 severely restricted open-air use of chemical agents, and the M72 CAIS were replaced by the M72A simulant filled sets known as simulated chemical agent identification and training sets. Between 1978 and 1982, during Operation SETCON, all the K945 kits were shipped to Rocky Mountain Arsenal, CO where they were destroyed (8).

Bottles containing GF were produced to replace those containing GB. A total of 8,000 bottles of GF were manufactured at Edgewood Arsenal. In 1978 and 1979, the 8000 GF filled refill bottles were destroyed by incineration at the Aberdeen Proving Ground Pilot Plant during testing for the CAIS incineration system at Rocky Mountain Arsenal. The GF bottles were never boxed or placed into a CAIS configuration and were being maintained to refill the K945 CAIS (8).

Although it is unlikely that any M72 CAIS remain, they are physically similar to the M72A1 SCAITS. The discovery of a set resembling this description should provoke a careful comparison of labels to determine if it is really a K945 CAITS (M72) or a SCAITS (M72A1) (1 p. 15).

Key Dates

CAIS, Training Set, Chemical Agent Identification, K945, M72, CAITS - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1964	AMCTC 3492	4 (p. 11)
Standardized	1967	AMCTC 5507 (Standard-A)	4 (p. 17)
Obsoleted	about 1971	MSR 03736121	6 (p. 53)

Sources

1. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.
2. Chemical-Biological-Nuclear Subcommittee. 1967. AMCTC Item # 5647, Minutes of ET/ST Review (IPR #5) on Training Set, Chemical Agent Identification: M72 (SM72) (E18) (CAITS) (Task 1B643606D02209) (AMCMS 5666.12.022.009). U.S. Army Materiel Command.
3. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
4. Chemical-Biological-Nuclear Subcommittee. 1967. AMCTC Item # 5507, Reclassification of Training Set, Chemical Identification: M72 (XM72) (E18) (CAITS) from Development Type to Standard-A Type; Completion of RDT&E Task. U.S. Army Materiel Command.
5. U.S. Army. 1970. Technical Manual, TM 3-1365-2000-10, Operators Manual, Training Set, Chemical Agent Identification: M72. U.S. Army Materiel Command.
6. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
7. Army Materiel Command. 1967. Technical Information Report 33.3.7.5, Chemical Agent Identification Training Set, M72 (E18), Interim Report. August.
8. Chemical Materials Agency. 2004. William Brankowitz, Deputy Product Manager for Non-Stockpile Chemical Materiel, Memorandum to Commander, U.S. Army Engineering and Support Center, Huntsville, Subject: Accounting for K945 Chemical Agent Identification Sets (CAIS). January 5.

9.7 CAIS, Simulants Chemical Agent Identification Training Set (SCAITS), M72A1, M72A2

Figures

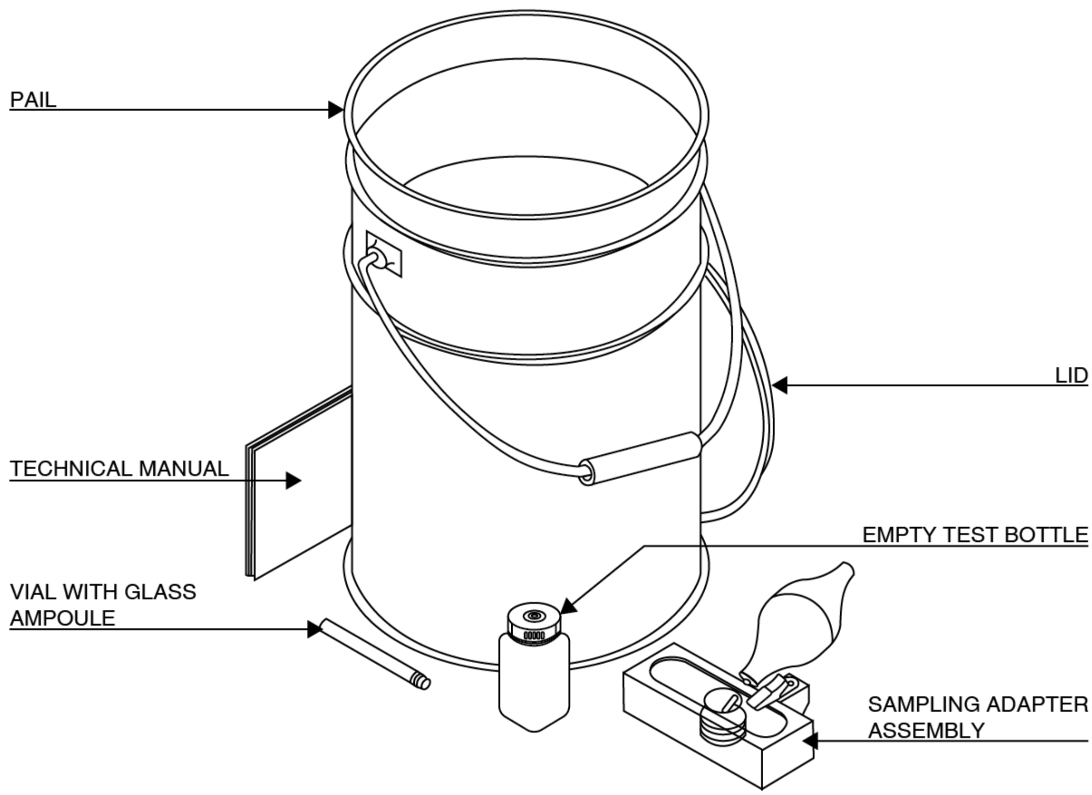

Figure 107: CAIS, M72A1, M72A2, SCAITS - Line Drawing

Figure 108: SCAITS, M72A2 - Photograph

CAIS, Chemical Agent Identification, Simulants, M72A1, M72A2, SCAITS

Specifications

CAIS, Chemical Agent Identification, Simulants, M72A1, M72A2, SCAITS - Specifications and Other Data		Citation
Historical Name	Training Set, Chemical Agent Identification, Simulant, M72A1	1 (p. 14-11)
Type	CAIS	-
Service	Army, Navy	1 (p. 14-11), 2 (p. 1-1)
Diameter	Available references did not provide this information.	-
Length	Available references did not provide this information.	-
Width	Available references did not provide this information.	-
Height	Available references did not provide this information.	-
Construction Material	Steel pail, plastic vials, glass ampoules	2 (p. 2-2)
NSN	6910-00-106-4800 (M72A1) 6910-01-04302090 (M72A2)	1 (p. 14-11), 2, 3 (p. i)

General Use and Description

The M72A1 SCAITS was a training device intended for use by qualified instructors to demonstrate color changes associated with chemical detectors, such as detector tubes, tickets, and paper. Although the SCAITS contained only agent simulants, the color changes produced were the same as those obtained with toxic chemical agents under field conditions (1 p. 14-11).

The SCAITS consisted of a steel pail with handle and removable lid, eight empty test bottles, three bottles of liquid simulants, 450 vials of agent simulants (nine boxes each holding 50 vials), one sampling adapter assembly, and one copy of Technical Manual, TM 3-6910-227-10. The test bottles and vials containing ampoules of vapor simulants had corresponding colored markings to assure proper matching during use. The sample adapter assembly was provided with a rubber squeeze bulb and was threaded to receive a test bottle when performing tests (1 p. 14-11), (3).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, Chemical Agent Identification, Simulants, M72A1, M72A2, SCAITS - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
Simulant-AC	0.003	0.001	0.264	0.12	Ampoule: AC and CK-1 Simulant. 1.0 mL per ampoule, 100 mL per set. Sodium hypochlorite	3 (p. E-5)
Simulant-CG	0.001	0.0004	0.040	0.018	Ampoule: Phenyl chloroformate. 0.3 mL per ampoule, 15 mL per set.	3 (p. E-6)
Simulant-CK-2	0.004	0.002	0.187	0.085	Ampoule: Sodium thiocyanate. 1.0 mL per ampoule, 30 mL per set.	3 (p. E-6)

CAIS, Chemical Agent Identification, Simulants, M72A1, M72A2, SCAITS - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
Simulant-G	0.001	0.0004	0.86	0.039	Ampoule: G- and Cx Simulant. 0.3 mL per ampoule. Benzoyl chloride and benzene sulfonyl chloride in one-to-one mixture.	3 (p. E-4)
Simulant-G	0.041	0.019	0.41	0.019	Bottle: hexylene glycol (13.5 mL) and methoxy ethanol (6.5 mL). Total 20 mL per bottle.	3 (p. E-1)
Simulant-H	0.001	0.0004	0.44	0.020	Ampoule: Dimethyl sulfate. 0.3 mL per ampoule, 15 mL per set.	3 (p. E-3)
Simulant-H	0.046	0.021	0.46	0.021	Bottle: Isoamyl salicylate. 20 mL per bottle.	3 (p. E-1)
Simulant-L	0.001	0.0003	0.36	0.017	Ampoule: Phenyl hydrazine. 0.3 mL per ampoule, 15 mL in set.	3 (p. E-4)
Simulant-V	0.002	0.001	0.116	0.053	Ampoule: Glacial acetic acid. 1 mL per ampoule, 50 mL in set.	3 (p. E-5)
Simulant-V	N/A	N/A	N/A	N/A	Bottle: Tetrahydrofurfuryl alcohol (70 g), N-methyglucamine (16 g), and diethylene glucol (300 g). Total 20 mL per bottle.	3 (p. E-2)

Shipping/Packing

The training set was packaged one per steel pail. The filled pail weighed approximately 14 pounds and occupied about 1.3 cubic feet (1 p. 14-11), (3 p. 1-6).

Miscellaneous Information

The M72A1 were physically similar to the K945 Chemical Agent Identification Training Sets (CAITS) (M72). The discovery of a set resembling this description should provoke a careful comparison of labels to determine if it is really SCAITS M72A1 or K945 CAITS M72 (4 p. 15).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
2. Department of the Army. 1979. Technical Manual, TM 3-6910-227-10, Operators Manual Training Set, Chemical Agent Identification: Simulants, M72A2. U.S. Government Printing Office.
3. Department of the Army. 1985. Technical Manual, TM 3-6910-226-10, Operators Manual, M72A1 Simulants Chemical Agent Identification Training Set (NSN 6910-00-106-4800). Headquarters, Department of the Army.
4. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.

9.8 CAIS, War Gas Identification Set, Instructional, Detonation K951/K952, M1

Figures

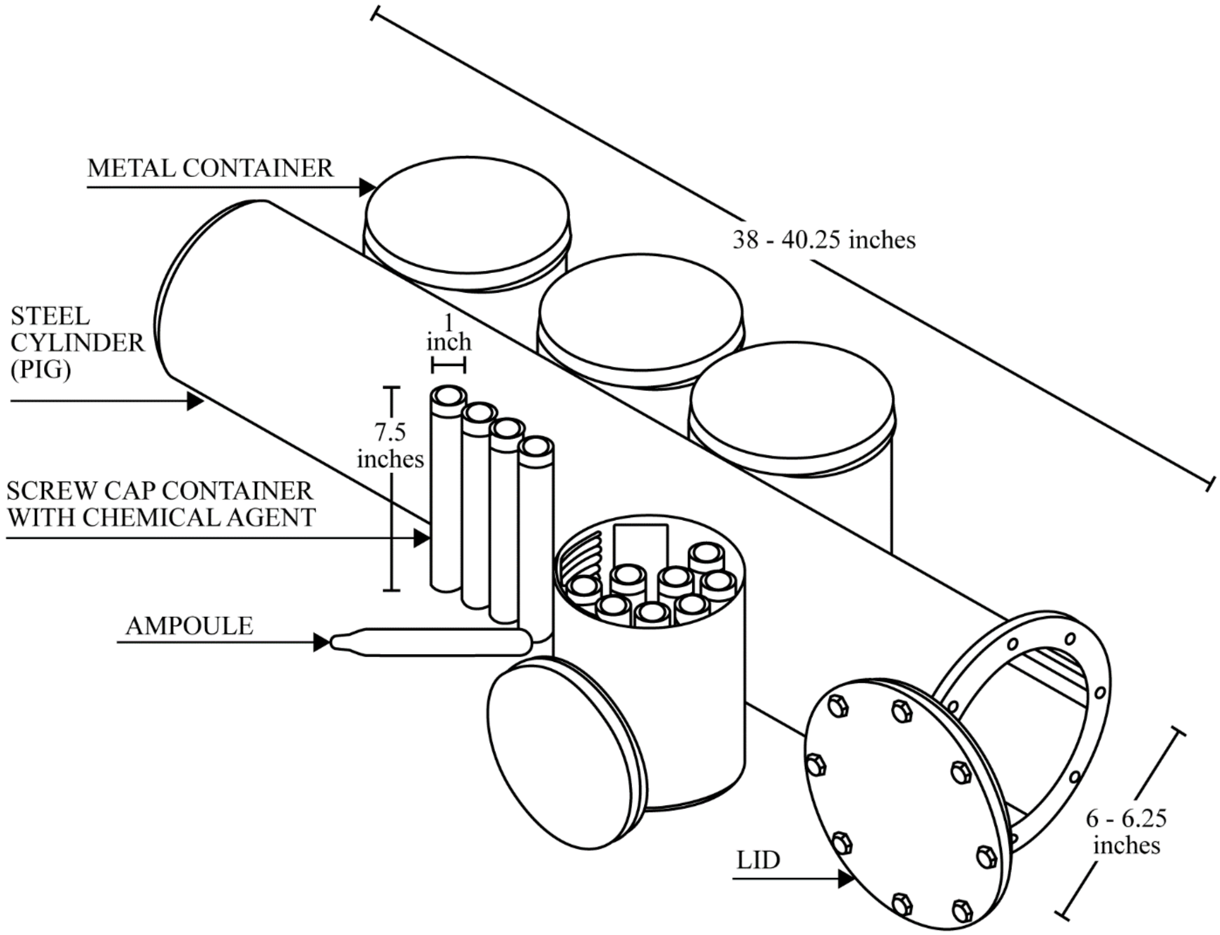

Figure 109: CAIS, War Gas Identification Set, Detonation, M1 - Line Drawing

Figure 110: CAIS, War Gas Identification Set, Instructional, Detonation, K951/K952, M1 - Photograph - K951/K952 Steel Cylinder (PIG) and Contents

Specifications

CAIS, War Gas Identification Set, Instructional, Detonation, K951/K952, M1 - Specifications and Other Data		Citation
Historical Name	Set, Gas Identification, Detonation, and War Gas Identification Set, Instructional, Detonation, M1	1 (p. 19), 5 (p. 142), 6 (p. 2)
Type	CAIS	1 (p. 19)
Conflict	WWI, WWII, and Cold War	1 (p. 19), 5 (p. 143)
Service	Air Force, Army, Navy	2 (p. 255), 5 (p. 143)
Diameter	Ampoule: 1-in. (2.564 cm) Steel cylinder: 6.62 (16.82 cm)	1 (p. 19), 3 (p. 15-19, 15-21)
Length	Ampoule: 7.5 in. (19.05 cm) Steel cylinder: 38.0-40.25 in. (96.52-102.23 cm)	1 (p. 19), 3 (p. 15-19)
Other	Flange Diameter: 9.25 in. (23.49 cm)	3 (p. 15-21)
Specification	MIL-S-11149 (M1)	3 (p. 15-21)
Drawing	D18-21-22	3 (p. 15-21)
FSN	1365-025-3272 (K951) with blasting caps 1365-025-3723 (K951) without blasting caps 1365-025-3783 (K952) without blasting caps	1 (p. 19), 5 (p. 143)
NSN	1365-00-025-3283 (M1)	3 (p. 15-21)

General Use and Description

The M1 Instructional Gas Identification Set was a training device for use outdoors by qualified instructors to identify chemical agents by their odors (1 p. 19), (3 p. 15-19).

The K951/K952 CAIS M1 contained 48 Pyrex, flame sealed ampoules (approximately 7.5 inches long and 1-inch in diameter), 12 each containing a 40 milliliter (1.4-ounce) solution of H (5% in chloroform), L (5% in chloroform), PS (50% in chloroform), or CG for a total of 26 ounces of agent, less the chloroform, per set.

Each ampoule was packed in a cardboard screw cap container (mailing tube-type) with agent type indicated by letters on the cardboard container. Twelve cardboard containers each, and one tape holder, with adhesive tape were packaged into metal inner packages. Fiber containers inner packages of early sets were later replaced by the metal inner packages. The open end of the shipping cylinder was closed by a flanged end cover that was secured by eight bolts.

In 1941, the Army increased use of the M1 set and began providing sets to many units where an exploder, wire, and blasting caps were not at hand to detonate the glass tubes of agent in the set. Hence, a requirement was established for a group of accessories to consist of: (1) a 10-Cap Blasting Machine, (2) a reel of regular firing wire, (3) two 500-foot lengths of firing wire, and (4) a pair of pliers. This equipment was adopted as the Standard MI Accessories Set.

The only difference between K951 and K952 was that K951 was issued with blasting caps that were packed and shipped in a separate container (1 p. 19), (3 p. 15-19), (5 p. 139), (9 p. 1, 2).

Explosive Train

There was no explosive train in the agent-containing container. There was an associated container holding No. 8 blasting caps (5 p. 139).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, War Gas Identification Set, Instructional, Detonation, K951/K952, M1 - Fill Types and Weights						
Chemical	**Fill Weight***		**Gross Weight***		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	0.13	0.05	1.50	0.68	The set held 12 40 mL ampoules of CG.	1 (p. 19), 3 (p. 15-19), 4 (p. 6)
H	0.01	0.00	0.07	0.03	-	1 (p. 19), 3 (p. 15-19), 4 (p. 5)
L	0.01	0.00	0.10	0.04	-	1 (p. 19), 3 (p. 15-19), 4 (p. 6)
PS	0.07	0.03	0.89	0.04	-	1 (p. 19), 3 (p. 15-19), 4 (p. 6)
* Weight is per ampoule.						

Shipping/Packing

The steel shipping container (110 pounds; 2.1 cubic feet) known as a PIG included strips of adhesive tape and instructions for use. The open end of the steel shipping container was flanged with the cover held in place by eight 5/8-inch machine bolts. Four metal, inner containers were packed into the shipping container. Inside each inner container were 12 cardboard screw cap containers, each containing a hermetically sealed glass ampoule. Double-faced corrugated cardboard fillers were placed on top of the containers, and a double face corrugated strawboard filler was placed on the bottom so that well-cushioned packing was supplied when the blind flange with its gasket was bolted down tight on the shipping container flange. This packing was airtight and would withstand 250 psi internal pressure when bolted tight. The nuts were hexagonal and can be removed with a standard 1 1/4-inch wrench. The 70 blasting caps and lead wires were shipped separately. The Detonating Equipment, War Gas Identification: M1, was packaged in a box of about 3.0 cubic feet, weighing 77 pounds (2 p. 248, 255), (3 p. 15-21), (5 p. 140, 144), 9 (p. 1, 2).

Miscellaneous Information

In 1933, authority for the Limited Procurement of 120 M1 sets was approved with their issue to the Army posts for extended service testing under supervision of Post Chemical Warfare officers. Ultimately, 81,120 M1 sets were procured. The Army procured 216 in 1935 to 1936, 52,047 in 1940 to 1944, and 21,357 in 1951 to 1953. The Navy procured 7,500 sets in 1951. When the sets were obsoleted in 1971, the Army had 3,258 on hand in depots and the Marine Corps also had a total of 785 M1 and M1A1 sets. At the time of obsolescence, the Army had 47 sets of the M1 detonating equipment (5, p. 143), (8 p. 3).

The glass ampoules associated with early sets were approximately one-inch in diameter, six inches long and contained about one ounce of liquid. The agent brevity codes were marked in red on each of the glass tubes of these early sets (9 p. 1).

The K951/K952 ampoules (also called vials) are frequently found in burial sites at old WWII training areas. They are sometimes found loose, sometimes found in their original steel cylinders (also called "PIGS"), and are sometimes found in drums, cans, or other disposal containers. When found loose the agent type cannot be readily identified without sophisticated spectrographic equipment, and a worst-case assumption of CG should be made by field personnel (1 p. 19), (5 p. 143).

CAIS, War Gas Identification Set, Instructional, K951/K952, M1

Key Dates

CAIS, War Gas Identification Set, Instructional, Detonation, K951/K952, M1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Procured	1933	CCTC 1933-44 (Limited Procurement)	8 (p. 3)
Standardized	1934	CCTC 1934-57, 1935-14	6
Standardized	1941	CCTC 334 (Standardization of an Accessories Set for Use With Set, Gas Identification, Detonation, MI)	5 (p. 137)
Standardized	1955	CCTC 3125 (Ltd Standard)	5 (p. 138)
Standardized	1958	CCTC 3408 (Detonation Standard-B, M1 Instructional Navy Limited Standard)	7 (p. 110, 117)
Obsoleted	1971	AMCTC 8516, CBN 4868	5 (p. 144)

Sources

1. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.
2. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.
3. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
4. Department of the Navy. 1945. Ordnance Pamphlet, OP 1447, Gas Identification Sets. Department of the Navy.
5. Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8516 (CBN Item #4868), Reclassification of War Gas Identification Sets, Instructional; Detonation, M1 & AN-M1A1; and Detonating Equipment, War Gas Identification: M1 from Standard-A/B Types to Obsolete Types. U.S. Army Materiel Command.
6. Chemical Corps Technical Committee. 1935. CCTC Item # 1935-14, Set, Gas Identification, Detonation, M1 - Standardization of, 24 Dec 34, approved 28 Mar 35. U.S. Army Materiel Command.
7. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
8. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-44, Limited Procurement of Set, Gas Identification, Detonation. Chemical Warfare Service. October 3.
9. Chemical Warfare School 1935. Pamphlet No 37, Instructions for Using Gas Identification Sets. Edgewood Arsenal. June.

9.9 CAIS, War Gas Identification Set, Instructional, Detonation, K953/K954, AN-M1A1

Figures

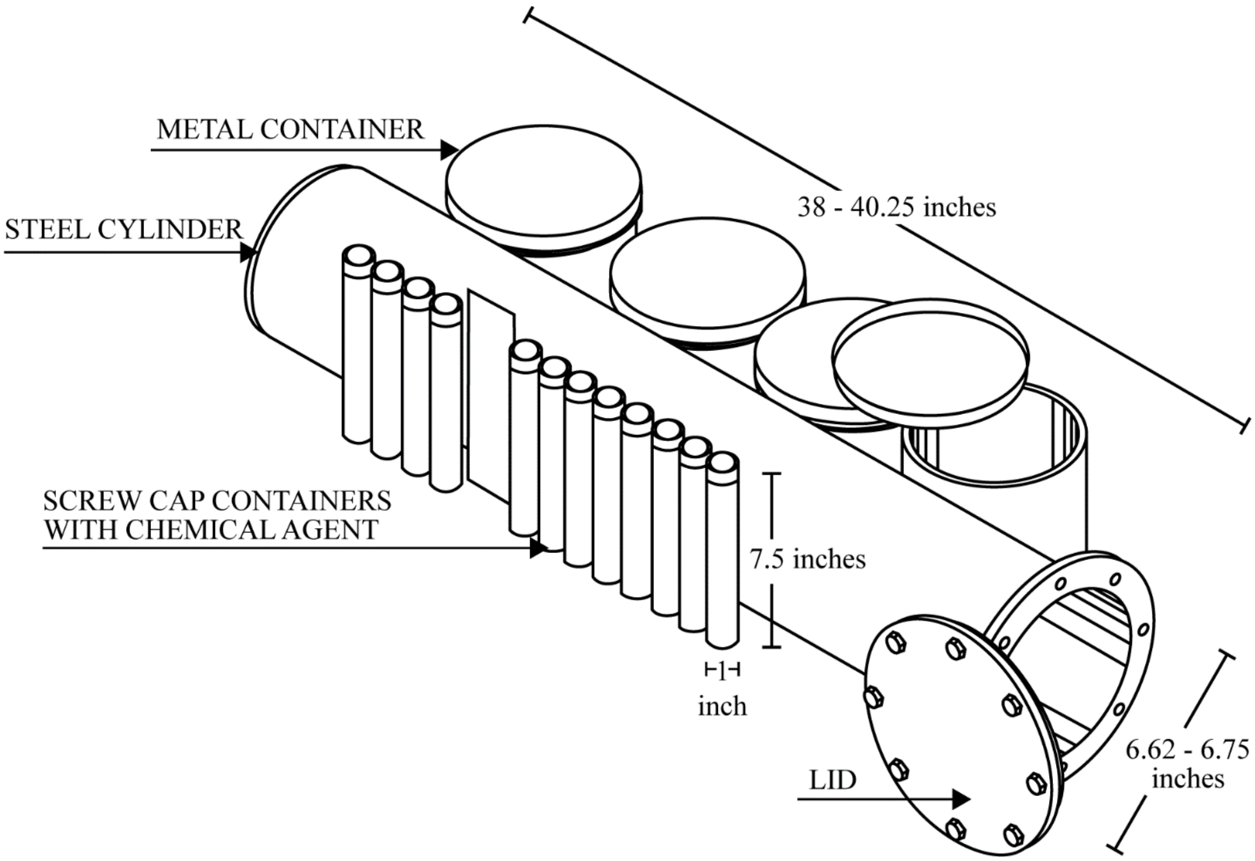

Figure 111: CAIS, War Gas Identification Set, Instructional, Detonation, K953/K954, AN-M1A1 - Line Drawing

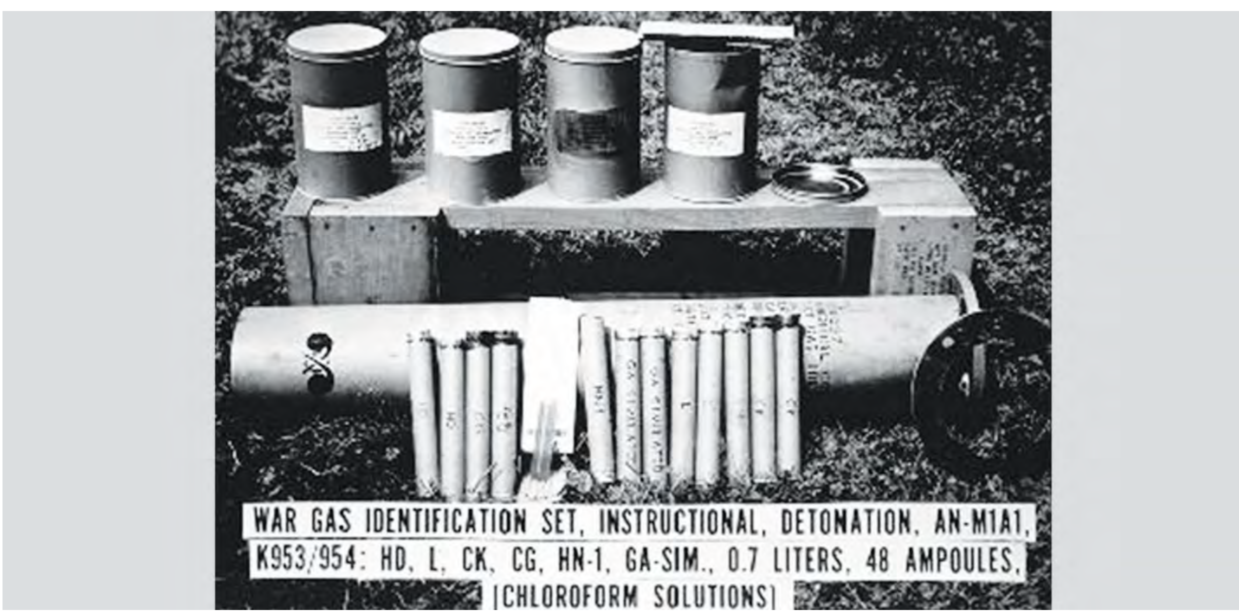

Figure 112: CAIS, War Gas Identification Set, Instructional, Detonation, K953/K954, AN-M1A1 - Photograph

CAIS, War Gas Identification Set, Instructional, Detonation, K953/K954, AN-M1A1

Specifications

CAIS, War Gas Identification Set, Instructional and Detonation, K953/K954, AN-M1A1 - Specifications and Other Data		**Citation**
Historical Name	War Gas Identification Set, Detonation, AN-M1A1, and War Gas Identification Set, Instructional, Detonation, AN-M1A1	1 (p. 25), 3 (p. 15-23)
Developmental Information	E7	1 (p. 25), 4 (p. 2-3, 6-7)
Type	CAIS	1 (p. 25)
Conflict	Cold War	4, 6 (p. 2)
Service	Air Force, Army, Navy	2 (p. 256)
Diameter	Ampoule: 1-in. (2.54 cm) Steel cylinder: 6.62-6.75 in. (16.83-17.15 cm)	3 (p. 15-32, 15-25)
Length	Ampoule: 7.5 in. (19.05 cm) Steel cylinder: 38-40.25 in. (96.52-102.24 cm)	3 (p. 15-23, 15-25)
Other	Flange Diameter: 9.25 in. (23.49 cm)	3 (p. 15-25)
Other Engineering Data	The only difference between the K953 and the K954 CAIS was that the K953 was issued with blasting caps.	1 (p. 25), 4 (p. 2-3, 6-7)
Specification	MIL-S-11149 MIL-S-12398 (detonation accessories) MIL-S-12281 (AN-M1A1 detonation), MIL-W-12281	2 (p. 256), 3 (p. 15-25), 4 (p. 1-2, 2-3)
Drawing	C18-21-54	2 (p. 256)
FSN	1365-323-7782 (K953) with blasting caps 1365-338-0735 (K954) without blasting caps	2 (p. 256), 4 (p. 6-7)

General Use and Description

These sets were used by military to train Soldiers to identify chemical agents in the field. The AN-M1A1 provided sample tubes of common chemical agents for outdoor training of group personnel by developing a small agent cloud by detonation using the M1 accessory set (2 p. 256), (3 p. 15-23), (4 p. 5-6).

The K953/K954 were identical in configuration to the K951/K952 except for the number and fill of the ampoules (the K953/K954 does not contain H or PS). The M1A1 contained eight ampoules each of CG, L (5% in chloroform), HD (5% in chloroform), CK, HN-1 (10% in chloroform) and GA-simulant for a total of 23.8 fluid ounces of agent, less the chloroform, per set.

These sets were packed in containers identical to the K951 and K952. The only difference between the K953 and K954 CAIS is that the K953 was issued with blasting caps. These were not packaged in the steel cylinder and were in a separate box.

Whenever encountered, individual bottles or complete sets K953/K954 are handled as CWM until addressed and identified (2 p. 256), (3 p. 15-24).

Explosive Train

There was no explosive train in the agent-containing container. Seventy No. 6 Blasting Caps with lead wire were shipped separately for use with this set and the original model. No. 8 Blasting Caps associated with the K951 set were available as alternate types (4 p. 4-5).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

CAIS, War Gas Identification Set, Instructional and Detonation, K953/K954, AN-M1A1 - Fill Types and Weights						
Chemical	**Fill Weight***		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	0.13	0.05	1.04	0.47	8 ampoules per set, 40 mL of CG per ampoule.	1 (p. 25), 2 (p. 256), 3 (p. 15-23)
CK	0.11	0.05	0.84	0.38	8 ampoules per set, 40 mL of CK per ampoule.	1 (p. 25), 2 (p. 256), 3 (p. 15-23)
HD	0.01	0.00	0.04	0.02	8 ampoules per set, with 2 mL of HD per ampoule.	2 (p. 256), 3 (p. 15-23)
HN-1	0.01	0.00	0.08	0.03	8 ampoules per set, 4 mL of HN-1 per ampoule.	1 (p. 25), 2 (p. 256), 3 (p. 15-23)
L	0.01	0.00	0.07	0.03	8 ampoules per set, 2 mL of L per ampoule.	1 (p. 25), 2 (p. 256), 3 (p. 15-32)
Simulant-GA	0.09	0.04	0.70	0.31	8 ampoules per set, 40 mL of GA-simulant per ampoule.	1 (p. 25), 2 (p. 256), 3 (p. 15-23)

Notes:
* Fill weight is per ampoule.

Shipping/Packing

The AN-M1A1 set was packaged in one steel cylinder, weighing 110 pounds, and a cubage of 2.1 cubic feet. There were 48 tubes in each set (2 p. 256), (3 p. 15-25), (4 p. 8-9).

Miscellaneous Information

In 1948, the Chemical Corps recommended that the agents in the Set, Gas Identification, Detonation, MI be modernized by replacing the H in the set with HD, the deletion of PS, and the addition of HN-1 and a simulated G-agent. Due to large existing stocks of the MI Set, this upgrading was assigned a low priority, but eventually the M1 was replaced with the AN-M1Al.

It was reported that a total of 1,518 AN-M1A1 sets had been procured between 1958 and 1959 (958 by the Air Force, and 560 by the Marine Corps). As of 1971, there was a total of 785 M1 and AN M1A1 sets remaining in Marine Corps inventory (4 p. 4-5, 7-8).

Note that there was also a Set, Gas Identification, Instructional, M1A1 (a sniff set) proposed in 1943. This set was never standardized.

Key Dates

CAIS, War Gas Identification Set, Instructional, Detonation, K953/K954, AN-M1A1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1952	CCTC 2579 (Procurement of 25 sets)	7
Standardized	1954	CCTC 2930 (Standard - Air Force)	6
Standardized	1955	CCTC 3125	4
Standard Modernization	1958	CCTC 3408 (Standard-A)	5
Other	1971	AMCTC 8441 (Revised nomenclature)	8
Obsoleted	1971	AMCTC 8516	4

Sources

1. U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. Department of Defense.
2. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.
3. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
4. Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8516 (CBN Item #4868), Reclassification of War Gas Identification Sets, Instructional; Detonation, M1 & AN-M1A1; and Detonating Equipment, War Gas Identification: M1 from Standard-A/B Types to Obsolete Types. U.S. Army Materiel Command.
5. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
6. Chemical Corps Technical Committee. 1954. CCTC Item # 2930, Items Type-Classified by the Air Force (Read for Record). Department of the Army.
7. Chemical Corps Technical Committee. 1952. CCTC Item # 2579, Development Procurement of Set, Gas Identification, Detonation, E7. Department of the Army.
8. Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8441 (CBN Item #4862), Revised Nomenclatures for War Gas Identification Set, Instructional: Detonation, MI & AN-M1Al, and Toxic Gas Set: HD, M1 & M2. U.S. Army Materiel Command. 30 March.

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10 Grenade

Grenades are a class of ammunition used in close quarters. Within certain limitations, grenades augment primary infantry weapons with a missile similar in action to a small shell or bomb. Chemical grenades that produce clouds of irritant gases are also effective in dispersing mobs, quelling riots, etc. (War Department 1944, 234, 253-254).

Grenades are classified according to their method of projection: hand or rifle. They are also identified according to use as service, practice, or training; and filler as explosive, chemical, illuminating inert or with a spotting charge. Certain grenades are designed to be thrown by hand and others are designed to be projected from a rifle by means of grenade launcher and a special grenade-launching weapon (e.g., M203 grenade launcher) (Department of the Army, 1966, pp. 1-1). The various types of hand grenades are used to supplement small arms for effect against an enemy in close combat. They may be used for producing a harassing effect, for smoke screening and signaling, and for incendiary purposes. The various types of rifle grenades are for use against armored targets and for screening and signaling smokes (Department of the Army, 1966, pp. 1-9).

Time grenades have a delay of five to seven seconds until detonation after the grenade is projected. They are the most common type of grenade. The delay prevents premature functioning and gives the thrower time to provide for their safety after the grenade is thrown. Percussion grenades have no delay. The impact of the grenade when it strikes its objective is sufficient to set the firing mechanism in motion and to cause immediate functioning. The objection to the percussion grenade is that it sometimes strikes a hard object at the instant of firing and functions prematurely. Both hand and rifle grenades can be either time or percussion.

Hand grenades are designed to be thrown by the human arm, unassisted by any device not a part of the grenade itself. The fill for hand grenades can be HE, gas, smoke, and incendiary. They are limited in size by the hand-grasp and in weight by the throwing power of the average Soldier.

Rifle grenades are designed to be thrown by the regular service rifle of the period. Rifle grenades can be filled with HE, gas, smoke, or incendiary. Their size and shape are designed to conform to the convenience of the Soldiers and the method of their use. One variety is furnished with a stem which is placed in the barrel of the rifle; the other is fired by means of a special tromblon attachment adapted to the end of the barrel. The stem type is no longer used.

The gas grenade could take the place of the HE grenade, accomplishing by its suffocating, blinding, poisoning, and demoralizing action what the other grenade could accomplish by force. The smoke grenade was essential to intricate tactical maneuvering, either offensive or defensive. It gave the Army using it the advantage of obscuration from the enemy (Department of the Army 1966, 1-9, War Department 1944).

10.1 Grenade, Frangible, M1

Figures

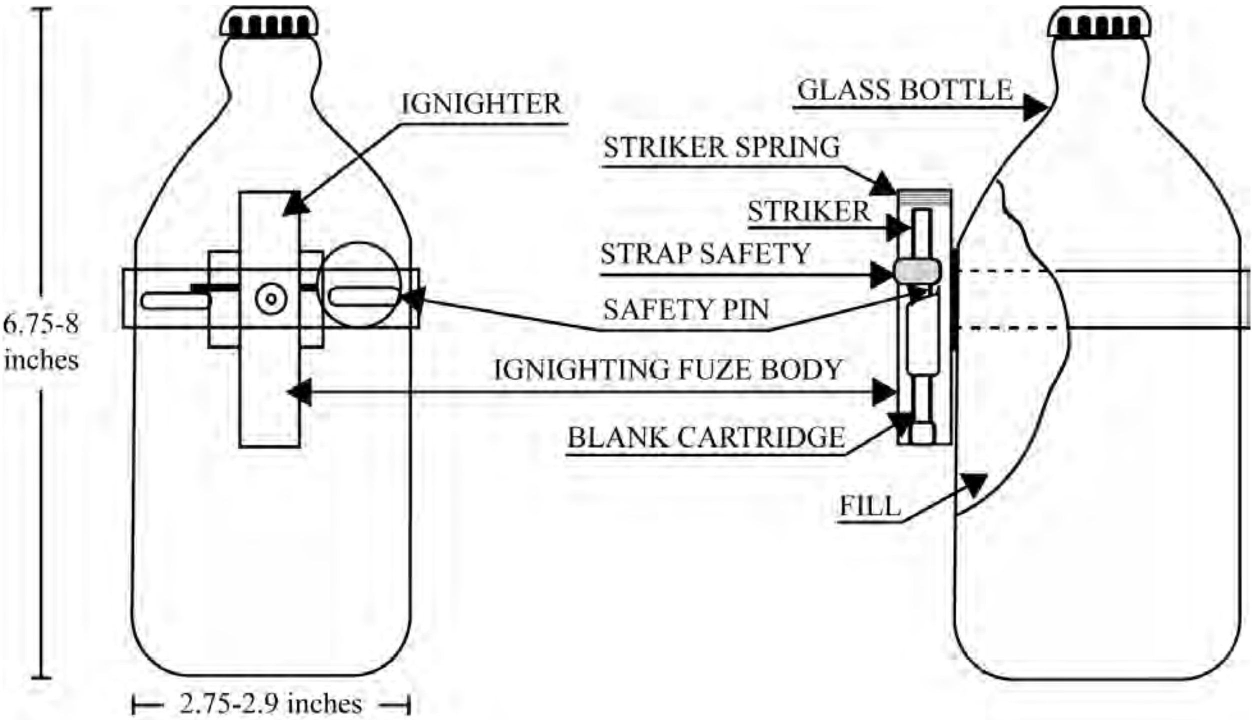

Figure 113: Grenade, Frangible, M1 – Line Drawing

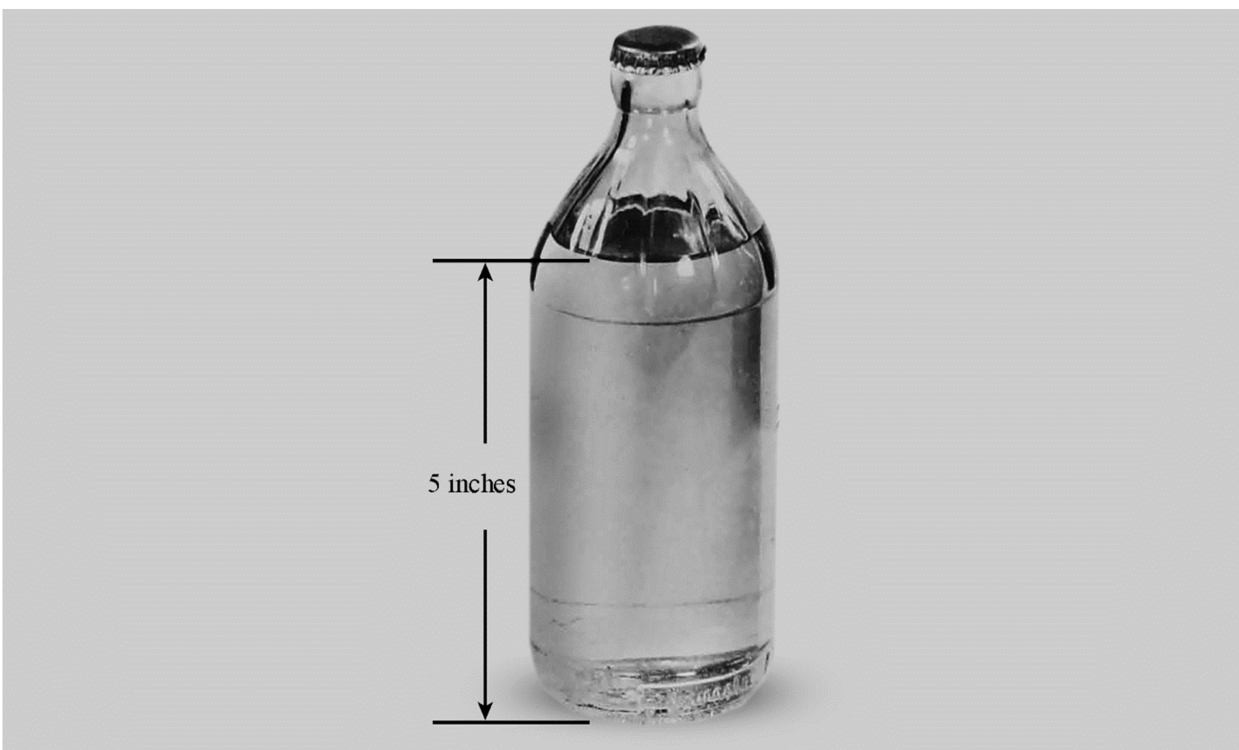

Figure 114: Grenade, Frangible, M1 – Photograph

Grenade, Frangible, M1

Specifications

Grenade, Frangible, M1 – Specifications and Other Data		Citation
Historical Name	Grenade, Frangible, M1	1 (p. I-3), 2, 3 (p. O-44)
Type	Grenade	1 (p. I-3), 3 (p. O-44), 4 (p. 1)
Size	1-pint	1 (p. V-46), 4 (p. 3, 4)
Conflict	WWII	6, 7 (p. 29)
Service	Army	6, 8 (p. 2)
Diameter	2.75-2.9 in. (6.99-7.37 cm)	4 (p. 4), 5 (p. 1)
Height	6.75-8.0 in. (18.7-20.3 cm)	4 (p. 4), 5 (p. 1)
Construction Material	Glass	1 (p. V-46), 4 (p. 10), 6 (p. 1)
Drawing	B13-9-31	3 (p. O-44)
Stock No.	352143: AC 252343: AW 332243: CNS 212243: FS 252353: IM 322243: L 252361: NP	1 (p. I-3)

General Use and Description

The M1 frangible grenade was developed as an anti-tank munition. It was a round glass bottle with a chemical filling that was thrown by hand or grenade projector (2). It consisted of a 17.38-ounce overflow, round glass bottle with a filler and a 26-millimeter crimped crown bottle cap (6 p. 1), (7 p. 29). The filling vaporized or ignited when the bottle was broken. FS is highly corrosive and is similar to other strong mineral acids in its action on clothing, flesh, and equipment (1 p. V-68). Tests by the Tank Destroyer Board to determine the relative obscuring power of smoke grenades indicated that the bursting-type WP grenade was superior to the FS frangible grenade (7 p. 32).

The grenades, frangible, gasoline solidified, IM, and NP were incendiary grenades. They consisted of the M1 frangible grenade with the fuze igniter, M3, fastened around the bottle just below the shoulder. The NP and IM were jellied gasoline fillings, while the gasoline and AW were non-jellied gasoline mixtures (1 p. V-68), (9 p. 11).

Explosive Train

The grenade functioned by being thrown against a hard surface (e.g., concrete, iron) with enough force to shatter the glass (8 p. 2). When the grenade was filled with an incendiary filler, it was equipped with an igniter. The M3 fuze consisted of a barrel containing a spring, firing pin, and .38 caliber blank cartridge held to the grenade by a special Tinnerman clamp, which also acted as a trigger when the bottle was broken (9 p. 11). The fill vaporized when the bottle was broken and created smoke (1 p. 68).

Fuzing

Grenade, Frangible, M1 – Fuzing		
Fuze	**Notes**	**Citation**
M1	Fuze igniter	1 (p. V-71), 4 (p. 49), 11 (p. 49), 14 (p. 10)
M2	Fuze igniter	2, 11 (p. 46), 14 (p. 10)
M3	Fuze igniter (only used with incendiary fillings)	1 (p. V-68, V-71), 3 (p. O-44), 9 (p. 11), 10 (p. 1)

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Grenade, Frangible, M1 – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC (HCN)	0.83	0.38	0.88	0.39	–	1 (p. I-3), 2, 5 (p. 1), 8 (p. 1), 10 (p. 1), 11 (p. 49), 12 (p. 7), 13 (p. 1)
AW	N/A	N/A	2.5	1.13	55% benzene, 25% Carbon Disulphide, 20% WP, rubber strip.	1 (p. I-3, V-68). 4 (p. 2, 3), 5 (p. 1), 11 (p. 49), 14 (p. 3, 7, 10)
CK	N/A	N/A	N/A	N/A	Experimental	15
CNS	1.56	0.71	2.19	0.99	–	1 (p. I-3), 2, 5 (p. 1), 8 (p. 1), 11 (p. 49), 14 (p. 7, 10)
FS	1.64-1.98	0.74-0.90	2.50-2.63	1.13-1.19	–	1 (p. I-3), 2 (p. 46), 4 (p. 4), 5 (p. 1), 8 (p. 1), 9 (p. 12), 10 (p. 7), 11 (p. 49), 12 (p. 7, 10)
Gasoline, liquified or solidified	N/A	N/A	1.5	0.68	Used brevity code GA which is the same as that for tabun	14 (p. 3, 7, 10)
IM	0.85	0.39	1.47-1.53	0.66-0.69	–	1 (p. I-3), 2, 3 (p. O-44), 10 (p. 4), 11 (p. 49), 12 (p. 7)
L (M-1)	1.97	0.89	2.63	1.19	–	1 (p. I-3), 2, 5 (p. 1), 8 (p. 1), 11 (p. 49), 14 (p. 7, 10)
NP	0.69	0.31	0.94-1.45	0.42-0.66	–	1 (p. I-3), 3 (p. O-44), 11 (p. 49), 12 (p. 7)
WP	1.5	0.68	N/A	N/A	–	2, 6 (p. 1)

Shipping/Packing

The frangible grenades were packed in a single-faced, corrugated pasteboard sleeve around each grenade, fitting into individual, double-faced, corrugated pasteboard cartons with double-faced, two-ply, corrugated pasteboard liners. Twenty-four of these individually packed grenades were placed in a larger corrugated carton. These corrugated cartons (24 frangible grenades) were sealed in waterproof paper bags, and two cartons (48 grenades) were placed in a wooden box with an average unit shipping weight of 3.59 pounds (2 Section 9, p. 8) (7 p. 29).

Miscellaneous Information

At the time they were obsoleted (1944), there were 24,999 NP, 112,204 IM, and no AC-filled M1 grenades on hand (8 p. 2) (16 p. 65).

Grenade, Frangible, M1

Key Dates

Grenade, Frangible, M1 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1942	CCTC 400, 447, and 484 (AC-, FS-, L-, CNS-, AW-, and gasoline-fill)	1 (p. 1), 5 (p. 1), 7 (p. 33)
Standardized	1942	CCTC 495 and 548 (HCN-, AC-fill), Letter SPCUH 471.6/68 (IM-fill Standard, NP-fill Substitute Standard)	5 (p. 2), 13 (p. 1), 17 (p. 43)
Obsoleted	1942	CCTC 562 and 609 (AW-fill)	11 (p. 49)
Obsoleted	1943	CCTC 692 and 746 (AW-, CNS-, L-fill)	7 (p. 33),11 (p. 49)
Reclassified	1944	CCTC 902 and 959 (NP-fill Standard, IM-fill Limited Standard)	17 (p. 43), 18 (p. 108)
Obsoleted	1944	CCTC 1117 and 1201 (AC-, FS-fill), 1187 (IM-, NP-fill), CCTC 1240 (IM-, NP-fill, fuze igniter M3)	7 (p. 33), 11 (p. 49), 16 (p. 64, 65), 19 (p. 71)

Sources

1. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office. 15 September.
2. Chemical Warfare Service. 1943. Chemical Warfare Service Field Materiel Data. July. U.S. Government Printing Office.
3. Chemical Corps Technical Committee. 1944. Chemical Corps Book of Standards.
4. Taylor, Thomas, Col. 1941. Report of the Infantry Board, No. 1231, Incendiary and Fra[n]gible Type Chemical Smoke Grenades. Office of the Infantry Board.
5. Chemical Warfare Technical Committee. 1942. CCCTC Item # 495, Subcommittee Report – Standardization of HCN Filling for Grenade, Frangible, M1.
6. Shaw, F.B. Cpt., and F.D. Canning 2Lt, 1942. Test Report 10, Grenades, Frangible (AW), M1, in Simulated Tropical Storage., Chemical Warfare Center, 7 October.
7. Finklestein, Leo. 1964. History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 - 31 December 1945) Screening Smokes Part III. Chemical Research and Development Laboratories (CRDL).
8. Chemical Warfare Technical Committee. 1944. Memorandum to Chairman, Subject: Obsoletion of Grenade, Frangible (AC), M1.
9. Research & Development Department. 1942. Monthly Report, September 1942.
10. Chemical Warfare Board. 1943. Grenade, Frangible, M1, Project No. 365. 29 December.
11. Chemical Corps Technical Committee. 1959. Chemical Corps Book of Standards, Edition of 25 November 1959. Department of the Army.
12. War Department. 1944. Basic Field Manual, FM 23-30, Hand and Rifle Grenades, Rocket, AT, HE, 2.36-inch. February 14.
13. Chemical Warfare Technical Committee. 1942. CCTC Item # 548, Standardization of HCN Filling for Grenade, Frangible, M1. June 3. Chemical Warfare Service.
14. War Department. 1942. Basic Field Manual, FM 23-30, Grenades. June 15.
15. Kabrich, W.C. Brigadier General. 1945. Frangible Grenade Filled with CK. Army Service Forces.
16. Chemical Warfare Technical Committee. 1944. CCTC Item # 1187, Obsoletion of Grenade, Frangible (IM), M1; Grenade, Frangible (NP), M1 and Igniter, Frangible Grenade, M3. October 26.
17. Chemical Corps Technical Committee. 1944. CCTC Item # 902, Reclassification of Fillings for Grenade, Frangible, M1. Department of the Army.
18. Chemical Corps Technical Committee. 1944. CCTC Item # 959, Reclassification of Fillings for Grenade, Frangible, M1. Department of the Army.
19. Chemical Corps Technical Committee. 1944. CCTC Item # 1240, Obsoletion of Grenade, Frangible (IM), M1; Grenade, Frangible (NP), M1 and Igniter, Frangible Grenade, M3. Department of the Army.

10.2 Grenade, Hand, MK1

Figures

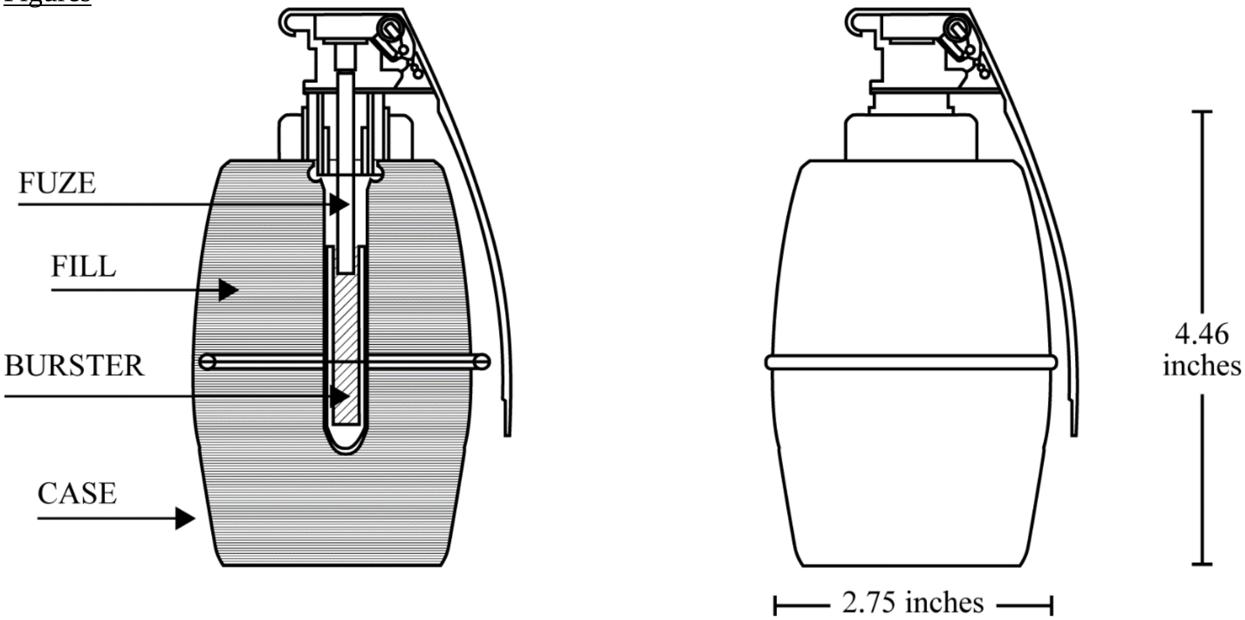

Figure 115: Grenade, Hand, MK1 - Line Drawing

Figure 116: Grenade, Hand, MK1 - Photograph - Top: Intact, Bottom: Cutaway Rifle Projected, without Fuze *(note the long rod attached to the base is part of the grenade as designed)*

Specifications

Grenade, Hand, MK1 - Specifications and Other Data		**Citation**
Historical Name	B.M. Smoke Hand Grenade, MK. I.	1
Type	Grenade	1, 2 (p. 1-3)
Diameter	2.75 in. (6.98 cm)	1
Height	4.46 in. (11.34 cm)	1
Other Engineering Data	Could be used with M1A1 and M1A2 grenade projection adapter	2 (p. 2-11)
Construction Material	Steel	1

Grenade, Hand, MK1

General Use and Description

The Mark I grenade was designed to provide close range, offensive, chemical capabilities (1), (2 p. 1-3).

The MK I grenade was semi-ovoid in shape with a smooth surface. It was similar in form to the phosphorus grenade, save for the two annular corrugations on the body, near the bottom, to serve as a distinguishing mark (1).

Explosive Train

Upon release of the lever, the striker would be impelled by its stiff spring, which would rotate around the hinge pin, force up the lever, and strike the primer, first perforating the tinfoil disk, which was sealed over the top of the cap to waterproof the primer. The end of the fuze was tipped with a priming powder composition, which ignited by the primer and in turn ignited the fuze. In five seconds, the flame from the fuze would spit into the fulminate composition of the detonator causing it to explode. The explosion of the detonator was sufficient to burst the body of the grenade and scatter the contents in all directions (1).

Fuzing

Grenade, Hand, MK1 - Fuzing		
Fuze	**Note**	**Citation**
Bouchon assembly MK III	2-inch fuze and No. 8 detonator	1

Booster, Adapter-Booster, or Burster

Grenade, Hand, MK1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
No. 8 Detonator	N/A	N/A	-	1

Fills

Grenade, Hand, MK1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BM	N/A	N/A	1.87	0.84	Developmental	1

Shipping/Packing

The grenades were packed 24 to a wooden box (1).

Miscellaneous Information

This grenade did not go into production (1).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Pankey, A.V. n.d. Monograph on Hand Grenades, Volume 51. War Department American University Experiment Station Chemical Warfare Service.

2. Headquarters Departments of the Army and the Navy. 1995. Technical Manual, TM 9-1330-200-12, Operators and Organizational Maintenance Manual for Grenades, Change 15. Headquarters Departments of the Army and the Navy.

10.3 Grenade, Hand, MK II

Figures

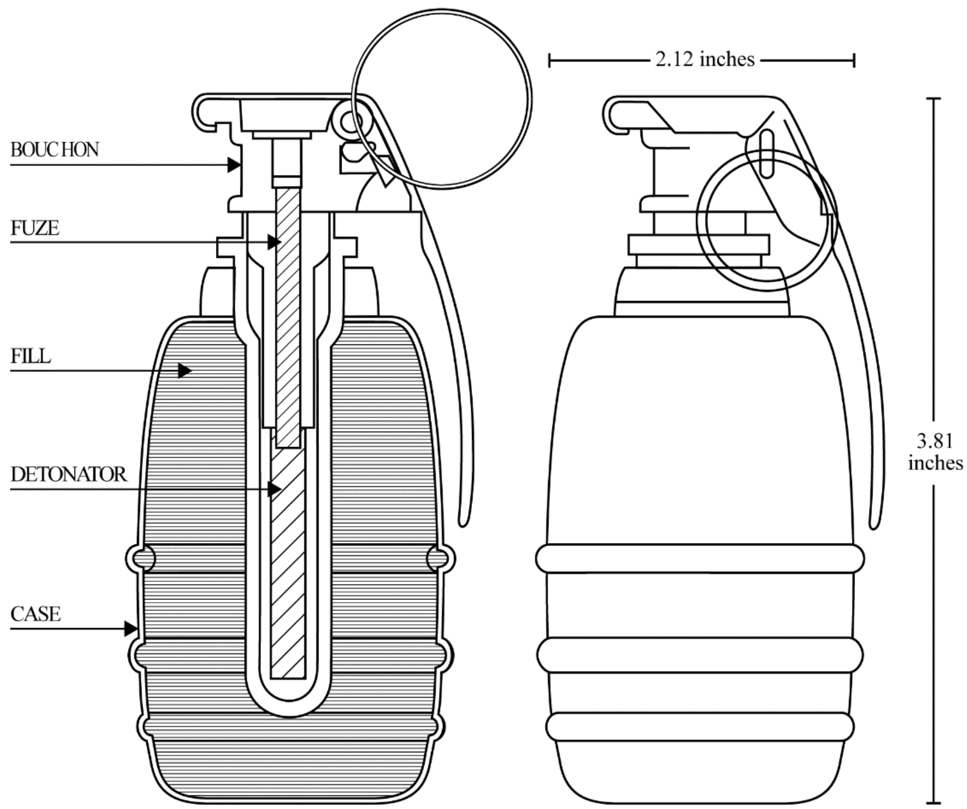

Figure 117: Grenade, Hand, MK II - Line Drawing

Figure 118: Grenade, Hand, MK II - Photograph: Left: Cutwway, without Fuze, Middle: Gas. Right: Phosphorus

Grenade, Hand, MK II

Specifications

Grenade, Hand, MK II - Specifications and Other Data		Citation
Historical Name	Gas Hand Grenade, Mark II	1 (p. 12)
Type	Grenade	2
Conflict	WWI	3 (p. 296)
Service	Army	4
Diameter	2.12 in. (5.39 cm)	2
Length	3.81 in. (9.68 cm)	2
Construction Material	Sheet steel welded body	2, 3 (p. 297)

General Use and Description

The gas cloud produced by the MK II grenade was intensely irritating to the eyes and respiratory passages and caused lacrimation and violent coughing (3 p. 297).

The Mark II grenade was the same as the French “Suffocante et Lachrymogene” hand grenade. This grenade consisted of a sheet steel body, steel bushing, detonator thimble, detonator, and automatic firing mechanism (bouchon). The gas grenade was similar in form to the phosphorus grenade, except for the two annular corrugations on the body, near the bottom, to serve as a distinguishing mark (1 p. 13), 3 p. 297), (4 p. 224).

Explosive Train

Upon release of the lever, the striker would be impelled by its stiff spring rotating around the hinge pin, forcing up the lever, and striking the primer, first perforating the tinfoil disk, which was sealed over the top of the cap to waterproof the primer. The end of the fuze was tipped with a priming powder composition, which ignited by the primer and in turn would ignite the fuze. In five seconds, the flame from the fuze would spit into the fulminate composition of the detonator causing it to explode. The explosion of the detonator was sufficient to burst the body of the grenade and scatter the contents in all directions (1 p. 13).

Fuzing

Grenade, Hand, MK II - Fuzing		
Fuze	**Note**	**Citation**
Mk II bouchon and fuze assembly	2-inch (5-cm) fuze	2

Booster, Adapter-Booster, or Burster

Grenade, Hand, MK II - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
No. 8 detonator	N/A	N/A	-	2

Fills

Grenade, Hand, MK II - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
KJ (Stannic chloride)	0.45-0.61	0.20-0.28	1.37	0.62	-	3 (p. 297), 4 (p. 224), 5 (p. 75)

Shipping/Packing

The grenades were packed 24 grenades per wooden box (2).

Miscellaneous

In 1918, Edgewood Arsenal filled 363,776 grenades with KJ (5 p. 76).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. American Expeditionary Forces. 1919. Gas Manual Part IV, Use of Gas by Infantry, A.E.F. No. 1475-4 G-5. General Headquarters American Expeditionary Forces.
2. Pankey, A.V. n.d. Monograph on Hand Grenades, Volume 51. War Department American University Experiment Station Chemical Warfare Service.
3. Prentiss, Augustin M. 1937. Chemicals in War: A Treatise on Chemical Warfare. McGraw-Hill Book Company, Inc.
4. Office, Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. Government Printing Office.
5. Edgewood Arsenal 1919. An Historical Sketch of Edgewood Arsenal. March 1.

10.4 Grenade, Hand, M6

Figures

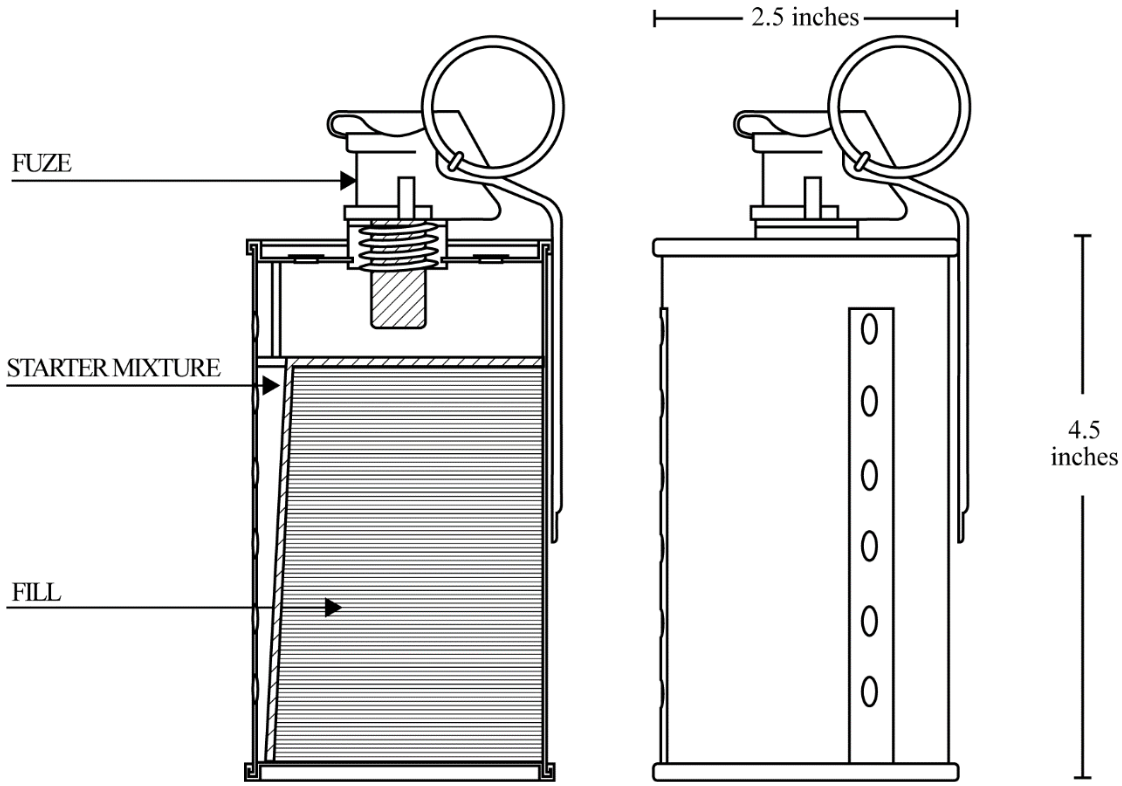

Figure 119: Grenade, Hand, M6 - Line Drawing

Figure 120: Grenade, Hand, M6 - Photograph

Grenade, Hand, M6

Specifications

Grenade, Hand, M6 - Specifications and Other Data		**Citation**
Historical Name	Grenade, Hand, Irritant, CN-DM, M6	1 (p. 31)
Developmental Information	E17R1: M6A1	2 (p. 62, 63), 6 (p. 66, 69)
Type	Grenade	1 (p. 31), 2 (p. 62-63), 3 (p. 3-2), 4 (p. 23)
Service	Air Force, Army, Navy	2 (p. 62-63), 3 (p. 2-12)
Diameter	2.5 in. (6.35 cm)	1 (p. 31), 2 (p. 62-63), 3 (p. 3-2), 5 (p. 13)
Height	4.5 in. (11.43 cm)	1 (p. 31), 3 (p. 3-2), 4, 5 (p. 13)
Other Engineering Data	The M6 grenade could be launched from a rifle or carbine with the use of the M2A1 grenade projection adapter.	1 (p. 33)
Construction Material	Sheet metal	1 (p. 31), 4 (p. 23)
Specification	MIL-G-10124 (M6) MIL-G-4501 (M6A1)	2 (p. 62-63), 3 (p. 3-2)
Drawing	B13-22-2 C13-22-2 (M6) D13-22-8 (M6A1)	2 (p. 62-63), 3 (p. 3-2)
FSN	1330-219-8579 (M6) 1330-555-5373 (M6A1)	2 (p. 62), 6 (p. 71)

General Use and Description

The M6 grenade was used to cause vomiting and tear formation (1 p. 32), (3 p. 3-2).

The M6 CN-DM grenade was essentially a cylindrical container filled with 10-1/4 ounces of CN-DM mixture and fitted with an M201A1 grenade igniting fuze. The body of the grenade was a thin sheet metal cylinder. There were six emission holes in its top and 18 holes in its sides. The fuze was screwed into an adapter in the top of the grenade.

The CN-DM filling was a mixture of CN, DM, magnesium oxide, and smokeless powder. The filling was coated with a starter which aided ignition. The ignition holes were covered with adhesive tape to protect the filling from moisture (1 p. 31), (3 p. 3-2), (4 p. 24), (5 p. 13).

The M6A1 grenade was designed to meet higher storage limits (160° F) and other acceptance and surveillance criteria. A major change in the design from the M6 was the placement of the CN and DM in separate cups rather than being intimately mixed (6 p. 69).

Explosive Train

Releasing the safety lever allowed the striker to hit the primer, which ignited a delay element, which would burn for 0.5 to 3 seconds. Upon expiration of the delay time, the delay element ignited the ignition mixture, which ignited the grenade starter mixture and grenade filling (21% CN, 21 % DM, 55.4% EC Powder, 2.6% magnesium oxide). The adhesive tape was blown off the emission holes and CN-DM gas was emitted for 20-60 seconds (1 p. 32), (2 p. 62, 63), (3 p. 3-2), (4 p. 23, 24), (6 p. 68, 69).

Fuzing

Grenade, Hand, M6 - Fuzing		
Fuze	**Notes**	**Citation**
M200	-	6 (p. 69)
M201	-	6 (p. 69)
M201A1	Grenade igniting fuze	1 (p. 32), 2 (p. 62-63), 3 (p. 3-2), 5 (p. 13)

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Grenade, Hand, M6 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CN-DM	0.62-0.64	0.28-0.29	1.00-1.06	0.45-0.48	-	1 (p. 32), 3 (p. 3-2), 4 (p. 23), 5 (p. 13)

Shipping/Packing

The M6 and M6A1 grenades were either packed 16 units per case, which weighed 33 pounds or 25 per case with the case weight being approximately 50 pounds (2 p. 62, 63), (3 p. 3-2), (4 p. 23).

Miscellaneous Information

A total of 582,327 M6 grenades were procured between 1941 and 1944 and 103,000 M6A1 grenades were procured between 1959 and 1960. At the time they were obsoleted in 1970, there remained 75,000 serviceable and 13,000 unserviceable M6/M6A1 grenades in the inventory (6 p. 72).

Key Dates

Grenade, Hand, M6 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1933	CCTC 1933-14 (known as Candle, Irritant, Fast, MI)	7 (p. 3)
Standardized	1933	OCM 10598, 10651 (transfer to Ordnance Corps and redesignated Grenade, Hand, Irritant, (CN-DM), M6)	9 (p. 28), 10 (p. 4)
Standardized	1954	CCTC 2930 (M6 CN-DM-fill – Standard – Air Force)	11 (p. 1)
Military Characteristics	1955	CCTC 3057	2 (p. 62, 63)
Standardization	1957	CCTC 3330 (M6 Limited Standard; M6A1 (E17R1) Standard)	2 (p. 62, 63), 6 (p. 66, 69)
Standardized	1958	CCTC 3408 (M6 Standard-B; M6A1 Standard-A)	2 (p. 62, 63), 8 (p. 111)
Obsoleted	1970	AMCTC 7865 (M6 & M6A1)	6 (p. 73)

Sources

1. Department of the Army. 1956. Technical Manual, TM 3-300, Ground Chemical Munitions. U.S. Government Printing Office.

2. Department of the Army. 1961. Technical Manual, TM 3-500, Chemical Corps Equipment Data Sheets. U.S. Government Printing Office.

3. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

4. Secretary of War. 1944. Technical Manual, TM 3-300, Miscellaneous Chemical Munitions. War Department.
5. School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. U.S. Army Missile and Munitions Center.
6. Chemical-Biological-Nuclear Subcommittee. 1970. AMCTC Item # 7865, Obsoletion of Riot Control Agents, Diphenylaminechlorarsine: DM & DM1.; Grenades Hand: Riot, CN-DM, M6 & M6A1; and Grenade, Hand: Riot, DM1, ABC-M25A2. U.S. Army Materiel Command.
7. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-14, Standardization of Candle, Irritant, CN-DM, Fast, MI, [redesignated Grenade, Hand, Irritant, CN-DM, M6 when transferred to the Ordnance Dept. as recorded on OCM 10598, 6 Apr 33] approved 21 January. Chemical Warfare Service.
8. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
9. Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10598, Candles, Chemical – Transferred to the Chief of Ordnance for Procurement, Storage and Issue – Designation Changed to “Grenades”. April 6.
10. Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10651, Candles, Chemical – Approval for Transfer to the Chief of Ordnance for Procurement, Storage and Issue; and Change of Designation Changed to “Grenades” (Read for Record). April 27.
11. Chemical Corps Technical Committee. 1954. CCTC Item # 2930, Items Type-Classified by the Air Force (Read for Record). Department of the Army.

10.5 Grenade, Hand, M58 (XM58)

Figures

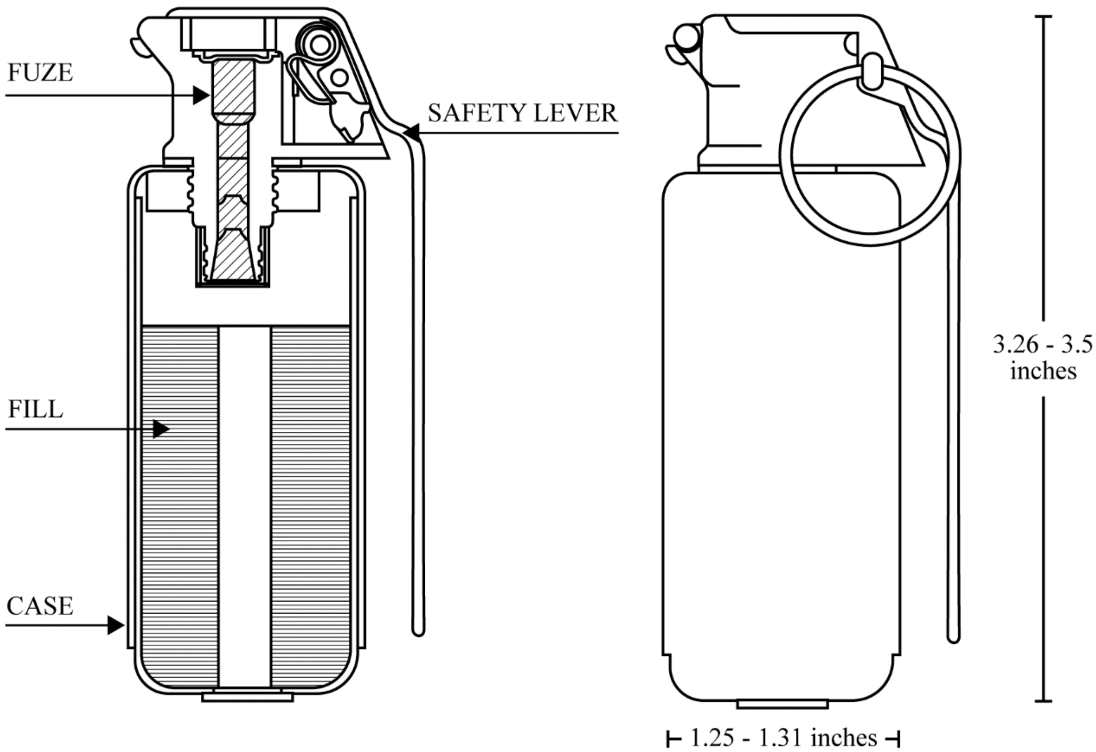

Figure 121: Grenade, Hand, M58 (XM58) - Line Drawing

Figure 122: Grenade, Hand, M58 (XM58) - Photograph

U.S. Chemical Weapons and Related Materiel Reference Guide

Grenade, Hand, M58 (XM58)

Specifications

Grenade, Hand, M58 (XM58) - Specifications and Other Data		**Citation**
Historical Name	Grenade, Hand: Riot, Pocket, CS, M58	1 (p. 2-53, 2-58)
Developmental Information	XM58	3 (p. 31b)
Type	Grenade	1 (p. 2-53)
Service	Army	1 (p. 2-53)
Diameter	1.25-1.31 in. (3.17-3.33 cm)	1 (p. 2-53), 2 (p. 17)
Height	3.26-3.5 in. (8.28-8.46 cm)	1 (p. 2-53), 2 (p. 17)
Construction Material	Aluminum	1 (p. 2-53)
Drawing	Assembly: 13-21-16 Fuze: 13-21-23	1 (p. 2-54)
NSN	1330-00-143-7003	1 (p. 2-54)

General Use and Description

The M58 grenade was designed to simulate casualty agents during training by causing irritation to the upper respiratory passage, coughing, difficulty in breathing and chest tightness. Nausea and vomiting would also occur (1 p. 2-53, 2-54), (4 p. 1-4).

The grenade contained a CS-pyrotechnic composition. There was a hole in the base of the body that was used for agent emission after functioning (1 p. 2-53).

The fuze in the M58 (i.e., hand grenade M201A1E1) was similar to the M201A1. The hand grenade fuze M201A1 was a pyrotechnic delay-igniting fuze. The body contained a primer, fire mixture, pyrotechnic delay column, and ignition mixture. Assembled to the body were a striker, striker spring, safety lever, and safety pin with pull ring. The split end of the safety pin had an angular spread (1 p. 2-53).

Safety clips were not required with these grenades (1 p. 2-53), (4 p. 1-4).

Explosive Train

Removal of the safety pin permitted release of the safety lever. When the safety lever was released, it was forced away from the grenade body by a striker acting under the force of a striker spring. The striker spring rotated on its own axis and struck the percussion primer. The primer initiated the first-fire mixture. The fire train, fuze delay element, ignition mixture, grenade starter mixture and filler were initiated in turn by preceding component. The pressure sensitive tape was blown off the emission holes and CS fill was emitted for 8 to 28 seconds (1 p. 2-54).

Fuzing

Grenade, Hand, M58 (XM58) - Fuzing		
Fuze	**Note**	**Citation**
M201A1E1	Igniting 0.7 to 4 seconds delay	1 (p. 5-23), 2 (p. 17), 4 (p. 1-4)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Grenade, Hand, M58 (XM58)

Fills

Grenade, Hand, M58 (XM58) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CS	0.09	0.04	0.26	0.11	CS-pyrotechnic composition.	1 (p. 2-53), 2 (p. 17)

Shipping/Packing

The grenades were packed 10 per fiberboard packing box. The box and grenades weighed 45 pounds and occupied 2.4 cubic feet (1 p. 2-54).

Key Dates

Grenade, Hand, M58 (XM58) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Classified	1969	AMCTC 7297 (Limited Production Type)	3 (p. 31b)
Standardized	1971	AMCTC 8602 (Standard-B)	-
Obsoleted	1974	MSR 08746046	5 (p. 333)

Sources

1. Headquarters, Department of the Army. 1994. Technical Manual, TM 43-0001-29, Army Ammunition Data Sheet for Grenades. Headquarters, Department of the Army.

2. School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. U.S. Army Missile and Munitions Center.

3. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.

4. Headquarters Departments of the Army and the Navy. 1995. Technical Manual, TM 9-1330-200-12, Operators and Organizational Maintenance Manual for Grenades, Change 15. Headquarters Departments of the Army and the Navy.

5. Department of the Army. 1974. Materiel Status Record Submission, MSR 08746046, Type Reclassification of Grenade, Hand: Riot, CS, M47 (XM47E3) and Grenade, Hand: Red Smoke, RS, M48 (XM48E3) from Limited Procurement (LP) to Standard, and Type Reclassifications of Other Hand Grenades. Headquarters, United States Army Armament Command.

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11 Mine

Land mines may be hidden in the path of the enemy to hinder movement or to impede access to a certain area. Mines may produce casualties by blast overpressure, secondary impact (i.e., a body is thrown into a stationary object), thermal pulse, fragmentation, shaped charge effect, or by release of harassing or lethal agents (Department of the Army, 1964, p. 4). Chemical mines (e.g., harassing and lethal agent land mines) were designed to disperse fills from fixed locations and to provide area contamination in barrier and nuisance minefields. The fill may be dispersed in liquid or vapor form. The chemical mine was also designed to be used in anti-tank minefields or elsewhere as an anti-personnel mine. (Department of the Army, 1964, p. 7).

In general, all chemical land mines consist of three parts: container, fill, and explosive train (War Department. 1942). Chemical landmines were containers of chemical agent (e.g., HD) designed to be planted in roads, fields, or buildings, or for use as booby traps. The mines were exploded to spread chemical agents that would hinder or harass the enemy and inflict casualties. They were inexpensive, had a high chemical efficiency, and, when the standard containers were not available, substitutes could be readily improvised (Department of the Army, 1964, p. 7). The land mines filled with simulants (e.g., MR) were used in training. Chemical mines are discussed in the subsections below.

11.1 Mine, Land, E2

Figures

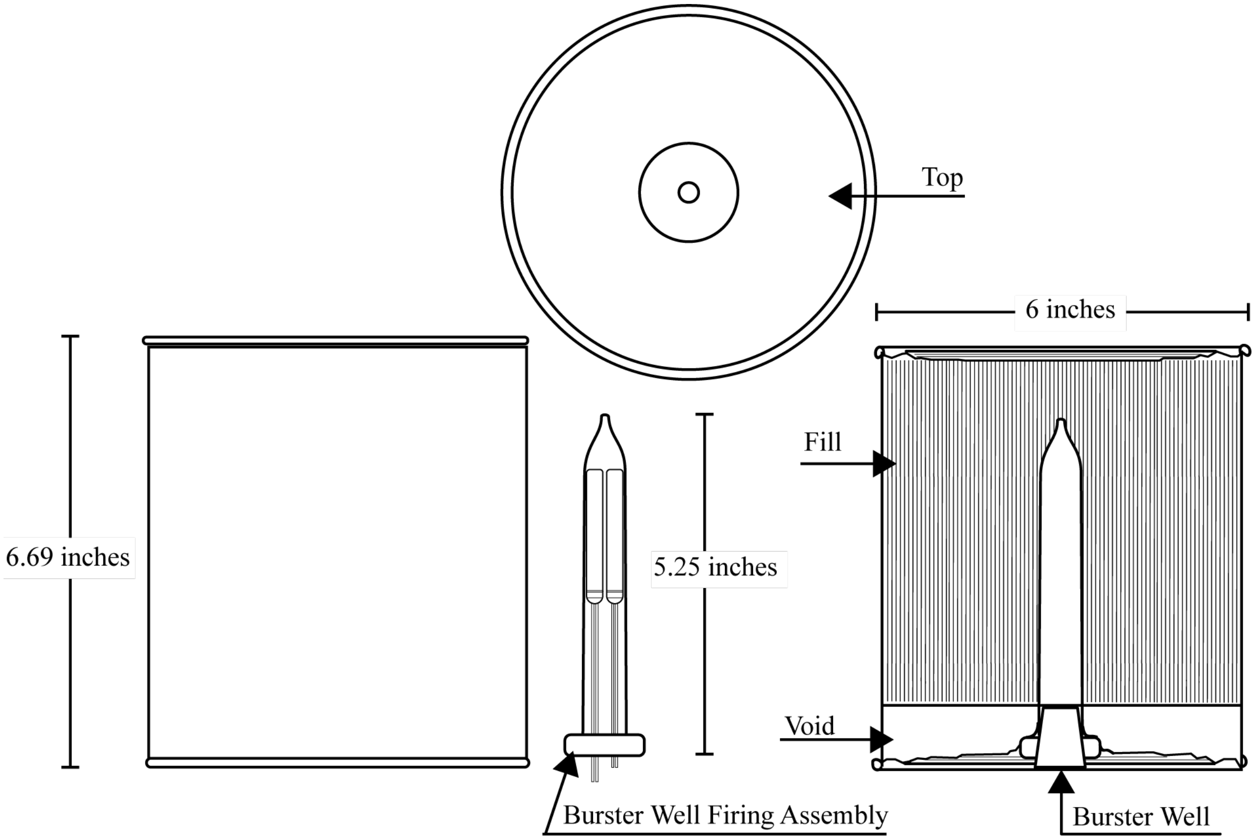

Figure 123: Mine, Land, E2 – Line Drawing

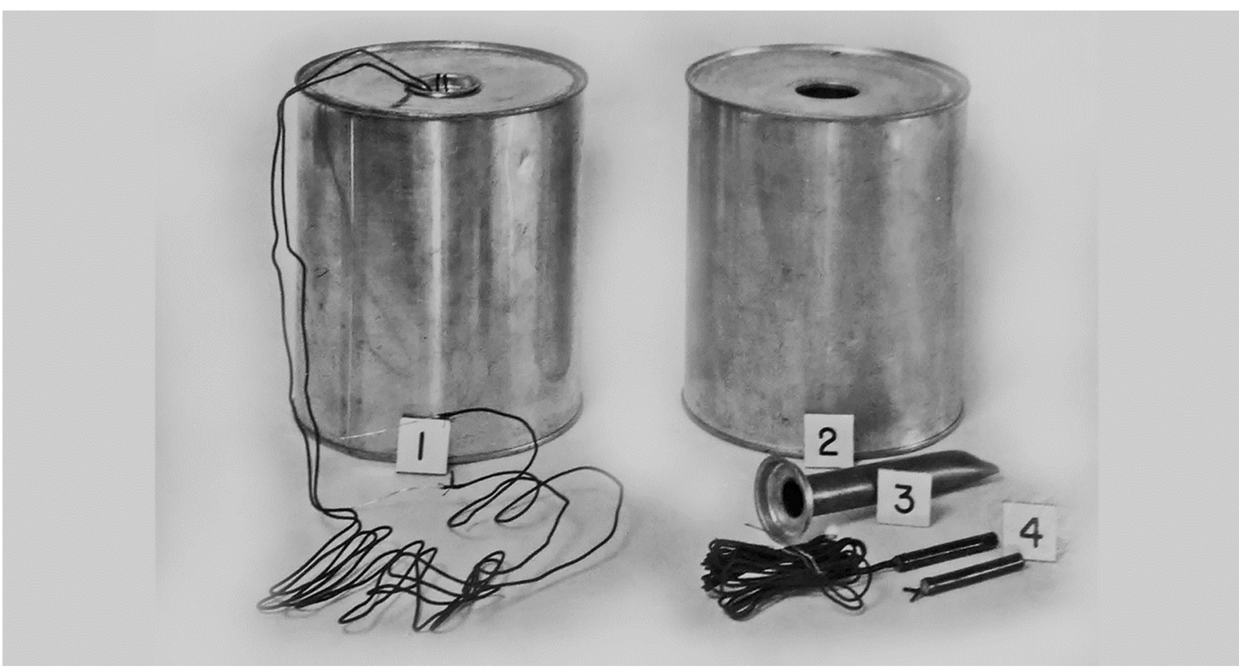

Figure 124: Mine, Land, E2 – Photograph

Mine, Land, E2

Specifications

Mine, Land, E2 – Specifications and Other Data		Citation
Historical Name	HS Chemical Land Mine E2	1 (p. 1, 17)
Type	Mine	1 (p. 1, 17)
Conflict	Post-WWI, WWII	1 (p. 1)
Service	Army	1 (p. 1)
Diameter	6 in. (15.2 cm)	1 (appendix p. 2), 3
Length	Burster tube: 5.25 in. (13.3 cm)	1 (appendix p. 3)
Height	6.69-7.00 in. (16.98-17.78 cm)	1 (appendix p. 2), 3
Other Engineering Data	1.38-in. recessed friction closure	1 (p. 17, appendix p. 2)
Construction Material	Container: tin Burster well: brass tubing	1 (appendix p. 1, 3)
Specification	196-21-2	1 (p. 18)
Drawing	B22-25-17, C37-1-8	1 (16, appendix p. 2, 4)

General Use and Description

The E2 land mine was a special mine was designed to utilize cans from the pineapple packing industry and were available in quantity in the Hawaiian Department (1 p. 25).

The mine provided an economical means of contaminating ground and vegetation with HS to prevent the occupation by an enemy of beachhead areas, roads, trails, corridors, and similar territory in the Hawaiian Department. The E2 mine consisted of a container, burster, and the filling. It was modified from a commercial number 10 can, which had an approximate capacity of 0.82 gallons (1 p. 17).

Explosive Train

A number 6 commercial detonator was used to fire the mines (1 p. 19).

Fuzing

Mine, E2 – Fuzing		
Fuze	**Note**	**Citation**
No. 6 Detonator	Commercially available.	1 (p. 19)

Booster, Adapter-Booster, or Burster

Mine, E2 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Internal burster charge	0.07 lbs. (0.03 kg)	Tetryl	Two blasting caps inserted in burster well.	1 (p. 17, appendix p. 3)

Fills

Mine, E2 – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
HS	7-7.75	3.17-3.52	8.1	3.67	–	1 (p. 25, appendix p. 4), 2 (p. 1)

Shipping/Packing

The filled E2 mines were packed six per wooden box. The blasting caps (No. 8 detonators) were packed in a commercial container (1, appendix p. 4).

Mine, Land, E2

Key Dates

Mine, E2 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Canceled	1946	CCTC 1681 (Mine, Land, Chemical, H, Round)	3

Sources

1. Greene, L.W. 1937. Edgewood Arsenal Technical Report, EATR 247, HS Chemical Land Mines E1 and E2, Engineering Tests. Chemical Warfare Service.
2. Hawaiian Chemical Warfare Depot. 1940. Report on the Test of Five (5) Land Mines Filled with HS. August 31.
3. Chemical Corps Technical Committee. 1946. CCTC Item # 1681, Cancellation of Miscellaneous Experimental Munitions and Weapons. October 23.

11.2 Mine, 1-gallon, Land, M1

Figures

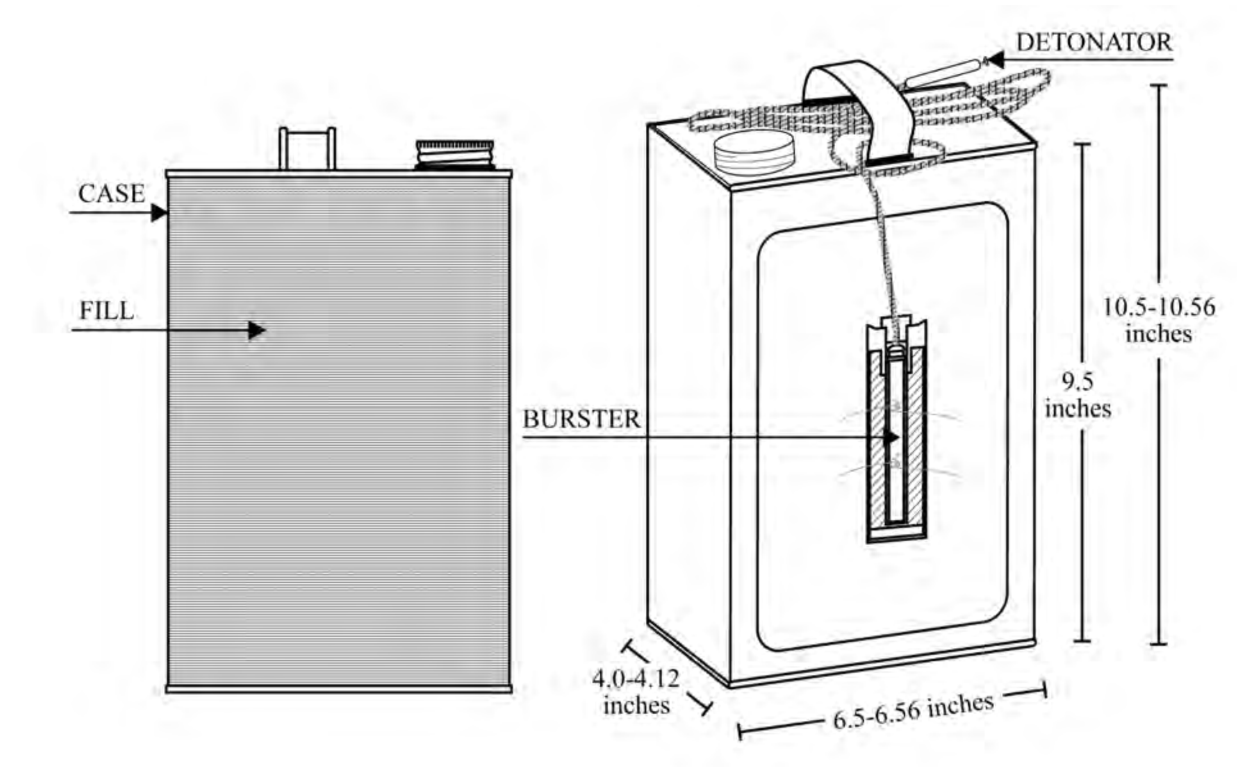

Figure 125: Mine, 1-gallon, Land, M1 - Line Drawing

Figure 126: Mine, 1-gallon, Land, M1 - Photograph - Left: Back View, Right: Front View

Mine, 1-gallon, Land, M1

Specifications

Mine, 1-gallon, Land, M1 - Specifications and Other Data		Citation
Historical Name	Mine, Land, Chemical, 1-Gallon	1 (p. 64)
Developmental Marking	E1	(9 p. 1-3, 5)
Type	Mine	2 (p. 20)
Size	1-gallon	1 (p. 64), 3 (p. 101)
Conflict	WWII	2 (p. 20)
Service	Army	1 (p. 164), 4 (p. 16)
Length	4-4.12 in. (10.16-10.47 cm)	1 (p. 64), 2 (p. 20), 5 (p. 60)
Width	6.5-6.56 in. (16.51-16.66 cm)	1 (p. 64), 2 (p. 20), 5 (p. 60)
Height	With handle: 10.5-10.56 in. (26.67-26.82 cm)	1 (p. 64), 2 (p. 20), 5 (p. 60)
Construction Material	Constructed of light gauge metal (tin).	2 (p. 20), 3 (p. 101)
Specification	MIL-C-10518	1 (p. 64), 5 (p. 60)
Drawing	C37-5-5 D37-5-5	1 (p. 64), 5 (p. 60)
FSN	1345-289-6938	5 (p. 60)

General Use and Description

The 1-gallon chemical landmine was used to provide area contamination in barrier and interdictory minefields. They were designed to be employed in combination with HE mines in mine fields (1 p. 64), (6 p. 64).

The M1 chemical land mine was a one-gallon can fitted with a carrying handle and a threaded cap. The can was painted gray with green markings. Two eight-inch short wires were soldered to the side of the can for use when attaching a burster. The one-inch opening was covered by a cap lined with a gasket made of cork or rubber and faced with lead foil. The capacity of the mine is 1.1 gallons, which allows for a 10% void when the mine was filled with one gallon of liquid (2 p. 20, 21), (6 p. 68).

Explosive Train

The 1-gallon land mine could be detonated with either a No. 8 electric detonator or nonelectric detonator and safety fuze assembly. Several types of bursters were used: early versions used the M2 (nitrostarch), PETN; the M3 burster (primacord), and the M4 (1 p. 64), (2 p. 22), (3 p. 101), (6 p. 67, 71), (7).

Fuzing

Mine, 1-gallon, Land, M1 – Fuzing		
Fuze	**Note**	**Citation**
Not designated	Safety fuze – The firing component for the mine was a No. 8 blasting cap attached to a 19 3/8-inch safety fuze.	2 (p. 20 – 22)

Booster, Adapter-Booster, or Burster

Mine, 1-gallon, Land, M1 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M2	N/A	Nitrostarch		2 (p. 22)
M3	N/A	PETN	Detonating Cord (4-8 feet). Nonelectrically functioning	3 (p. 101), 6 (p. 71), 7
M4	N/A	N/A	The M4 was 0.75 inches in diameter and 3.75 inches long.	7
Not designated	N/A	Blasting cap	Electrically functioning	2 (p. 22), 3 (p. 101)

Mine, 1-gallon, Land, M1

Fills

Mine, 1-gallon, Land, M1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AS (asbestine suspension)	9.50	4.30	12.0	5.44	-	2 (p. 22, 26)
HD	9.90	4.50	11.0	4.98	-	3 (p. 101), 15 (p. 47)
HS	9.90-10.5	4.49-4.76	11.0-13.0	4.99-5.90	-	2 (p. 21, 26), 8 (p. 102), 10 (p. 3)
L	N/A	N/A	N/A	N/A	Substitute Standard	14 (p. 29), 15 (p. 48)
MR	9.50-10.4	4.30-4.71	10.0-11.5	4.53-5.21	Density of MR is 10.4 pounds per gallon	2 (p. 22, 26)

Shipping/Packing

The 1-gallon mines were shipped ten mines (empty) per fiberboard box. Each box weighed 15 pounds and displaced 2.3 cubic feet (1 p. 64), (6 p. 68).

Miscellaneous Information

During development, this was known as Chemical Mine E1.

The chemical mine was a post-WWI development. The chemical mine was first proposed in 1923 but the development was of a sporadic nature through fiscal year 1936 when test samples were prepared. The Chemical Warfare School conducted many tests with chemical land mines by prior to 1934. A comprehensive discussion of the military requirements for and the military characteristics of chemical mines was prepared in 1935. The Chemical Land Mine E2 was similar but used a round No. 10 fruit can readily available in Hawaii (9 p. 1 -3, 5).

In 1955, HN-1 was identified as a possible fill for the 1-gallon land mine (15 p. 47).

Key Dates

Mine, 1-gallon, Land, M1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1933	CCTC 1933-02 (HS-fill)	10 (p. 3)
Standardized	1938	CCTC 1938-20 (E1 mine)	16 (p. 4)
Standardized	1939	CCTC 1939-4	17
Standardized	1944	CCTC 1049, 1094 (HD-fill Standard, HS-fill Limited Standard)	18 (p. 101, 102)
Obsoleted	1946	CCTC 1601 (AS-fill)	11
Standard Modernization	1958	CCTC 3408 (Standard-B)	12
Standard Modernization	1958	CCTC 3450 (Standard-A)	13

Sources

1. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.

2. Secretary of War. 1942. Technical Manual, TM 3-300, Irritant Candles, Tear Pots, Smoke Pots, and Chemical Land Mines. War Department.

3. Department of the Army. 1964. Technical Manual, TM 9-1345-200, Land Mines. U.S. Government Printing Office.

4. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

5. Department of the Army. 1961. Technical Manual, TM 3-500, Chemical Corps Equipment Data Sheets. U.S. Government Printing Office.

6. Department of the Army. 1956. Technical Manual, TM 3-300, Ground Chemical Munitions. U.S. Government Printing Office.

7. Chemical Warfare Service. 1943. Chemical Warfare Service Field Materiel Data. U.S. Government Printing Office.

8. War Department. 1942. Field Manual, FM 3-5, Chemical Warfare Service Field Manual: Tactics of Chemical Warfare. War Department. 20 July.

9. Greene, L.W. 1937. Edgewood Arsenal Technical Report, EATR 247, HS Chemical Land Mines E1 and E2, Engineering Tests, Project B 7.1-1. War Department.

10. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. Department of the Army.

11. Chemical Corps Technical Committee. 1946. CCTC Item # 1601, Obsoletion of Simulated Mustard AS. Department of the Army.

12. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.

13. Chemical Corps Technical Committee. 1958. CCTC Item # 3450, Reclassification of 22 Standard-B Items to Standard-A Based on Revised Interpretation of Definitions Thereof. Department of the Army.

14. Chemical Corps Technical Committee. 1951. Chemical Corps Book of Standards. Department of the Army.

15. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.

16. Chemical Corps Technical Committee. 1938. CCTC Item # 1938-20, Mine, Land, Chemical – Subcommittee Report on Recommendation for Standardization. CWS 470.6/235. Department of the Army.

17. Chemical Corps Technical Committee. 1946. CCTC Item # 1681, Cancellation of Miscellaneous Experimental Munitions and Weapons. October 23.

18. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

11.3 Mine, 2-gallon, M23

Figures

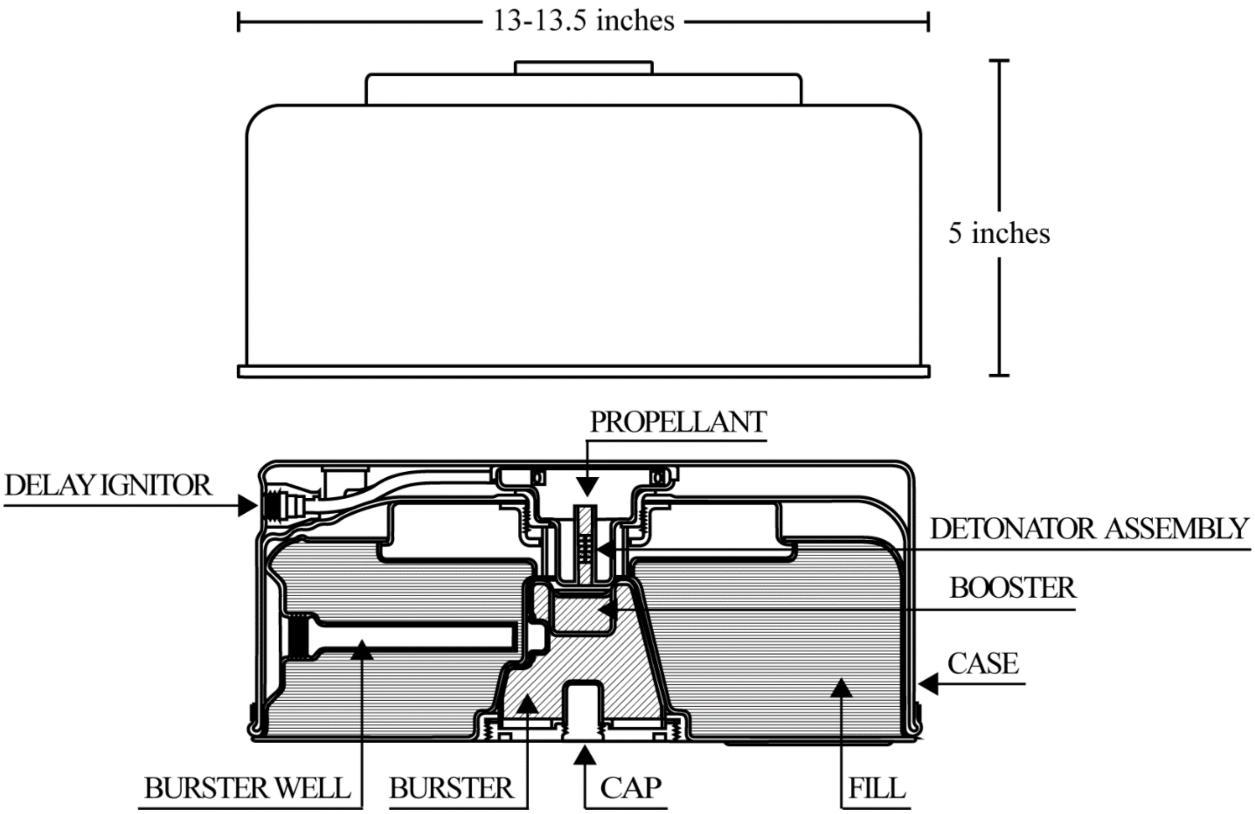

Figure 127: Mine, 2-gallon, M23 - Line Drawing

Figure 128: Mine, 2-gallon, M23 - Photograph – Left: cutaway, Center: Intact, Right: Shows raised projections on mine surface

Specifications

Mine, 2-gallon, M23 - Specifications and Other Data		Citation
Historical Name	Mine, Chemical Agent, VX, M23	1 (p. 102)
Developmental Information	E5	1 (p. 102), 3 (p. 4-190)
Type	Mine	2 (p. 63), 3 (p. 4-189)
Size	2-gallon	2 (p. 63)
Conflict	Cold War	-
Service	Army	2 (p. 63)

Mine, 2-gallon, M23 - Specifications and Other Data		Citation
Diameter	13-13.5 in. (33.3-34.3 cm)	1 (p. 103), 4 (p. 83), 5 (p. 4-4), 8 (p. A-7)
Height	5 in. (12.7 cm)	1 (p. 103), 4 (p. 83), 5 (p. 4-4), 8 (p. A-7)
Other Engineering Data	Later model mines used a coil spring instead of a Belleville spring. Weight, Unfuzed: 22.75 lbs. (10.32 kg)	1 (p. 102, 103), 3 (p. 4-190)
Construction Material	Steel	1 (p. 103), 3 (p. 4-190), 5 (p. 4-4), 7 (p. 33)
Spec/PD No	MIL-M-46984	2 (p. 63)
Drawing	LM 37-1-13 D37-1-14	2 (p. 63), 6 (p. 61)
NSN	1345-00-542-1580	7 (p. 33)
FSN	1345-542-1580	2 (p. 63), 6 (p. 59)

General Use and Description

The M23 was a two-gallon persistent VX-filled chemical agent mine designed to provide obstacles for restricting enemy movement. The mine was used for barrier and interdictory minefields and to contaminate demolition work (2 p. 63).

The mine consisted of a thin-walled, steel body that housed a pressure plate assembly, a primary fuze well, and two secondary fuze wells. Primary fuzing consisted of a top fuze. The pressure plate assembly consisted of a pressure plate, a Belleville spring, a fuze retainer spring, and an arming plug. Later model mines used a coil spring instead of a Belleville spring. The M23 mine was similar in size, shape, and function to the M15 anti-tank (AT) mine. The M23 chemical land mine can be distinguished visually and by touch from the M15 AT mine by eight raised projections spaced in pairs around the periphery of the top of the chemical mine (at 90-degree intervals) (1 p. 102), (2 p. 63), (3 p. 4-189).

Explosive Train

Primary, side, and bottom fuze wells were proved for fuzing the mine. The side fuze well was part of a burster tube that contained a tetryl burster held in place by a retaining ring. The bottom fuze well was part of a cover adapter plate, which held a Composition B burster cone in place.

The M603, an instantaneous mechanical-pressure type fuze, was the primary fuze for the M23 mine. The main fuze well had a M120 booster. When the shutter of the arming plug was in the armed position, the fuze was designed to function when a force of 300 to 400 pounds exerted on the pressure plate depressed the mine spring. As the pressure plate was depressed, the shutter depressed the pressure plate of the fuze. A force of 140 to 240 pounds on the fuze pressure plate, depressed the fuze Belleville spring, causing it to snap into a reversed position, driving the firing pin into the detonator. Initiation of the detonator caused the booster to function, which in turn initiated the burster and dispersed the agent. The initiator was tetryl or Composition B (4 p. 84).

Secondary fuzing consisted of side and bottom fuze wells designed to accept the standard M1 activator and an M1A1, M2, M3, or M5 firing device. Secondary fuzing provided an antipersonnel capability by booby trapping (1 p. 102 - 104), (2 p. 63).

Mine, 2-gallon, M23

Fuzing

Mine, 2-gallon, M23 - Fuzing		
Fuze	**Notes**	**Citation**
M1	Delay type	1 (p. 103)
M1A1	Pressure	1 (p. 103)
M2	Pull-friction	1 (p. 103)
M3	Pull-release	1 (p. 103)
M5	Pressure-release	1 (p. 103)
M603	Primary, for AT use	1 (p. 102), 3 (p. 4-190), 4 (p. 84), 5 (p. 4-3, 4-4)
M608	Alternate for AT use	5 (p. 4-3, 4-4)

Booster, Adapter-Booster, or Burster

Mine, 2-gallon, M23 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M120 booster	0.001 lbs. (0.0005 kg)	Primer mix	Used with M603 fuze	1 (p. 103), 3 (p. 4-190)
M38	0.8 lbs. (0.36 kg)	Composition B	Used with M603 fuze	3 (p. 4-190), 8 (p. A-7), 9 (p. 4-189)
M48 burster	N/A	N/A	-	3 (p. 4-190)

Fills

Mine, 2-gallon, M23 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
HD	14.5	6.58	27.5	12.5	Experimental, E5-fill, gross weight estimated.	10 (p. 2)
VX	10.5-11.5	4.76-5.21	22.7-26.5	10.2-12.0	-	1 (p. 102, 103), 2 (p. 63), 3 (p. 4-189, 4-190), 4 (p. 83), 9 (p. 4-188)

Shipping/Packing

M23 mines were packaged and shipped three to a 16-gallon, steel drum. Three primary fuzes and three M1 activators were included in the shipment, which weighed 115 pounds (1 p. 103), (2 p. 63), 5 (p. 4-4).

Miscellaneous Information

A “Pop-Up” adapter to the M23 chemical land mine was developed as an addition to the Standard-A Type M23 to improve its efficiency. The “Pop-Up” adapter provided for airburst of the standard M23 mine, resulting in an increased area coverage (11 p. 2).

Key Dates

Mine, 2-gallon, M23 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1960	CCTC 3705	2 (p. 63), 6 (p. 61)
Standardized	1960	CCTC 3750	-
Classified	1960	CCTC 3710	9 (p. 4-189)
Standard Modernization	1961	CCTC 3788 (standardized as ABC-M23)	12 (p. 1)

Sources

1. Department of the Army. 1964. Technical Manual, TM 9-1345-200, Land Mines. U.S. Government Printing Office.

2. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.

3. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

4. Secretary of the Army. 1967b. Technical Manual, TM 9-1385-51, Identification of Ammunition (Conventional) for Explosive Ordnance Disposal. Department of the Army.

5. Department of the Army. 1997. Technical Manual, TM 43-0001-36, Army Ammunition Data Sheets for Land Mines (FSC 1345), Change 2. U.S. Government Printing Office.

6. Department of the Army. 1961. Technical Manual, TM 3-500, Chemical Corps Equipment Data Sheets. U.S. Government Printing Office.

7. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.

8. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.

9. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

10. Chemical Warfare Laboratories. 1956. Test Division Field Trials Report No. 11, Summary Report of Trials of the E5 Land Mine Detonation with Side and Bottom-attached Firing Devices and By Action on the Pressure Plate. Army Chemical Center.

11. Cornell Aeronautical Laboratory. 1967. Pop-Up Adapter for the M23 Chemical Land Mine. U.S. Army Chemical Research and Development Laboratory.

12. Chemical Corps Technical Committee. 1961. CCTC Item # 3788, Chemical Corps Items Designated ABC-Army Standard. Department of the Army.

12 Miscellaneous

This category includes candles, bulk containers, cylinders, drone weapons systems, and spray tanks.

12.1 Candle, Comings

Figures

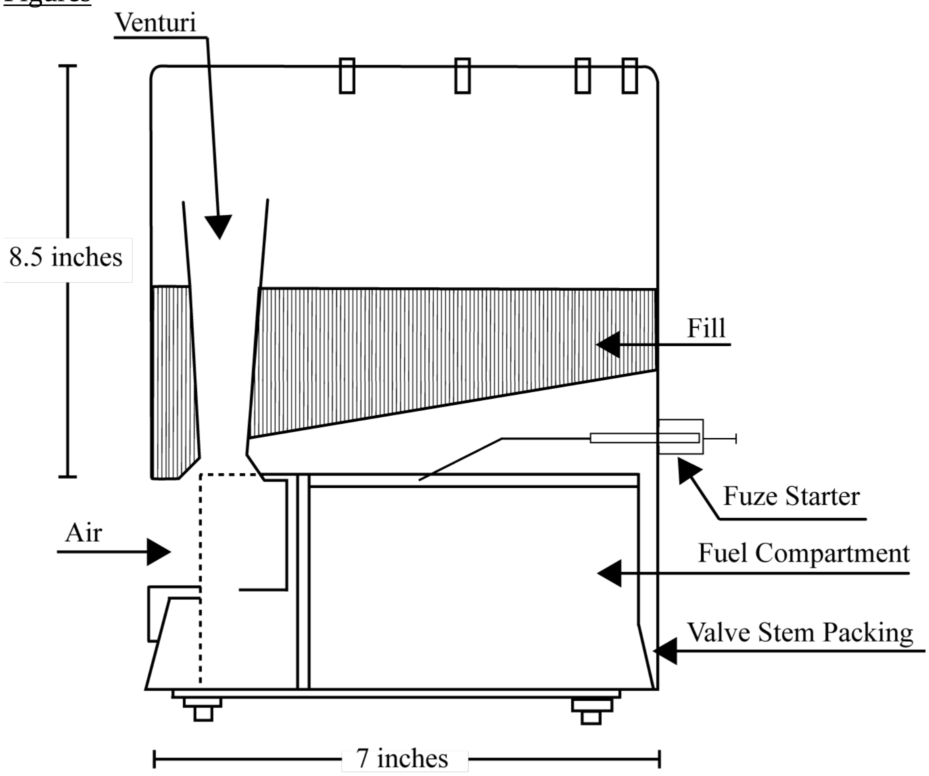

Figure 129: Candle, Comings, D10 – Line Drawing

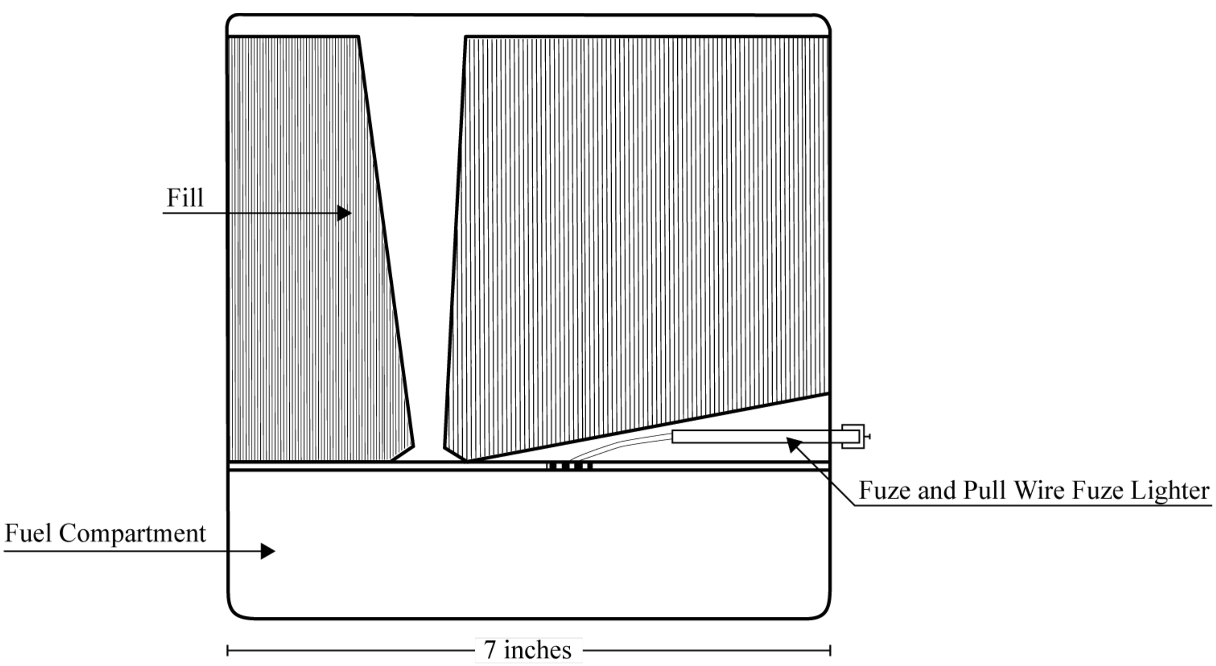

Figure 130: Candle, Comings, F7A – Line Drawing

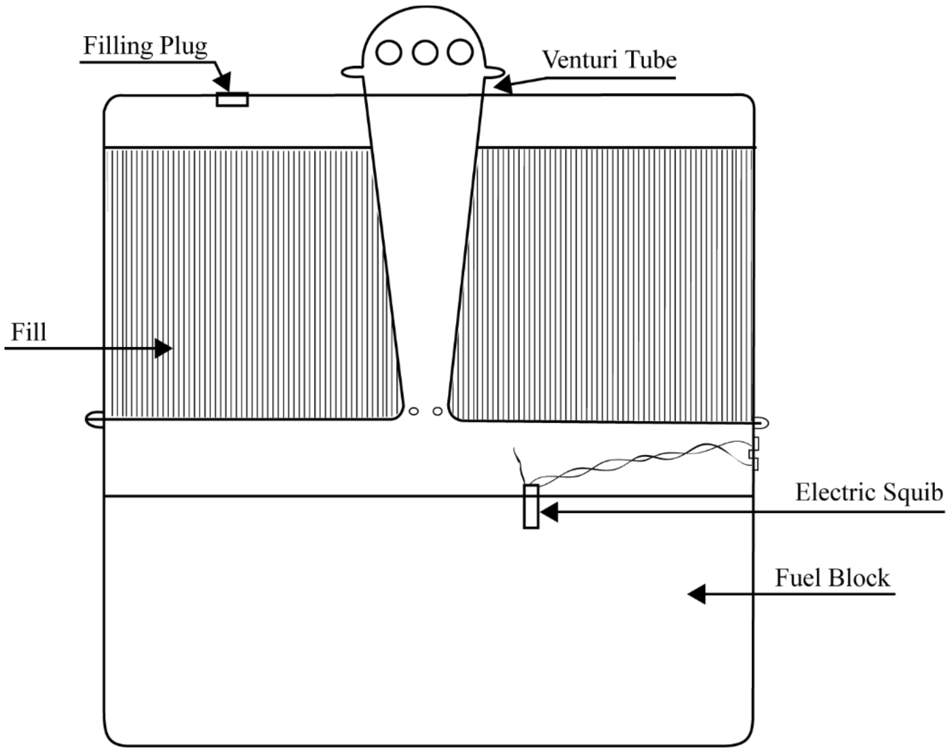

Figure 131: Candle, Comings, F7A2 Thermal Generator – Line Drawing

Figure 132: Candle, Mustard, F6 – Photograph

Specifications

Candle, Comings – Specifications and Other Data		Citation
Historical Name	Comings Candle, Thermal Generator Candle, F-7-A Thermal Generator, Mustard Candle	1 (p. 3), 2 (p. 7), 3 (p. 1), 4, 5 (p. 278), 6 (p. 1), 7 (p. 21), 8 (p. 1)
Type	Candle	1 (p. 3), 2, 3 (p. 1), 4, 5 (p. 278), 8 (p. 1)
Conflict	WWII	1 (p. i), 2 (p. 15 - 27)
Service	Army	3
Diameter	F7A: 7 in. (17.78 cm)	2 (p. 5), 6 (Figure 3), 9 (Figure 1)
Height	F7A: 8.25 in. (20.9 cm) H Candle: 10 in. (25.4 cm) Agent compartment: 4-6.5 in. (10.2-16.5 cm)	2 (p. 5), 6 (p. 20, Figure 3), 9 (Figure 1)
Other Engineering Data	Weight, Fuel Block: DM Candle: 2.65 lbs. (1.2 kg) H Candle: 3 lbs. (1.36 kg) Thermal Generator Candle: 3.12 lbs. (1.42 kg) Fuel compartment pipe: 3.0-3.5-in. (7.62-8.89-cm)	2 (p. 7), 4, 5 (p. 279), 6 (p, 1), 9 (Figure 1)
Construction Material	F7A: 20-gauge sheet steel	2 (p. 5)

General Use and Description

To secure a device that could evolve mustard agent in a nonpersistent form, two types of candles were investigated. The first was a one-compartment intimate mixture (H and smokeless powder) type, and the second was a two-compartment type. The one-compartment type candle was discontinued. Two versions of the two-compartment type were studied; candles in which the mustard was held by some absorbent (e.g., sawdust, Kieselguhr) and those in which no absorbent was used (5 p. 278, 279), (10). Comings candles were designed as practical hand carry munitions for the use of dispersal of HD as an aerosol (2 p. 1). There were many variations of the Comings Candle or thermal generators; including the D and F series (2 p. 1, 5, 12), (6, p. 16). The D series candles were abandoned in favor of the F models (6 p. 16).

The Comings Candle had a double compartment container (1 p. 3). A relatively slow burning solid fuel mixture was contained in the lower compartment, the mixture was ignited by an electric squib. The fuel block would burn for about four minutes. The fuel block for the F7A consisted of a starter mix (20 grams), fast base mix (400 grams), and a slow base mix (1,000 grams) (2 p. 5, 6). The upper compartment contained the agent. A venturi shaped tube connected the fuel compartment with the agent compartment. The flared end of the venturi tube passed through the top of the agent compartment and was covered by a perforated cap. The throat of the venturi tube was provided with feed holes, which were closed by a small amount of low melting alloy (1 p. 3), (3 p. 5).

The thermal generator was tested with several agents for setting up screening and toxic smokes as well as highly concentrated vapors. The materials which were vaporized successfully were paraffin wax, oleum, sulfur, CN, DM, DC, tertiary butyl stearate, methyl salicylate, triethyl-phosphate, glaurin, diol, and other high-boiling hydrocarbon oils, and several varieties of mustard agent, including unpurified Levinstein, extracted Levinstein, and mustard from the thiodiglycol process (9 p. 5, 6).

Explosive Train

The fuel block was ignited electronically. The hot gases of combustion passed up through the venturi tube and the alloy plugs were quickly melted. Liquid from the agent compartment flowed through the holes in the venturi throat into the stream of hot gases. The liquid flow was caused by the pressure developed in the agent compartment plus the liquid head, and the vacuum in the venturi throat. The high velocity and temperature of the gases broke up the liquid into fine droplets which evaporated rapidly in the diverging section of the venturi. Expansion of the gases in the discharge end of the venturi rapidly cooled them. The mixture of gas, vapor, and liquid particles emitted to the air through the perforated venturi cap. On mixing with cooler air, partial condensation took place forming an aerosol (1 p. 3).

Fuzing

Candle, Comings – Fuzing		
Fuze	**Notes**	**Citation**
Bickford, fuze	Tipped with black powder	6 (p. 5-6)
Electric squib	–	1 (p. 3)

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Candle, Comings – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
DM	1.65	0.75	9.0	4.1	–	3 (p. 6), 4 (p. 1), 5 (p. 278)
H	2.0-6.5	0.905-2.54	11.5-12.3	5.22-5.58	–	2 (p. 9), 5 (p. 278), 6 (p. 1, 6, 13, 18), 8 (p. 1), 9 (p. 7-8),
HD	5.5-6.5	2.49-2.95	13	5.9	F-4 and F7A2	1 (p. 3), 2 (p. 1, 7)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

In 1923, two different types of' two-compartment candles were tested, and both were believed to give better results than the intimate mixture of H and smokeless powder candle even though the intimate mixture candle was used when newly made. In one of the types a container similar to the nine-pound DM candle container was used, the H in the upper compartment was absorbed in Kieselguhr, and the fuel (ammonium nitrate and charcoal) were pressed into the lower compartment. In the other type, the fuel was held in one chamber and liquid H in the other (10). During the exploratory phase of investigation of thermal generators during WWII mustard candles weighed 12, 20, or 25 pounds (11 p. 127).

In 1942, a candle was designed using the principle behind the M2 candle, except that the hot gaseous products of combustion of the fuel mixed with the atmosphere to cool the gases so that the toxic agent could be volatilized at a lower temperature. This type of candle became known as the Comings Candle, named after the inventor (6 p. 2, 3).

The D, E, F and H models of the Comings Candle were developed. The E models had an agent compartment separated from the fuel compartment by an air space. Although the E model was successful, the F model was more effective in dispersing agent. The D models relied on air entrainment and were abandoned in favor of the F models. The H model thermal generators were similar to aerial bombs under development (6 p. 16, 17, 21, 22).

The F7A was a venturi thermal generator for hand carry. There was no tactical requirement for a hand carry pot; it was an intermediate stage for development of a munition incorporating a thermal generator for dispersion of agent. The F6 generator could not be moved once filled with agent. The thermal generator principle was used in development of the M69 and M74 bombs (2 p. 1, 4, 8).

Testing of the candles was done using H, HD, butyl carbitol, triethyl-phosphate, and DDT in solution (3 p. 15-27).

Key Dates

Available references did not provide this information.

Sources

1. Leighton, P.A.; Bogese, S; D'Ercole, A.D.; Lanier, H.; and Albert, L. 1946. A Special Report, Isokinetic Sampling of H Aerson (As produced by the Comings Candle). February. Dugway Proving Ground. CBRNIAC-CB-004085.
2. Adams, C., M. Raila, E. Comings. 1945. Office of Scientific Research and Development, OSRD 6431, Development of an Experimental Thermal Generator Pot for Dispersing Mustard Gas as an Aerosol. December. Office of Scientific Research and Development. CBRNIAC-CB-051091.
3. Johnstone, H.F.; Comings, E.W. 1943. Office of Scientific Research and Development, OSRD No. 3012 Progress Report: The Generation and Use of Concentrated Mustard Vapor Clouds. December. National Research Defense Research Committee. CBRNIAC-CB-180892.
4. Macintire, B.G. 1942. Test of Coming's Candle with DM.
5. Brigham, C.E. Lt. Col. 1931. Edgewood Arsenal Technical Report, EATR 50, Review of the Research Activities of the Chemical Division, Edgewood Arsenal, 1919-1928, Section 2. Chemical Warfare Service.
6. Comings, E. 1943. Office of Scientific Research and Development, OSRD 3150, Progress Report: Development of the Thermal Generator Candle. January. National Defense Research Committee.
7. Comings, E.W. 1946. Office of Scientific Research and Development, OSRD No. 6574, Development of a Thermal Generator Bomb For Dispensing Concentrated Mustard Aerosol. February. National Defense Research Committee.
8. LeTourneau, R.L. 1944. Florida field trials on the Model F-6 and F-7 thermal generator candle. Chemical Warfare Service.
9. Johnston, H.F., Comings, E.W. 1943. Office of Scientific Research and Development, OSRD Informal Report No. 10.4-38, HE Generation and Use of Concentrated Mustard Vapor Clouds. National Defense Research Committee.
10. Anonymous. 1923. Yearly Report, Chemical Division.
11. Chemical Warfare Service. 1946. Report of Activities of the Technical Division During World War II. January. Army Service Forces.

12.2 Container, Bulk, One-ton, Type A

Figures

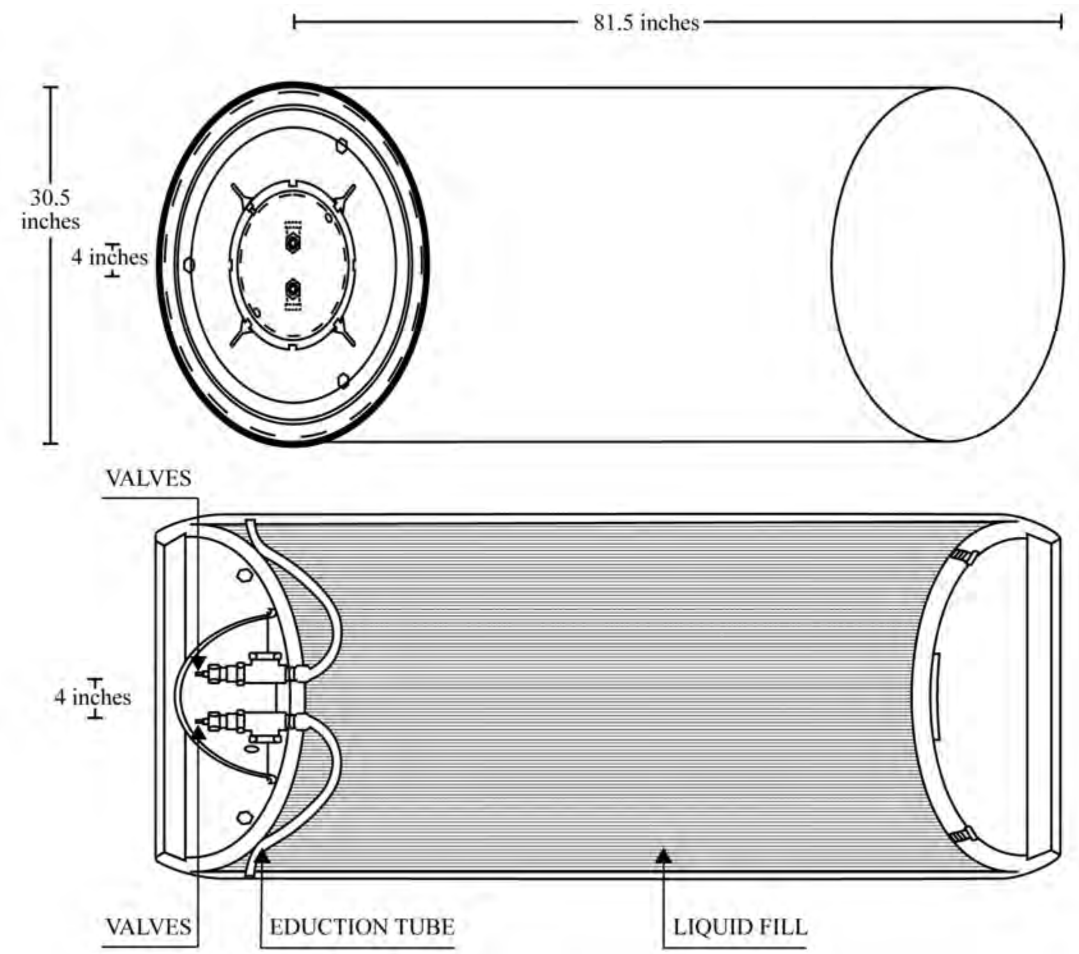

Figure 133: Container, Bulk, One-ton, Type A - Line Drawing

Figure 134: Container, Bulk, One-ton, Type A - Photograph – Container Replica, Cutaway View

Container, Bulk, One-ton, Type A

Specifications

Container, Bulk, One-ton, Type A - Specifications and Other Data		Citation
Historical Name	Container, One-Ton, Type A	1 (p. 12-4)
Type	Miscellaneous	1 (p. 12-4)
Size	One-ton	1 (p. 12-4)
Service	Air Force, Army	2 (p. 4)
Diameter	30.5 in. (77.47 cm)	1 (p. 12-5), 2 (p. 9), 3 (p. 8-4), 4 (p. 1)
Length	81.5 in. (207.01 cm)	1 (p. 12-5), 2 (p. 9), 3 (p. 8-4), 4 (p. 1)
Wall Thickness	0.406 in. (1.03 cm)	1 (p. 12-5)
Other Engineering Data	Weight, Maximum gross: 3,500 lbs. (1,588 kg) Empty: 1.310-1,600 lbs. (894-726 kg) Capacity: 170 gallons (644 liters) Eduction tube spacing: 4 in. (10.16 cm) apart. Eduction tube diameter: 0.5 in. (1.27 cm)	1 (p. 12-5), 2 (p. 9), 3 (p. 8-4), 4 (p. 1), 5 (p. 8)
Drawing	Chemical Corps drawing: C6-10-2	7 (p. 129)
NSN	1365-277-3038 1365-277-3053	-

General Use and Description

The Type A, One-Ton Container was used primarily for transporting and storing bulk quantities of dangerous chemical agents that were gaseous at atmospheric pressure (2 p. 4), (3 p. 8-4), 4 (p. 3).

The Type A container was a steel cylinder. The side walls were approximately 0.41 inches thick and could withstand a maximum internal pressure of 500 psi. The front head of the tank was a concave 0.75-inch thick sheet of steel. Two eduction tube outlets spaced four inches apart and threaded to receive ¾-inch valves were in the middle of the front head. Three tapered plugs were in the middle of the front head as safety devices. The plugs were screwed into 0.75-inch holes. When the container was to be filled with chlorine, fusible plugs that melt at 175 degrees Fahrenheit were installed. When the container was filled with any other chemical agent, nonfusible plugs that would blow out at an internal pressure of 375 psi were installed. For protection during shipment, a metal shipping bonnet, similar to an auto hub cap was fastened over the valves by three bonnet clips and a bonnet-locking clip. A 0.75-inch Chlorine Institute valve was screwed into each eduction tube outlet. A cap with a gasket covered the valve outlet when the valve was not in use (1 p. 12-4, 12-5), (3 p. 8-4), (4 p. 3).

In operation, the container was placed on a stand that was higher than the receptacle that was filled. The shipping bonnet was removed, and the container was rolled until the valves were aligned vertically and was then choked to prevent further rolling. When the valves were aligned one above the other, the end of the eduction tube leading to the upper valve was out of the liquid and could then be used for venting. The end of the other eduction tube was in the liquid, and the contents could be withdrawn through the lower valve. Instructions for the use of one-ton containers were included with the specific item being filled (1 p. 12-4), (3 p. 8-5).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Container, Bulk, One-ton, Type A

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Container, Bulk, One-ton, Type A - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	1,000	453	2,600	1,179	-	1 (p. 12-5), 3 (p. 8-4), 4 (p. 5), 7 (p. 131)
CG	1,600	725	3,200	1,451	-	1 (p. 12-5), 3 (p. 8-4), 6 (p. 2), 7 (p. 131)
CK	1,600	725	3,200	1,451	-	1 (p. 12-5, 3 (p. 8-4), 6 (p. 2), 7 (p. 131)
Cl	1,600-2,000	725-907	3,200-3,455	1,451-1,567	-	1 (p. 12-5), 3 (p. 8-4), 5 (p. 8), 7 (p. 131)
PS	2,000	907	3,310-3,500	1,501-1,588		5 (p. 8)

Shipping/Packing

For protection during shipment, a metal shipping bonnet similar to an auto hub cap was fastened over the valves by three bonnet clips and a bonnet-locking clip. A 0.75-inch Chlorine Institute valve was screwed into each eduction tube outlet. A cap covered with a gasket covered the valve outlet when the valve was not in use (1 p. 12-4), (4 p. 3).

Miscellaneous

Ton containers were used for the storage and shipment of chemical agents and smokes from WWI. Commercial items were used prior to, during, and after WWII. As of 1955, 8,476 Type A containers had been procured with 2,070 empties on hand and 350 additional leased (7 p. 128, 130).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
2. Departments of the Army and Air Force. 1955. Technical Manual, TM 3-255/Technical Order, TO 11C8-1-1, Chemical Filling and Handling Equipment. Departments of the Army and Air Force.
3. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
4. Department of the Army. 1964. Technical Bulletin, TB CML 111, One-Ton Containers. Naval Ordnance Systems Command.
5. War Department. 1944. Technical Manual, TM 3-255, Chemical Handling and Loading Equipment. Change 2.
6. Chemical Corps Technical Committee. 1959. Chemical Corps Book of Standards, Edition of 25 November 1959. Department of the Army.
7. Chemical Corps Technical Committee. 1955. CCTC Item # 3011, Status of One Ton Containers, Types A, D & E for Storage & Shipment of Chemical Agents, Read for Record. Department of the Army. 1 April.

12.3 Container, Bulk, One-ton, Type D

Figures

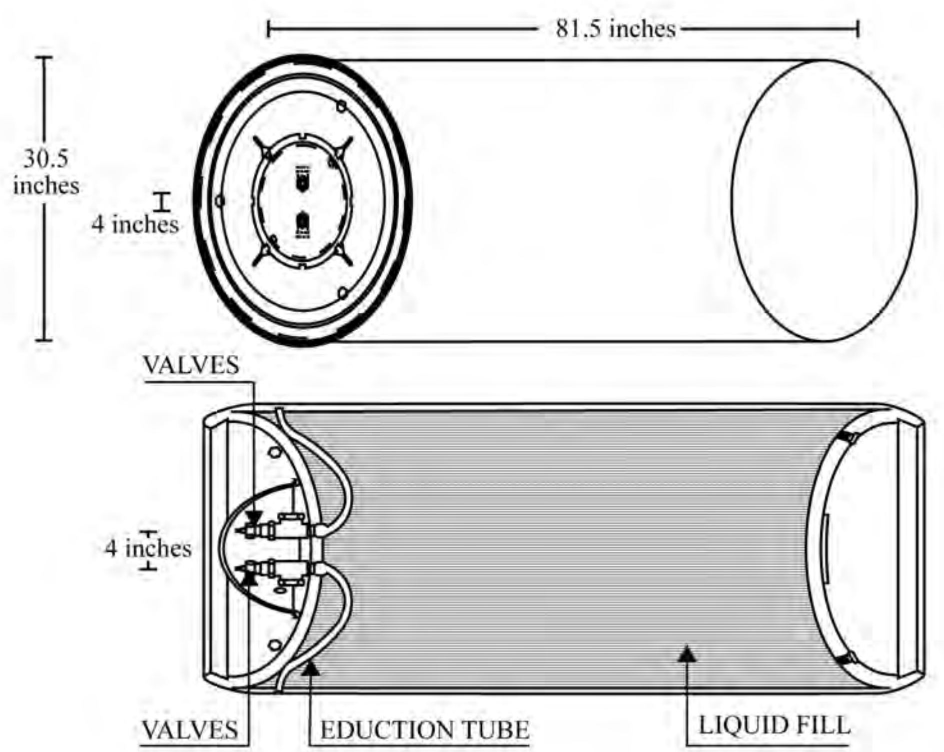

Figure 135: Container, Bulk, One-ton, Type D - Line Drawing

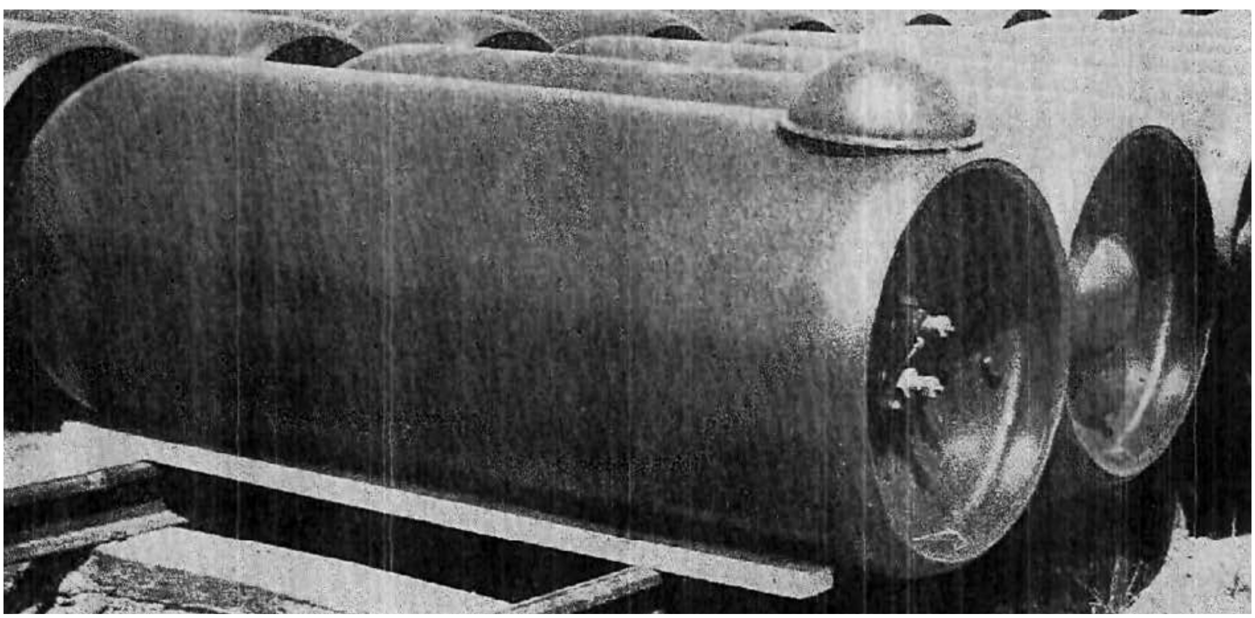

Figure 136: Container, Bulk, One-ton, Type D - Photograph

Figure 137: Container, Bulk, One-ton, Type D - Photograph

Specifications

Container, Bulk, One-ton, Type D - Specifications and Other Data		Citation
Historical Name	Container, One-Ton, Type D	1 (p. 12-6)
Type	Miscellaneous	1 (p. 12-6), 2 (p. 1)
Size	Bulk, One-ton	1 (p. 12-6), 2 (p. 1)
Diameter	30.5 in. (77.47 cm) Eduction tube: 1 in (2.54 cm)	1 (p. 12-6), 3 (p. 8-7), 4 (p. 5)
Length	81.5 in. (207.01 cm)	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5)
Wall Thickness	0.406 in. (1.03 cm)	1 (p. 12-7)
Other Engineering Data	Weight, Maximum gross: 3,500 lbs. (1,588 kg) Empty: 1,600 lbs. (726 kg) Capacity: 170 gallons (644 liters) Eduction tube spacing: 4 in. (10.16 cm) apart	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 8 (p. 8), 9 (p, 155)
Drawing	Chemical Corps drawing: C6-10-8	2 (p. 2), 7 (p. 218)
Specification	MIL-C-3250	7 (p. 128)
NSN	1365-293-9239 1365-277-3039 1365-277-3040 1365-277-3041	-

General Use and Description

The Type D One-Ton Container was used primarily for transporting and storing bulk quantities of chemical agents that were either liquid or gaseous at atmospheric pressure. Type D containers were preferred for all purposes while the other types were only used when an alternative was needed (1 p. 12-6), (3 p. 8-8), (4 p. 1), (7 p. 128).

The Type D container was a steel cylinder 81.5-inches long and 30.5 inches in diameter. The Type D container was identical with the Type A container except for the inside diameter of the eduction tubes and eduction tube outlets. The inside diameter of the eduction tubes in the Type D Container was one-inch. The two curved eduction tubes were welded inside the front head. Each tube was connected to its separate valve and the other ends of both tubes went in opposite directions to the side wall. The ends came within 0.25-inch of the side walls.

Chlorine Institute one-inch valves or one-inch angle valves were screwed into the eduction tube outlets. Angle valves were used only in containers under low internal pressure. Chlorine Institute valves were used in containers under high-pressure.

Three tapered safety plugs were spread evenly around the outer edges of the front and rear heads. These were designed to fail and release in the event of extreme pressure build up. The center of the rear head had a circular soldered plate with the serial number, date tested, and ownership (1 p. 12-6), (3 p. 8-8), (4 p. 3, 5).

The operation of the Type D Container was the same as that for the Type A, except that there was a choice of Chlorine Institute one-inch valves or one-inch angle valves (1 p. 12-6), (3 p. 8-8).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Container, Bulk, One-ton, Type D - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	1,000	453	2,600	1,179	Chlorine valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 7 (p. 131)
CG	1,600	725	3,200	1,451	Chlorine valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 7 (p. 131)
CK	1,600	725	3,200	1,451	Chlorine valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 7 (p. 131)
Cl	1,600	725	3,200	1,451	Chlorine valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 7 (p. 131)
GA	1,400-1,600	635-725	3,000-3,200	1,360-1,588	-	4 (p. 5), 7 (p. 129, 131)
GB	1,500-1,600	680-725	3,100-3,200	1,406-1,451	Angle valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 5 (p. 2), 7 (p. 129, 131)
H	1,800-1,900	816-861	3,400-3,500	1,542-1,588	Angle valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 7 (p. 129, 131), 8 (p. 8)
HD	1,800-1,855	816-841	3,400-3,500	1,542-1,588	Angle valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 7 (p. 129, 131)
HN-1	1,800	816	3,400	1,542	Angle valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 7 (p. 129, 131)
HT	1,800	816	3,400	1,542	Angle valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5), 5 (p. 3), 7 (p. 129, 131)
L	1,900-2,660	862-1,206	3,500	1,588	Angle valve	7 (p. 129, 131), 8 (p. 8), 9 (p. 155)
VX	1,500	680	3,100	1,406	Angle valve	1 (p. 12-7), 3 (p. 8-7), 4 (p. 5)

Shipping/Packing

The containers were shipped uncrated. A 14-inch shipping bonnet was installed over the valves was secured by four clips (2 p. 5), (9 p. 158).

Miscellaneous

Ton containers were used for the storage and shipment of chemical agents and smokes from WWI. Commercial items were used prior to, during, and after WWII. As of 1955, 72,847 Type D containers had been procured with 22,600 empty and on hand. Only 1,980 Type D containers had been procured between the end of WWII and 1955 (7).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
2. Chemical Corps. 1949. Chemical Corps Tentative Specification No. 196-61-22, Container, One-Ton, Type D. Naval Sea Systems Command.
3. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
4. Department of the Army. 1964. Technical Bulletin, TB CML 111, One-Ton Containers. Naval Ordnance Systems Command.
5. Chemical Corps Technical Committee. 1959. Chemical Corps Book of Standards, Edition of 25 November 1959. Department of the Army.
6. Chemical Corps Technical Committee. 1955. Chemical Corps Book of Standards, 1955. Department of the Army.
7. Chemical Corps Technical Committee. 1955. CCTC Item # 3011, Status of One Ton Containers, Types A, D & E for Storage & Shipment of Chemical Agents, Read for Record. Department of the Army. 1 April.
8. War Department. 1944. Technical Manual, TM 3-255, Chemical Handling and Loading Equipment. Change 2.
9. War Department. 1943. Technical Manual, TM 3-255, Chemical Handling and Loading Equipment. 30 October.

12.4 Container, Bulk, One-ton, Type E

Figures

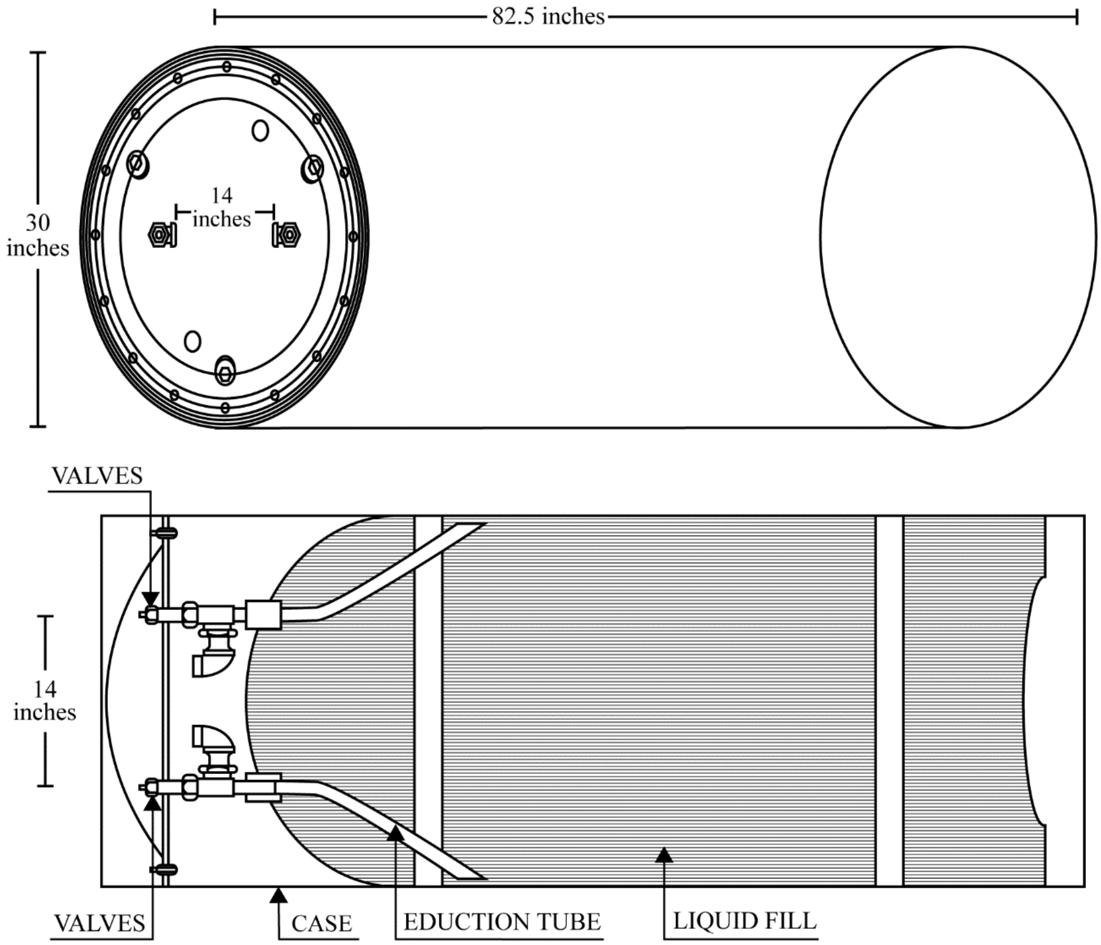

Figure 138: Container, Bulk, One-ton, Type E - Line Drawing

Specifications

Container, Bulk, One-ton, Type E - Specifications and Other Data		**Citation**
Historical Name	Container, One-Ton, Type E	1 (p. 12-8)
Type	Miscellaneous	1 (p. 12-8), 2 (p. 1)
Size	Bulk, One-ton	1 (p. 12-8), 2 (p. 1)
Diameter	30 in. (76.2 cm) Eduction tube: 1 inch (2.54 cm)	1 (p. 12-9), 3 (p. 8-9), 4 (p. 3, 5)
Length	Total: 82.5 in. (210 cm) Without protective housings: 73 in. (185.4 cm)	1 (p. 12-9), 3 (p. 8-9), 4 (p. 3, 5), 7
Wall Thickness	0.28 in. (0.71 cm)	1 (p. 12-9), 3 (p. 8-9), 4 (p. 3)
Other Engineering Data	Weight, Maximum gross: 3,500 lbs. (1,588 kg) Empty: 900 lbs. (408 kg) Capacity: 170 gallons (644 liters) Eduction tube spacing: 14 in. (35.56 cm) apart	1 (p. 12-9), 3 (p. 8-9), 4 (p. 5), 5 (p. 8-9)
Construction Material	Open hearth or electric furnace steel	2 (p. 1), 4 (p. 3)
Drawing	CWS 06-10-14	2 (p. 1), 7 (p. 129)
Spec	96-31-64	2, 7 (p. 130)
NSN	1365-277-3038	-

Container, Bulk, One-ton, Type E

General Use and Description

The Type E One-Ton Container was used as a substitute for either Type A or Type D containers for transport and storage of gaseous agents or liquid chemical agents in bulk quantities (1 p. 12-8), (3 p. 8-10), (4 p. 1).

During WWII, steel forgings for ton containers were not available and the Type E Container was designed commercially and an alternate. Although resembling Types A and D containers in size and function, the Type E Container differed significantly in construction. The Type E Container was lightweight, longitudinally fusion-welded, of rolled-steel plate with convex ends projecting beyond the of the cylinder shell to protect the valves. The Type E Container without the front and rear protective housings is a container 73 inches long and 30 inches in diameter, with elliptical front and rear heads. The walls are 0.28 inches thick. With front and rear protective housings, the container length is 81.5 inches (7) (8 p. 9).

The front head was a convex dome welded to the front end of the container. Two eduction tube outlets, 14 inches apart, were in the front head. Each outlet was threaded to receive a one-inch (either Chlorine Institute or angle) valve. Three tapered plugs were screwed into 0.75-inch holes spaced equally around the outer edge of the front and rear heads. The plugs would blow out when the internal pressure became too high. Fusible plugs were installed when the container was filled with Cl, CG, or PS; nonfusible plugs were installed when it was filled with other chemical agents. A circular protective cover was bolted to the front protective housing (by 16 3/8-inch bolts) to protect the front head during shipment. The rear head is identical to the front with the exception that there are no eduction tube outlets. A rear protective housing protrudes about an inch beyond the rear head (1 p. 12-8), (3 p. 8-10), (4 p. 3, 4), (8 p. 9, 10).

The operation of the type E Container is the same as that for the Type A or D, depending on the type of valve installed (1 p. 12-8), (3 p. 8-10).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Container, Bulk, One-ton, Type E - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	1,000	453	1,900	862	Chlorine valve	1 (p. 12-9), 3 (p. 8-9), 7 (p. 131)
CG	1,600-1,850	726-839	2,500-2,750	1,134-1,166	Chlorine valve	1 (p. 12-9), 2 (p. 3), 3 (p. 8-9), 6 (p. 2), 7 (p. 131), 9 (p. 159)
CK	1,600	726	2,500	1,134	Chlorine valve	1, 3 (p. 8-9), 7 (p. 131), 8
Cl	1,600	726	2,500	1,134	Chlorine valve	1 (p. 12-9), 2 (p. 3), 3 (p. 8-9), 7 (p. 131), 8 (p. 9)
GA	1,600	726	2,500	1,134-1,134	Angle valve	7 (p. 131)

Container, Bulk, One-ton, Type E

Container, Bulk, One-ton, Type E - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1,600	726	2,500	1,134	Angle valve	1 (p. 12-9), 3 (p. 8-9), 7 (p. 131)
H	1,800	816	2,700	1,225	Angle valve	1 (p. 12-9), 3 (p. 8-9), 7 (p. 131), 8 (p. 9)
HD	1,800	816	2,700	1,225	Angle valve	1 (p. 12-9), 3 (p. 8-9), 7 (p. 131)
HN-1	1,800	816	2,700	1,225-	Angle valve	1 (p. 12-9), 3 (p. 8-9), 7 (p. 131)
HT	1,800	816	2,700	1,225	Angle valve	1 (p. 12-9), 3 (p. 8-9), 7 (p. 131)
L	1,900	862	2,800	1,270	Angle valve	7 (p. 131), 8 (p. 9)
PS	N/A	N/A	N/A	N/A	Chlorine valve	8 (p. 9)
VX	1,500	680	2,400	1,088	Angle valve	1 (p. 12-9), 3 (p. 8-9)

Shipping/Packing

Available references did not provide this information.

Miscellaneous

The Type E Container was not compliant with Interstate Commerce Commission specifications and unlike the Type A and D containers was only authorized for military shipments. As of 1955, 18,604 Type E containers had been procured with 9,400 empty and on hand (7 p. 130).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
2. Chemical Warfare Service. 1943. Chemical Warfare Service Specification No. 196-31-64, Container, One-Ton, Type E. Chemical Warfare Procurement.
3. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
4. Department of the Army. 1964. Technical Bulletin, TB CML 111, One-Ton Containers. Naval Ordnance Systems Command.
5. Department of the Navy. n.d. NAVWEPS Ordnance Pamphlet, OP 2212 Vol. 1 Aircraft Bombs, Fuzes and Associated Equipment. Department of the Navy.
6. Chemical Corps Technical Committee. 1955. Chemical Corps Book of Standards, 1955. Department of the Army.
7. Chemical Corps Technical Committee. 1955. CCTC Item # 3011, Status of One Ton Containers, Types A, D & E for Storage & Shipment of Chemical Agents, Read for Record. Department of the Army. 1 April.
8. War Department. 1944. Technical Manual, TM 3-255, Chemical Handling and Loading Equipment. Change 2.
9. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.

12.5 Cylinder, Portable, MI, MIA1, MIA2

Figures

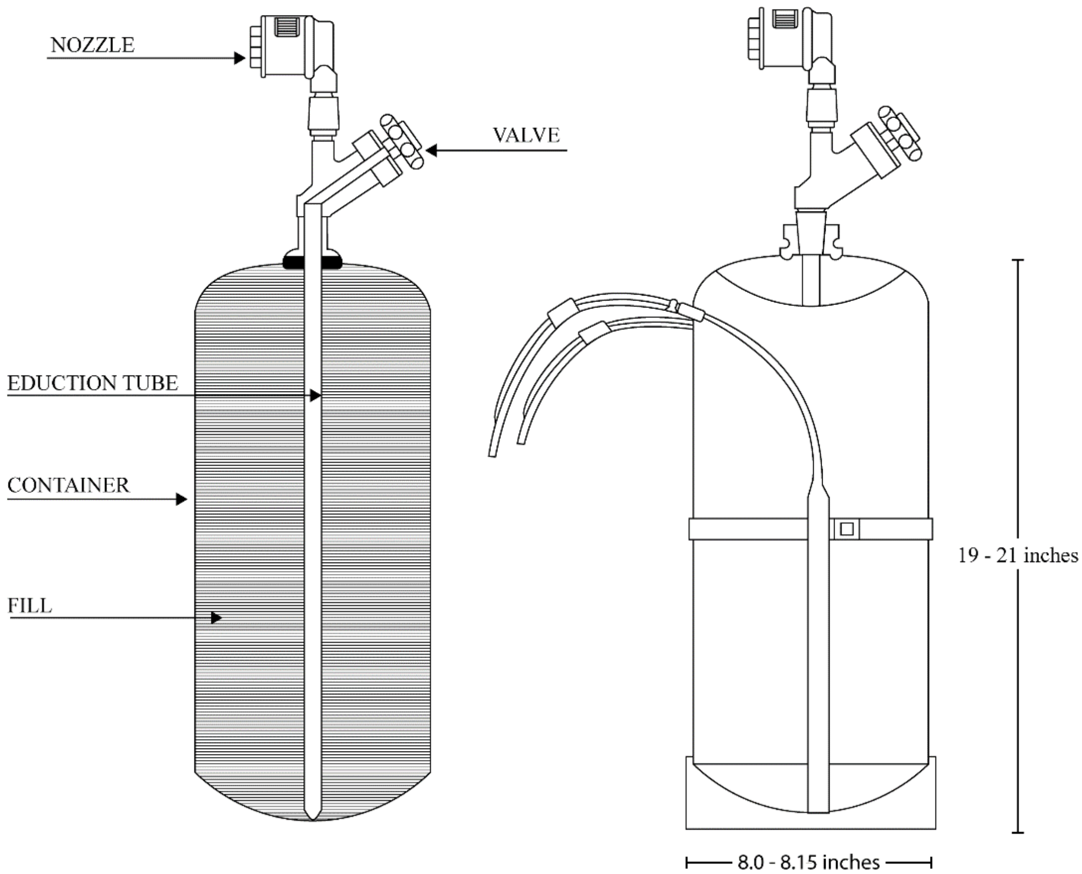

Figure 139: Cylinder, Portable, MI, MIA1, MIA2 - Line Drawing - M1A1, M1A2

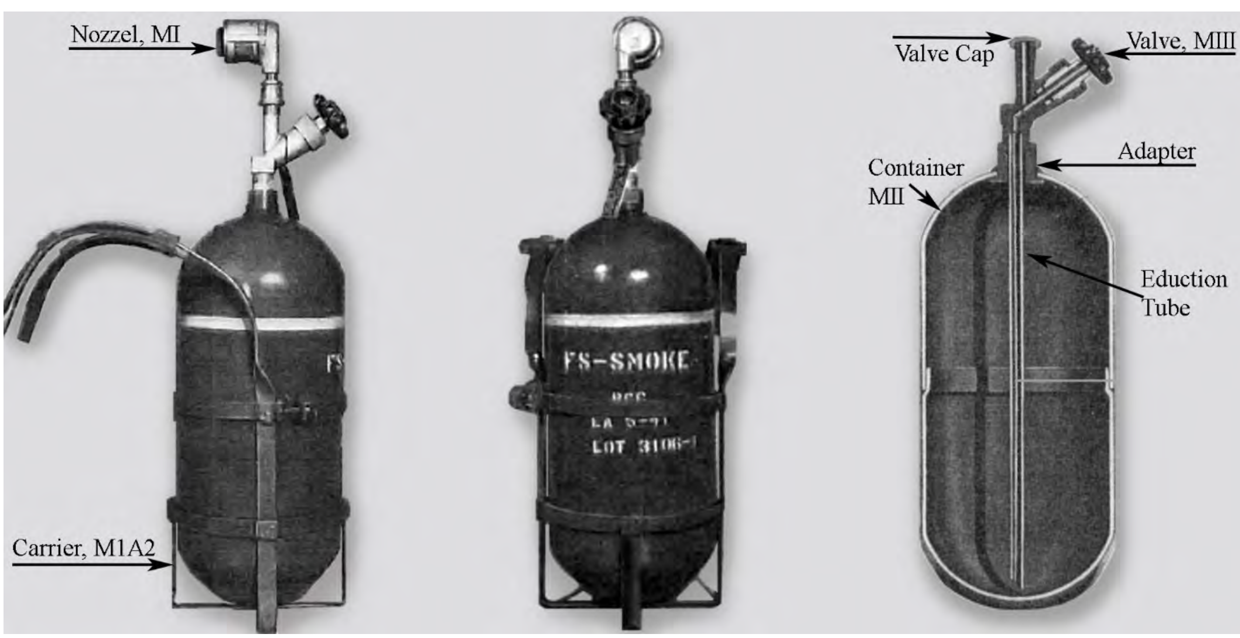

Figure 140: Cylinder, Portable, MIA2 - Photograph

Cylinder, Portable, MI, MIA1, MIA2

Specifications

Cylinder, Portable, MI, MIA1, MIA2 - Specifications and Other Data		Citation
Historical Name	Portable Chemical Cylinder, MI, MIA1, MIA2	1 (p. 3)
Developmental Information	E3: MIA1	1
Type	Miscellaneous	1
Diameter	MI, MIA1: 8 in. (20.32 cm) MIA2: 8.15 in. (20.72 cm)	1 (p. 3, 5)
Length	MI: 19.75 in. (50.16 cm) MIA1: 21 in. (53.34 cm) MIA2: 19 in. (48.26 cm)	1 (p. 3, 5)
Wall Thickness	0.078 in. (0.198 cm)	6 (p. 3)
Other Engineering Data	The MK 1 chemical cylinder was redesignated MI. Weight, Empty: 22 lbs. (9.98 kg).	1 (p. 14)
Construction Material	Container MII: Steel Valve MIII: Brass	1 (p. 5, 8)

General Use and Description

Cylinder was the name given to the gas container intended to be carried forward and discharged in or near the front line (3 p. 25), (4 p. 2), (5), (6).

The portable chemical cylinder was a weapon of high mobility and chemical efficiency, but its use depended entirely upon opportunity, favorable weather, and terrain conditions. The portable cylinder was designed to be man-portable, as noiseless as possible when discharging, and adopted for use without the need for special emplacement or digging in. The Toxic Gas Cylinder, Mark I (MI) consisted of a toxic gas nozzle, gas valve, and firing mechanism for opening the cylinder. The MIA1 is essentially the same as the MI except for some minor changes (1 p. 2).

The MIA2 cylinder consisted of five parts:

1. Container MII: This was a steel cylinder that had a hemispherical top and bottom. The bottom half was joined to the upper half by a welded joint (1 p. 5).
2. Eduction tube: The eduction tube was 19-9/16 inches long and consisted of standard black wrought iron pipe. It was cut at its bottom at a 45-degree angle to insure free flow of liquid (1 p. 6).
3. Valve MIII: The valve was of the Y-type. The brass body had the shape of an offset Y, and was provided with threads at the bottom to receive the eduction tube and to screw into the container adapter, and at the top to receive the nozzle or outlet cap. The copper nickel valve stem operated by a screw thread along the inside of a brass packing gland to open or close the valve (1 p. 8).
4. Carrier MIA2: Portable chemical cylinder carrier MIA2 was constructed of steel strips. The steel strips were 1/8-inch thick and 7/8-inch wide. Leather shoulder pads were slipped over the carrier hooks for comfort (1 p. 13), (3 p. 26).
5. Nozzle MI: The nozzle was attached to the threaded end of the valve outlet and was designed to decrease the loud hissing noise caused by gas escaping under pressure. This nozzle was used only when the principle of surprise was to be utilized (1 p. 10).

The limited standard cylinders were the MI and MIA1. They differed from the standard MIA2 cylinder only in the method of construction of the container, and a slight difference in the carrier dimensions. The bottom of the MI cylinder container was a lipped metal cup inserted into the container and welded at its bottom edge. The bottom of the MIA1 cylinder container was convex in shape and welded to the extreme bottom of the container without insertion (1 p. 3), (2), (3 p. 26), (4), (5 p. 2), (6).

Explosive Train

This item required no explosive train. The standard method of releasing the contents of the cylinder was by a manually operated valve. One person could fire three to five cylinders by hand. The E4 nozzle could fire the cylinder electrically (1 p. 2, 3, 10), (2), (3 p. 26), (4), (5 p. 18), (6).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Cylinder, Portable, MI, MIA1, MIA2 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	31.0-32.5	14.1-14.7	55.0-57.5	24.9-26.1	-	1 (p. 5), 7 (p. 12)
CG/Cl	N/A	N/A	N/A	N/A	50% CG, 50% Cl	8 (p. 4)
CNB (chloroacetophenone solution)	23.0	10.4	48.0	21.8	Authorized for training	1 (p 5)
CNS	28.5-30.0	12.9-13.6	55.0	24.9	Authorized for training	1 (p. 5), 7 (p. 12)
FM	36.0	16.3	60.0	27.2	-	1 (p. 5)
FS (Sulfur trioxide and chlorosulfonic acid)	36.0	16.3	60.0	27.2-27.1	-	1 (p. 5)
PS/Cl	N/A	N/A	N/A	N/A	30% PS, 70% Cl	8 (p. 4)

Shipping/Packing

Two complete portable cylinders were packed together in a wooden box for shipment. The dimensions of the packing box permitted the portable cylinders to be packed with the valves and eduction tubes assembled to the containers. The standard MI nozzles were packed separately in the box. The components of the portable chemical cylinder were sometimes packed in an unassembled condition, in which case a shipping plug was screwed into the opening of the container.

The packing box was constructed of wood. The packing box with empty cylinders weighed approximately 77 pounds and displaced approximately 4 cubic feet. (1 p. 15, 16).

Miscellaneous Information

In 1946 when the cylinders were recommended for obsolescence, there were 5 MI, 4,406 MIA1 and 4,239 MIA2 in the inventory. At the time of obsolescence, a small number of cylinders were retained for use as shipping containers for small quantities of chemical agents (8 p. 8), (9 p. 122).

Cylinder, Portable, MI, MIA1, MIA2

Key Dates

Cylinder, Portable, MI, MIA1, MIA2 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1921	Letter AGO 471, CG/CL-fill, Approved Type	8 (p. 4)
Standardized	1924	Letter CWS 400.114/280, Mark I Standard	8 (p. 4)
Redesignated	1930	Letter CWS 400.114/1668, Mark I redesignated MI	8 (p. 4)
Standardized	1932	CWSBC Item 36, MIA1 Standard	8 (p. 4)
Standardized	1933	CCTC 1933-02 (GC, FM, and CN-solution fill)	10 (p. 2)
Standardized	1936	Memo CWS 400.12/28, MIA2 Standard, MI Limited Standard	8 (p. 5)
Standardized	1942	CCTC 486 (CNB-fill)	-
Obsoleted	1945	CCTC 1464, 1527 (CL-fill)	8 (p. 7), 11 (p. 83)
Obsoleted	1946	CCTC 1545, 1614 (M1, M1A1 and M1A2) (CG, CNB, FS, and FM-fill)	8 (p. 9), 9 (p. 122)

Sources

1. War Department. 1942. Technical Manual, TM 3-315, Portable Chemical Cylinder MIA2. War Department.
2. Perkins, George W. 1943. Chemical Warfare Board Project No. 362, Cylinder, Portable, Chemical M1A2. Chemical Warfare Board.
3. Liebig, George F., Jr. 1924. Department of Technique, Book IV, Materiel, Cylinders. Chemical Warfare School, Department of Technique.
4. Weaver, F.R. 1934. Edgewood Arsenal Technical Report, EATR 147, Portable Chemical Cylinder MIA1 (E3), A Final Report. War Department.
5. Greene, L.W. 1937. Edgewood Arsenal Technical Report, EATR 228, Portable Chemical Cylinder MIA2, Complete, Engineering Tests. War Department.
6. Powell, Hartley C. 1934. Edgewood Arsenal Technical Report, EATR 169, Portable Chemical Cylinder MII, A Status Report. War Department.
7. Bouder, N.M., & Powell, H.C. 1931. Approximate Average Weights of Fillings in Chemical Munitions. Information Division.
8. Chemical Corps Technical Committee. 1946. CCTC Item # 1545, Subject: Obsoletion of Cylinders, Portable, Chemical, MI, MIA1, MIA2 and Apparatus, Charging, Portable Chemical Cylinder, MI. Department of the Army.
9. Chemical Corps Technical Committee. 1946. CCTC Item # 1614, Subject: Obsoletion of Cylinders, Portable, Chemical, MI, MIA1, MIA2 and Apparatus, Charging, Portable Chemical Cylinder, MI. Department of the Army.
10. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. Department of the Army.
11. Chemical Corps Technical Committee. 1945. CCTC Item # 1527, Cancellation of the Authorization to Use Cl as a Chemical Warfare Agent Filling. Department of the Army.

12.6 Cylinder, 150-pound

Figures

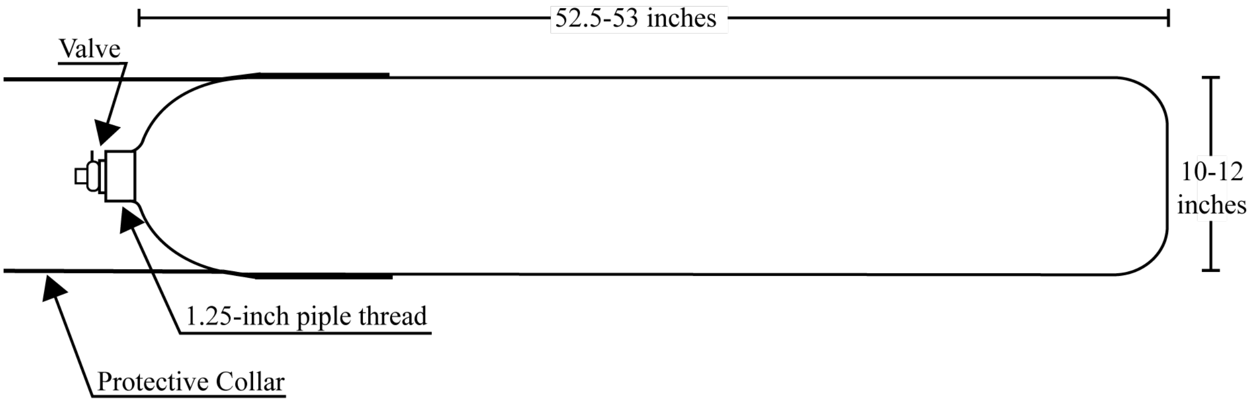

Figure 141: Cylinder, 150-pound – Line Drawing

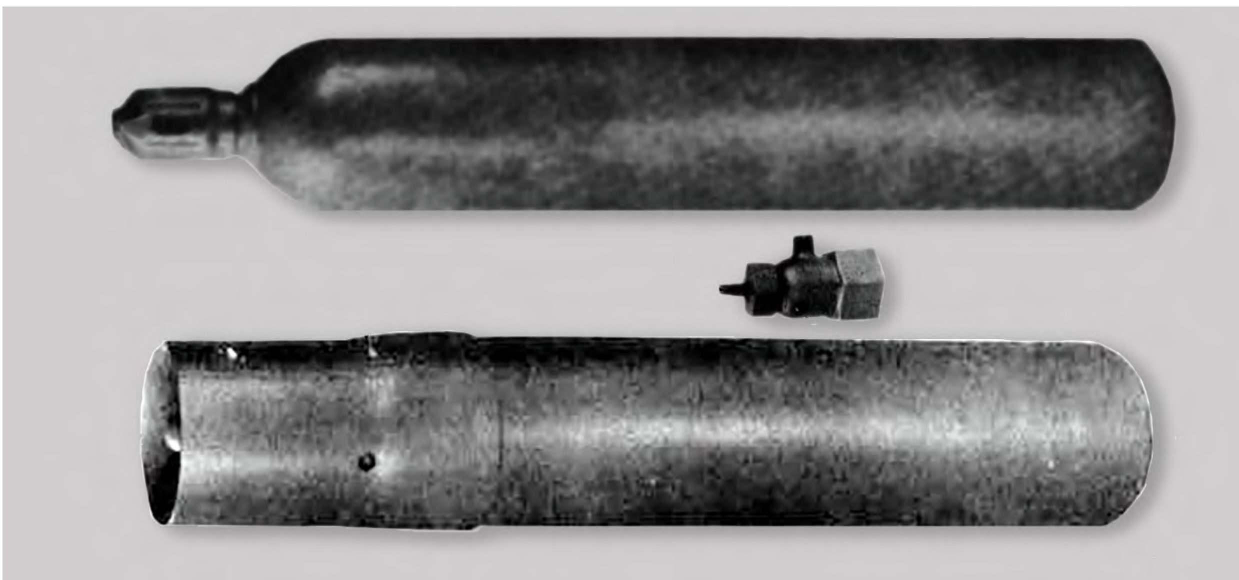

Figure 142: Cylinder, 150-pound – Photograph, Top: without protective collar, Bottom: with protective collar

Specifications

Cylinder, 150-pound – Specifications and Other Data		Citation
Historical Name	150-pound Steel Cylinder	1 (p. 198)
Type	Container	1 (p. 198)
Size	150-pound	2 (p. 10)
Service	Army	3 (p. 2)
Conflict	WWII, Cold War	1, 3, 4
Diameter	10-12 in. (25.4-30.5 cm)	1 (p. 198), 5 (p. 11)
Height	52.5-53 in. (133-136 cm)	1 (p. 198), 5 (p. 11)
Other	Weight, Empty: 182 lbs. (82.6 kg)	5 (p. 11)
Construction Material	Body: Steel Valve: Bronze	2 (p. 10)
Specification/PD No	3D, 33 96-6-303	2 (p. 10)

Cylinder, 150-pound

General Use and Description

The 150-pound capacity cylinder was used to transport mustard or phosgene (5 p. 11). The cylinder had an extension ring on the top to protect the valves. The cylinder closure was a double bronze valve. The outlets were a 1/8-inch standard pipe size and the female opening closed with a Monel or brass plug. The entire valve assembly was covered by a bronze protection cap that was screwed on to the cylinder and made gastight with a gasket (2 p. 10).

Explosive Train

There was no explosive train for this container.

Fuzing

There was no fuze for this container.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this container.

Fills

Cylinder, 150-pound – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
CG	150	68	332	151	1 (p. 198), 2 (p. 10), 5 (p. 11, 87)
H	N/A	N/A	N/A	N/A	1 (p. 198)

Shipping/Packing

The 150-pound cylinders were fitted with a transit cap for shipment and also had a permanent protective collar (1 p. 198) (3 p. 12). The cylinders were packed in open crates to prevent relative movement during flight (5 p. 51).

Key Dates

Cylinder, 150-pound – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1941	CCTC 353 (Specification cancellation recommended)	6

Sources

1. War Department. 1943. Technical Manual, TM 3-255 Chemical Handling and Loading Equipment. October.
2. Safety and Fire Protection Committee. 1967. Chemical Safety Data Sheet SD-95, Properties and Essential Information of Safety Handling and Use of Phosgene. July. Manufacturing Chemists Association.
3. Department of the Army. 1969. Technical Manual, TM 3-250 Storage, Shipment Handling and Disposal of Chemical Agents and Hazardous Chemicals. March.
4. War Department. 1943. AR 850-60, Miscellaneous, Compressed Gas Cylinders; Safe Handling, Storing, Shipping, Using. April. U.S. Government Printing Office.
5. The Chemical Corps School. 1951. Special Text 3-250-1, Bulk Chemicals and Chemical Agents. February.
6. Chemical Corps Technical Committee. 1941. CCTC Item # 353, Cancellation of Obsolete Specifications - Subcommittee Report for Approval. (CWS 400.114/1916). Department of the Army. July 22.

12.7 Cylinder, 300-pound

Figures

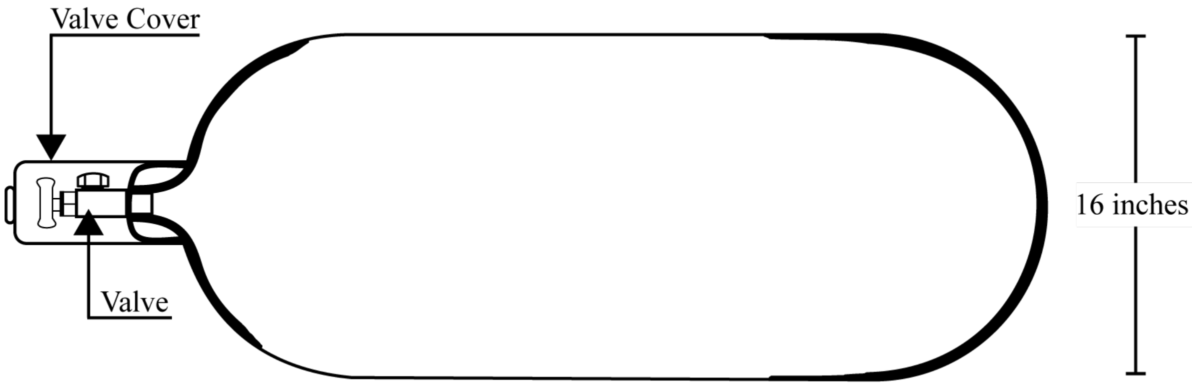

Figure 143: Cylinder, 300-pound – Line Drawing

Specifications

Cylinder, 300-pound – Specifications and Other Data		Citation
Historical Name	Cylinder, Steel, 300 lbs., steel, intra-plant	1 (p. 3)
Type	Container	1 (p. 3)
Size	300-pound	1 (p. 3), 2 (p. 2)
Diameter	16 in. (40.6 cm)	3
Length	Without valve: about 43 in. (109 cm)	3
Construction Material	Steel	1 (p. 3), 2 (p. 2), 3
Specification	96-61-3	1 (p. 3)

General Use and Description

The shipment of CG required a container that would withstand a relatively high-pressure and corrosive action. Special steel containers were designed for this purpose. The 300-pound cylinder was originally designed to transport CG from the manufacturing plant at Edgewood Arsenal to the filling plant (2 p. 2).

Explosive Train

There was no explosive train for this shipping container.

Fuzing

There was no fuze for this shipping container.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this shipping container.

Fills

Cylinder, 300-pound – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
CG	300	136	N/A	N/A	4 (p. 69)

Shipping/Packing

Available references did not provide this information.

Miscellaneous

As of March 1919, Edgewood Arsenal had purchased 3,500 300-pound phosgene cylinders with 2,500 having been delivered (2 p. 2), (4 p. 69).

Key Dates

Available references did not provide this information.

Sources

1. Montgomery, E. Major. 1928. Chemical Warfare Board Project No. 5, System of Marking Chemical Warfare Munitions. Edgewood Arsenal. November 21.
2. Unknown. n.d. Report on Toxic Gas Containers, Edgewood Arsenal. AD0495499.
3. Anonymous. 1922. Drawing. Gas Container, 300-pound.
4. Edgewood Arsenal 1919. An Historical Sketch of Edgewood Arsenal. March 1.

12.8 Drone Weapon System, Multipurpose, AN-USD-2

Figures

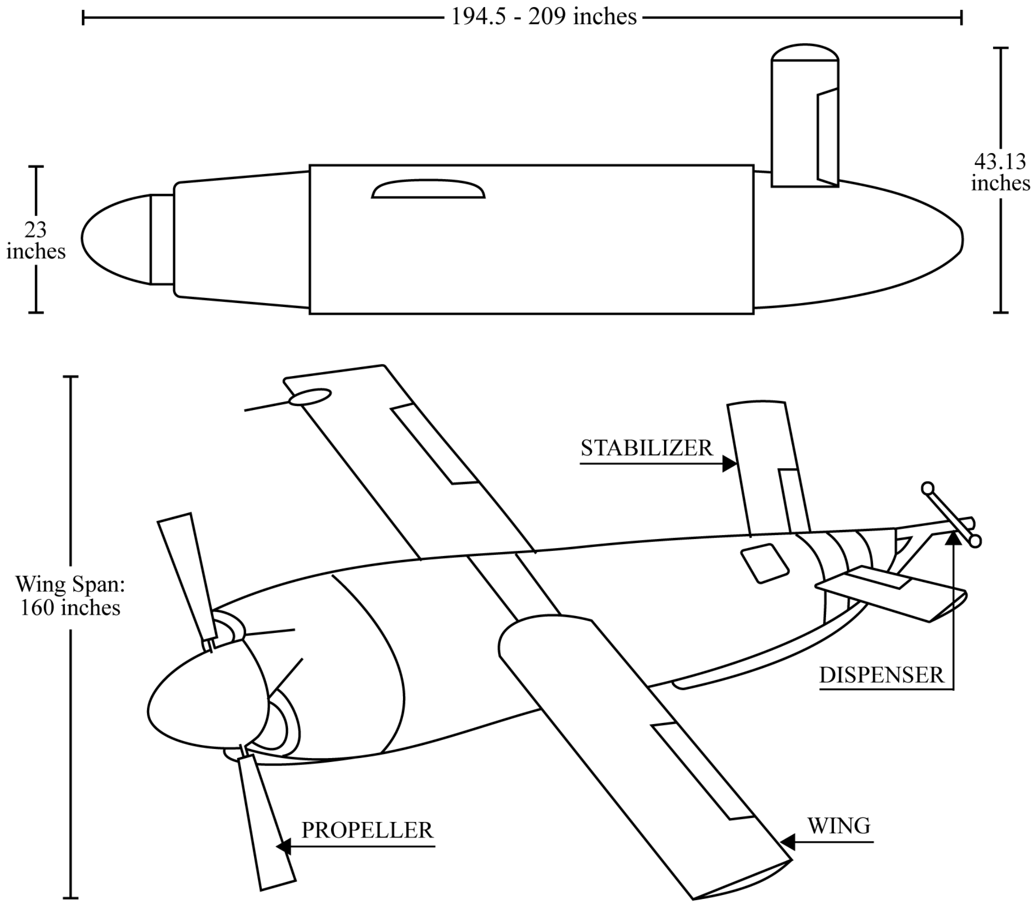

Figure 144: Drone Weapon System, Multipurpose, AN-USD-2 - Line Drawing

Figure 145: Drone Weapon System, Multipurpose, AN-USD-2 - Photograph

Drone Weapon System, Multipurpose, AN-USD-2

Specifications

Drone Weapon System, Multipurpose, AN-USD-2 - Specifications and Other Data		**Citation**
Historical Name	Drone Weapons System, Multipurpose, AN-USD2	1 (p. 4-88), 2 (p. 4-88)
Type	Miscellaneous	1 (p. 4-88), 2 (p. 4-88)
Diameter	23 in. (58.42 cm)	2 (p. 4-89), 3 (p. 4-88)
Length	194.5-209 in. (494-531 cm)	2 (p. 4-89), 3 (p. 4-88)
Height	43.13 in. (110 cm) including stabilizer	3 (p. 4-87)
Other	Wingspan: 160 in. (406 cm)	2 (p. 4-89), 3 (p. 4-88)
Other Engineering Data	Weight, Operational: 1,500 lbs. (630 kg) Empty: 790 lbs. (358 kg) Fill Payload: 210 lbs. (95.3 kg) Drone Capacity: 25 gallons (94.6 liters)	2 (p. 4-89), 3 (p. 4-88)

General Use and Description

The AN-USD-2 was developed for use in dissemination of biological and chemical agents, as well as for combat surveillance 2 (p. 4-88), 3 (p. 4-87)

The AN-USD 2 was a remote controlled, low endurance, recoverable drone. The guidance system was line-of-sight command and pre-programming.

The dissemination nozzle was in the tail section. Dispensing altitude was 100 to 250 feet (30.48-76.42 meters) (2 p. 4-88, 4-89), (3 p. 4-87, 4-88).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Drone Weapon System, Multipurpose, AN-USD-2 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
VX	210	95.2	1,500	680	-	2 (p. 4-88), 3 (p. 4-87)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

Sarin was not recommended for use in drones (2 p. 4-88).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1966. NAVWEPS Report 8566, Characteristics of Biological and Chemical Munitions and Delivery Systems. Naval Ordnance Laboratory.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
3. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

12.9 Drone Weapon System, Multipurpose, AN-USD-4

Figures

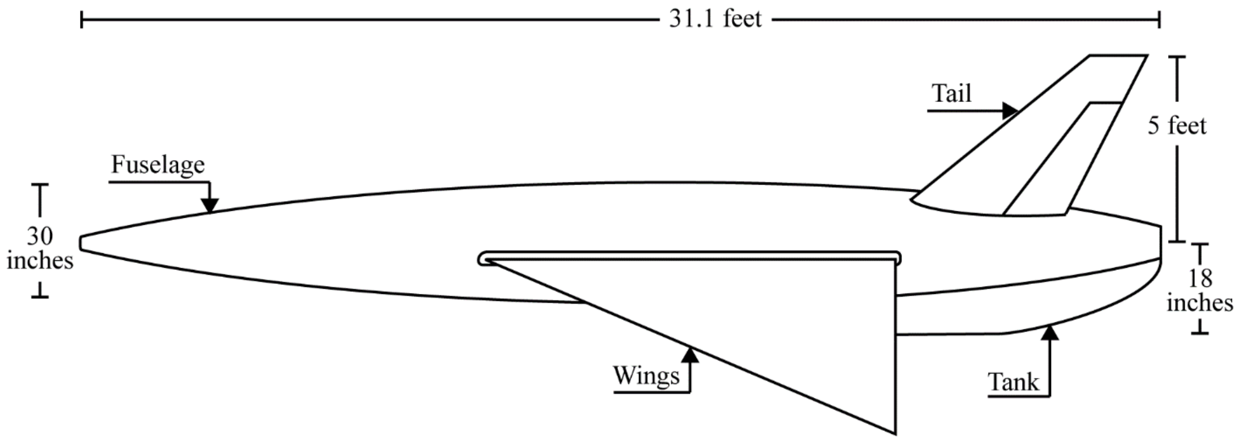

Figure 146: Drone Weapon System, Multipurpose, AN-USD-4 - Line Drawing

Specifications

Drone Weapon System, Multipurpose, AN-USD-4 - Specifications and Other Data		Citation
Historical Name	Drone Weapons System, Multipurpose AN-USD-4	1 (p. 4-89)
Type	Miscellaneous	1 (p. 4-89)
Diameter	Fuselage: 30 in. (76.2 cm) Tank: 18 in. (45.7 cm)	1 (p. 4-90)
Length	31.1 feet (9.47 meters)	1 (p. 4-90)
Width	Wingspan: 11.45 feet (3.48 meters)	1 (p. 4-90)
Other Engineering Data	Weight, Empty: 2,992 lbs. (1,357 kg)	1 (p. 4-90)
Propellant	J-60 Turbojet engine.	1 (p. 4-90)

General Use and Description

The AN-USD-4 drone was used for dissemination of biological and chemical fills (1 p. 4-89).

The AN-USD-4 was a remote controlled, medium endurance, recoverable drone. The system was designed for either low or high penetration of enemy territory to disseminate biological or chemical agents and return the drone to its launch point for recovery by parachute. Guidance was by pre-programmed inertial system using a Minneapolis-Honeywell inertial platform. There was also a short-range line-of-sight command guidance system employed. The drone could be launched from a zero launcher mounted on a flatbed trailer. Jet Assisted Take Off boosters were used for launching and were mounted beneath the drone. Two different size boosters were used. The drone could carry external tanks mounted under wings.

There was a nozzle located in the tail section for dissemination of agent (1 p. 4-89).

Explosive Train

This item required no explosive train.

Drone Weapon System, Multipurpose, AN-USD-4

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Available references did not include information regarding fills for this item.

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

No specific fills provided in available references.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

12.10 Drone Weapon System, Multipurpose, AN-USD-5

Figures

Figure 147: Drone Weapon System, Multipurpose, AN-USD-5 - Photograph

Specifications

Drone Weapon System, Multipurpose, AN-USD-5 - Specifications and Other Data		Citation
Historical Name	Drone Weapons System, Multipurpose, AN-USD-5	1 (p. 4-91)
Developmental Information	XE-1	1 (p. 4-91)
Type	Miscellaneous	1 (p. 4-91)
Length	36.58-36.72 feet (11.15-11.19 meters)	1 (p. 4-92), 2 (p. 227)
Height	8.25 feet (2.51 meters)	1 (p. 4-92), 2 (p. 227)
Diameter	Fuselage: about 30 in. (76.2 cm)	2 (p. 227)
Width	Wingspan: 24.7 feet (7.53 meters)	1 (p. 4-92), 2 (p. 227)
Propellant	Pratt and Whitney-J60-P-2 engine	1 (p. 4-92), 2 (p. 227)
Other Engineering Data	Engine thrust: 2,900 lbs. (1,315 kg) Payload: 450-1,260 lbs. (204-572 kg) Fill Capacity: 200 gallons (757 liters) Weight, Empty: about 4,400 lbs. (1,995 kg)	1 (p. 4-92), 2 (p. 227)
Construction Material	Constructed with an aluminum alloy, circular fuselage, and fiberglass-honeycomb core wings.	1 (p. 4-92), 2 (p. 227)

Drone Weapon System, Multipurpose, AN-USD-5

General Use and Description

The AN-USD-5 was used for the dissemination of biological and chemical weapons (1 p. 4-91).

The AN-USD-5 (XE-1) had a delta wing cylindrical body configuration with a maximum takeoff gross weight, including booster, of approximately 10,000 pounds. The AN-USD-5 was a remote controlled, recoverable, long-distance drone. It was capable of human incapacitation; the degree was dependent upon the agent used. For broad battlefield coverage and weapon effectiveness, timing for enemy incapacitation could be selected, and roads and facilities would not be destroyed in compromising the enemy.

The drone could change heading, altitude, speed, and commands to subsystem in a pre-programmed manner. There was a nozzle located in the tail section for dissemination of chemical fill (1 p. 4-91), (2 p. 226).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Available references did not include information regarding fills for this item.

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

No information regarding specific fills was contained in available references.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
2. Cornell Aeronautical Laboratory. 1961. Combat Surveillance Project, Notes for an Integrated AN/USD-5 Systems Test Plan. September 27.

12.11 Drum, 55-gallon

Figures

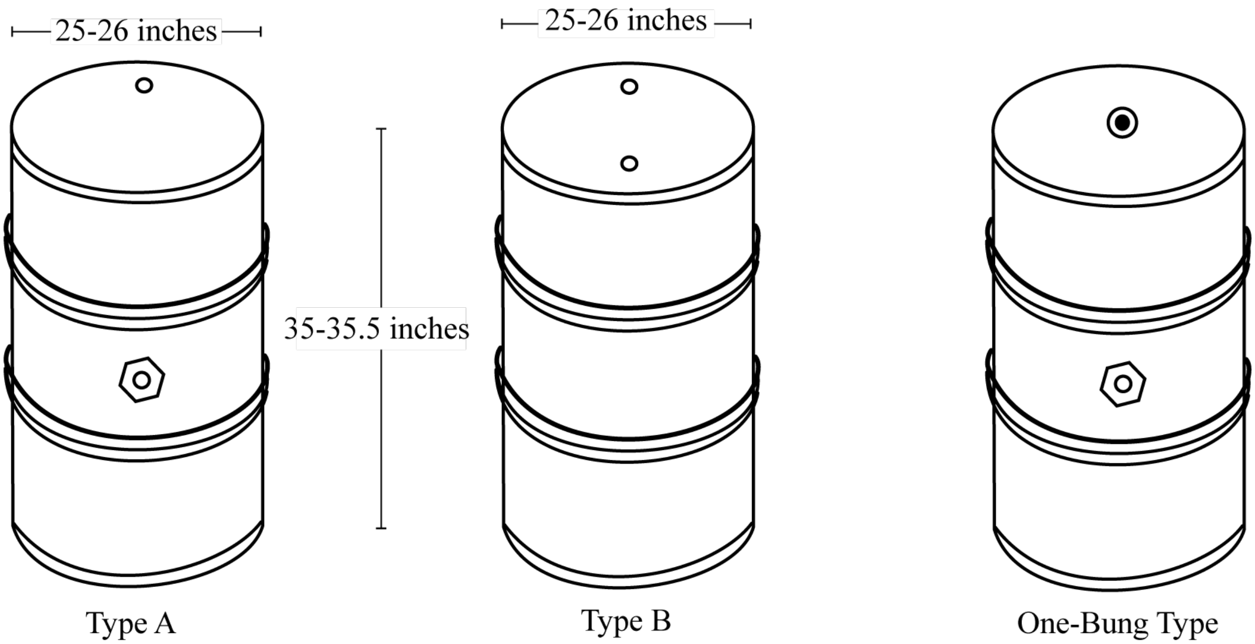

Figure 148: Drum, 55-gallon – Line Drawing

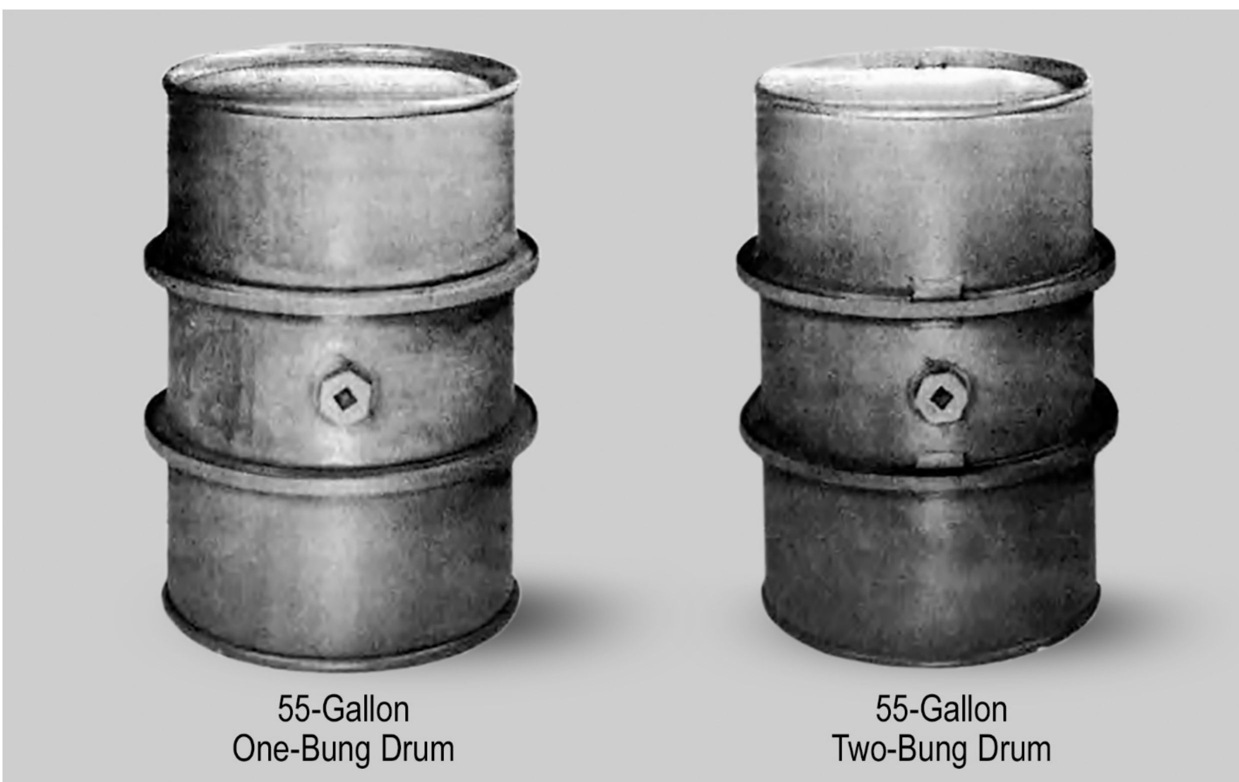

Figure 149: Drum, 55-gallon, Type A – Photograph

Drum, 55-gallon

Specifications

Drum, 55-gallon – Specifications and Other Data		Citation
Historical Name	55-gallon drum	1 (p. 1), 2 (p. 7), 3 (p. 153)
Type	Container	3 (p. 153)
Size	55-gallon	1 (p. 1), 2 (p. 7), 3 (p. 153)
Conflict	WWI, WWII	3 (p. 153), 12 (p. 69)
Service	Army	4
Diameter	Type A and B: 25-26 in. (63.5-66 cm)	2 (p. 11), 5 (p. 13), 6 (p. 9)
Length	Type A and B: 35-35.5 in. (88.9-90.2 cm)	2 (p. 11), 5 (p. 13), 6 (p. 9)
Other	Weight, Empty: Type A and B: 98-115 lbs. (44.5-52.2 kg) Type 5: 110 lbs. (49.9 kg) Type 5A: 113 lbs. (51.3 kg) Type 5B (bung): 80 lbs. (36.3 kg) Type 5B (open head): 90 lbs. (40.8 kg)	2 (p. 11), 4 (p. 159), 5 (p. 13), 6 (p. 9), 7 (p. 1)
Construction Material	Type 5A: Steel 14-gauge or heavier Type 5C: Stainless steel Type 5K: Nickel	1 (p. 2), 2 (p. 11), 5 (p. 13), 6 (p. 9), 8 (p. 23)
Specification	CN: 1365-277-3045, MIL-C-10338A CNB:1365-277-3047, MIL-G-10620A CNC: 1365-277-3048, MIL-C-10371A CNS: MIL-C-10619 DM: 1365-277-3051, MIL-D-11772A FM: 1365-277-3028 FS: 1365-290-0020 H: 1365-277-3039 HD: 1365-277-3040 MR: 1365-277-3044	4 (p. 131, 137, 138), 7 (p. 1, 3, 4)
Drawing	Type B: E6-2-2	9 (p. III-2)
Stock No.	Type A: 611110 Type B: 611115 Type 5A: 611510 CN: 334110 CNB: 334310 CNC: 334510 CNS: 444210 DA: 344110 DM: 344210 FM: 214310 FS: 214210 H: 324110 MR: 324910	4 (p. 131, 137, 138, 147, 149, 150), 10

General Use and Description

Many chemical agents and liquid chemicals were stored and shipped in 55-gallon-capacity steel drums (1 p. 2) (2 p. 7, 11) (10). The 55-gallon drums were used for small shipments of chemicals and as intermediate containers for transfer from ton containers for filling in the field (3 p. 153). There were several types of 55-gallon drums, Type A and Type B. Type A had a 2.25-inch bung on the side and a 0.75-inch bung in the end. Type B had two 0.75-inch bungs on the end (5 p. 13). The drums were used primarily for storing nonburning liquid smokes, cresylic acid, MR (type A only), and liquid riot control agents. They were also used for limited storage of HD with special authorization (2 p. 11). Type B drums were used for liquid solvents, persistent chemical agents, and some low persistency chemical agents (8 p. 23). Type B filled with HS were stored on end with the opening on the upper side (11 p. 1).

The weight of empty drums varied according to the manufacturer (7 p. 1). These drums could be further classified by conformance to Interstate Commerce Commission specifications. Types 5, 5A, 5B bung type, 5B open head type, 5C, and 5D were Interstate Commerce Commission specification 5. The drums had either expanded or attached rolling hoops to protect them from damage (4 p. 159), (5 p. 13), (7 p. 1). Type 6 drums were used for storage and transport of phosphorus (10).

Explosive Train

There was no explosive train for this shipping container.

Fuzing

There was no fuze for this shipping container.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this shipping container.

Fills

Drum, 55-gallon – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CN	274-374	124-170	384	174	Type 5	4 (p. 131), 7 (p. 1)
CNB	445	202	555	252	Type 5	4 (p. 137), 6 (p. 9), 7 (p. 1),
CNC	580-583	263-264	693	314	Type 5	4 (p. 138), 6 (p. 9), 7 (p. 1)
CNS	583	264	693	314	–	4 (p. 138), 6 (p. 9)
DA	284	129	384	174	–	4 (p. 138)
DM	274-284	124-129	384	174	Type 5	4 (p. 138), 7 (p. 1)
ED	N/A	N/A	N/A	N/A	–	4 (p. 150), 6 (p. 64)
FM	722	327	835	379	Type 5A	1 (p. 2), 4 (p. 150), 7 (p. 4)
FS	747	339	860	390	Type 5A	4 (p. 149), 6 (p. 9), 7 (p. 4)
GB	N/A	N/A	N/A	N/A	–	6 (p. 66), 4 (p. 147)
H	567	257	680	308	Type B or 5A	1 (p. 2), 4 (p. 147), 7 (p. 3) 9 (p. III-1), 11
HD	532	241	645	293	Type 5A	2 (p. 11), 4 (p. 147), 6 (p. 61), 7 (p. 3)
HN	N/A	N/A	N/A	N/A	–	6 (p. 62)
L	N/A	N/A	N/A	N/A	–	6 (p. 62), 11
MD	N/A	N/A	N/A	N/A	–	6 (p. 64)
MR	510	231	590	268	Type A or 5B	2 (p. 58), 4 (p. 147), 6 (p. 121), 7 (p. 3)
PD	N/A	N/A	N/A	N/A	–	6 (p. 65)
PS	N/A	N/A	N/A	N/A	–	1 (p. 2), 6 (p. 86)
WP	N/A	N/A	N/A	N/A	–	10

Shipping/Packing

Filled and empty 55-gallon drums were shipped uncrated (5 p. 15).

Drum, 55-gallon

Miscellaneous

As of March 1919, Edgewood Arsenal had purchased 76,000 55-gallon standard acid drums with 25,942 having been delivered "for shipment of gases" (12 p. 69).

Key Dates

Available references did not provide this information.

Sources

1. Unknown. n.d. Report on Toxic Gas Containers, Edgewood Arsenal. AD0495499.
2. Department of the Army. 1969. Technical Manual, TM 3-250, Storage, Shipment Handling and Disposal of Chemical Agents and Hazardous Chemicals. March. U.S. Government Printing Office.
3. War Department. 1943. Technical Manual, TM 3-255, Chemical Handling and Loading Equipment.
4. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook.
5. Departments of the Army and Air Force. 1955. Technical Manual, TM 3-255/Technical Order, TO 11C8-1-1, Chemical Filling and Handling Equipment. Departments of the Army and Air Force.
6. Chemical Corps School. 1951. Special Text 3-250-1, Bulk Chemicals and Chemical Agents.
7. Chemical Corps Technical Committee. 1959. Chemical Corps Book of Standards, Edition of 25 November 1959. Department of the Army.
8. Department of the Army. 1957. Technical Manual, TM 3-250, Storage, Shipment Handling and Disposal of Chemical Agents and Hazardous Chemicals. February.
9. Macy, Dr.; Harris, Captain; Witten, Dr. 1946. Monthly Progress Report – Historical Branch.
10. Delancey, R. King, Colonel. 1946. Obsoletion of Drum 55 gallon. Chemical Warfare Service.
11. Engle, E.B. Major. 1943. Storage of 55-Gallon Drums for HS. Chemical Warfare Service.
12. Edgewood Arsenal 1919. An Historical Sketch of Edgewood Arsenal. March 1.

12.12 Tank, 23-gallon, Airplane, E6R9

Figures

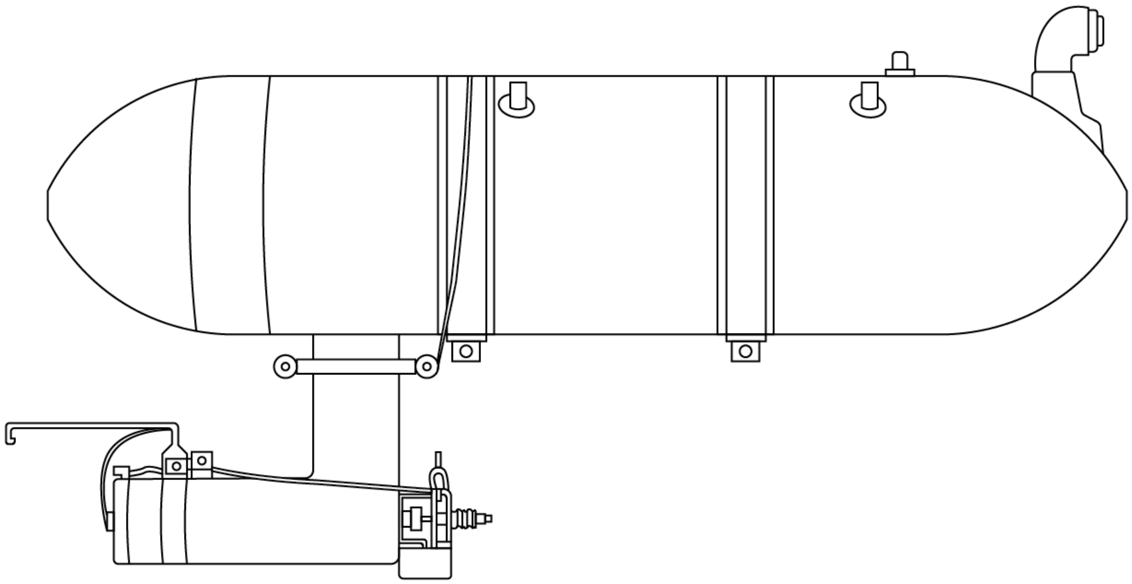

Figure 150: Tank, 23-gallon, Airplane, E6R9 - Line Drawing

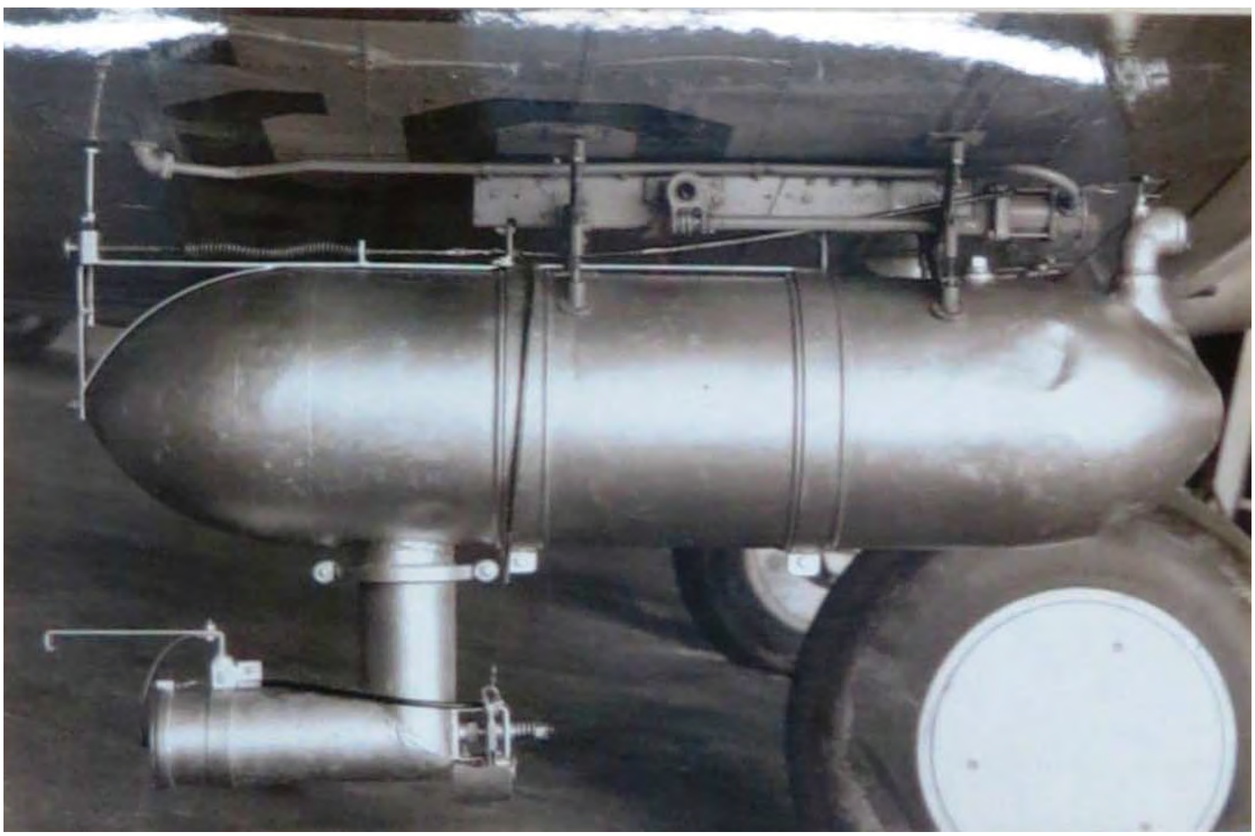

Figure 151: Tank, 23-gallon, Airplane, E6R9 - Photograph - Right Side View - Airplane Chemical Spray Tank E6R9

Tank, 23-gallon, Spraying Apparatus, E6R9

Specifications

Tank, 23-gallon, Airplane, E6 Series - Specifications and Other Data		Citation
Historical Name	Tank, Airplane Chemical Spray, E6R9	1 (p. 95)
Developmental Information	E6R1, E6R2, E6R3, E6R4, E6R5	3
Type	Miscellaneous	2 (p. 1)
Size	23-gallon	2 (p. 1)
Conflict	WWII	2 (p. 1)
Service	Army, Army Air Corps	2 (p. 1)
Diameter	12.5-in. (91.8 cm)	3
Other Engineering Data	Filling capacity: 22 gallons (83.3 liters)	2 (p. 14-17)
Construction Material	Steel, 20-gauge	3
Drawing	E28-4-171	1 (p. 95)

General Use and Description

The E6R9 was used for dispersing chemical agents from airplanes. It was designed to provide an airplane dispersing apparatus with a tank that could be filled at a depot, securely closed, stored for an indefinite period, and prepared for use by the addition of the necessary apparatus (1).

The last spraying apparatus standard for use by the Air Corps was the E6R9 chemical tank, a wing tank installation for use on single engine attack airplanes. The apparatus consisted of a cylindrical tank, which had a total capacity of 23 gallons with uniform ogival front and rear, assembled with continuous discharge mechanism, and poppet-type vent with air scoop.

The apparatus consists of a streamlined tank, a discharge valve and discharge line, an air vent, and the necessary connections. When the valve is opened, the agent flows down through the discharge line and into the air. Here it is subjected to the natural shearing effect of the air blast and is broken up into very fine particles which drift with the wind.

The discharge mechanism consisted of a detachable closure plate and a rotating shaft for releasing the plate. Operation was by a spring mechanism actuated by a solenoid attached to the plane (1), (3 p. 142-145).

Explosive Train

Operation was by electro-mechanical means, and the discharge of the contents was accomplished by release of a closure plate from the end of the discharge line (1).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Tank, 23-gallon, Spraying Apparatus, E6R9

Fills

Tank, 23-gallon, Airplane, E6 Series - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CNB	N/A	N/A	N/A	N/A	-	1
CNS	N/A	N/A	N/A	N/A	-	1
FM	N/A	N/A	N/A	N/A	-	1
FS	240	108	N/A	N/A	-	1, 2 (p. 3, 11)
H	N/A	N/A	N/A	N/A	-	1
HL	N/A	N/A	N/A	N/A	-	1
L	N/A	N/A	N/A	N/A	-	1
MR	N/A	N/A	N/A	N/A	-	2 (p. 2, 3)
PS	N/A	N/A	N/A	N/A	-	1

Shipping/Packing

Available references did not provide this information.

Key Dates

Tank, 23-gallon, Airplane, E6 Series - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Classified	1938	CCTC 1938-07	4

Sources

1. Chemical Corps Technical Committee. 19746. CCTC Item 1683, Cancellation of Miscellaneous Experimental Items. 22 October.
2. Weaver, F.R. 1938. Technical Division Memorandum Report, TDMR 127, Report of Comparative Tests of Airplane Chemical Spray Tank E6R9 and Air Corps A-17 Chemical Tank with Airplane YIA-18. Chemical Warfare Service.
3. Unknown. 1938. Airplane Chemical Spray Tank Designations (For A17 and A17-A Airplanes). DENIX file name: NARA College Park_RG175_EUD-2A_Bx103.
4. Chemical Corps Technical Committee. 1938. CCTC Item # 1938-07, Airplane Chemical Spray Tank E6R9 – Classification of. Department of the Army.

12.13 Tank, 30-gallon, Airplane, M10 (E12)

Figures

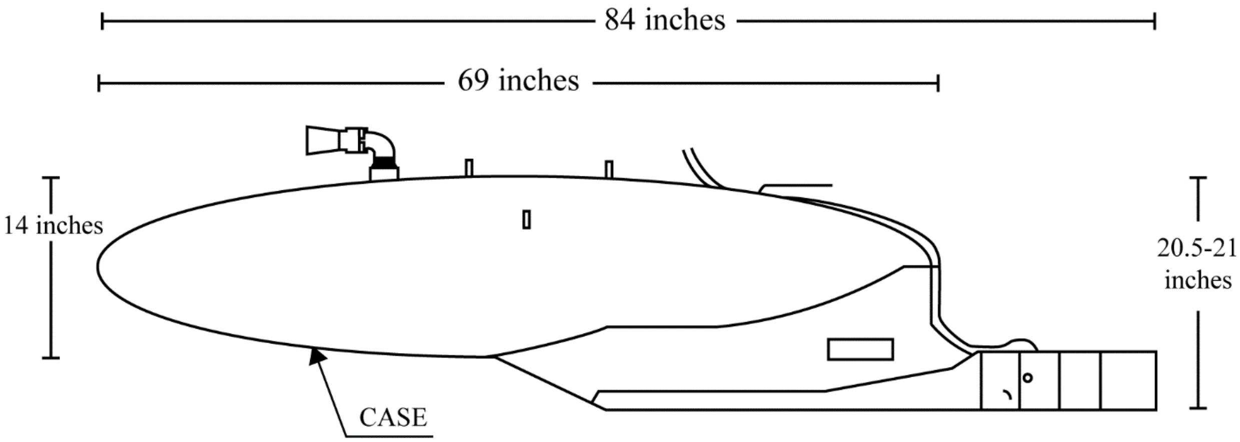

Figure 152: Tank, 30-gallon, Airplane, M10 (E12) - Line Drawing

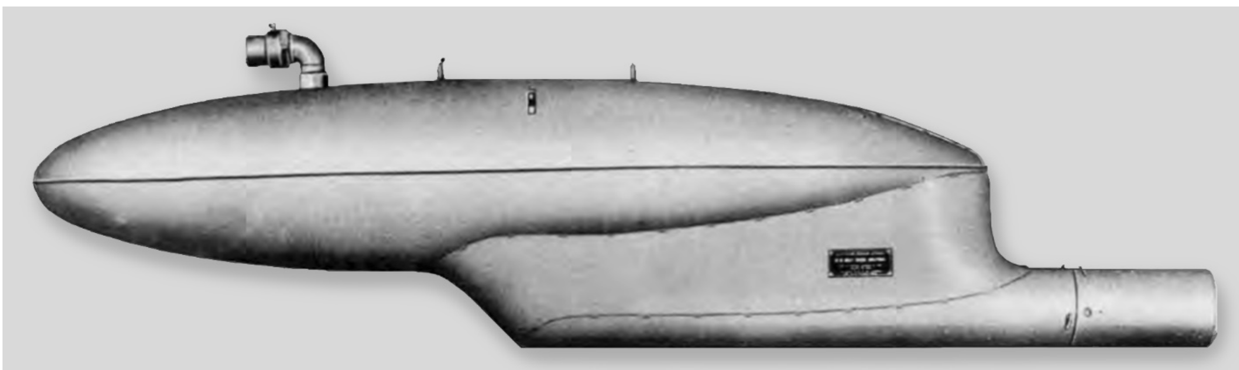

Figure 153: Tank, 30-gallon, Airplane, M10 (E12) - Photograph

Specifications

Tank, 30-gallon, Airplane, M10 (E12) - Specifications and Other Data		Citation
Historical Name	Smoke Tank, Airplane, M10	1 (p. 236, 237), 2 (p. 9)
Developmental Information	E12	1 (p. 237)
Type	Miscellaneous	-
Size	30-gallon	2 (p. 9), 3 (p. 3), 4 (p. 4)
Conflict	WWII	4
Service	Air Force, Army, Navy	1 (p. 247), 2 (p. 9), 3 (p. 3), 5 (p. 1)
Diameter	14 in. (35.5 cm)	1 (p. 239), 2 (p. 9), 6 (p. 42.7)
Length	69-84 in. (175 - 213 cm)	1 (p. 239), 2 (p. 9), 4 (p. 6), 6 (p. 42.7)
Height	20.5-21 in. (52.1-53.3 cm)	1 (p. 239), 2 (p. 9), 4, 6 (p. 42.7)
Other Engineering Data	Weight, Empty: 68 lbs. (30.8 kg) Capacity: 20 to 25 gallons (75.7 – 94.6 liters)	1 (p. 236), 5 (p. 1)
Construction Material	Copper-bearing steel	1 (p. 239)
Specification	MIL-S-13610, MIL-5-13610	2 (p. 2), 5 (p. 1)
Drawing	D28-4-348, C28-4-348, 57A9821	2 (p. 2), 3 (p. 3), 5 (p. 1)
FSN	1040-368-6078	5 (p. 1)

Tank, 30-gallon, Airplane, M10 (E12)

General Use and Description

The M10 airplane smoke tank was used to lay smoke screens and to spray blister agents, riot control agents, and simulated liquid agents for mustard from airplanes (4 p. 1), (5 p. 1).

The M10 airplane smoke tank was a streamlined gravity discharge tank with ogival ends having a net capacity of 30 gallons. The empty tank weighed about 68 pounds and measured 84 by 20.5 by 14 inches. It consisted of three parts. A container assembly, an air inlet assembly, and a discharge line assembly (2 p. 9), (4 p. 140), (5 p. 1).

Explosive Train

The contents of the tank were released by explosion of electric blasting caps (detonators) that shattered frangible seals in the air inlet and discharge line assemblies (3 p. 3). Breaking of the seals resulted in the gravitational release of the liquid contents of the tank from the discharge pipe. Air entering the air inlet assembly helped force the liquid out of the discharge pipe. The slipstream of the airplane would break up the liquid into a spray (2 p. 9), (4 p. 140), (5 p. 1).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Tank, 30-gallon, Airplane, M10 (E12) - Fill Types and Weights

Chemical	Fill Weight		Gross Weight		Notes	Citation
	Pounds	Kilograms	Pounds	Kilograms		
AS	255	115	323	146	-	4 (p. 49)
CNB	285	129	353	160	-	4 (p. 49), 6 (p. 42.7), 12 (p. 50, 76)
CNC (chloroacetophenone solution)	326	148	394	179	-	6 (p. 42.7), 12 (p. 50, 76)
CNS	367-368	166-137	435-436	197-198	-	4 (p. 49), 12 (p. 50, 76)
FM	360	163	428	194	-	4 (p. 49)
FS	432-480	195-217	500-548	226-248	-	1 (p. 240), 4 (p. 49), 6 (p. 42.7), 12 (p. 50, 76)
GA	270	122	338	153	-	7 (p. 16)
H	339	153	407	184	-	4 (p. 49), 12 (p. 76)
HD	321	145	389	176	-	4 (p. 49), 6 (p. 42.7), 12 (p. 76)
HL	405	183	473	214	-	4 (p. 49)
HN	290	132	358	162	-	12 (p. 47, 76)
HV	315	142	383	173	-	4 (p. 49)
L	432-471	195-213	500-539	226-244	-	4 (p. 49), 12 (p. 47)
MR	264	119	332	150	-	4 (p. 49), 6 (p. 42.7), 12 (p. 74)

Tank, 30-gallon, Airplane, M10 (E12)

Shipping/Packing

The tank is packed in a wooden case and is fastened to the top of the case by threaded hooks engaging the suspension lugs. The air inlet assembly is packed in the case, in a box placed under the nose of the tank. The shipping weight is between 150-177 pounds (68-80 kilograms), and the displacement is approximately 28 cubic feet (2 p. 9), (5 p. 1).

Miscellaneous Information

As of 1948, there were 52,934 M10 smoke tanks on hand (9 p. 2), (10).

Key Dates

Tank, 30-gallon, Airplane, M10 (E12) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1940	CWTC 216, 281	1 (p. 237), 5 (p. 1), 13 (p. 1)
Standardized	1944	CCTC 1049, 1094 (HD-fill Standard, H-fill Substitute Standard)	14 (p. 101, 102)
Cancellation	1946	CCTC 1595, 1653 (Cancellation of CNS-fill)	15 (p. 103)
Obsoleted	1946	CCTC 1601 (AS-fill)	16 (p. 88)
Standardization	1949	CCTC 2045 (CNC-fill Standard)	17 (p. 141, 142)
Standard Modernization	1958	CCTC 3408 (Standard-A)	10 (p. 116)
Obsoleted	1977	Materiel Status Record (MSR) 08776018	11 (p. 3)

Sources

1. Finklestein, Leo. 1964. History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 - 31 December 1945) Screening Smokes Part III. Chemical Research and Development Laboratories (CRDL).
2. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.
3. Department of the Army. 1961. Technical Manual, TM 3-500, Chemical Corps Equipment Data Sheets. U.S. Government Printing Office.
4. War Department. 1944. Technical Bulletin, TB 3-255A-1, Airplane Smoke Tank M10. War Department.
5. Army Chemical Center. 1957. Reclassifications, obsoletions, and related actions which have occurred since publication of EP 79, Chemical Corps Equipment Data Sheets. U.S. Army Chemical Corps Engineering Command.
6. Department of the Army. 1967. Field Manual, FM 3-8, Chemical Reference Handbook. U.S. Government Printing Office.
7. Gibby, I., Layton, L., Stone, W., & Clay, J. 1953. Dugway Proving Ground Report, DPGR 129, Assessment of Hazard from Aerial Spray, DPG CW 3-53. Chemical Warfare Division.
8. Chemical Corps Technical Committee. 1958. CCTC Item # 3483, Subject: Use of Airplane Smoke Tank M10 on L19 and L20 Aircraft. U.S. Army Chemical Center and Chemical Corps Materiel Command.
9. Chemical Corps Technical Committee. 1948. CCTC Item # 1913, Subject: Obsoletion of Tanks, Airplane Smoke, M10, AN-M33A1, M40 and Accessory Equipment. Chemical Corps.
10. Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.
11. Department of the Army. 1977. Materiel Status Record Submission, MSR 08776018, Reclassification of Smoke Tank, Airplane: M10 and Accessory Equipment as Obsolete. Headquarters, United States Army Armament Command.

12. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.
13. Chemical Corps Technical Committee. 1940. CCTC Item # 281, Standardization of Type 1 and Type 2 Airplane Smoke Tanks. Department of the Army.
14. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.
15. Chemical Corps Technical Committee. 1946. CCTC Item # 1653, Cancellation of CNS as an Authorized Filling for the Airplane Smoke Tank. Department of the Army.
16. Chemical Corps Technical Committee. 1946. CCTC Item # 1601, Obsoletion of Simulated Mustard, AS. Department of the Army.
17. Chemical Corps Technical Committee. 1949. CCTC Item # 2045, Reclassification of Irritant Agents, CNS, CNB, PS and Standardization of CNC. Department of the Army.

12.14 Tank, Airplane, 30-gallon, M21, Pressure

Figures

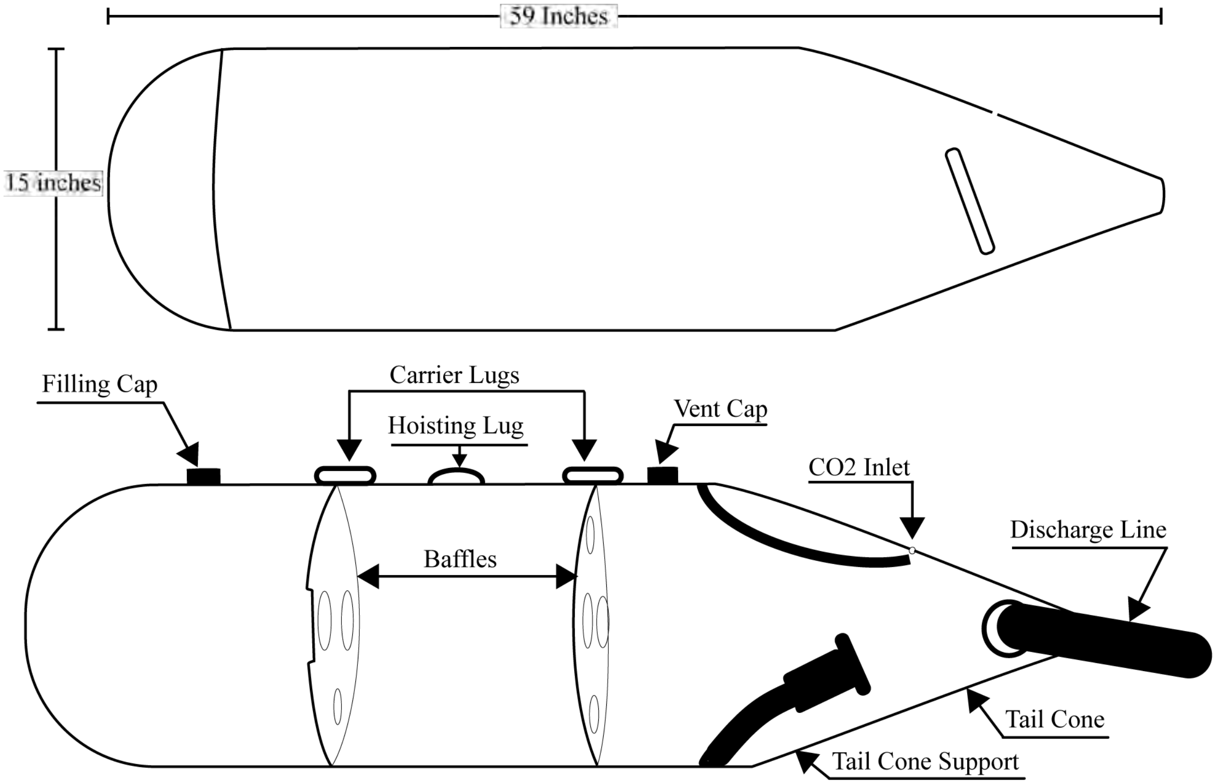

Figure 154: Tank, Airplane, 30-gallon, M21, Pressure – Line Drawing

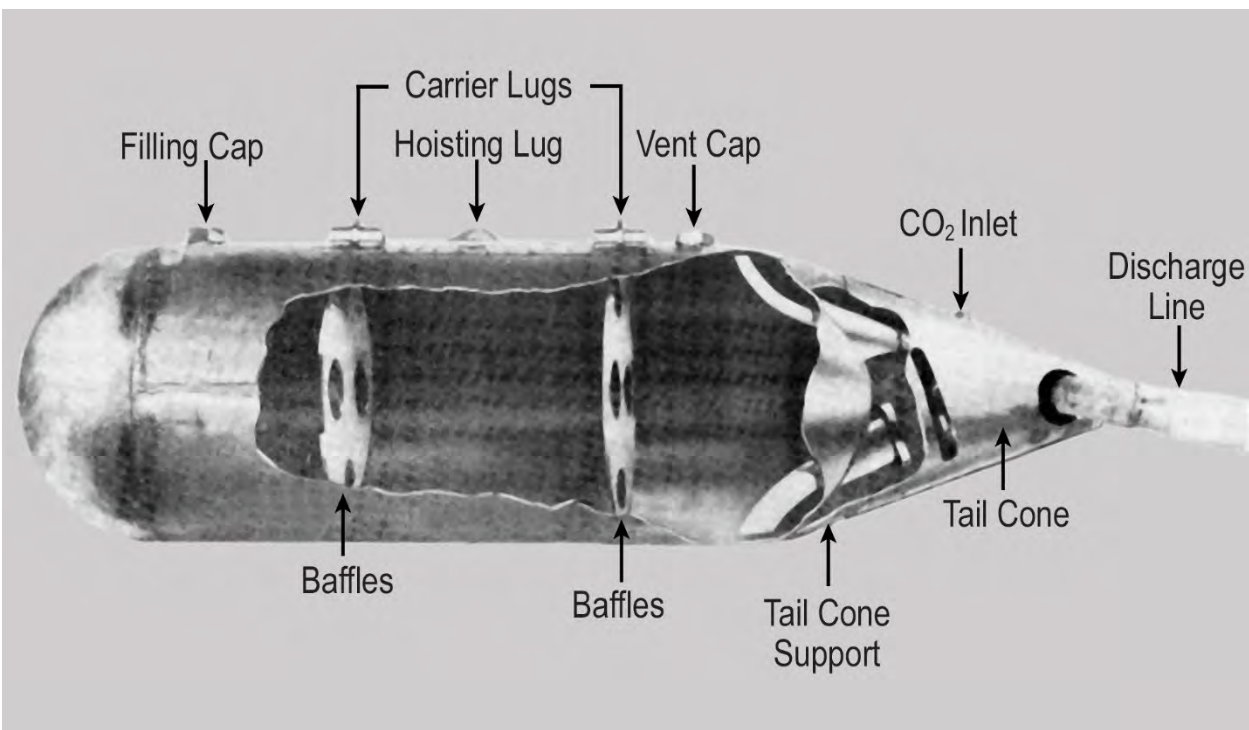

Figure 155: Tank, Airplane, 30-gallon, M21, Pressure – Photograph, Cutaway View

Tank, Airplane, 30-gallon, M21, Pressure

Specifications

Tank, Airplane, 30-gallon, M21, Pressure – Specifications and Other Data		Citation
Historical Name	Tank, Airplane, Smoke, M21, M21A1, Mark 6	1 (p. 114), 2 (p. I-7), 3 (p. 21), 4, 7 (p. 6)
Type	Tank	1 (p. 114)
Size	30-gallon	5 (p. 4)
Conflict	WWII	3 (p. 21)
Service	Air Force, Army, Navy	1 (p. 114), 3 (p. 21), 4
Diameter	15 in. (38.1 cm)	3 (p. 21), (6, p. 56)
Length	58-59 in. (147-150 cm)	3 (p. 21), (6, p. 56)
Other	Weight, Empty: 120 lbs. (54.4 kg) Carbon dioxide tank: 19 lbs. (8.62 kg)	5 (p. 1), (6, p. 56)
Construction Material	Mild or copper-bearing steel (M21, M21A1) Monel (Navy Mark 6)	7 (p. 6)
CWS Stock No.	M21: 450120 M21A1: 450122 Navy Mark 6, Mod 2: 3-T-156	2 (p. I-7), 7 (p. 61), 8 (p. 28)

General Use and Description

The M21 airplane smoke tank was designed for laying smoke screens but were also used for disseminating other liquid chemical agents from aircraft (5 p. 1). Each M21 airplane smoke tank consisted of a container, a tail cone assembly, a discharge line, and carbon dioxide equipment (5 p. 1). It was a gas pressure discharge type tank and required a carbon dioxide bottle or cylinder with a 7.25-pound capacity (3, p. 21). It was used to discharge liquid chemical agent (7 p. 2). The M21 and M21A1 included a tank with discharge line and a carbon dioxide cylinder with a pressure regulator (5 p. 1, 2) (8 p. 28).

The container had a hemispherical leading end and a conical streamlined covering on the trailing end. The M21 tank had a gross capacity of 30.7 gallons. The tank was attached to the rack by means of two carrier lugs. A hoisting lug was provided for lifting the tank into position by means of the bomb hoist, which each airplane was equipped with. The tank was reinforced at the carrier lug and hoisting lug positions by a single large metal plate. Two filling caps were located at the top of the container. Two openings were formed when the filling caps were removed; one opening was used as a vent and the other as a filling opening. Two flanges were provided in the tail portion of the container, the lower flange was fastened to the discharge tube which extended down inside the container, and the upper flange was fastened to the inlet tube which extended up inside the container. Various valves and fittings and the tail cone making up the tail cone assembly were secured to these flanges (5 p. 2).

The tail cone assembly consisted of a check blow-off valve, a discharge tube, an inlet tube, a blow-off tube, a discharge valve, a tail cone, a tail cone support assembly, and miscellaneous fittings. The check blow-off valve served a dual purpose. It provided a check valve to prevent the liquid under pressure in the tank from backing up into the carbon dioxide lines and fouling the regulator, and it was also adjusted to prevent the building up of pressure in the tank greater than that for which the valve was set. The excess carbon dioxide was by-passed into the blow-off tube and then into the discharge line. The discharge line assembly consisted of a tube of streamline cross section, a swivel elbow, and an adjustable cable-connecting clamp. When the smoke tank was installed in the bomb bay of the airplane, as in the A-25 airplane, a special discharge line that projected through the bomb bay doors was required. The extended portion of this line was retracted against the lower surface of the fuselage during flight (5 p. 2).

The Army M21 smoke tank was identical to the Navy Mark 6 Type, except that the Army tanks were constructed of mild or copper-bearing steel instead of Monel (7 p. 6). The Navy initially developed the tank for use on Navy type bombers. Production on the M21 by the Chemical Warfare Industrial division began in 1942 (3 p. 21).

Shortly before the airplane approached its target the discharge line was lowered by releasing the tension on the discharge-line-retracting cable. The force of gravity, aided by a coil spring in the case of the internal tank, caused the discharge line to assume a position of approximately 45° with the horizontal. The locking pin of the carbon dioxide cylinder was then removed, the seal wire broke prior to the take-off. The adjusting strew of the pressure regulator valve was be screwed as far as possible in a counterclockwise direction, if it was not already in that position before the cylinder valve was opened all the way. The pressure regulator was then adjusted by turning the adjusting screw in a clockwise direction to build up the required rate of chemical flow.

Discharge of the contents of the tank was accomplished by opening the discharge valve. The discharge could be intermittent or continuous and would continue if the discharge valve was kept open and there was liquid in the tank. After the tank was empty or the mission was completed, the discharge line was retracted against the under surface of the fuselage as soon as sufficient time had elapsed to permit complete drainage of the tank.

The control was such that the flow of the chemical dispersed had a sharp beginning but tapered off during the last five seconds of the discharge. When the level of the chemical agent in the tank reached the lower end of the discharge tube in the tank, there was a rush of carbon dioxide together with the chemical agent until the liquid was entirely discharged (5, p. 2, 3).

The M21A1 differ from the M21 only in the use of double hinged discharge tubes. These are used when the tanks were installed in the bomb bay of an airplane to allow the agent to be discharged safely beneath the plane (9 p. 32) (10 p. 67).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Tank, Airplane, 30-gallon, M21, Pressure – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
AS	255	116	375	170	6 (p. 56, 57)
CNB	285	129	405	184	6 (p. 56, 57)
CNS	367	166	487	220	6 (p. 56, 57)
FS	480	218	600	272	6 (p. 56, 57), 11
H	339	154	459	208	6 (p. 56, 57), 11
HL	N/A	N/A	N/A	N/A	11
HV	N/A	N/A	N/A	N/A	11
L	471	214	591	268	6 (p. 56, 57), 11
MR	264	120	384	174	6 (p. 56, 57)

Tank, Airplane, 30-gallon, M21, Pressure

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The M21 tank was first developed by the Navy for use on Navy type bombers. The procurement was originally made through the Navy as they were in the best position to procure because most of the development work had been completed by them. Sources were later developed by the CWS, and production began in September 1942 (3 p. 20).

As of July 1944, there were 5,225 M21 and 288 M21A1 spray tanks on hand (10 p. 69).

Key Dates

Tank, Airplane, 30-gallon, M21, Pressure – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1940	CCTC 281 M21	9 (p. 32), 12
Standardized	1942	M21A1	9 (p. 32)
Standardized	1944	CCTC 1094 (HD-fill Standard, H-fill Substitute Standard)	13 (p. 101)
Reclassified	1944	CCTC 899 and 971 M21 and M21A1 Limited Standard	1 (p. 114), 9 (p. 34)
Obsolete	1944	CCTC 1129 and 1190 Obsoletion of tanks, airplane, smoke, M21, M21Al and related handling equipment	2 (p. I-7), 10 (p. 68, 69)

Sources

1. Chemical Warfare Technical Committee. 1944. Item # 971, Reclassification of airplane smoke tanks M20, M20A1, M21 and M21Al, March 17.
2. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office. 15 September.
3. Chemical Warfare Industrial Division. 1942. Production Data Sheets (Items Presenting Procurement Problems). September 25.
4. Third Air Force. 1945. Report of Controlled and Other Critical Items of Equipment.
5. Loucks, Charles. 1942. Chemical Warfare Technical Bulletin No. 13-1-3, Airplane Smoke Tanks, Tanks M23 and M21 – Description, Assembly and Maintenance. July 18. War Department.
6. War Department. 1943. Technical Manual, TM 3-255 Chemical Handling and Loading Equipment. October.
7. Blandy, W.H.P. 1943. Preliminary Manuscript for Proposed Ordnance Pamphlet, Aircraft Chemical Smoke and Vesicant Spray, dated 1 July 1943. September 15. Navy Department, Bureau of Ordnance.
8. Control Division. 1946. Disposition of CWS-Owned Materiel. February 8. Chemical Warfare Service.
9. Chemical Warfare Technical Committee. 1944. Item # 899, Reclassification of airplane smoke tanks M20, M20A1, M21 and M21Al. January 21.
10. Chemical Warfare Technical Committee. 1944. Item # 1129, Obsoletion of tanks, airplane, smoke, M20, M20Al, M21, M2lAl and related handling equipment. August 31.
11. Adams, A.S., Captain. 1944. Navy Toxic Gas Handler’s Course (Officers), Edgewood Arsenal, Maryland – Revision of. September 16. Navy Department, Bureau of Naval Personnel. September 16.
12. Chemical Corps Technical Committee. 1940. CCTC Item # 281, Standardization of Type 1 and Type 2 Airplane Smoke Tanks. Department of the Army.
13. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

12.15 Tank, 31-gallon, Airborne, Aero 15A

Figures

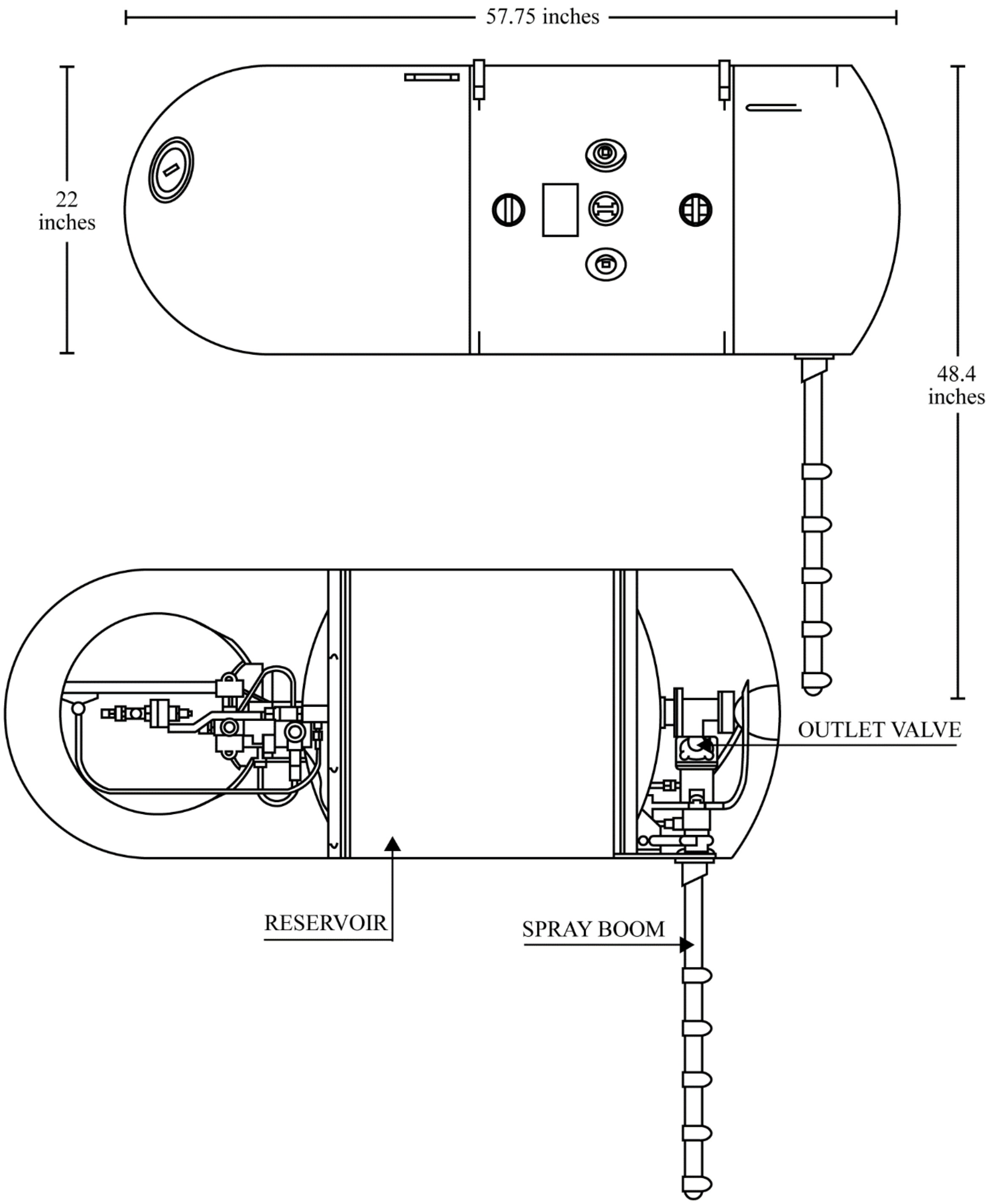

Figure 156: Tank, 31-gallon, Airborne, Aero 15A - Line Drawing

Tank, 31-gallon, Airborne, Aero 15A

Specifications

Tank, 31-gallon, Airborne, Aero 15A - Specifications and Other Data		Citation
Historical Name	Spray Tank, Airborne, Aero 15A	1 (p. 11-5)
Type	Miscellaneous	1 (p. 11-5)
Size	31-gallon	1 (p. 11-5)
Diameter	22 in. (55.88 cm)	1 (p. 11-7), 2 (p. 7-4)
Length	57.75 in. (146.69 cm) Boom: 26.40 in. (67.06 cm)	1 (p. 11-7), 2 (p. 7-4)
Other	Suspension: 2 lugs, 14 in. (35.56 cm) apart	1 (p. 11-7), 2 (p. 7-4)
Other Engineering Data	Weight, Empty: 111.0 lbs. (50.3 kg) Filled: 375 lbs. (170 kg) Agent: 260 lbs. (118 kg) Agent Capacity: 31 Gallons (117 liters) Used with: Helicopter UH-34	1 (p. 11-7), 2 (p. 7-4)
Construction Material	Heavy aluminum	2 (p. 7-4)

General Use and Description

The Aero 15A Airborne Spray Tank was a system designed to disseminate insecticide and various liquid agents from a helicopter. With minor modifications, the system could be adapted to operate from ground vehicles or small agricultural aircraft (1 p. 11-5), (2 p. 7-4).

The Aero 15A Spray Tank was cylindrical and constructed of heavy aluminum. Rounded nose and tail fairings provided minimum resistance under low-speed aerodynamic conditions. The tank had a capacity of 31 gallons with 5 gallons of space reserved as a void. Spray action power was provided by a spherical pressure bottle with filtered compressed air or compressed nitrogen. The high-pressure gas supply was controlled by a pressure regulator that maintained 50 psi on the agent storage reservoir.

A low-pressure gauge was mounted in a cutout in the nose fairing, and the pilot could view this gauge through the cockpit window to be sure the pressure required to disseminate the agent was present.

The heart of the Aero 15A tank was the pressure control system assembly. Its main components were the pressure bottle and holder assembly, bottle valve, safety head and regulator assembly, low-pressure gauge, solenoid valve, and check valve. The system was mounted on the forward part of the agent reservoir, except for the solenoid valve, which was mounted on the read of the reservoir. The nose fairing protected the front-end components.

The pressure bottle received its gas charge through a filter assembly that contained a check valve, purifying filter, and high-pressure gauge.

A bottle valve distributed filtered, compressed air or nitrogen from the bottle to the pressure regulation system, and from the high-pressure line through a check valve to the outlet valve. This valve was of aluminum and was a 28/24-volt direct current electrically operated solenoid valve controlled by the pilots control box.

The outlet valve mounted on the rear of the agent reservoir and sheltered by the tail fairing controlled the discharge of agent from the reservoir.

The discharge nozzle assembly could be attached to the output of the outlet valve (1 p. 11-5), (2 p. 7-4, 7-5, 7-6).

Explosive Train

This item required no explosive train. To disseminate the agent from the tank, the pilot activated the spray tank control box switch (1 p. 11-5), (2 p. 7-4, 7-5).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Available references did not include information regarding fills for this item.

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.

2. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

12.16 Tank, Airplane, 50-gallon, M20, Pressure

Figures

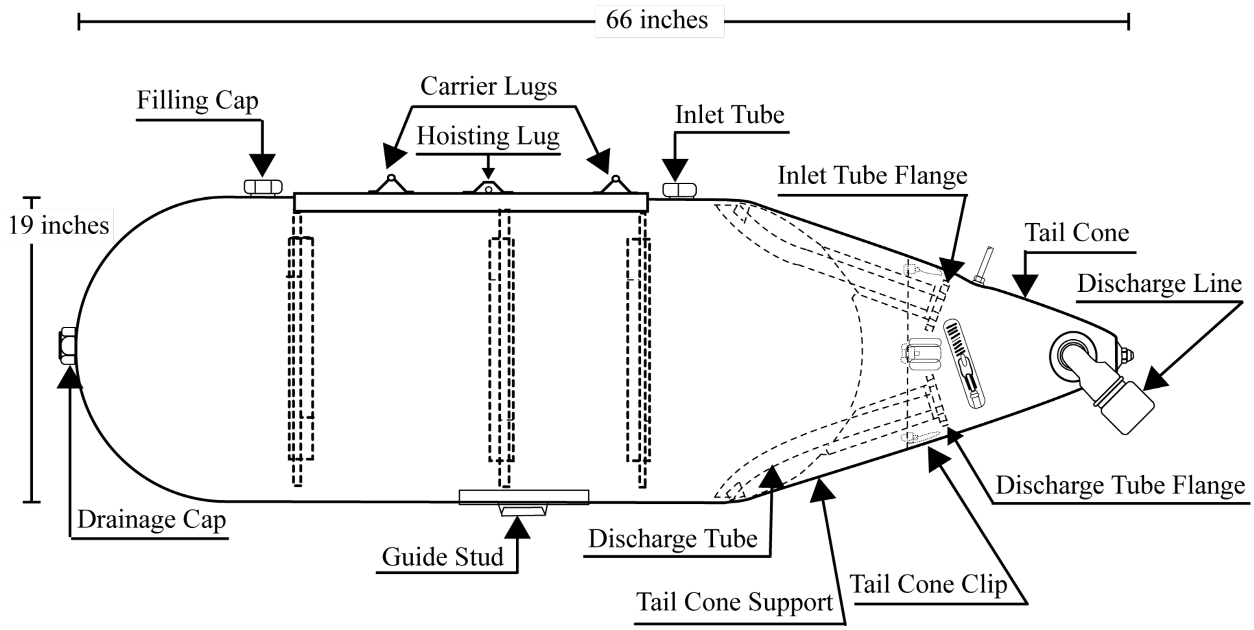

Figure 157: Tank, Airplane, 50-gallon, M20, Pressure – Line Drawing

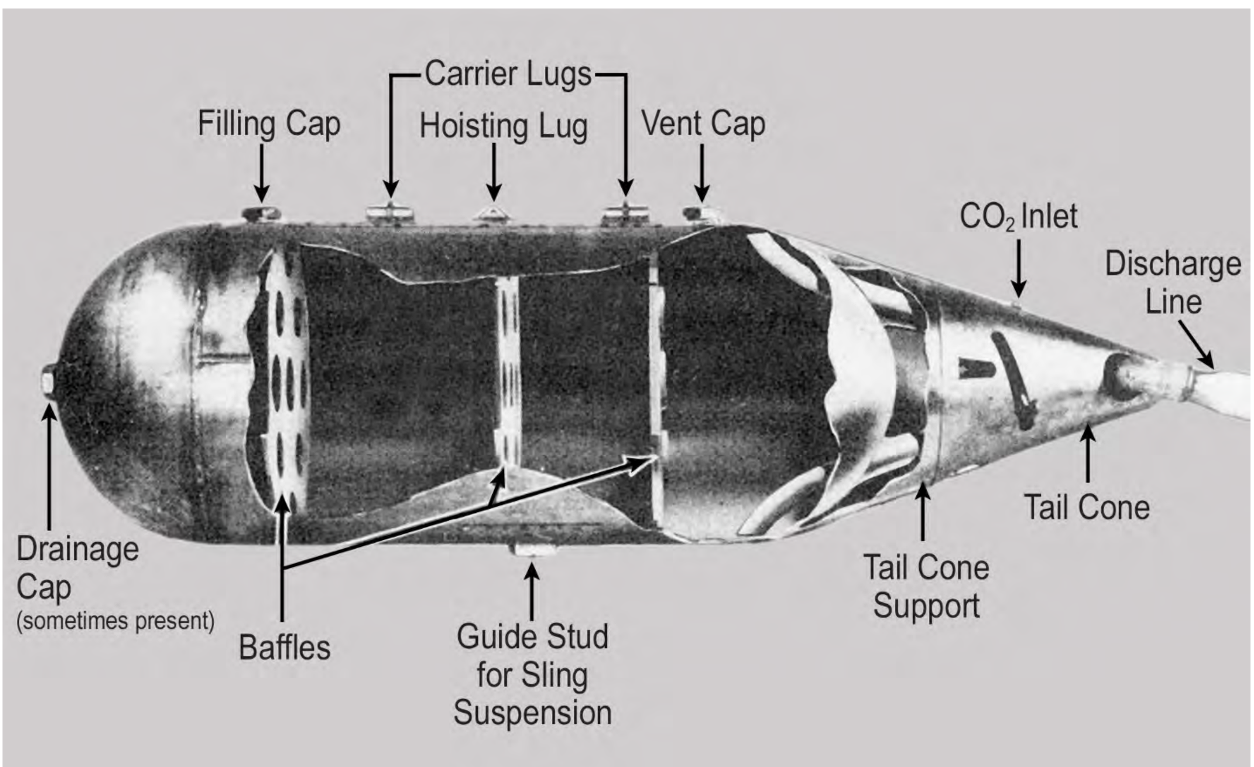

Figure 158: Tank, Airplane, 50-gallon, M20, Pressure – Photograph, Cutaway View

Figure 159: Tank, Airplane, 50-gallon, M20, Pressure – Photograph, Attached to Aircraft

Specifications

Tank, Airplane, 50-gallon, M20, Pressure – Specifications and Other Data		Citation
Historical Name	Tank, Airplane Smoke, M20, M20A1, Mark 5	1 (p. 20), 2 (p. 7), 3 (p. 28), 4 (p. 6)
Type	Tank	1 (p. 20)
Size	50-gallon	1 (p. 20)
Conflict	WWII	1 (p. 20)
Service	Army, Navy	1 (p. 20)
Diameter	19 in. (48.3 cm)	1 (p. 20)
Length	66 in. (168 cm)	1 (p. 20)
Other Engineering Data	Weight, Empty: 189 lbs. (85.7 kg) Carbon dioxide tank: 31 lbs. (14.1 kg) Capacity: 51.2 gallons (194 liters)	5 (p. 1, 2), 8 (p. 56)
Construction Material	Mild or copper-bearing steel (M20, M20A1) Monel (Navy Mark 5)	4 (p. 6)
CWS Stock Number	M20: 450110 M20A1: 450112 Navy Mark 5, Mod 2: 3-T-151	2 (p. I-7), 3 (p. 28), 4 (p. 61)

General Use and Description

The M20 airplane smoke tank was designed for laying smoke screens but was also used for disseminating other liquid chemical agents from aircraft (5 p. 1). Each M20 airplane smoke tank consisted of a container, a tail cone assembly, a discharge line, and carbon dioxide equipment (5 p. 1). The M20 was a gas pressure discharge type tank and required a carbon dioxide bottle or cylinder with a 12.6-pound capacity (1 p. 20). It was used to discharge liquid chemical agent (4 p. 2). The M20 and M20A1 included a tank with discharge line and a carbon dioxide cylinder with a pressure regulator (3 p. 28).

The container had a hemispherical leading end and a conical streamlined covering on the trailing end. The M20 tank had a gross capacity of 51.2 gallons. The tank was attached to the rack by means of two carrier lugs. A hoisting lug was provided for lifting the tank into position by means of the bomb hoist, which each airplane was equipped with. The tank was reinforced at the carrier lug and hoisting lug positions by a single large metal plate. Two filling caps were located at the top of the container. Two openings were formed when the filling caps were removed; one opening was used as a vent and the other as a filling opening. Two flanges were provided in the tail portion of the container, the lower flange was fastened to the discharge tube which extended down inside the container, and the upper flange was fastened to the inlet tube which extended up inside the container. Various valves and fittings and the tail cone making up the tail cone assembly were secured to these flanges (5 p. 2).

The tail cone assembly consisted of a check blow-off valve, a discharge tube, an inlet tube, a blow-off tube, a discharge valve, a tail cone, a tail cone support assembly, and miscellaneous fittings. The check blow-off valve served a dual purpose. It provided a check valve to prevent the liquid under pressure in the tank from backing up into the carbon dioxide lines and fouling the regulator, and it was also adjusted to prevent the building up of pressure in the tank greater than that for which the valve was set. The excess carbon dioxide was by-passed into the blow-off tube and then into the discharge line. The discharge line assembly consisted of a tube of streamline cross section, a swivel elbow, and an adjustable cable-connecting clamp. When the smoke tank was installed in the bomb bay of the airplane, as in the A-25 airplane, a special discharge line that projected through the bomb bay doors was required. The extended portion of this line was retracted against the lower surface of the fuselage during flight (5 p. 2).

The Army M20 smoke tank was identical to the Navy Mark 5 type, except that the Army tanks were constructed of mild or copper-bearing steel instead of Monel (4 p. 6). It was first developed by the Navy for use on Navy type bombers. Production on the M20 by the Chemical Warfare Industrial division began in 1942 (1 p. 21).

The M20A1 differ from the M20 only in the use of double hinged discharge tubes. These are used when the tanks were installed in the bomb bay of an airplane to allow the agent to be discharged safely beneath the plane (6 p. 32) (7 p. 67).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Tank, Airplane, 50-gallon, M20, Pressure – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
AS	425	193	614	279	8 (p. 56)
CNB	475	215	664	301	8 (p. 56)
CNS	612	278	801	363	8 (p. 56)
FS	800	363	989	449	8 (p. 56), 9
H	565	256	754	342	8 (p. 56), 9
HL	N/A	N/A	N/A	N/A	9
HV	N/A	N/A	N/A	N/A	9
L	775	352	964	437	8 (p. 56), 9
MR	440	200	629	285	8 (p. 56)

Shipping/Packing

Available references did not provide this information.

Tank, Airplane, 50-gallon, M20, Pressure

Miscellaneous Information

The M20 tank was first developed by the Navy for use on Navy type bombers. The procurement was originally made through the Navy as they were in the best position to procure because most of the development work had been completed by them. Sources were later developed by the CWS, and production began in September 1942 (1 p. 20).

The M20 could also be used on A-24, A-25, A-32, and other type airplanes which were equipped with suitable carrying racks and controls. The equipment for a single airplane consisted of one tank secured to the underside of the fuselage or in the bomb bay (5 p. 1).

As of July 1944, there were 2,296 M20 and 264 M20A1 spray tanks on hand (7 p. 69).

Key Dates

Tank, Airplane, 50-gallon, M20, Pressure – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1940	CCTC 281 M20	6 (p. 32), 11
Standardized	1942	M20A1	6 (p. 32)
Reclassified	1944	CCTC 899, 971 M20 and M20A1 Limited Standard	10 (p. 113-114)
Standardized	1944	CCTC 1094 (HD-fill Standard, H-fill Substitute Standard)	12 (p. 101)
Obsoleted	1944	CCTC 1129 & 1190 Obsoletion of tanks, airplane, smoke, M20, M20Al and related handling equipment	2 (p. I-7), 7 (p. 68)

Sources

1. Chemical Warfare Industrial Division. 1942. Production Data Sheets (Items Presenting Procurement Problems). September 25.
2. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office. 15 September.
3. Control Division. 1946. Disposition of CWS-Owned Materiel. February 8. Chemical Warfare Service.
4. Blandy, W.H.P. 1943. Preliminary Manuscript for Proposed Ordnance Pamphlet, Aircraft Chemical Smoke and Vesicant Spray, dated 1 July 1943. September 15. Navy Department, Bureau of Ordnance.
5. Loucks, Charles. 1942. Chemical Warfare Technical Bulletin No. 13-1-3, Airplane Smoke Tanks, Tanks M23 and M21 – Description, Assembly and Maintenance. July 18. War Department.
6. Chemical Warfare Technical Committee. 1944. Item # 899, Reclassification of airplane smoke tanks M20, M20A1, M21 and M21Al. January 21.
7. Chemical Warfare Technical Committee. 1944. Item # 1129, Obsoletion of tanks, airplane, smoke, M20, M20Al, M21, M2lAl and related handling equipment. August 31.
8. War Department. 1943. Technical Manual, TM 3-255 Chemical Handling and Loading Equipment. October.
9. Adams, A.S., Captain. 1944. Navy Toxic Gas Handler’s Course (Officers), Edgewood Arsenal, Maryland – Revision of. September 16. Navy Department, Bureau of Naval Personnel.
10. Chemical Warfare Technical Committee. 1944. Item # 971, Reclassification of airplane smoke tanks M20, M20A1, M21 and M21Al. March 17.
11. Chemical Corps Technical Committee. 1940. CCTC Item # 281, Standardization of Type 1 and Type 2 Airplane Smoke Tanks. Department of the Army.
12. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

12.17 Tank, 70-gallon, Airplane, M33 and AN-M33A1

Figures

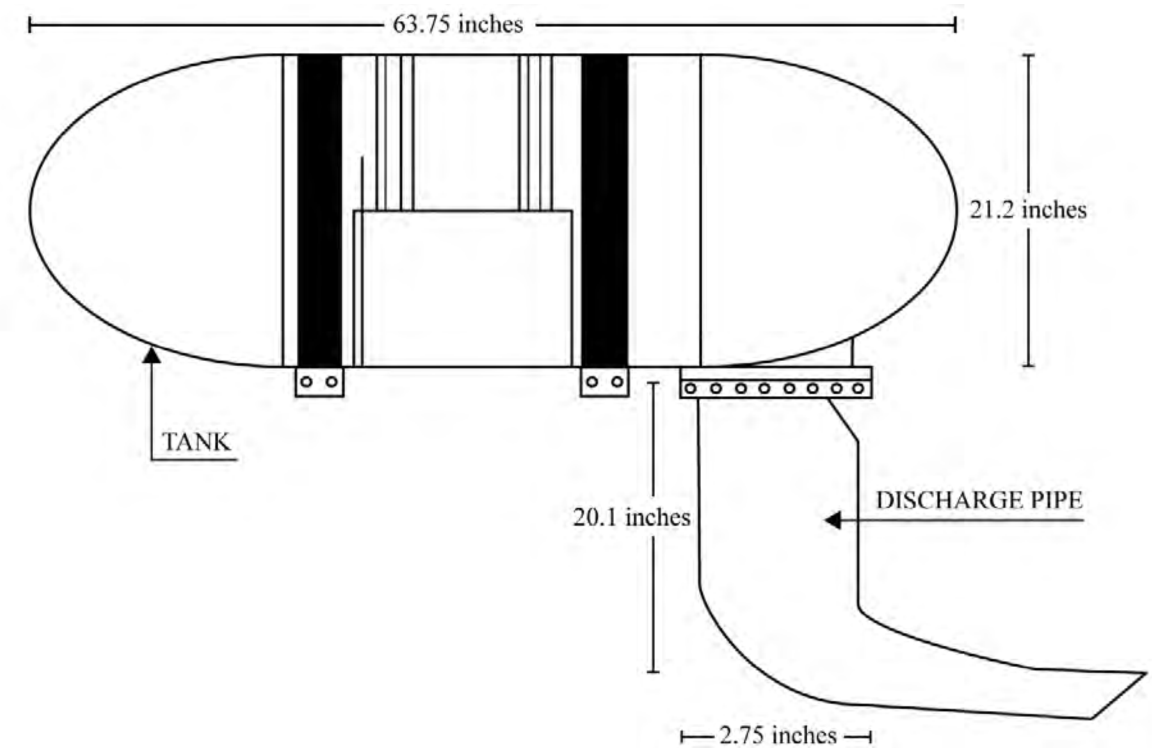

Figure 160: Tank, 70-gallon, Airplane, M33 and AN-M33A1 – Line Drawing

Figure 161: Tank, 70-gallon, Airplane, M33 and AN-M33A1 – Photograph

Tank, 70-gallon, Airplane, M33 and AN-M33A1

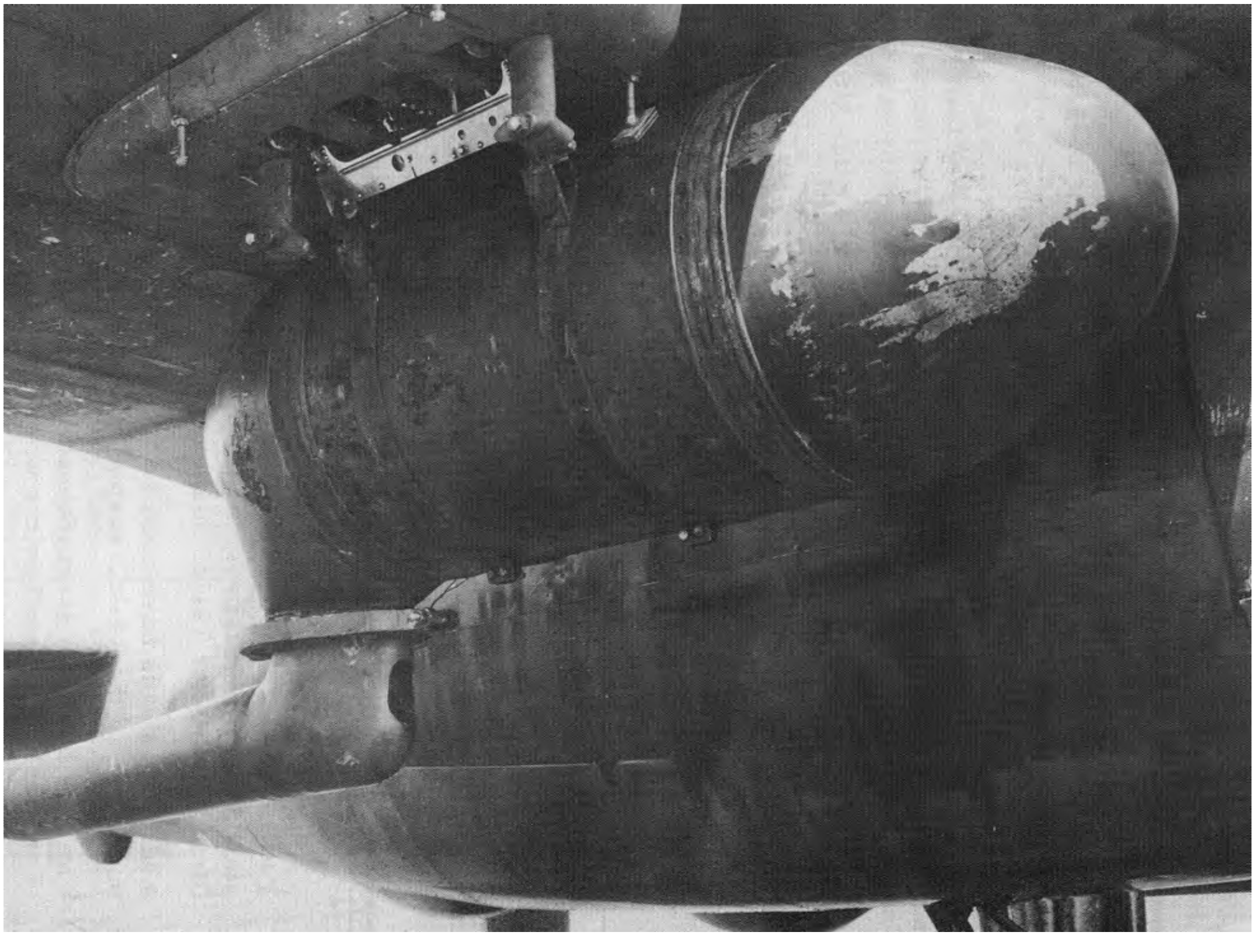

Figure 162: Tank, 70-gallon, Airplane, M33 – Photograph – attached to aircraft

Specifications

Tank, 70-gallon, Airplane, M33 and AN-M33A1 – Specifications and Other Data		Citation
Historical Name	Airplane Smoke Tanks AN-M33A1 And M33	1
Type	Miscellaneous	1
Size	70-gallon	1
Service	Army, Navy	2 (p. K1, K6)
Diameter	Outside: 21.4 in. (54.3 cm) Vent pipe: 2.75 in. (6.99 cm)	1 (p. 14), 3 (p. 257)
Length	Overall minus insulating cover: 63.75-64.75 in. (162 cm) Vent pipe: 20.1 in. (51 cm)	1 (p. 14), 3 (p. 258)
Other Engineering Data	Gross volume: 78 gallons (295.26 liters). Operating volume: 70 gallons (264.78 liters). During development, the M33 was known as the E16R1	1 (p. 14), 3 (p. 257)
Construction Material	The tank was constructed of 16-gauge copper-bearing steel	4 (p. 33, 38)
Specification	96-31-78 (AN-M33A1)	8 (p. F3)

General Use and Description

The AN-M33A1 and M33 smoke tanks were used to lay smoke screens and to spray blister agents, tear gases, and training mustard simulants from airplanes. They were mounted either on the wings or inside the bomb bay of various airplanes. The M33 and M33A1 conformed to the dimensions of a 2,000-pound bomb (3 p. 257), (4 p. 33-38).

The tanks were symmetrical cylindrical with ogival ends, approximately 65 inches long and about 21-3/8 inches in diameter.

Both the AN-M33A1 and M33 airplane smoke tanks had the same components; the tank body assembly, closure plate assembly wired for electric control, and one of the various discharge pipe assemblies. They differed only in tank body assemblies. The AN-M33A1 had a tank carrier assembly that could be adjusted for either 14- or 30-inch suspension of the tank, depending on the airplane installation. Only 30-inch suspension could be used on the M33. Additional beading was provided on the AN-M33A1 tank body to hold the suspension straps in the 14-inch suspension position.

There were two flat steel straps that fit tightly around the tank for suspension. The tank body held the liquid, which was sprayed from the tank. There were two filling openings at the rear of the tank that were closed by square-head pipe plugs. Beading on the tank body held the suspension straps in place.

The vent and discharge assembly consisted of a flanged closure assembly with a discharge opening and a vent pipe. The vent pipe was welded at the bottom to the closure flange.

There were two types of discharge pipes and two types of discharge elbows. The M1 discharge pipe was a basic discharge line for bomb bay installations. The M2 discharge pipe was short and used for wing mounted smoke tanks (1 p. 19), (3 p. 257, 258).

Explosive Train

A wiring conduit was welded to the side of the tank. Detonator lead wires were run through this conduit and a CWS detonator (electric blasting cap) fit into the vent pipe detonator retainer.

The discharge detonator retainer had a recess into which a CWS No. 6 detonator was inserted and a hole at one end of the recess through which the lead wires were threaded. The detonator retainer, with detonator, was inserted into a retaining screw.

The detonators shattered the frangible seals in the air inlet and discharge line assemblies resulting in the gravitational release of the liquid contents of the tank from the discharge pipe. Air entering the air inlet assembly helped force the liquid out of the discharge pipe. The slipstream of the airplane would break up the liquid into a spray (4 p. 34).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Tank, 70-gallon, Airplane, M33 and AN-M33A1

Fills

Tank, 70-gallon, Airplane, M33 and AN-M33A1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AS	595	270	736	334	-	1 (p. 102)
CNB	665	302	806	366	-	1 (p. 102)
CNS	858	389	999	453	-	1 (p. 102)
FM	1,015	460	1,156	524	-	1 (p. 102)
FS	1,120	508	1,261	572	-	1 (p. 102)
H	791	359	932	423	Unclear why reference used a density of 1.35 g/mL to calculate fill.	1 (p. 102)
HD	749	340	890	404	-	1 (p. 102)
HL	945	429	1,086	493	-	1 (p. 102)
L	1,099	498	1,240	562	-	1 (p. 102)
MR	616	279	757	343	-	1 (p. 102)

Shipping/Packing

The tank body was shipped in a single crate with a gross weight of 295 pounds. The discharge pipes, accessories set, and insulating cover were shipped separately (1 p. 64) (4 p. 34).

Miscellaneous Information

As of 1947, there were 2,654 M33 smoke tanks on hand of which 2,602 were new and unused. As of 1948, there were 7,831 AN-M33A1 smoke tanks on hand (2 p. K6) (9 p. 58).

Key Dates

Tank, 70-gallon, Airplane, M33 and AN-M33A1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1943	CCTC 633, 711 (M33)	3 (p. 251, 257)
Standardized	1944	CCTC 989, 1092 (M33A1 Standard, M33 Limited Standard)	5 (p. 97, 98)
Standardized	1944	CCTC 1049, 1094 (HD-fill Standard, H-fill Substitute Standard)	11 (p. 101, 102)
Cancellation	1946	CCTC 1595, 1653 (Cancellation of CNS-fill)	12 (p. 103)
Obsoleted	1946	CCTC 1601 (AS-fill)	10 (p. 88)
Obsoleted	1947	CCTC 1772 (M33)	2 (p. 1). 6 (p. K8)
Standardization	1949	CCTC 2045 (CNC-fill Standard)	13 (p. 141)
Obsoleted	1952	CCTC 2576 (AN-M33A1)	8 (p. F4)

Sources

1. War Department. 1945. Technical Bulletin, TB 3-255B-1, Airplane Smoke Tanks AN-M33A1 and M33. War Department.

2. Chemical Corps Technical Committee. 1948. CCTC Item # 1913, Subject: Obsoletion of Tanks, Airplane Smoke, M10, AN-M33A1, M40 and Accessory Equipment. Chemical Corps.

3. Finklestein, Leo. 1964. History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 - 31 December 1945) Screening Smokes Part III. Chemical Research and Development Laboratories (CRDL).

4. Finklestein, Leo. 1964. CRDL Special Publication 1-42, History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 – 31 December 1945) Screening Smokes Part IV, CBRNIAC-CB-009967. Chemical Research and Development Laboratories (CRDL).

5. Chemical Corps Technical Committee. 1944. CCTC Item # 1092, Subject: Standardization of Tank, Airplane Smoke, M33A1. Department of the Army.

6. Chemical Corps Technical Committee. 1948. CCTC Item # 1881, Subject: Obsoletion of Tanks, Airplane Smoke, M10, AN-M33A1, M40 and Accessory Equipment. Chemical Corps.

7. Chemical Corps Technical Committee. 1949. CCTC Item # 1946, Subject: Obsoletion of Tanks, Airplane Smoke, M10, AN-M33A1, M40 and Accessory Equipment, Request Denied. Department of the Army.

8. Chemical Corps Technical Committee. 1952. CCTC Item # 2576, Obsoletion of Tank, Airplane Smoke, AN-M33A1, M40 and Related Accessories. Department of the Army.

9. Chemical Corps Technical Committee. 1947. CCTC Item # 1772 Obsoletion of Tank, Airplane Smoke, M33. Department of the Army.

10. Chemical Corps Technical Committee. 1946. CCTC Item # 1601, Obsoletion of Simulated Mustard, AS. Department of the Army.

11. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

12. Chemical Corps Technical Committee. 1946. CCTC Item # 1653, Cancellation of CNS as an Authorized Filling for the Airplane Smoke Tank. Department of the Army.

13. Chemical Corps Technical Committee. 1949. CCTC Item # 2045, Reclassification of Irritant Agents, CNS, CNB, PS and Standardization of CNC. Department of the Army.

12.18 Tank, 84-gallon, Aircraft, Aero 14B

Figures

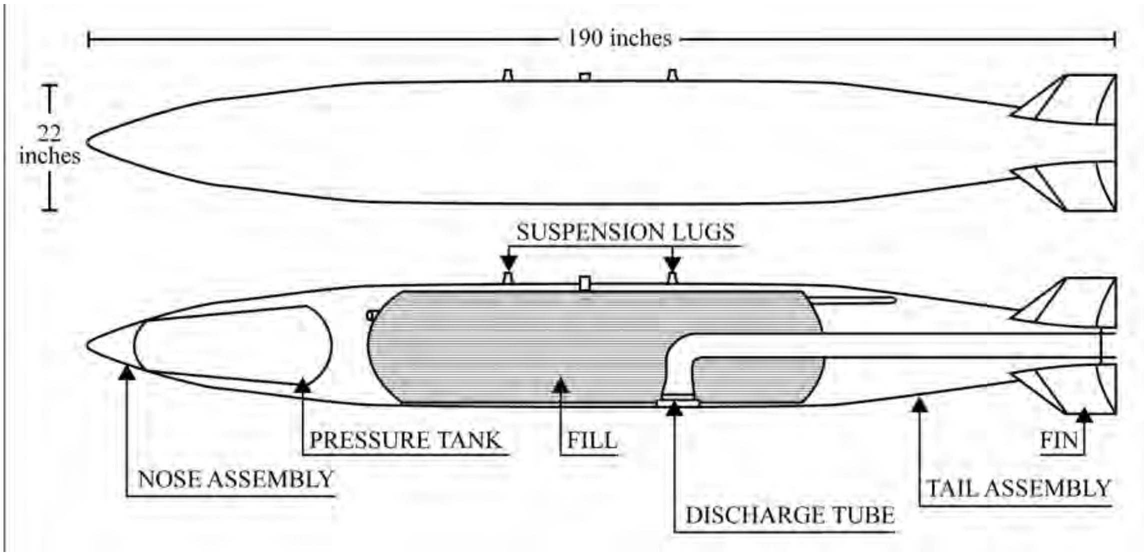

Figure 163: Tank, 84-gallon, Aircraft, Aero 14B - Line Drawing

Figure 164: Tank, 84-gallon, Aircraft, Aero 14B - Photograph - Top: Model, Exterior, Bottom: Model, Cutaway View with simulated agent

Specifications

Tank, 84-gallon, Aircraft, Aero 14B - Specifications and Other Data		**Citation**
Historical Name	Spray Tank, Liquid Aircraft, Aero 14B	2 (p. 4-92)
Type	Miscellaneous	1 (p. 4-93)
Size	84-gallon	1 (p. 4-94)
Service	Marine Corps, Navy	1 (p. 4-93), 2 (p. 4-92)
Diameter	22 in. (55.88 cm)	1 (p. 4-94), 2 (p. 4-93), 3 (p. 11-3), 4 (p. 7-2)
Length	190 in. (483 cm)	1 (p. 4-94), 2 (p. 4-93), 3 (p. 11-3), 4 (p. 7-2)
Other Engineering Data	It was expected that this unit would be replaced by the Aero X18A. Weight, Empty: 650-660 lbs. (295-299 kg) Suspension: 2 lugs 30 in. (76.2 cm) apart	1 (p. 4-93, 4-94), 2 (p. 4-93), 3 (p. 11-3), 4 (p. 7-2)
Drawing	54A50E1	3 (p. 11-2), 4 (p. 7-2)

Tank, 84-gallon, Aircraft, Aero 14B

General Use and Description

The Aero 14B Liquid Aircraft Spray Tank was designed to provide chemical offensive capability as a pressure spray, single fluid, air-to-surface system (1 p. 4-93), (2 p. 4-92), (3 p. 11-2), (4 p. 7-2).

This spray tank was a pressure controlled, combination storage and airborne dispersion system for various liquid chemical agents such as GB and VX nerve agents. The spray tank consisted of a nose assembly, center section, tail section, pressure control system, and discharge nozzle assembly. The nose assembly contained an 1,800-psi tank with regulator that could reduce the tank pressure to 100 psi for operation. The discharge nozzle was located at the rear of the tail section. Four removable fins were attached to the tail section. The center section contained the agent reservoir. A pneumatically operated valve controlled by the pilot released the agent through the discharge tube. Two integral lugs, spaced 30 inches apart, were provided for tank attachment to the underside of the aircraft. A minimum of two fins were required for gravity drop, although four are provided on the normal spray tank. The fins were adjustable in 45 degrees increments. No fins were required for ejector type racks (1 p. 4-93), (2 p. 4-92), (3 p. 11-2), (4 p. 7-2).

The pilot activated the tank by an electric switch coupled to the pneumatic valve through the electrical connector on top of the center section. The agent would then be forced out through the nozzle in the tail by the air released from the pressure tank in the nose section (1 p. 4-93), (2 p. 4-92), (3 p. 11-2), (4 p. 7-2).

Explosive Train

This item required no explosive train.

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Tank, 84-gallon, Aircraft, Aero 14B - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
FS	1,348	611	2,032	922	-	5 (p. 61)
GB	700-772	317-350	1,350-2,000	612-907	-	1 (p. 4-94), 2 (p. 4-93), 3 (p. 11-2), 5 (p. 61)
HD	894	406	1,578	716	-	5 (p. 61)
VX	700-725	317-328	1,350-2,000	612-907	-	1 (p. 4-94), 2 (p. 4-93), 3 (p. 11-2)

Shipping/Packing

Shipping weights (pounds):

- center section empty - 909
- center section filled - 1,810
- components container - 650

Shipping cubage: Center section 85 cubic feet, components container 66 cubic inches (4 p. 7-2).

Tank, 84-gallon, Aircraft, Aero 14B

Miscellaneous Information

Used with Aircraft A-1, A-4, and AF-1E and filling unit, chemical tank MK3 Mod0, MK 4 Mod 0 (3 p. 11-3), (4 p. 7-2).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
3. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
4. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
5. Booz-Allen Applied Research. 1962. A Study of Biological and Chemical Warfare Target Effects. Volume II. Characteristics of Biological and Chemical Agents in Munitions. AD0350553. Naval Ordnance Systems Command.

12.19 Tank, Aircraft, TMU-28/B

Figures

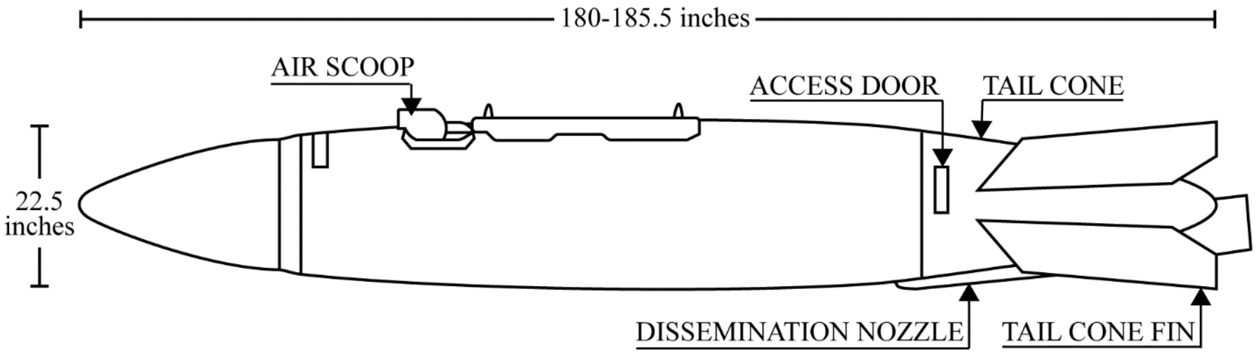

Figure 165: Tank, Aircraft, TMU-28/B - Line Drawing

Figure 166: Tank, Aircraft, TMU-28/B - Photograph

Specifications

Tank, Aircraft, TMU-28/B - Specifications and Other Data		**Citation**
Historical Name	Tank, Spray, Chemical, TMU-28/B	1 (p. 218)
Type	Miscellaneous	1 (p. 218), 2
Service	Air Force	3 (p. 16)
Diameter	22.5 in. (57.15 cm)	1 (p. 218), 2 (p. 2-16)
Length	180-185.5 in. (457-471 cm)	1 (p. 218), 2 (p. 2-16)
Width	Fin: 35 in. (88.90 cm)	2 (p. 2-1)
Other Engineering Data	Weight, Empty: 567 lbs. (257 kg) Capacity, Total: 178.2 gallons (674.6 liters) Agent: 160.4 gallons (607.2 liters)	2 (p. 2-1, 2-16)
Construction Material	Agent Container: Stainless steel	2 (p. 2-2)
NSN	1325-00-900-5542 (Tank, spray, liquid agent) 1325-00-225-0901 (Tank, spray, empty)	2 (p. 2-16)

General Use and Description

The TMU-28/B liquid agent spray tank was designed for airborne dissemination of toxic liquid agents by high-performance aircraft (2 p. 2-1).

The TMU-28/B was a ram air spray tank that was filled with VX. It was fabricated of four major components, agent container, hardback assembly, tail cone section, and dissemination nozzle. The hardback assembly was attached to the top of the agent container. The tail cone section was removable and enclosed the electrical system components. Four each 30-inch suspension lugs were installed on hardback with threaded mountings for 14-inch suspension lugs and a metal, pressure sensitive identification nameplate.

The agent container was fabricated of stainless steel with a filler boss located on the top right side. The filler boss was welded shut after the container was filled with agent.

The tail cone was attached to the aft bulkhead by 34 screws. An access door located on left side of tail cone, gave access to the electrical system components, which were housed in tail cone section. Four removable tail cone fins were also attached to tail cone assembly.

The inlet cutter was installed on the forward top section of spray tank under the air scoop. The cutter contained an explosive charge of 13.8 grains of RDX, two PETN/lead azide detonators, one lead azide bridge wire, and two PETN boosters. The detonators were connected to the electrical cable.

The dissemination nozzle was maintained in a retracted position in tail cone during flight and was extended before dissemination of contents. After dissemination, the spray tank was released from the aircraft (1 p. 218), (2 p. 2-1, 2-2, 2-3, 2-4, 6-5).

Explosive Train

When the explosive cutters were fired, front and rear caps were blown off, and ram air would force the agent out of the spray boom at a rate of 20 gallons a second (1 p. 218), (2 p. 2-1), (4 p. 3).

Fuzing

Tank, Aircraft, TMU-28/B - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Electrically fired explosive cutters	1 (p. 218), 2 (p. 2-2)

Booster, Adapter-Booster, or Burster

Tank, Aircraft, TMU-28/B - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	PETN	Two boosters required.	2 (p. 2-4)

Fills

Tank, Aircraft, TMU-28/B - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
VX	1,300-1,356	589-615	1,935-1,966	877-891	-	1 (p. 218), 2 (p. 2-16), 4 (p. 3), 5 (p. 1-7, A-22)

Shipping/Packing

Shipped and stored in CNU-77/E23 shipping and storage container. The tank was supplied already filled with the chemical agent, and was not reusable (1 p. 238), (2 p. 2-16), (4 p. 3).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. U.S. Army Missile and Munitions Center.
2. Secretary of the Air Force. 1982. Liquid agent spray tank, TMU-28/B and shipping and storage container, CNU-77/E23. Secretary of the Air Force.
3. Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. Department of the Army.
4. Andrulis Research. 1984. Chemical Munitions/Airframes Compatibility, Technical Report (CBRNIAC-CB-005440). Department of Defense.
5. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.

12.20 Tank, Airplane, E28R2

Figures

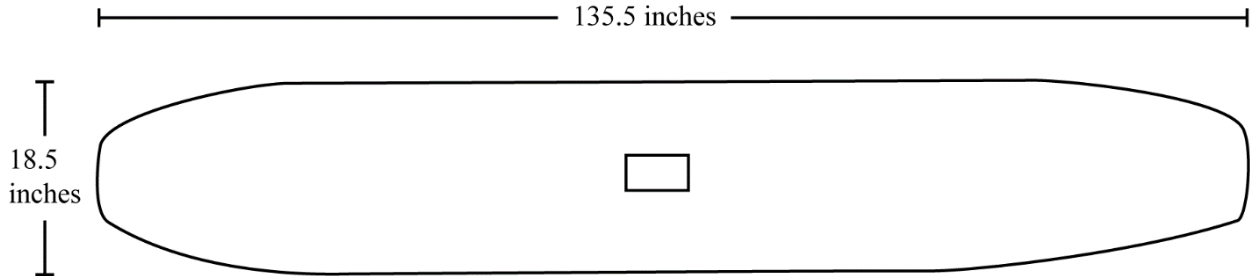

Figure 167: Tank, Spray, E28 - Line Drawing

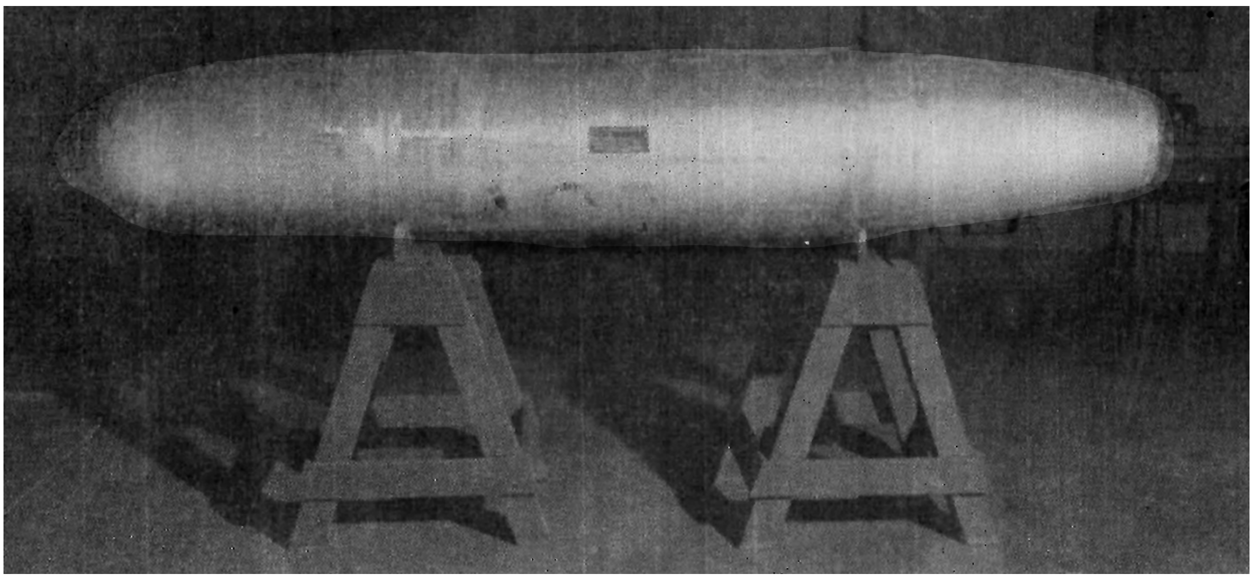

Figure 168: Tank, Spray, E28R1 - Photograph

Specifications

Tank, Airplane, E28R2 - Specifications and Other Data		**Citation**
Historical Name	Tank, Airplane, Spray, E28R2	1 (p. 5)
Type	Miscellaneous	1 (p. 5), 2 (p. 2)
Service	Air Force	2 (p. 7)
Diameter	18.5 in. (46.99 cm)	1 (p. 16)
Length	135.5 in. (344.17 cm)	1 (p. 16)
Other Engineering Data	Weight, Empty: 98.5 lbs. (44.7 kg) Capacity: 110 gallons (416 liters)	1 (p. 16)
Construction Material	Steel bulkhead	2 (p. 15)

General Use and Description

The E28R2 smoke tank was used to lay smoke and to spray liquid agents from airplanes.

The E28R2 spray tank weighed 98.5 pounds empty. The gross volume of the tank was 110 gallons. This tank had an orifice of eight inches and an approximate flow rate of 33 gallons per second at 480 miles per hour. Its performance was considered similar to that expected from a Russian spray tank with a reported 29 gallons per second discharge rate and a 7.9-inch orifice.

Tank, Airplane, E28R2

During development, the E28R2 was an E74R1 firebomb converted to an airplane spray tank with the Kit, conversion, fire-bomb-to-spray-tank, E121R1 with an eight-inch nozzle (1 p. 16), (2 p. 12, 17).

Explosive Train

When the E28R1 functioned, the plastic nut was broken, which would release the tension on the spider, and the pressure of the fill would force the bulkhead and spider out of the rear orifice (2 p. 17).

Fuzing

There was no fuze for this item.

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Tank, Airplane, E28R2 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GA	900	408	999	453	-	1 (p. 16, 19)
GB	810	367	909	412	-	1 (p. 16), 2 (p. 17)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Gibby, I., Layton, L., Stone, W., & Clay, J. 1953. Dugway Proving Ground Report, DPGR 129, Assessment of Hazard from Aerial Spray, DPG CW 3-53. Chemical Warfare Division.

2. Dugway Proving Ground. 1953. Dugway Proving Ground Report, DPGR 121, Airplane Spray Tank Development Test: development test of the tank, airplane spray, E261R1, E28R1, and E28R2, DPG CW 8-52. Chemical Corps.

12.21 Tank, Spray, E26R1

Figures

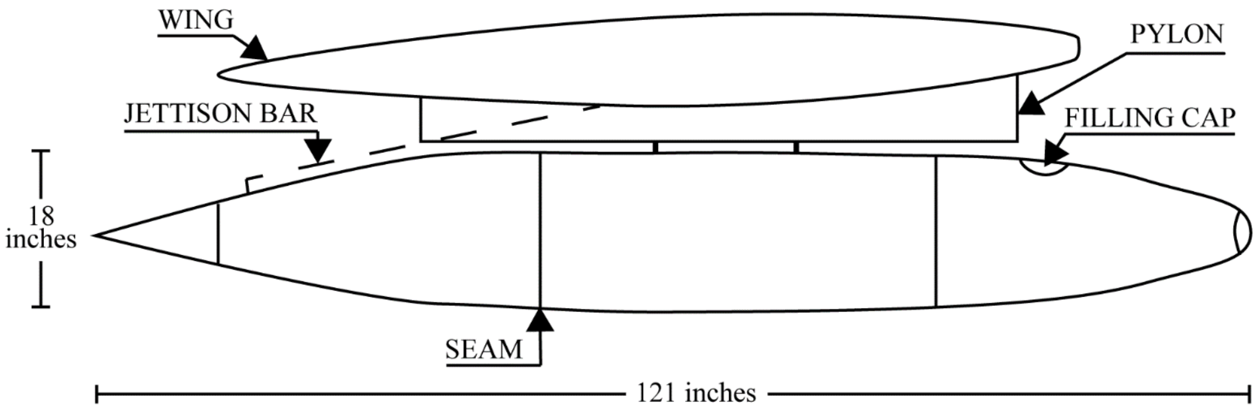

Figure 169: Tank, Spray, E26R1 - Line Drawing

Specifications

Tank, Spray, E26R1 - Specifications and Other Data		Citation
Historical Name	E26R1 Spray Tank	1 (p. 1)
Type	Miscellaneous	1 (p. 1)
Service	Air Force	1 (p. 1)
Diameter	18 in. (45.75 cm)	1 (p. 1)
Length	121 in. (320.04 cm)	1 (p. 1)

General Use and Description

This tank was developed to provide the Air Force with an interim spray tank capability for disseminating smoke, non-toxic, and toxic agents from high-speed aircraft (1 p. 1).

The basic configuration for the tank was the E74 firebomb, 750-pound capacity, which is converted to a spray tank by use of the E12R3 Spray Tank conversion kit. The kit introduced an intake and outlet manifold along the horizontal center line of the firebomb to cutaway ports on the nose and tail section. The intake manifold curved upward from the nose port to direct ram air against the upper surface of the spray tank, thereby distributing the pressure over the surface of the agent in the tank. The outlet manifold had three branched openings, which were positioned approximately one-inch from the bottom of the tank. The branches blended at the horizontal center line, thus forcing the liquid agent through the single discharge orifice at the tail of the tank (1 p, 1, 2).

Upon successful detonation and destruction of both the nose and tail closure plates the tank functioned as a spray dispenser, utilizing ram air principle (1 p. 2).

Explosive Train

To initiate a spray operation, the glass closure plates, located at the cutaway nose and discharge orifice, were removed simultaneously by the firing of blasting cap detonators. The firing of these caps also removed the tail cone fairings (1 p. 2).

Fuzing

There was no fuze for this item.

Tank, Spray, E26R1

Booster, Adapter-Booster, or Burster

There was no booster, adapter-booster, or burster for this item.

Fills

Available references did not include information regarding fills for this item.

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

Available references did not provide fill data for this munition.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Air Force Armament Center. 1954. Test of the E26R1 Spray Tank for Spraying Chemical Agents From F-84 and F-86 Type Aircraft Project "Work Horse". Air Research and Development Command.

13 Mortar

A mortar is an indirect fire weapon that launches a low velocity shell in a high arc over shorter ranges than howitzers or cannons. During WWI, mortars were used for the projection of shells with any of the four classes of chemical agents (American Expeditionary Forces, France, 1919, p. 7). The primary role of the mortars is to provide immediately available, indirect fire that supports the maneuver of the company and that reinforces direct fire during close combat. Chemical agent mortar shells are discussed in the subsections below.

13.1 Mortar, 81-mm, M57

Figures

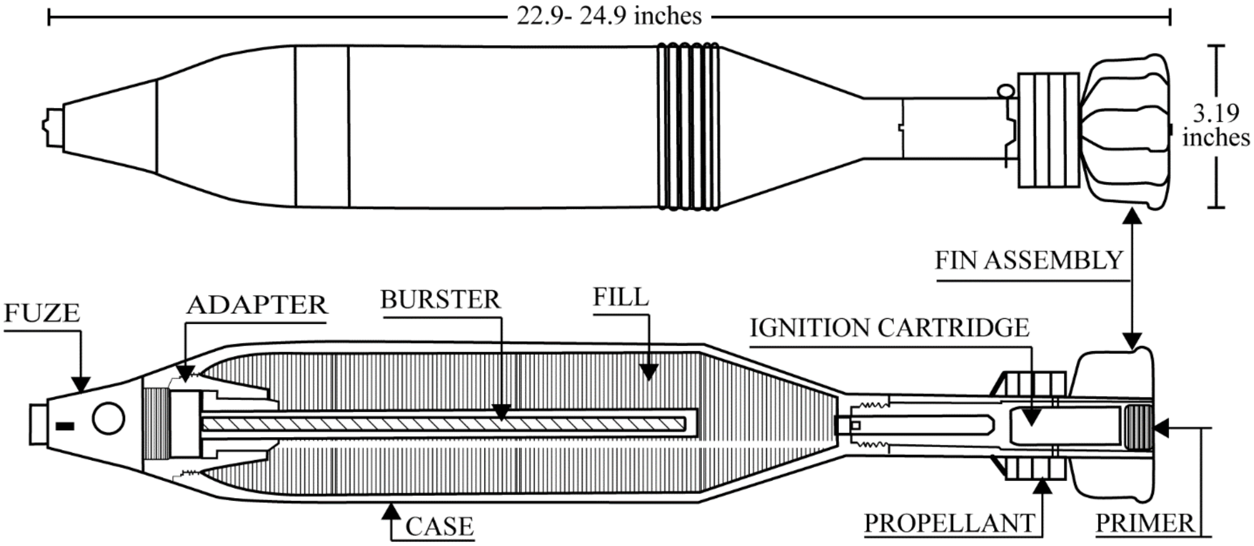

Figure 170: Mortar, 81-mm, M57 - Line Drawing

Figure 171: Mortar, 81-mm, M57 - Photograph - Top: Exterior, Bottom: Cutaway View

Specifications

Mortar, 81-mm, M57 (T9), M57A1 - Specifications and Other Data		Citation
Historical Name	Shell, Smoke, Phosphorus, WP, M57, 81-mm Mortar	1 (p. 155)
Developmental Information	T9	2 (p. 13, 21), 3 (p. 1)
Type	Mortar	4 (p. 289)
Size	81-mm	4 (p. 289)
Service	Army	5 (p. 4-37)
Diameter	81 mm (3.19 inches)	4 (p. 289)
Length	M57 with M52 or M52A1 fuze: 22.9 in. (58.12 cm) M57 with M77 fuze: 24.9 in. (63.2 cm) M57A1 with M525 or M77 fuze: 24.4 in. (62 cm)	4 (p. 291), 6 (p. 100), 7 (p. 1-9, 1-10, 5-12), 8 (p. 168)

Mortar, 81-mm, M57 (T9), M57A1 - Specifications and Other Data		**Citation**
Other Engineering Data	M57 used M4 fin assembly. M57A1 used M4A1 fin assembly. Weight, Empty: 5.29 lbs. (2.4 kg)	3 (p. 2), 5 (p. 4-38), 3 (p. 2)
Construction Material	Forged, steel tube	5 (p. 4-37), 9 (p. 12)
Propellant	M2 (820 grains) M2A1 (0.12 pound)	4 (p. 302), 5 (p. 4-38), 6 (p. 100), 9 (p. 12)
Maximum Range	M52/M52B2 fuze: WP-fill: 2,466 yards (2,254 meters) FS-fill 2,431 yards (2,222 meters) M52A1 fuze: WP-fill 2,470 yards (2,258 meters) FS-fill 2,431 (2,222 meters) M52A2 fuze: FS-fill 2,470 yards (2,258 meters) M77 fuze: WP-fill 2,330 yards (2,160 meters) FS-fill 2,431 (2,222 meters) M57A1: 2,470 yards (2,258 meters)	1 (p. 155), 6 (p. 100), 8 (p. 168, 169), 10 (p. 62.9)
Drawing	75-1-93 (with M52A1 fuze and WP-fill) 75-1-94 (with M52A1 fuze and FS-fill) 75-1-128 (with M52 fuze and HS-fill) 75-1-198 (with M77 fuze and FS-fill) 75-1-199 (with M77 fuze and WP-fill)	5 (p. 4-38), 9 (p. 12), 11 (p. 11)
Specification	196-131-43 (HS-fill)	-

General Use and Description

This projectile was used for the placing of smoke screens and gas clouds with a secondary incendiary effect when WP was used as its chemical filler (4 p. 290), (7 p. 5-10).

In general construction, this mortar shell body had the same outer characteristics as the HE Shell M56. It was a smooth-bore, muzzle-loading weapon for high angle fire. The nose of the projectile was threaded to receive the type of adapter peculiar to chemical shell. The adapter was threaded internally to receive the point detonating Fuze M52, which had a superquick action. The base of the projectile is internally threaded to accept the fin assembly.

All chemical shells, to produce efficient dispersion of filler, needed to burst above ground. A superquick action fuze was therefore used to produce such action. The fin assembly, ignition cartridge, propellant increments, and percussion primer were identical to those used with the HE Shell M56 (1 p. 155), (4 p. 290).

Explosive Train

When the cartridge slid down the mortar tube, the percussion primer in the ignition cartridge stuck the firing pin in the base cap of the mortar. The primer ignited the ignition cartridge, and the cartridge ignited the propellant charge. The burning propellant expelled the projectile from the mortar tube projecting it to the target. The fuze functions on impact detonating the burster charge, which ran through the entire length of the shell and split the shell from nose to tail allowing for the dispersion of all the chemical filler in the shell (4 p. 290), (5 p. 4-37).

Fuzing

Mortar, 81-mm, M57 (T9), M57A1 - Fuzing		
Fuze	**Notes**	**Citation**
M25A1	Point detonating	10 (p. 38)
M45	Point detonating. Used with T9.	3 (p. 2)
M52	Point detonating, superquick	1 (p. 155), 4 (p. 290, 302), 6 (p. 100), 7 (p. 5-8), 11 (p. 11)
M52A1	Point detonating	9 (p. 12)
M5A2	Point detonating. Used with M57A1	10 (p. 62.9)
M52B2	Point detonating	6 (p. 100)
M53	Point detonating. Only for emergency combat use.	7 (p. 5-8)
M77	Time, superquick	1 (p. 147), 7 (p. 5-8), 9 (p. 12), 10 (p. 62.9),
M82	Point detonating. Only for emergency combat use.	7 (p. 5-8)
M525	Point detonating	7 (p. 5-8)

Booster, Adapter-Booster, or Burster

Mortar, 81-mm, M57 (T9), M57A1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M1 Burster	0.08 lbs. (0.04 kg)	Tetryl pellets or tetrytol	The Burster Charge M1 consisted of tetryl pellets or tetrytol in an aluminum or cardboard cylinder	4 (p. 290), 5 (p. 4-38), 9 (p. 12), 11 (p. 11)
Burster- not designated	0.04 lbs. (0.02 kg)	Tetryl	Used with T9	3 (p. 1)

Fills

Mortar, 81-mm, M57(T9), M57A1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	3.13	1.42	10.25	4.65	Experimental (T9)	12 (p. 1-3), 13 (p. 11)
FS	4.51-4.59	2.04-2.08	11.7-13.1	5.31-5.94	*	2 (p. 16-17), 3 (p. 3), 4 (p. 290), 6 (p. 100), 8 (p. 169), 9 (p. 12), 10 (p. 62.9), 11 (p. 11), 14 (p. 1)
H	2.93-3.15	1.32-1.43	10.5	4.76	-	2 (p. 16-17), 4 (p. 290)
WP	3.89-4.09	1.83-1.86	11.3-12.5	5.12-5.67	*	2 (p. 16-17), 3 (p. 3), 4 (p. 290), 6 (p. 100), 7 (p. 1-10), 8 (p. 168), 9 (p. 12), 10 (p. 62.9), 11 (p. 11)

Notes:
* Gross weight varied depending on fuze used.

Shipping/Packing

The rounds were packed completely assembled and ready to fire. There was one round per fiber container, three fiber containers per bundle, and one bundle per wooden crate (4 p. 288, 291). The packing box weighed 43 pounds and was 28 by 9 $^{11}/_{16}$ by 6 $^{15}/_{32}$ inches (5 p. 4-38).

Miscellaneous

The T9 was standardized as the M57, and the T9E1 was developed with a high explosive fill (4.3 pounds of TNT) and was standardized as the M56 (2 p. 21).

Mortar, 81-mm, M57 (T9), M57A1

The M57 is fitted with the M4 fin assembly and the M57A1 uses the M4A1 assembly. These differ in minor manufacturing details only (5 p. 4-38). When fitted with the M52 series of fuzes, the M57 was only issued for emergency use (7 p. 5-2).

Key Dates

Mortar, 81-mm, M57 (T9), M57A1 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1940	OCM 15627 (WP-fill)	2 (p. 13)
Standardized	1961	MSR 11756003 (WP-fill Standard-C)	5 (p. 4-37)
Obsoleted	1961	OCM 37196 (FS-fill)	5 (p. 4-37)

Sources

1. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
2. Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15627, Shell, 81 mm High Explosive and Chemical, T9, Adopted as Standard and Designated Shell, High Explosive, 81 mm, M56, Chemical Shell Designated Shell Chemical, 81 mm, M57; Shell High Explosive, 81 mm, M45 Reclassified From Standard to Limited Standard.
3. Woodberry, David L. 1938. Technical Division Memorandum Report, TDMR 149, Report of Static Fragmentation Test of 81-mm Chemical Shell, T9, FS and WP Filled. December 12. CBRNIAC-CB-023440.
4. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.
5. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. April. U.S. Government Printing Office.
6. War Department. 1946. Field Manual, FM 3-5, Characteristics and Employment of Ground Chemical Munitions. War Department.
7. Chief of the Bureau of Naval Weapons. 1966. NAVWEPS Ordnance Pamphlet, OP 1743, Second Revision, 81-mm Mortar Mark 2 Mod 0, Description, Operation, and Maintenance with Replaceable Parts Breakdown. 1 May.
8. Department of the Army. 1950. Technical Manual, TM 9-1901, Artillery Ammunition. U.S. Government Printing Office.
9. Chief of Ordnance. 1950. No. 5981, Complete Round Charts, Sheet No. 18. ORDIM.
10. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.
11. Anonymous. 1941. Complete Round Charts, issued and revised various dates (RMA barcode GE104415 GE028220-1). U.S. Government Printing Office.
12. Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 220, Test of 81 mm. Mortar and the 4.2-in. Chemical Mortar Using Phosgene Filled Ammunition. May 12. Chemical Warfare Service.
13. McCullough, G. 1941. TDMR 311, Test of 81mm Mortar M1 Firing Shell M57, Phosgene Filled. CBRNIAC-CB-003529. U.S. Government Printing Office.
14. Avery, R.L. 1939. 81-mm Chemical Shell, T9 (Project B2). Chemical Warfare Service. September 28.

13.2 Mortar, Stokes, 4-inch, E1 Series

Figures

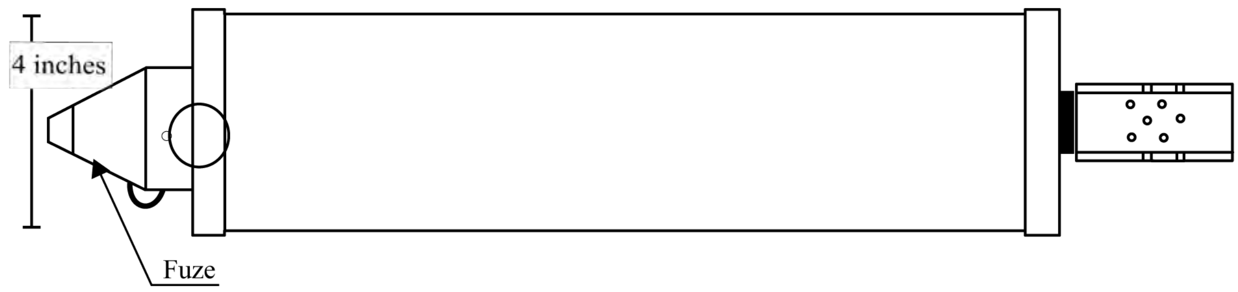

Figure 172: Mortar, Stokes, 4-inch, E1 – Line Drawing

Figure 173: Mortar, Stokes, 4-inch, E1R1 – Photograph

Specifications

Mortar, Stokes, 4-inch, E1 Series – Specifications and Other Data		Citation
Historical Name	4" Stokes Mortar Shells E1, E1R1, E1R2	1 (p. 1), 2
Type	Mortar	1 (p. 1), 2
Size	4-inch	1 (p. 1), 2
Conflict	WWI	1
Diameter	4 in. (7.62 cm)	1 (p. 1)
Other Engineering Data	Ignition cartridge: MII, commercial 12-gauge shot gun shell loaded with 120 grains flake ballistic powder	1 (p. 1), 2 (p. 8, 13, 14, 21)
Construction Material	Seamless steel tube	1 (p. 1), 2 (p. 8a)
Propellant	E1: Hivel Ring, MK II, E5 E1R1: MII	1 (p. 1), 2 (p. 11)
Drawing	E1: CX8-13-3A E1R1: CX8-13-3 E1R2: C8-13-36	1 (p. 1), 2 (p. 9, 24)

General Use and Description

The 4-inch Stokes Mortar shell and fuze were developed for the 4-inch Stokes Mortar. This shell and fuze were designed and developed for the purpose of supplying the using service with a standard shell that could be used with any of the known war gases, smokes, or liquids, and a fuze that would function all-ways and be bore safe. At the same time a universal burster charge was provided that could be used in the shell with any desired chemical filling (1 p. 1).

The E1 was designed to be made from steel tubing with the head and base buttwelded to the casing and the burster tube welded to the head. It was designed for base filling and the threaded stud by which the cartridge container was screwed into the base of the shell served as a filling hole plug. The cartridge container of this shell was threaded on the outside and was provided with two nuts which were used to hold the disk powder over the cartridge container vent holes (2 p. 8a). The only difference between the E1 and the E1R1 was the cartridge container; the outside of the E1 was threaded and the E1R1 was smooth, and the E1R1 did not require the upper nut or the stricker-nut assembly (2 p. 9). The E1 was redesigned to include a burster tube well, and designated E1R2 (2 p. 8).

Explosive Train

Available references did not provide this information.

Fuzing

Mortar, Stokes, 4-inch, E1 Series – Fuzing		
Fuze	**Notes**	**Citation**
E1	All-ways	1 (p. 2), 2 (p. 8a)
E1R1	All-ways, used with the E1R2	2 (p. 8)
MK XI	All-ways, used with gas rounds	2 (p. 3)
MK V	Time delayed, used with smoke and incendiary rounds	2 (p. 3)

Booster, Adapter-Booster, or Burster

Mortar, Stokes, 4-inch, E1 Series – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Burster- not designated	0.093 lbs. (0.042 kg)	Tetryl pellets	–	1 (p. 2), 2 (p. 8)

Fills

Mortar, Stokes, 4-inch, E1 Series – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	N/A	N/A	N/A	N/A	E1R2	1 (p. 2), 2 (p. 7, 10, Appendix B), 3 (p. 6)
CN	N/A	N/A	N/A	N/A	–	3 (p. 6), 2 (p. 4, 7), 3 (p. 6)
CNS	N/A	N/A	N/A	N/A	E1R2	2 (p. 7, Appendix B)
FM	8	3.63	24.3	11.0	E1R2	1 (p. 2), 2 (p. 7, 10, 21, Appendix B), 3 (p. 6)
FS	N/A	N/A	N/A	N/A	–	2 (p. 7, Appendix B)
HS	N/A	N/A	N/A	N/A	E1R2	2 (p. 7, Appendix B)
WP	8.44	3.83	24.7	11.2	E1R2	1 (p. 2), 2 (p. 7, 10, 21, Appendix B)

Shipping/Packing

Two mortar shells and fuzes were packed in a single box and secured in place with copper wire twist ends. The shipping container was closed with nailless seals (2 Appendix B).

Key Dates

Available references did not provide this information.

Sources

1. Brigham, C.E. Lt. Col. 1930. Memorandum to Chief, Chemical Warfare Service, Subject: 4" Stokes Mortar Shell and Fuze. Chemical Warfare Service. July 16.
2. Woodberry, D.L. 1934. Edgewood Arsenal Technical Report, EATR 140, Project B 1.2-lb, 4-in. Chemical Mortar Empty Complete Round E1. May 17. Chemical Warfare Service.
3. Coughlan, J.D., Major. 1931. 4" Stokes Mortar Shell and Fuzed – C.W.B. Project No. 126. Chemical Warfare Service.

13.3 Mortar, 4-inch, MI, Stokes

Figures

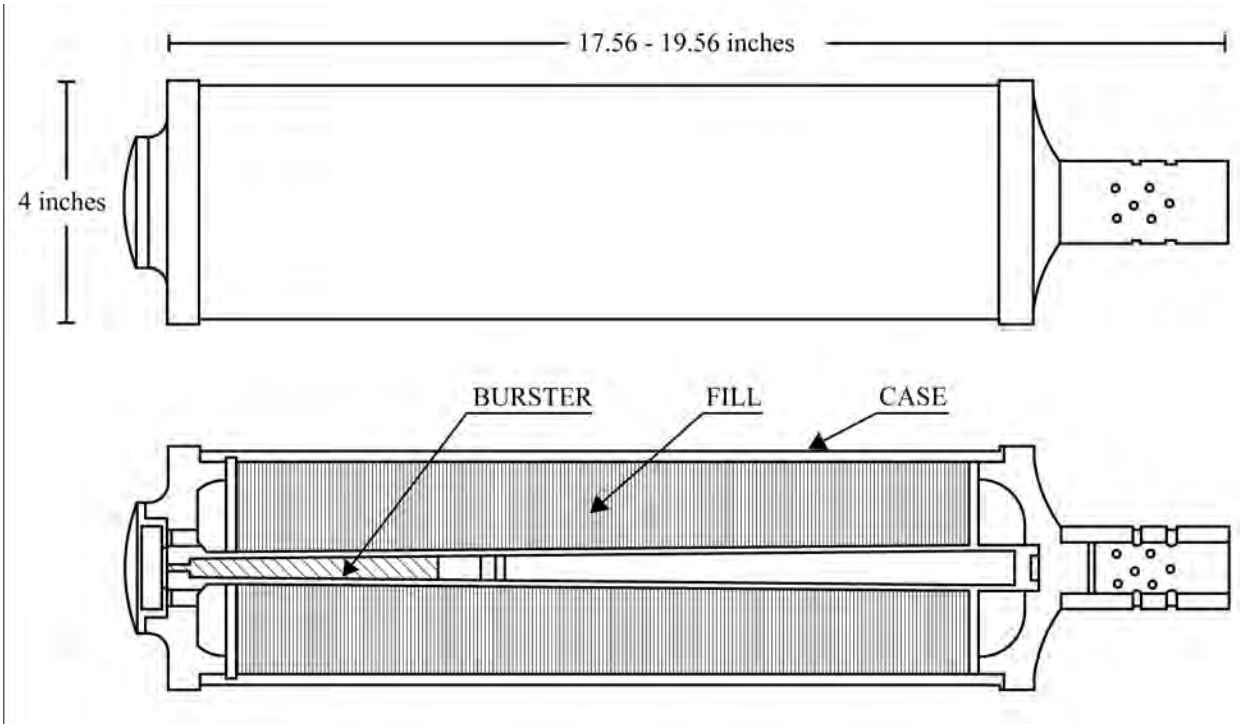

Figure 174: Mortar, 4-inch, MI, Stokes - Line Drawing

Figure 175: Mortar, 4-inch, MI, Stokes - Photograph - Top: Exterior View, Bottom: Cutaway

Mortar, 4-inch, MI, Stokes

Specifications

Mortar, 4-inch, MI, Stokes - Specifications and Other Data		Citation
Historical Name	4-Inch Stokes Mortar Shell; Shell, 4" S.M., Chemical Mk. I; Shell, and 4" S.M., Chemical M1	1 (p. 1), 9 (p. 2)
Type	Mortar	2 (p. 30-33, 38)
Size	4-inch	1 (p. 1), 2 (p. 30)
Conflict	WWI	1 (p. 1), 2 (p. 29-32)
Service	Army	3 (p. 169), 4 (p. 35)
Diameter	Body: 4-in. (10.16 cm) Guide disks: 4.178 in. (10.61 cm)	2 (p. 30-32), 5 (p. 7)
Length	Overall, Gas: 19.56 in. (49.68 cm) Overall, Smoke: 18.56 in. (47.14 cm) Overall, Thermite; 17.56 in. (44.60 cm) Body length: 15 in. (38.1 cm)	2 (p. 30-32), 3
Construction Material	Steel or wrought iron	1 (p. 1), 2 (p. 30-32)
Propellant	E.C. 3 Powder, Cordite, or Ballistite (400 grains).	2 (p. 29, 33, 42), 5 (p. 9)
Maximum Range	1,050-1,100 yards (960-1006 meters)	4 (p. 35), 5 (p. 7)
Drawing	75-19-34, 7-19-35, B8-13-43	5 (p. 8), 8

General Use and Description

The Stokes Mortar was used in active offensive where its mobility permitted it to be pushed far forward and brought into operation on short notice. Within its range, it was a particularly suitable weapon for projecting gas. It was also known as the Shell, 4-inch Chemical Mortar (3 p. 200).

The 4-inch Stokes Mortar was a smooth-bore muzzle-loading weapon with a high angle of fire. The 4-inch Stokes Mortar was reclassified as the 4-inch Chemical Mortar, MI. The complete 4-inch Stokes Mortar projectile consisted of the shell body, burster, fuze, and propellant charge. The projectile body was a cylindrical tube, 4 inches in diameter and 15 inches long, fabricated from drawn steel tubing or rolled metal with an overlapped weld.

The body contained a forward disk and a base disk. The forward or nose disk was machined to 4.178 inches in diameter and designed to retain the forward end of the burster tube and fuze. The base disk was also machined to 4.178 inches and designed to support the aft end of the burster tube and accommodate the cartridge container. The cartridge container was a steel cylinder 2.875 inches in length, 1-inch in diameter, and perforated with 16 holes to provide outlets for the gases generated by the propellant. The forward end (or nose disk) and base disk served as guides when the round was expelled from the mortar barrel.

The burster consisted of a gaine tube detonator and a felt washer. The gaine tube was a brass tube 0.5 inch in diameter and was recessed at the open end to take the detonator and felt washer.

The total length of the body assembly varied, depending on the type of filling that was required (2 p. 29-38), (3 p. 75), (4).

Explosive Train

Upon fuze functioning, a No. 8 detonator containing fulminate of mercury was exploded, which initiated the tetryl burster (3).

Fuzing

Mortar, 4-inch, MI, Stokes - Fuzing		
Fuze	**Notes**	**Citation**
31-D (M11)	-	2 (p. 36)
E1	All-ways acting, 1.5 pounds fully assembled	1 (p. 2)
Mark XI (M11)	All-ways acting	2 (p. 39), 5 (p. 9)
Mark XIM1 (M11A1)	All-ways acting	8
MK V	Essentially a copy of British No. 79, Mark II. For use when air bursts were desired.	2 (p. 37, 39)

Booster, Adapter-Booster, or Burster

Mortar, 4-inch, MI, Stokes - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
4-inch S.M.	0.093 lbs. (0.042 kg)	Tetryl	The brass tube had a 0.5-inch diameter.	1 (p. 3), 2 (p. 31)
Burster	N/A	EC Powder	-	5 (p. 13)

Fills

Mortar, 4-inch, MI, Stokes - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	8.1	3.67	N/A	N/A		10 (p. 6)
CA	7.22	3.27	N/A	N/A	-	6
CG	5.38-6.69	2.44-3.03	N/A	N/A	-	1 (p. 2, 4, 6), 4 (p. 37), 5 (p. 10, 13), 6, 7 (p. 7), 10 (p. 4)
CL	N/A	N/A	N/A	N/A	-	4
CN	5.25-6.45	2.38-2.92	N/A	N/A	-	1 (p. 6), 5 (p. 10, 13), 7 (p. 7)
CNB	N/A	N/A	N/A	N/A	-	4 (p. 37), 8
CNS	5.7-7.0	2.58-3.17	N/A	N/A	-	4 (p. 37), 7 (p. 8), 7
CS	N/A	N/A	N/A	N/A	-	7
FM	6.9-8.5	3.12-3.85	N/A	N/A	-	1 (p. 2), 4 (p. 37), 5 (p. 10), 7 (p. 8), 8
FS	N/A	N/A	N/A	N/A	-	4 (p. 37), 8
H	5.3-6.5	2.4-2.94	N/A	N/A	-	4 (p. 37), 5 (p. 13), 7 (p. 6), 8
KJ	9.5	4.31	N/A	N/A	Estimated	2, 3 (p. 200)
L	N/A	N/A	N/A	N/A	-	4, 7, 8
NC (PS and KJ)	7.56-8.43	3.42-3.82	N/A	N/A	-	3, 6, 10
PG	6.75	3.06	N/A	N/A	-	3 (p. 200), 6
PS	7.0	3.17	N/A	N/A	Estimated	3 (p. 200), 8
TH3 (thermite)	7.75	3.51	25.0	11.3	-	2 (p. 30), 6
WP	7.65-9.00	3.47-4.08	N/A	N/A	-	1 (p. 2), 4, 5 (p. 12), 7 (p. 7), 8, 10 (p. 6)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

There was a practice round and a ranging round identified in reference publications (3 p. 200).

Mortar, 4-inch, MI, Stokes

Key Dates

Mortar, 4-inch, MI, Stokes - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1924	CWS Letter 400.114/280	4 (p. 35)
Standardized	1930	CWS Circular 2 (Substitute Standard)	11
Standardized	1933	CCTC 1933-02 (HS, CG, WP, FM, and CN-solution fills)	9 (p. 2)
Standardized	1942	CCTC 505 (L-fill)	-
Obsoleted	1944	CWTC 938, 1033	4 (p. 35), 12 (p. 112, 113)

Sources

1. Coughlan, J.D., Major. 1931. 4" Stokes Mortar Shell and Fuze - CWB Project No. 126. Chemical Warfare Service.

2. American Expeditionary Forces. 1919. Gas Manual Part III, Use of Gas by Gas Troops, A.E.F. No. 1475-3. War Department.

3. Prentiss, Augustin M. 1937. Chemicals in War: A Treatise on Chemical Warfare. McGraw-Hill Book Company, Inc.

4. Chemical Warfare Technical Committee. 1944. CCTC Item # 938, Obsoletion of 4-inch Chemical Mortar Equipment. Department of the Army.

5. Rouiller, C.A. 1934. 4-In. Chemical Mortar MI, Complete With Ammunition, Accessories and Transportation Equipment. War Department.

6. Edgewood Arsenal. 1921. Weight of Chemical Fillings (NARA II. RG 175. E 1 (P1-8). Box 520.). Mechanical Division.

7. Bouder, N.M., & Powell, H.C. 1931. Approximate Average Weights of Fillings in Chemical Munitions. Information Division.

8. War Department. 1928. 4-Inch Chemical Mortar Shell Painting and Marking Diagram and Bill of Material. Chemical Warfare Service.

9. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. Department of the Army.

10. War Department 1918. Office of Chief of Ordnance, Trench Warfare Section, Memorandum to Colonel Walker, Subject Munitions to be Filled and Approximate Fill Weight. March 9.

11. Chemical Warfare Service 1930. Circular No. 2, Adoption as to Type and Standardization of Chemical Warfare Service Equipment. March 3.

12. Chemical Warfare Technical Committee. 1944. CWTC Item # 1033, Obsoletion of 4-inch Chemical Mortar Equipment. Department of the Army.

13.4 Mortar, 4.2-inch, M1A1, M2, M2A1

Figures

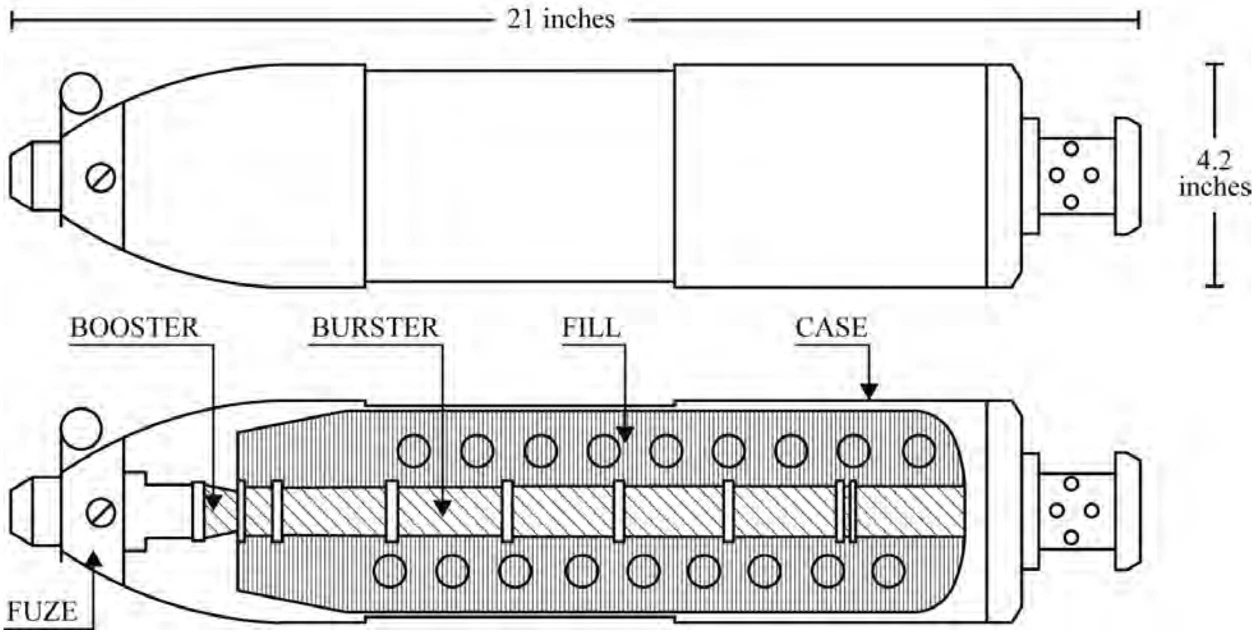

Figure 176: Mortar, 4.2-inch, M1A1, M2, M2A1 - Line Drawing

Figure 177: Mortar, 4.2-inch, M1A1, M2, M2A1 - Photograph - Model, Top: Exterior, Bottom: Cutaway View

Mortar, 4.2-inch, M1A1, M2, M2A1

Specifications

Mortar, 4.2-inch, M1A1, M2, M2A1 - Specifications and Other Data		Citation
Historical Name	Mortar, Chemical, 4.2-Inch, M2A1, M2, and M1A1	1 (p. 63)
Type	Mortar	2 (p. 4-83), 3 (p. 4-125), 4 (p. 4-127)
Size	4.2-inch	1 (p. 75), 4 (p. 4-126), 5 (p. 5-6)
Conflict	Cold War, WWII	1 (p. 63), 2 (p. 4-83), 6 (p. 16), 7 (p. 1)
Service	Army, Marine Corps	3 (p. 4-125), 4 (p. 4-126), 5 (p. 5-6), 6 (p. 16)
Diameter	4.2 in. (10.64 cm)	1 (p. 62), 3 (p. 4-126), 5 (p. 5-6), 8 (p. 2-25)
Length	Fuzed: 21 in. (53.4 cm)	2 (p. 4-84), 3 (p. 4-126), 5 (p. 5-6), 8 (p. 2-16)
Wall Thickness	0.116-0.233 in. (0.295-0.592 cm)	7 (p. 4)
Construction Material	Cartridge: seamless steel tubing Fuze assembly: aluminum or steel	1 (p. 63)
Propellant	M6: 0.43 lbs. (0.19 kg)	2 (p. 4-84), 9 (p. 1-17)
Maximum Range	4,300-4,879 yards (3,930-3,940 meters)	2 (p. 4-86), 3 (p. 4-126), 4 (p. 4-127), 5 (p. 5-6), 6 (p. 16)
Drawing	75-1-284, C8-13-71, C8-13-111 B8-10-13; B8-10-17 (Assembly Drawing)	3 (p. 4-126), 4 (p. 4-127), 5 (p. 5-6), 10
NSN	1325-00-028-5023 (M2 H-filled) 1325-00-028-5018 (M2 HD-filled) 1325-00-028-5027 (M2A1 HD-filled) 1315-00-028-5024, 1315-00-028-5025 (M2 HT-filled)	11 (p. 31)
FSN	1315 028 5021	-

General Use and Description

The mortar shell was used for casualty effect and could be filled with either nonpersistent gases or persistent gases (2 p. 4-83), (4 p. 4-125).

The complete round consisted of a projectile body, a point detonating fuze with an integral burster, and a tail assembly. The body contained a perforated vane assembly welded to the inside of the body and is designed to accommodate the burster tube that extended from the fuze. The tail assembly consisted of a pressure plate and rotating disk, a propelling charge, a cartridge container, and ignition cartridge, and a striker nut assembly. The M2 differed slightly from the M2Al cartridge in that the design of the obturating mechanism was different (2 p. 4-83).

Explosive Train

When the shell was released, it slid down the mortar tube until the percussion primer struck the firing pin. The flash from the primer ignited the ignition cartridge, which in turn, ignited the propelling charge. The spin imparted to the projectile as it left the weapon stabilized it in flight. The perforated vane caused the liquid filler to rotate with the projectile to reduce the possibility of erratic flight. The fuze functioned on impact, detonating the burster charge, which ruptured the projectile and dispersed the gas filler (2 p. 4-83).

Fuzing

Mortar, 4.2-inch, M1A1, M2, M2A1 - Fuzing		
Fuze	**Notes**	**Citation**
E15R8	-	7
M2 ignition cartridge	-	2 (p. 4-84), 3 (p. 4-126), 5 (p. 5-6)
M51A5	HT-filled M2 or M2A1	9 (p. A-19)
M8	Point detonating. Total Weight: 1.9 lbs. (0.86 kg) Overall Length: 16.25 in. (41.27 cm)	2 (p. 4-84), 3 (p. 4-126), 6 (p. 16), 9 (p. A-17, A-18), 12 (p. 1-11)

Booster, Adapter-Booster, or Burster

Mortar, 4.2-inch, M1A1, M2, M2A1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M14 Burster	0.14 lbs. (0.06 kg)	Tetryl	The charge extended the length of the body cavity.	3 (p. 4-126), 4 (p. 4-127), 5 (p. 5-6), 9 (p. A-17 - A-19), 12 (p. 1-12)

Fills

Mortar, 4.2-inch, M1A1, M2, M2A1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	5.75-8.00	2.61-3.63	23.8-24.7	10.8-11.2	-	1 (p. 62), 2 (p. 4-83, 4-84), 3 (p. 4-126), 10, 13 (p. 92), 14 (p. 204), 16 (p. 22)
CK	5.00-8.00	2.27-3.63	22.6-24.7	10.3-11.2	-	2 (p. 4-83, 4-84), 3 (p. 4-126), 13 (p. 92)
CN	5.22	2.73	23.2	10.5	-	15 (p. 11)
CNB	5.45-8.00	2.47-3.63	21.6-24.7	9.70-11.2	-	1 (p. 62), 2 (p. 4-83), 3 (p. 4-126), 14 (p. 204), 16 (p. 22)
CNS	5.75-8.00	2.60-3.63	23.1-25.0	10.4-11.3	-	1 (p. 62), 2 (p. 4-83), 3 (p. 4-126), 14 (p. 204), 16 (p. 22)
FM	7.50-7.56	3.40-3.43	25.1-25.7	11.3-11.6	-	3 (p. 4-126), 10, 14 (p. 207), 16 (p. 22)
FS	7.50-7.56	3.40-3.43	25.1-25.7	11.3-11.6	-	1 (p. 62), 3 (p. 4-126), 10, 14 (p. 207), 16 (p. 22)
H	5.75-11.6	3.60-3.62	23.7-24.7	10.7-11.2	-	2 (p. 4-83), 3 (p. 4-126), 13 (p. 92), 14 (p. 204)
HD	5.75-8.00	2.60-3.62	23.5-25.5	10.6-11.5	-	1 (p. 62), 2 (p. 4-83), 3 (p. 4-126), 4 (p. 4-127), 5 (p. 5-6), 6 (p. 16), 13 (p. 92), 14
HT	5.75-8.00	2.60-3.62	23.3-24.7	10.5-11.2	-	2 (p. 4-83), 3 (p. 4-126), 13 (p. 92), 14 (p. 204)
L	7.50-7.56	3.40-3.42	25.5-25.7	11.6-11.6	Filled as M-1	10, 17 (p. 2)
PWP	6.25	2.83	23.8-24.9	10.7-11.3	-	3 (p. 4-126), 14 (p. 207)
WP	7.50-7.56	3.40-3.43	24.9-25.7	11.2-11.6	-	1 (p. 62), 2 (p. 4-85), 3 (p. 4-126), 10, 14 (p. 207), 16 (p. 22)

Shipping/Packing

Each complete round was enclosed in a cylindrical, waterproof, fiber container. Two containers were packed in a wooden box that was approximately 25 inches long, 11 inches wide, and 7 inches high, and weighed 75 pounds (1 p. 74), (2 p. 4-84).

Miscellaneous Information

The M2A1 was used with the 4.2-inch M30 mortar. In the period between 1940 and 1945, the CWS produced 175 L-filled M2 shells (18 p. 28).

Key Dates

Mortar, 4.2-inch, M1A1, M2, M2A1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1933	CCTC 1933-02 (MI w/ HS, CG, WP, FM, and CN-solution fill)	19 (p. 2)
Standardized	1939	CCTC 54 (MII)	20 (p. 2)
Obsoleted	1939	CCTC 54 (MI)	20 (p. 2)
Classified	1940	CCTC 272	-
Standardized	1942	CCTC 505 (L-fill)	-
Standardized	1944	CCTC 1049 (HD-fill Standard, H-fill substitute Standard)	23 (p. 25)
Obsoleted	1945	CCTC 1269, 1342 (L-filled) CCTC 1527 (Cl-filled)	21 (p. 83), 22 (p. 3)
Standardized	1945	CCTC 1386, 1420 (CK-fill Standard) CCTC 1269, 1342 (HT-fill Substitute Standard)	22 (p. 3), 24 (p. 163, 164)
Standardized	1951	CCTC 2289 (CK-filled M2, Limited Standard)	25 (p. 76, 77)
Standardized	1958	OCM 36841 (M2A1 Standard-A)	11 (p. 31)
Standardized	1960	OCM 37119 (M2)	-
Obsoleted	-	MSR 05776015 (M2, gas) MSR 11756003 (M and M2A1, PWP and WP-filled)	2 (p. 4-83, 4-85)

Sources

1. War Department. 1945. Technical Manual, TM 3-320, Mortar, Chemical, 4.2-Inch. U. S. Government Printing Office.

2. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. U.S. Government Printing Office.

3. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

4. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

5. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

6. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

7. Mc Cullough, G.E., Lt. 1942. Technical Division Memorandum Report, TDMR 345, Engineering Test of 4.2-In. Chemical Mortar Shell M2 Alternate Manufactured by the Scaife Company, January 31, 1942. Technical Division.

8. Secretary of the Army. 1973. Technical Manual, TM 9-1300-251-20, Organizational Maintenance Manual Including Repair Parts and Special Tools List: Artillery Ammunition for Guns, Howitzers, Mortars, Recoilless Rifles and 40 MM Grenade Launchers. Department of the Army.

9. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.

10. Chemical Warfare Service. 1945. Army Service Forces Catalog CW 11-1, Chemical Warfare Supply Catalog, Ammunition, 4.2-Inch Chemical Mortar (Including Propelling Charges, Fuzes and Other Components). Army Service Forces.

11. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
12. Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Canceled Fuzes, MIL-HDBK-146. Department of Defense.
13. Department of the Army. 1956. Technical Manual, TM 3-300, Ground Chemical Munitions. U.S. Government Printing Office.
14. Department of the Army. 1950. Technical Manual, TM 9-1901, Artillery Ammunition. U.S. Government Printing Office.
15. Bouder, N.M., & Powell, H.C. 1931. Approximate Average Weights of Fillings in Chemical Munitions. Information Division.
16. War Department. 1942. Technical Manual, TM 3-320, 4.2-Inch Chemical Mortar, MIA1. Information Division.
17. War Department. 1945. Technical Bulletin, TB CW 27, Complete Round Charts of Chemical Munitions. Information Division.
18. Chemical Warfare Service. 1945. Report of Production 1 January 1940 through 31 December 1945. Production Branch, Procurement Division.
19. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. Department of the Army.
20. Chemical Corps Technical Committee. 1939. CCTC Item # 54, 4.2-inch Chemical Mortar Shell - Subcommittee Report on Standardization. Department of the Army.
21. Chemical Corps Technical Committee. 1945. CCTC Item # 1527, Cancellation of the Authorization to Use Cl as a Chemical Warfare Agent Filling. Department of the Army.
22. Chemical Corps Technical Committee. 1945. CCTC Item # 1342, Standardization of Persistent Agent, HT. Department of the Army.
23. Chemical Corps Technical Committee. 1943. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.
24. Chemical Corps Technical Committee. 1945. CCTC Item # 1420, Classification of CK as Standard Filling for 4.2-inch Chemical Mortar Shell. Department of the Army.
25. Chemical Corps Technical Committee. 1951. CCTC Item # 2289, Reclassification of Cyanogen Chloride, CK to Limited Standard Type. Department of the Army.

13.5 Mortar, 4.2-inch, T172

Figures

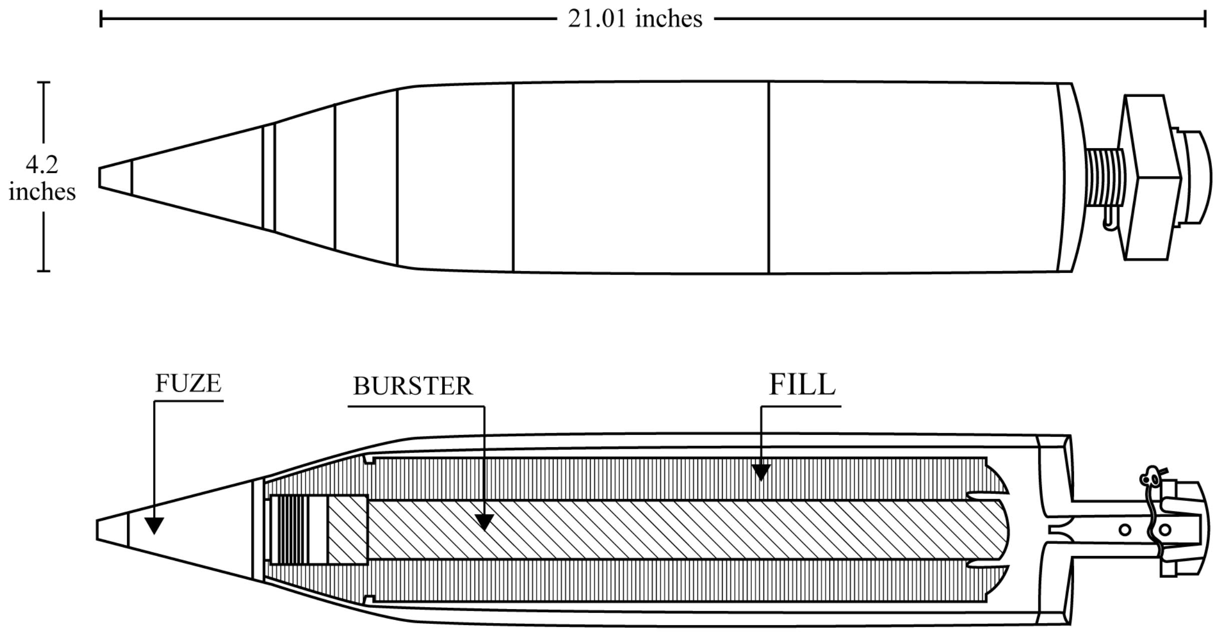

Figure 178: Mortar, 4.2-inch, T172 – Line Drawing

Figure 179: Mortar, 4.2-inch, T172 – Photograph, Cutaway View

Specifications

Mortar, 4.2-inch, T172 – Specifications and Other Data		Citation
Historical Name	Shell, Gas, Nonpersistent, 4.2-inch Mortar, T172	1 (p. 92), 2 (p. 1), 3 (p. 2)
Type	Mortar	1 (p. 92), 2 (p. 1), 3 (p. 2)
Size	4.2-inch	1 (p. 92), 2 (p. 1), 3 (p. 2), 4 (p. 2)
Diameter	4.2 in. (10.69 cm)	2 (p. 1), 3 (p. 2), 4 (p. 2)
Length	Fuzed: 21.01 in. (53.37 cm)	2 (p. 1), 4 (p. 2)

Mortar, 4.2-inch, T172

General Use and Description

Available references did not provide information on specific use.

Explosive Train

Available references did not provide information.

Fuzing

Mortar, 4.2-inch, T172 (Modified) – Fuzing		
Fuze	**Notes**	**Citation**
M48 series	-	-
M51	Superquick	2 (p. 2)
M51A4	Point detonating, Superquick for T172	2, 3 (p. 2, Appendix A), 4 (p. Appendix A)
Not Designated	Variable time	-

Booster, Adapter-Booster, or Burster

Mortar, 4.2-inch, T172 (Modified) – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M21A4	1.65 pounds	Tetrytol	-	2 (p. 1), 3 (Appendix A), 4 (Appendix A)

Fills

Mortar, 4.2-inch, T172 (Modified) – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	3.20-3.40	1.45-1.54	N/A	N/A	-	1 (p. 92), 2 (p. 1)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Department of the Army. 1956. Technical Manual, TM 3-300, Ground Chemical Munitions. U.S. Government Printing Office.
2. Planning and Evaluation Branch. 1952. Chemical and Radiological Laboratories Interim Report, CRLIR 80, Interim Report of Field Test 612 Dynamic Test of Multiple 4.2-Inch Gas Shell, T172, Filled GB, Fired to Impact on an Area of One Artillery Square. Test Division Chemical Corps.
3. Andrews, Lucius C. 1952. 4.2 inch Munitions Data DPG Addendum to DPG Field Tests 25a & b and 27-51. Technical Services Division.
4. Technical Services Division. 1952. Field Test DPG 25a-51, Shell, GB filled, 4.2-inch mortar, T172. Dugway Proving Ground.

13.6 Mortar, 8-inch, Livens Projector, MI, MII, MIIA1

Figures

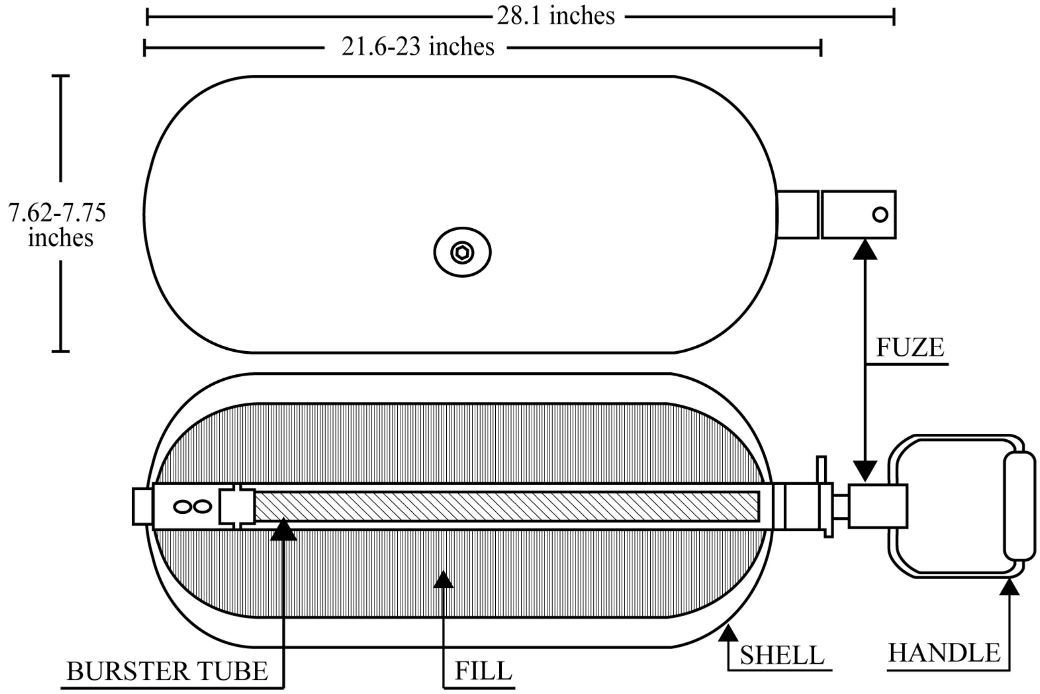

Figure 180: Mortar, 8-inch, Livens Projector, MI, MII, MIIA1 - Line Drawing

Figure 181: Mortar, 8-inch, Livens Projector, MI, MII, MIIA1 - Photograph - Top: Intact, Bottom: Cutaway

Mortar, 8-inch, Livens Projector, MI, MII, MIIA1

Specifications

Mortar, 8-inch, Livens Projector, MI, MII, MIIA1 - Specifications and Other Data		Citation
Historical Name	Livens Projector MI, Shells MII and MIIA1 Shell, Livens Projector, MII and MIIA1	1 (p. 2, 4, 6), 13 (p. 67, 68)
Type	Mortar	6 (p. 12)
Size	8-inch	1 (p. 6), 2 (p. 50), 13 (p. 67)
Conflict	WWI, WWII	1 (p. 1), 3 (p. 1)
Diameter	7.62-7.75 in. (19.3-19.69 cm)	1 (p. 6), 4 (p. 234)
Length	Unfuzed: 21.6-23 in. (54.8-58.42 cm) Fuzed: 28.1 in. (71.4 cm)	1 (p. 6), 4 (p. 234), 5
Wall Thickness	MII and MIIAI: 0.1875 inch (0.47625 cm)	1 (p. 6)
Other Engineering Data	Weight, Empty, MII and MIIA1: 33 lbs. (14.97 kg)	1 (p. 6)
Construction Material	Drawn steel tube	1 (p. 6)
Propellant	The propelling charge MIII assembly consisted of a charge container, a base charge, and a number of auxiliary smokeless powder charges. The propelling charge was 8.69 lbs. (3.94 kg)	1 (p. 4, 12), 13 (p. 69)
Range	910-1,500 yards (832-1,371 meters)	1 (p. 2), 13 (p. 69)

General Use and Description

The Livens Projector was a crude form of mortar that was designed to throw large quantities of chemical agents on distant targets. The high chemical content of the projectiles permitted a more rapid delivery of agent upon the target, and in higher concentration, thereby obtaining greater surprise than with other ground weapons available at the time (1 p. 2), (6 p. 12).

The complete round consisted of a filled "shell" (i.e., projectile), a loaded burster tube assembly, a fuze assembly, and a propelling assembly. The components of the complete round were assembled just prior to firing of the shell. In the 1920s, there was a 24-pound, 40-pound, and 60-pound "drum" (i.e., projectile) that could be used in the Livens Projector. In the 1940s, two types of projectile bodies were used in the Livens Projector, the MII and the MIIA1.

The projectile body, MII, was made of seamless drawn steel tubing 3/16-inch thick with forge-welded ends. It can be identified by the projections at each end, which were 1.69 inches in diameter and approximately 1-inch long. A central tube ran the length of the shell and was welded into it at both ends. A steel plug (coupling plug) was welded into the tube to divide it into the section used to receive the burster tube and the section used for filling the shell. The shell-filling passed from the tube into the shell through four holes located near the filling end of the projectile. There were also two vent holes. After filling, the shell was sealed by screwing a tapered plug into the filling hole.

The MIIA1 differed in construction in that it had rounded ends closed by fusion welding, with no projections on either end. The other details of its construction were the same as for the MII (1 p. 3, 5, 6), (7).

Explosive Train

A fuze assembly that consisted of an igniter head containing a primer; a 12-inch section of Type III safety fuze, and a No. 8 detonator was used in the burster tube assembly to set off the burster charge. When the shell is fired, the force of setback causes the inertia pellet to strike the primer which ignites the safety fuze. After a delay, the safety fuze fires the detonator that explodes the bursting charge and ruptures the shell (1 p. 5, 10), (13 p. 68).

Fuzing

Mortar, 8-inch, Livens Projector, MI, MII, MIIA1 - Fuzing		
Fuze	**Note**	**Citation**
MI Assembly	12-inch Type II safety fuze	1 (p. 6, 8)

Booster, Adapter-Booster, or Burster

Mortar, 8-inch, Livens Projector, MI, MII, MIIA1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
MI Burster tube assembly	0.14 lbs. (0.065 kg)	crystalline TNT	Consisted of a burster tube (0.875 by 16.938 in.) with adapter, body, cap, and handle. The assembly was 2 lbs.	1 (p. 4, 10, 30), 13 (p. 69)

Fills

Mortar, 8-inch, Livens Projector, MI, MII, MIIA1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	6.00-30.0	2.72-13.6	60.0-61.5	27.2-27.6	There were three sizes of Livens in 1921. The Mark I was produced in 24, 40 and 60-pound sizes.	1 (p. 6), 3 (p. 12), 5, 7, 8, 9 (p. 102), 14
Cl	28.0	12.7	61.0	27.6	Limited Standard fill.	1 (p. 2, 3), 5, 10 (p. 46)
FM	6.00-30.0	2.72-13.6	61.0	27.6	Limited Standard fill. There were three sizes of Livens in 1921. The Mark I was produced in 24, 40, and 60-pound sizes.	1 (p. 2, 3), 4 (p. 234), 7, 10 (p. 6)
FS	28.0	12.7	61.0	27.6	MII and MIIA1	1 (p. 6), 4 (p. 234), 10 (p. 6)
H	6.00-14.0	2.72-6.35	61.0	27.6	There were three sizes of Livens in 1921. The Mark I was produced in 24, 40, and 60-pound sizes. The 25 and 40-pound Mark I was HS-filled	5
NC	6.00-30.0	2.72-13.6	N/A	N/A	There were three sizes of Livens in 1921.	5, 7, 14 (p. 3)
PG	6.00-30.0	2.72-13.6	N/A	N/A	There were three sizes of Livens in 1921. The Mark I was produced in 24, 40, and 60-pound sizes.	7
PS	6.00-30.0	2.72-13.6	N/A	N/A	There were three sizes of Livens in 1921. The Mark I was produced in 24, 40, and 60-pound sizes.	5, 7
TH3	6.00-30.0	2.72-13.6	N/A	N/A	There were three sizes of Livens in 1921. The Mark I was produced in 24, 40, and 60-pound sizes.	5, 7

Shipping/Packing

Ammunition for the Livens Projector (i.e., MII and MIIA) were packed one in a single wooden box bound with metal straps for shipment. The box was approximately 27 inches long, 9.5 inches wide, and 9.5 inches high. The packed box weighed 83 pounds (1 p. 26).

Miscellaneous

The limited range and mobility of the Livens Projector made it inadequate for support of combat in WWII. This along with the development of the 7.2-inch chemical rocket (Project B 1.5-3), led to declaring the Livens Projector and related materials surplus in 1944 and its obsolescence.

When the Livens Projector was declared obsolete in 1944, there were 2,712 MII Shells (1,141 were filled) and 26,153 MIIA1 shells (115 filled) on hand. The filled shells include GC, CL, FM, and FS (14 p. 3, 4).

Key Dates

Mortar, 8-inch, Livens Projector, MI, MII, MIIA1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1924	Letter, 400.114 (MI & MII Projector)	13 (p. 67, 68)
Standardized	1933	CCTC 1933-02 (CG & FM-fill)	11 (p. 2, 3)
Standardized	1934	letter, CWS 400.114/9 (MII & MIIA1 Shells)	13 (p. 68, 69)
Obsoleted	1944	CCTC 1065, 1145 (MII & MIIA1 Shells)	12 (p. 101, 102), 13 (p. 70)

Sources

1. War Department. 1942. Technical Manual, TM 3-325, Livens Projector MI. Dugway Proving Ground.

2. American Expeditionary Forces. 1919. Gas Manual Part III, Use of Gas by Gas Troops, A.E.F. No. 1475-3. War Department.

3. Bouder, N.M., & Powell, H.C. 1931. Approximate Average Weights of Fillings in Chemical Munitions. Information Division.

4. Finklestein, Leo. 1964. History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 - 31 December 1945) Screening Smokes Part III. Chemical Research and Development Laboratories (CRDL).

5. McGeorge, Harvey J. 1993. Operation Safe Removal: WWI Chemical & Explosive Munitions Identification Guide (CBRNIAC-CB-188036). Public Safety Group.

6. Marine Corps Schools. 1993. Hand Book of Chemical Weapons and Munitions. Marine Corps Schools.

7. Edgewood Arsenal. 1921. Weight of Chemical Fillings (NARA II. RG 175. E 1 (P1-8). Box 520.). Mechanical Division.

8. Chemical Warfare Service. 1943. Chemical Warfare Service Field Materiel Data. U.S. Government Printing Office.

9. War Department. 1942. Field Manual, FM 3-5, Chemical Warfare Service Field Manual: Tactics of Chemical Warfare. War Department.

10. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. War Department.

11. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. Department of the Army.

12. Chemical Corps Technical Committee. 1945. CCTC Item # 1145, Obsoletion of Livens Projector Equipment. Department of the Army.

13. Chemical Corps Technical Committee. 1944. CCTC Item # 1065, Obsoletion of Livens Projector Equipment. Department of the Army. 7 July.

14. War Department 1918. Office of Chief of Ordnance, Trench Warfare Section, Memorandum to Colonel Walker, Subject Munitions to be Filled and Approximate Fill Weight. March 9.

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14 Projectile

A projectile is propelled by something else, usually the compression or expansion of gases. Projectiles, such as artillery rounds, deliver an explosive charge, chemical agent, or other fill from a ranged weapon.

There are several types of artillery ammunition designed for ease in handling and loading. Chemical and smoke rounds typically fall into three categories: fixed, semifixed, and separate-loading. Fixed artillery projectiles are used in gun cannons and recoilless rifles; semifixed in howitzers and mortars; and separate-loading in large caliber guns and howitzers.

Fixed ammunition consists of a complete round issued with the cartridge case (containing a nonadjustable propelling charge and a primer) permanently crimped or otherwise attached to the projectile. The complete round is loaded into the weapon as a unit.

In semifixed howitzer ammunition, the cartridge case is loose-fitted over the base of the projectile. The propelling charge, bagged inside the cartridge case, can be adjusted to obtain the desired range. The complete round, like that of fixed ammunition, is loaded into the weapon as a unit.

In separate-loading ammunition, the major components – projectile, propelling charge and primer – are issued unassembled and are loaded into the weapon separately. The propelling charge, loaded in cloth bags, is adjustable. It is loaded into the weapon immediately to the rear of the projectile. After the breechblock has been closed and locked behind the charge, with igniter, the primer is inserted into the firing mechanism of the breechblock (Department of the Army 1969, 4-1 to 4-3).

14.1 Projectile, 75-mm, MK II

Figures

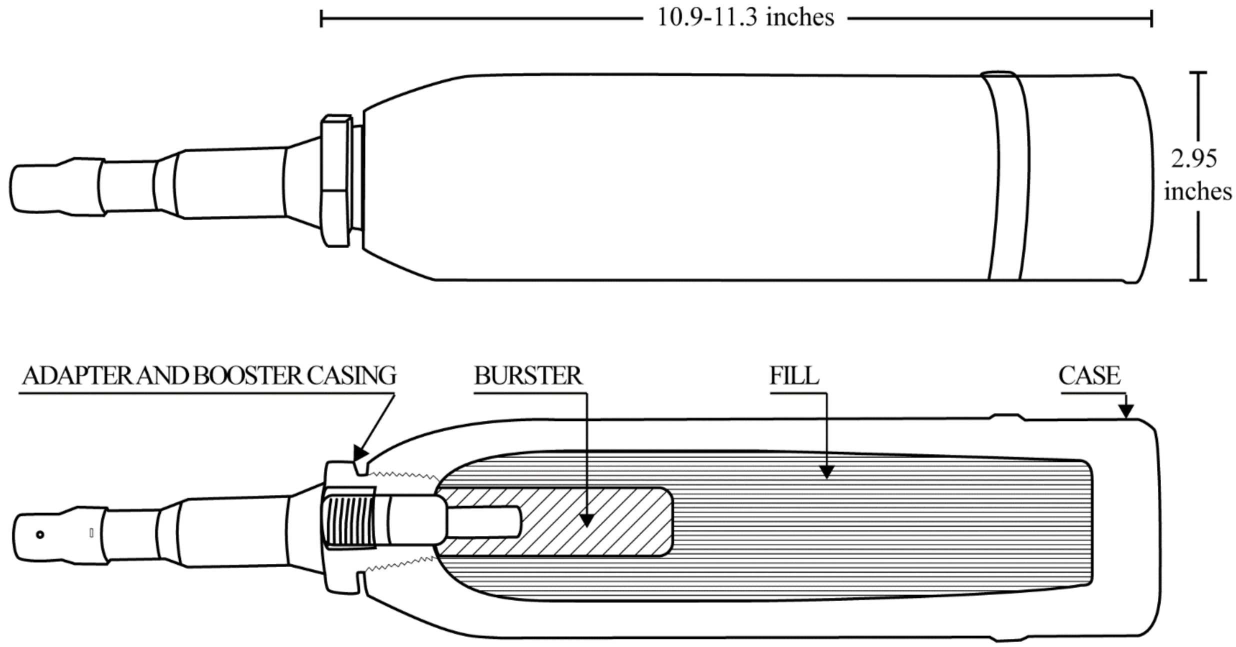

Figure 182: Projectile, 75-mm, MK II - Line Drawing

Figure 183: Projectile, 75-mm, MK II - Photograph - Top: Intact, Bottom: Cutaway View

Projectile, 75-mm, MK II

Specifications

Projectile, 75-mm, MK II - Specifications and Other Data		Citation
Historical Name	American 75 mm. Common Steel Shell Mark II	1 (p. 42), 9 (Table 16, p. 140)
Type	Projectile	1 (p. 42)
Size	75-mm	2 (p. 109)
Conflict	WWI, WWII	1 (p. 42), 3 (p. 419)
Diameter	2.95 in. (7.5 cm)	1 (p. 42, 43), 2 (p. 110)
Length	10.9-11.3 in. (27.8-28.7 cm), unfuzed	1 (p. 43), 2 (p. 110), 9 (Table 16, p. 140)
Wall Thickness	0.303 in. (0.76962 cm)	1 (p. 43)
Other Engineering Data	Weight, Empty: 10.27 lbs. (4.65 kg) Rotating band: 0.49 in. (1.25 cm)	1 (Table V), 2 (p. 110, 356, 357)
Construction Material	Body: Steel Rotating band: Copper	3 (p. 421), 4 (p. 7)
Propellant	Flashless nonhygroscopic (FNH) propelling powder (1.35 lbs. [0.61 kg])	2 (p. 109)
Maximum Range	8,600 yards (7,863 meters)	2 (p. 110)
Drawing	75-2-171	4 (p. 7), 10 (p. 10)
Specification	96-131-3 (WP-fill) 96-131-13 (H-fill)	-

General Use and Description

Available references did not provide information on specific use.

The Mark II shell design was an adaptation of the French M 1900 and represented the older type of shell in use before the streamlined shape was developed. It had a copper rotating band, two grooves behind the rotating band for stab crimping of the cartridge case to the projectile, and a square base. The nose did not take the fuzes directly but required an adapter that the booster was fitted to. The Mark II projectile varied from the HE Projectile MK I only in that it was pipe-threaded in the nose and had no base plate. (Absence of the base plate was common to chemical shells of all sizes.) The pipe threads in the nose of the shell insured a gastight seal in the joint between adapter-booster and the nose of the projectile (3 p. 421).

Explosive Train

The adapter-booster in this projectile performed the function of bursting the shell. It was not entirely efficient; sometimes fragmenting only the upper half of the shell and leaving the lower half in the form of a cup which would carry a portion of the chemical agent fill into the ground undispersed (3 p. 421).

Fuzing

Projectile, 75-mm, MK II - Fuzing		
Fuze	**Notes**	**Citation**
French I.A. Model 1915	Point detonating, superquick	1 (p. 34, 42)
French I.A.L. Model 1916	Point detonating, superquick	1 (p. 34, 42)
French R.Y	Point detonating, superquick	1 (p. 42)
French Schneider, Model 1916	Point detonating; only to be used if other fuzes were unavailable	1 (p. 42)
M46	Superquick, adapted for point detonating	2 (p. 109), 4 (p. 7)
Modified British No. 106	Superquick	1 (p. 42)
U.S. Mark III	Superquick	1 (p. 34, 42), 9 (p. 138)

Projectile, 75-mm, MK II

Booster, Adapter-Booster, or Burster

Projectile, 75-mm, MK II - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
MK IV Adapter-booster	N/A	N/A	-	1 (p. 43)
MK IVB Adapter-booster	N/A	N/A	-	3 (p. 421)
MK IVM1 Adapter-booster	N/A	N/A	-	3 (p. 421)

Fills

Projectile, 75-mm, MK II - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA (Bromoacetone)	1.97	0.89	10.6-12.3	4.80-5.57	-	1 (Table V, p. 42)
CA	1.45-1.55	0.65-0.70	10.6-12.3	4.80-5.57	-	1 (Table V, p. 42), 5
CG	1.32-1.36	0.59-0.61	10.6-12.3	4.80-5.57	-	1 (Table V, p. 42), 5
CN	0.95-1.05	0.43-0.47	N/A	N/A	-	6 (p. 4)
CNS	1.24	0.56	N/A	N/A	-	6 (p. 5)
FM	1.68-1.71	0.76-0.77	12.7	5.76	Gross weight is “as fired.”	1 (Table V, p. 42), 2 (p. 110, 356), 3 (p. 421), 5
FS	1.68-1.90	0.76-0.86	12.9	5.85	Gross weight is “as fired.”	2 (p. 110, 356), 3 (p. 421), 5
H	1.25-1.36	0.56-0.61	12.3	5.59	Gross weight is “as fired.”	1 (p. 24, 42), 2 (p. 110, 356), 3 (p. 421), 5
NC	1.74	0.78	10.6-12.0	4.85-5.58	-	1 (p. 24), 2 (p. 356), 3 (p. 421), 5
WP	1.81-1.91	0.82-0.86	12.8	5.82	Gross weight is “as fired.”	2 (p. 110, 357), 3 (p. 421), 5

Shipping/Packing

For domestic shipment, three individual fiber containers (3 rounds per) bundle with a shipping weight of 58.9 pounds and a volume of one cubic foot. For overseas shipment, one bundle (3 rounds) per crate. Shipping weight was 72 pounds, and the volume was 1.7 cubic feet.

Miscellaneous Information

In April 1932, there were 78,634 MK II, NC-filled shells on hand for war reserve. In 1933, these shells were declared obsolete and were recommended for use in training in the use of liquid-filled shells (11 p. 24, 25) (12 p. 2, 3).

The MK II was the only standard chemical shell for the 75-mm gun in 1944 (3 p. 419).

Projectile, 75-mm, MK II

Key Dates

Projectile, 75-mm, MK II - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1923	OCM 3344	10 (p. 10)
Standardized	1933	CCTC 1933-02 (HS-, WP-, FM-, CN-solution fill)	7 (p. 2, 3)
Obsoleted	1933	OCM 10898 (NC-fill)	12
Standardized	1943	CCTC 881 (H and WP-fill Standard, FS and L-fill Substitute Standard, FM-fill Limited Standard)	8 (p. 82)
Standardized	1944	CCTC 1049 (HD-fill Standard, H-fill Substitute Standard)	13 (p. 25, 26)
Standardized	1944	OCM 23422 (MKII Limited Standard)	-

Sources

1. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.
2. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
3. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.
4. Anonymous. 1941. Complete Round Charts, issued and revised various dates (RMA barcode GE104415 GE028220-1). U.S. Government Printing Office.
5. Edgewood Arsenal. 1921. Weight of Chemical Fillings (NARA II. RG 175. E 1 (P1-8). Box 520.). Mechanical Division.
6. Bouder, N.M., & Powell, H.C. 1931. Approximate Average Weights of Fillings in Chemical Munitions. Information Division.
7. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. Department of the Army.
8. Chemical Corps Technical Committee. 1943. CCTC Item # 881, Classification of Fillings for Chemical Munitions. Department of the Army.
9. Office of the Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. November. Government Printing Office.
10. Ordnance Committee. 1923. Ordnance Committee Meeting, OCM Item # 3344, Standardization of Chemical Shell and Boosters. November 1.
11. Ordnance Committee. 1932. Ordnance Committee Meeting, OCM Item # 9758, Shell, 155 MM, Chemical [Mark II Shell, HS-filled, and 75 MM, Mark II Shell, NC-filled] – War Reserve Test to Determine Serviceability and to Establish Data for Efficient Use. April 28.
12. Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10898, 75MM Shell [MK II], N. C. Filled – Declared Obsolete and Authorized for Use in Target Practice. August 10.
13. Chemical Corps Technical Committee. 1944. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.

14.2 Projectile, 75-mm, M64

Figures

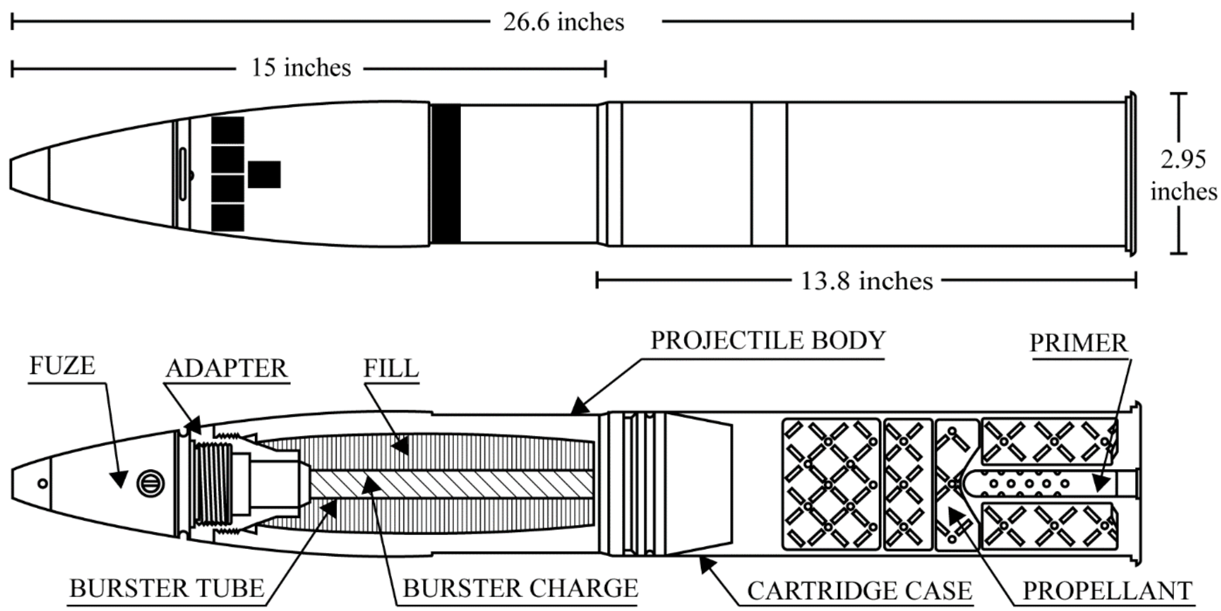

Figure 184: Projectile, 75-mm, M64 - Line Drawing

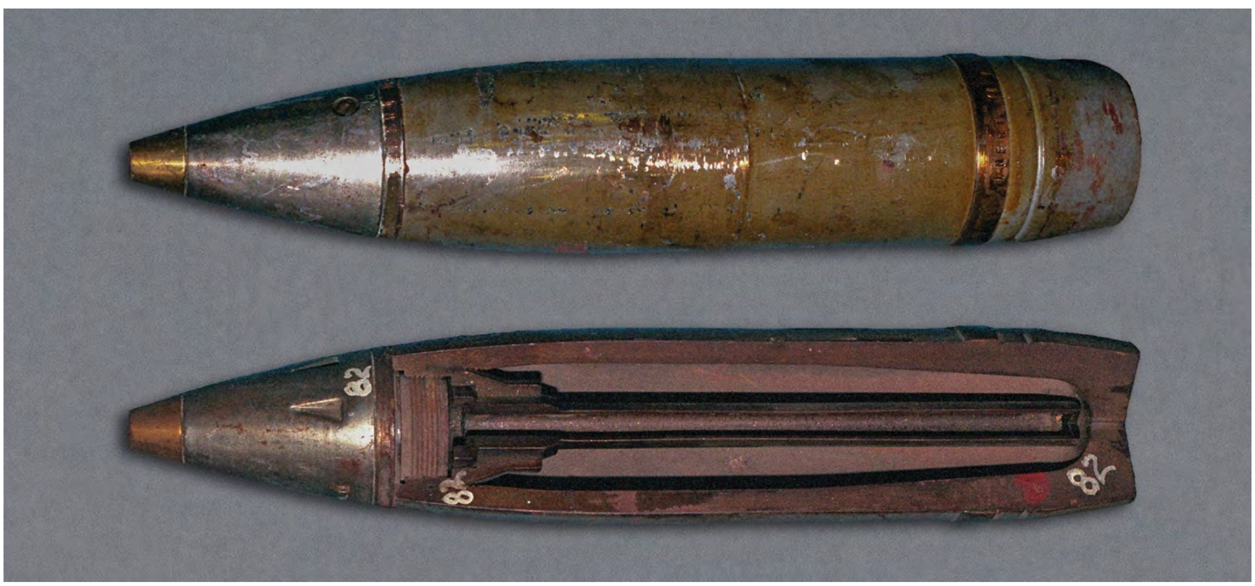

Figure 185: Projectile, 75-mm, M64 – Photograph - Top: Intact, Bottom: Cutaway View

Specifications

Projectile, 75-mm, M64 - Specifications and Other Data		Citation
Historical Name	Shell, Chemical, 75 mm, M64 Shell, Fixed, Gas, M64, 75-mm	1 (p. 108-109, 111, 121), 10
Developmental Information	Shell, Chemical, 75 mm, T9	10 (p. 45)
Type	Projectile	1 (p. 108)
Size	75-mm	1 (p. 108)

Projectile, 75-mm, M64

Projectile, 75-mm, M64 - Specifications and Other Data		**Citation**
Service	Army	2 (p. 4-100)
Diameter	2.95 in. (7.5 cm)	1 (p. 108)
Length	Complete Round: 26.6 in. (67.6 cm) Fuzed: 15.0 in. (38 cm) Cartridge case: 13.82 in. (35.1 cm)	1 (p. 109, 122)
Other Engineering Data	The M64 was a modification of the M48 HE shell. Primer: M31A2 or M1B1A2. Cartridge casing: M5A1 and M5A1B1	1 (p. 108), 3 (p. 432)
Construction Material	Steel	2 (p. 4-100), 4
Propellant	Propelling charge: FNH (2 lbs. [0.91 kg]) FNH, M1 (1.04 lbs. [0.47 kg])	1 (p. 108, 357, 358)
Maximum Range	9,610-13,860 yards (8,805-12,508 meters)	4, 5 (p. 103, 104)
Drawing	75-2-294	6 (p. 7)

General Use and Description

The M64 projectile was used for screening and incendiary purposes. It was also effective against personnel. The M64 was initially developed for the 75 mm pack howitzer (1 p. 108), (10 p. 45).

The design of the M64 was based on the body of the M48 high explosive shell with the projectile designated as Shell, Chemical, 75 mm, T9 during development. The shell body was a relatively thin-walled forged steel cylinder. A streamlined effect was obtained by boat-tailing the base. The projectile was a modification of the M48 HE shell, the nose being cut and threaded to hold an adapter which screwed into the body. The adapter served three purposes: to provide a tight seal for the chemical contents of the projectile; to hold the fuze; and to provide a seat for the forward end of the burster (1 p. 109, 121-122), 10 (p. 45).

Explosive Train

The M57 fuze was a superquick point detonating fuze. The burster contained a detonator relay chain and a burster charge (Charge, burster, M8) of HE to rupture shell and disperse the chemical agent (1 p. 109, 122).

Fuzing

Projectile, 75-mm, M64 - Fuzing		
Fuze	**Note**	**Citation**
M57	Point detonating, superquick	1 (p. 109, 357, 358), 3 (p. 431), 10 (p. 45)

Booster, Adapter-Booster, or Burster

Projectile, 75-mm, M64 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M6 Burster	N/A	N/A	-	1 (p. 109), 3 (p. 431), 7 (p. 109, 335, 356)
M8 Burster	1 ounce	Tetryl	Used in M6 burster casing. It was 7.9 in. long with a 0.5-in. diameter.	1 (p. 109, 335, 356), 3 (p. 431)

Projectile, 75-mm, M64

Fills

Projectile, 75-mm, M64 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CNS	1.10	0.49	15.0	6.80	-	1 (p. 356), 2 (p. 4-101), 5 (p. 104), 8 (p. IV-5)
FS	1.51	0.68	14.7-15.4	6.66-6.98	-	1 (p. 358), 2 (p. 4-101), 5 (p. 103), 8 (p. IV-5), 11 (p. 58)
H	1.04	0.47	12.8-14.9	5.80-6.75	-	1 (p. 358), 2 (p. 4-101), 5 (p. 103), 8 (p. IV-5), 9 (p. 13, 102)
HD	0.96	0.44	14.9	6.74	-	5 (p. 103)
L	N/A	N/A	N/A	N/A	-	2 (p. 4-101), 8 (p. IV-5)
WP	1.34-1.35	0.60-0.61	14.7-15.2	6.66-6.89	-	1 (p. 357, 358), 5 (p. 103, 104), 6 (p. 7), 9 (p. 102), 11 (p. 62.8)

Shipping/Packing

For domestic shipment, three individual fiber containers (3 rounds) per bundle with a shipping weight of 72.1 pounds and a volume of one cubic foot. For overseas shipment, one bundle (3 rounds) per crate. Shipping weight was up to 85 pounds, and the volume was up to 1.9 cubic feet depending on fill (5 p. 103, 104).

Miscellaneous Information

The M64 was used with the 75-mm guns M1897, M2, and M3 and 75-mm howitzers (1 p. 108, 121).

Key Dates

Projectile, 75-mm, M64 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1935	OCM 11935 (Military Requirements Established)	12 (p. 16)
Standardized	1941	OCM 16680, 16767 (WP-fill)	10 (p. 45)
Standardized	1943	CCTC 881 (H and WP-fill Standard, FS and L-fill Substitute Standard, FM-fill Limited Standard)	13 (p. 82)
Standardized	1944	CCTC 1049 (HD-fill Standard, H-fill Substitute Standard)	14 (p. 25, 26)
Cancellation	1949	CCTC 2004 (Cancellation of Specification for CNS, H, and WP fills)	15 (p. 119)

Sources

1. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
3. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.
4. Technical Division. 1944. Catalogue of Standard Ordnance Items, Second Edition 1944, Volume III. Office Chief of Ordnance.
5. War Department. 1946. Field Manual, FM 3-5, Characteristics and Employment of Ground Chemical Munitions. War Department.
6. Anonymous. 1941. Complete Round Charts, issued and revised various dates (RMA barcode GE104415 GE028220-1). War Department.

7. Department of the Army. 1950. Technical Manual, TM 9-1901, Artillery Ammunition. U.S. Government Printing Office.

8. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office.

9. War Department. 1942. Field Manual, FM 3-5, Chemical Warfare Service Field Manual: Tactics of Chemical Warfare. War Department.

10. Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16767, Ammunition, Complete Round, Chemical for 75 mm Howitzer, Classified as Standard – Designation of Shell, Chemical 75 mm, T9, Changed to Shell, Chemical, 75 mm, M64, Read for Record. May 22.

11.) Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.

12. Ordnance Committee. 1935. Ordnance Committee Meeting, OCM Item # 11935, Ammunition, Chemical, 75 mm Howitzer – Military Requirements Established (Read for Record). January 24.

13. Chemical Corps Technical Committee. 1943. CCTC Item # 881, Classification of Fillings for Chemical Munitions. Department of the Army.

14. Chemical Corps Technical Committee. 1944. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.

15. Chemical Corps Technical Committee. 1949. CCTC Item # 2004, Specification Changes for Record. Department of the Army.

14.3 Projectile, 75-mm, T10

Figures

No images were found in available references.

Specifications

Projectile, 75-mm, T10 – Specifications and Other Data		Citation
Historical Name	75-mm Chemical Shell, T10	1 (p. 1)
Type	Projectile, Artillery	1 (p. 1)
Size	75-mm	1 (p. 1)
Conflict	WWII	1 (p. 1), 2 (p. 1), 3 (p. 1)
Other Engineering Data	Detonator: M46 Weight, Empty: 11.09 lbs. (5.03 kg)	1 (p. 2, 4)
Construction Material	Cast iron	2 (p. 1), 3 (p. 1)
Propellant	1.04 pounds (0.472 kilograms) FNH powder	2 (p. 2)

General Use and Description

The T10 was designed to disperse chemical agent (1, p. 1).

Explosive Train

The detonator in the T18E2 fuze initiated the M46 detonator. The detonator in the fuze ruptured the nose of the M46 fuze (1 p. 4).

Fuzing

Projectile, 75-mm, T10 – Fuzing		
Fuze	**Notes**	**Citation**
T18E2	Point detonating	1 (p. 2, 4), 2 (p. 2)
T18E2 (M57) modified	Electric firing	3 (p. 2)
M46	Point detonating - lower	3 (p. 2)

Booster, Adapter-Booster, or Burster

Projectile, 75-mm, T10 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
T4 burster charge	14.9 grams	Tetryl	–	2 (p. 2)
T4 modified burster charge	8 grams	Tetryl	–	3 (p. 1, 2)
T4E1 buster charge	14.9 grams	Tetryl	–	1 (p. 1, 2, 6), 3 (p. 1)

Fills

Projectile, 75-mm, T10 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
FS	1.63	0.74	12.7	5.77	1 (p. 2), 4 (p. 6)
HS	1.06	0.48	12.2-14	5.53-6.35	1 (p. 2), 2 (p. 1), 3 (p. 2), 4 (p. 6)
MR	0.91	0.41	12	5.44	1 (p. 2, 3)
WP	1.4	0.64	12.5	5.67	1 (p. 2), 4 (p. 6)

Shipping/Packing

Available references did not provide this information.

Projectile, 75-mm, T10

Key Dates

Available references did not provide this information.

Miscellaneous

The cast iron shells were found to leak when tested with air pressure, but several did not leak when subjected to hydrostatic pressure. It was found that grinding and rebrazing eliminated occasional leaks (4 p. 6).

Sources

1. Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 226, Chemical Fillings for Artillery Shell, Static Tests of the 75-mm, Chemical Shells T10 and MK. II, Filled with FS, WP, and Simulated HS. May 21. Chemical Warfare Service.
2. Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 254, Chemical Fillings for Artillery Shell, Firing of 75-mm Chemical Shell T10 (Cast Iron), Filled with HS. November. Chemical Warfare Service.
3. Woodberry, David L. and Carson, J.S. 1940. Technical Division Memorandum Report, TDMR 258, Chemical Filling for Artillery Shell, Static Test of the 75-mm Chemical Shell T10 (Cast Iron) Filled with HS. December. Chemical Warfare Service.
4. Smith, B.F. 1940. Technical Division Memorandum Report, TDMR 227, 75-mm, Cast Iron Shell T10. Method for Sealing Leaks in Shell Bodies. May. Chemical Warfare Service.

14.4 Projectile, 105-mm, Howitzer, M60 (T4E1)

Figures

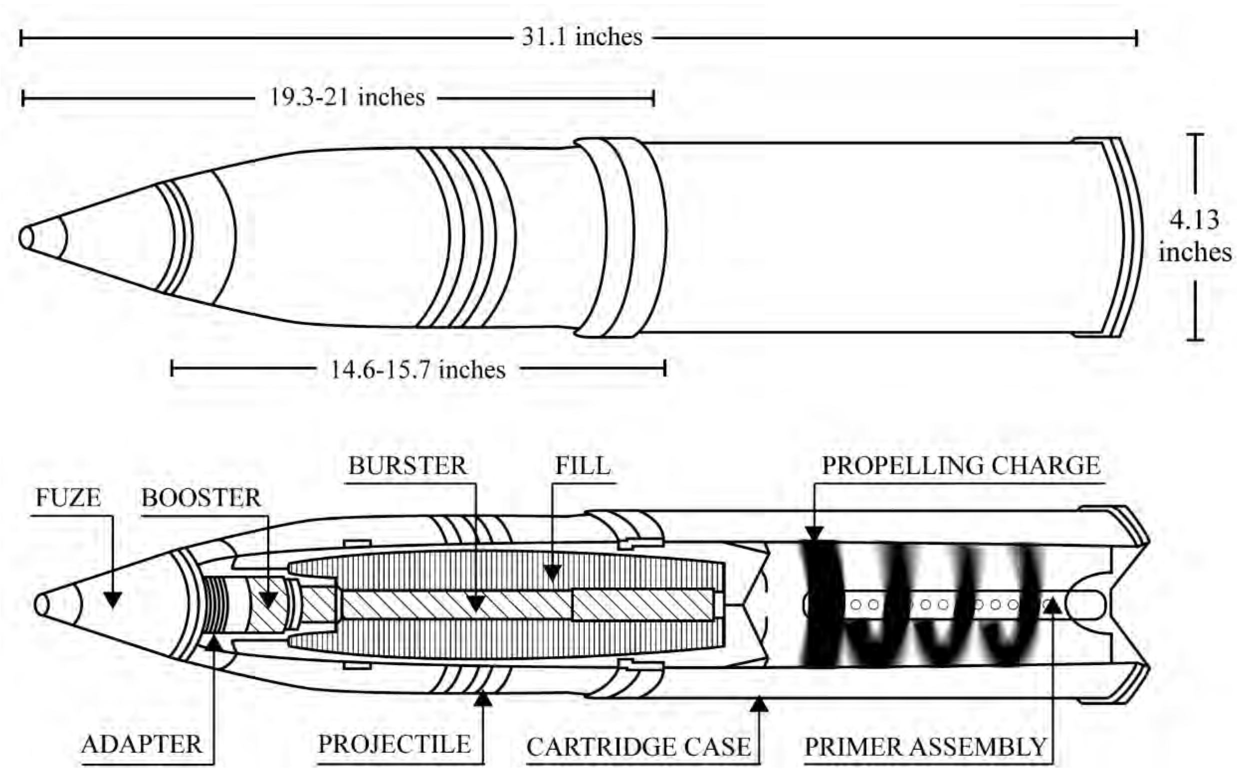

Figure 186: Projectile, 105-mm, Howitzer, M60 (T4E1) - Line Drawing

Figure 187: Projectile, 105-mm, Howitzer, M60 (T4E1) - Photograph

Specifications

Projectile, 105-mm, Howitzer, M60 (T4E1) - Specifications and Other Data		**Citation**
Historical Name	Shell, Semifixed, Gas, Persistent, H, M60, W/ Fuze, P.D. [point detonating], M57, 105-mm Howitzer	1 (p. 173, 174)
Developmental Information	T4E1	12 (p. 12)
Type	Projectile	2 (p. 36a), 3 (p. 5-2), 4 (p. 4-119)
Size	105-mm	4 (p. 4-119), 5 (p. 12), 6 (p. 3-15), 7 (p. 9), 8 (p. 8-3)

Projectile, 105-mm, Howitzer, M60 (T4E1) - Specifications and Other Data		**Citation**
Service	Army, Marine Corps	3 (p. 5-2), 4 (p. 4-119), 9 (p. 4-118)
Diameter	4.13 in. (10.5 cm)	1 (p. 173), 3 (p. 5-2), 4 (p. 4-120), 8 (p. 8-4), 9 (p. 4-119)
Length	Complete: 31.1 in. (78.94 cm) Projectile, Fuzed: 19.3-21 in. (49-53.3 cm) Cartridge case: 14.6-15.7 in. (37.2-39.9 cm)	1 (p. 173-174), 3 (p. 5-2), 4 (p. 4-120), 6 (p. 3-16), 8 (p. 8-4), 9 (p. 4-119), 10 (p. 473, 475, 476), 11 (p. A-15)
Other Engineering Data	Primer: M28A2 or M28B2	3 (p. 5-2), 4 (p. 4-120), 8 (p. 8-4), 9 (p. 4-119), 12 (p. 13)
Construction Material	M60: forged steel M60A1, M60A2: high strength aluminum	1 (p. 173), 3 (p. 5-2), 4 (p. 4-119), 6 (p. 3-16), 10 (p. 475)
Propellant	Propelling charge: M1- 2.75 lbs. (1.25 kg) M6- 2.8 lbs. (1.27 kg)	3 (p. 5-2), 8 (p. 8-4), 9 (p. 4-120), 11 (p. 1-7)
Maximum Range	12,150 yards (11,111 meters)	1 (p. 173), 5 (p. 12), 8 (p. 8-4), 9 (p. 4-119), 13 (p. 5-2)
Drawing	75-1-109	3 (p. 5-2), 4 (p. 4-120), 8 (p. 8-3)
NSN	1315-00-028-4795, 1315-00-028-4796, 1315-00-028-4829, 1315-00-060-0884, 1315-00-222-6365	7 (p. 32)

General Use and Description

The M60 was used with M2A1, M2A2, M4, M4A1, and M49 howitzers to disperse a casualty producing agent for use against enemy personnel (3 p. 5-2), (8 p. 8-3).

This round was assembled with the M60 smoke shell which resembled the HE shell in outward appearance. The body was one-inch shorter than the HE projectile, but the adapter necessary to hold the burster brings the length to the same as the HE. The projectile was boat-tailed and the nose was ogival and threaded to take an adapter. The adapter served three purposes: it provided a tight seal for chemical agent contents of the projectile; it held the fuze and booster; and it provided a seat for the forward end of the burster, which was a thin-walled steel tube that extended from the adapter to the rear of the shell cavity. The projectile had no base plate (1 p. 173), (3 p. 5-2), (4 p. 4-119), (9 p. 4-118), (10 p. 475).

The WP-filled M60 was renovated to the M60A2 (M60E3) by removing and replacing the M5 burster with the M53 which is closed on the bottom end with an aluminum plug and on top by a felt closure pad. The burster tube being made from high strength aluminum to address the issue of premature functioning with the M5 burster (15).

Explosive Train

Upon impact with the target, the point detonating fuze would detonate the burster charge rupturing the projectile and dispersing the chemical agent fill (1 p. 173), (3 p. 5-2), (4 p. 4-119), (6 p. 3-16), (9 p. 4-118), (10 p. 475).

Fuzing

Projectile, 105-mm, Howitzer, M60 (T4E1) - Fuzing		
Fuze	**Notes**	**Citation**
M51A4	Point detonating	3 (p. 5-3)
M51A5	Point detonating	3 (p. 5-2), 4 (p. 4-120), 9 (p. 4-119), 11 (p. A-15)
M557	Point detonating (M60, M60A1, M60A2))	8 (p. 8-4)
M564	Mechanical time, superquick (M60A1, M60A2)	6 (p. 3-16)
M57	Point detonating, used with M22 booster	1 (p. 173-174), 3 (p. 5-2, 5-3), 4 (p. 4-120), 9 (p. 4-119), 10 (p. 475), 11 (p. A-15)
M582	Mechanical time, superquick (M60A1, M60A2)	6 (p. 3-16)
M767	(M60A1, M60A2)	6 (p. 3-16)

Booster, Adapter-Booster, or Burster

Projectile, 105-mm, Howitzer, M60 (T4E1) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M22 Booster	N/A	Lead azide and tetryl	Used with M5 Burster.	1 (p. 173), 10 (p. 475), 12
M5 Burster	0.51 lbs. (0.23 kg)	Tetrytol	Used in the M60 with a M557 fuze.	3 (p. 5-2), 4 (p. 4-120), 6 (p. 3-16), 8 (p. 8-4), 9 (p. 4-119), 10 (p. 475), 11 (p. A-15)
M53 Burster	N/A	Composition B	Used in the M60A1 with a M557, M564, M582, or M767 fuze.	6 (p. 3-16)
M53A1 Burster	N/A	Composition B-5	Used in the M60A2 with a M557, M564, M582, or M767 fuze.	6 (p. 3-16)

Fills

Projectile, 105-mm, Howitzer, M60 (T4E1) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CNS	N/A	N/A	N/A	N/A	-	14 (p. IV-5)
FS	4.60-4.61	2.09-2.09	35.2-44.3	15.8-16.0	Gross weight is as fired	1 (p. 174), 10 (p. 475), 16 (p. 62.10)
H	2.86-3.17	1.30-1.44	33.4-42.8	15.1-17.1	Gross weight is as fired	1 (p. 174), 4 (p. 4-119), 7 (p. 32), 8 (p. 8-3), 10 (p. 475), 14 (p. IV-5), 16 (p. 62.10)
HD	2.69-3.10	1.22-1.40	32.0-43.3	14.5-19.6	-	4 (p. 4-119), 5 (p. 12), 6 (p. 212), 7 (p. 32), 8 (p. 8-4), 9 (p. 4-118), 11 (p. 1-7), 16 (p. 62.10)
HN-1	N/A	N/A	N/A	N/A	Possible fill	16 (p. 47)
HN-2	2.57	1.17	30.6	13.9	Experimental fill	17 (p. 5)
HN-3	2.63	1.19	30.7	13.9	Experimental fill	17 (p. 5)
KB-16	2.75	1.25	30.8	13.9	Experimental fill	17 (p. 5)
L	4.25	1.93	32.5	14.7	-	14 (p. IV-5), 17 (p. 5)
WP	4.06-4.10	1.84-1.86	34.3-43.8	15.6-19.9	Gross weight is as fired	1 (p. 173), 6 (p. 3-16), 10 (p. 475), 16 (p. 62.10)

Shipping/Packing

This cartridge is packed one per fiber container with two containers per wooden box. The filled box weighs approximately 120 pounds (8 p. 8-3).

Miscellaneous Information

The M60 series of projectiles were used in the following howitzers:

- M2
- M2A1
- M2A2
- M4
- M4A1
- M49 (M52, M52A1)
- M2A1
- M2A2 (101)
- M101A1, M103 (M108)
- M137 (M102) (4 p. 4-120), (6 p. 3-16), (9 p. 4-119), (13 p. 5-2)

Key Dates

Projectile, 105-mm, Howitzer, M60 (T4E1) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1933	OCM 10493, 10583 (Establish military requirement)	18 (p. 22, 23)
Standardized	1940	OCM 16063, 16143 (Chemical and Smoke fills)	12 (p. 15 - 17)
Standardized	1942	OCM 18058, 18159 (Smoke-fill Limited Standard)	19 (p. 41, 42)
Standardized	1944	CCTC 1049, 1094 (HD-fill Standard, H-fill Substitute Standard)	20 (p. 25, 26), 21 (p. 101, 102) (p. 119)
Cancellation	1949	CCTC 2004 (Cancellation of Specification for CNS-fill)	22
Standardized	1958	OTCM 36841 (H/HD-fill Standard-A)	7 (p. 32)
Standardized	1972	AMCTC 9102 (M60A1 WP-fill Standard-B; M60A2 WP-fill Standard-A)	15 (p. 448)
Obsoleted	1972	AMCTC 9102 (M60 WP-fill)	15 (p. 448)

Sources

1. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.

2. Chemical Corps Technical Committee. 1955. Chemical Corps Book of Standards, 1955. Department of the Army.

3. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

4. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

5. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

6. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. U.S. Government Printing Office.

7. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.

8. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.

9. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

10. War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. U.S. Government Printing Office.

11. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.

12. Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 16063, Ammunition, Complete Round, Chemical for 105 mm Howitzer, Classified as Standard - Designation of Shell, Chemical 105 mm, T4E1, Changed to Shell, Chemical, 105 mm, M60; Designation of Fuze PD T18E2 Changed to Fuze, PD, M-57; Designation of Booster, T8 Changed to Booster, M22. PEO-PM Cml Demil.

13. U.S. Naval Ordnance Laboratory. 1958. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

14. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. Department of the Navy.

15. Subcommittee on Weapons/Munitions Systems. 1972. AMCTC Item # 9102, Recording of Type Classification of Cartridge, 105MM: Smoke, WP, M60A2 and M60A1. U.S. Army Materiel Command. 3 February.

16. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.

17. Hale, N.H. and H.E. Skipper 1942. Technical Division Memorandum Report, TDMR 431, A Memorandum Report, New Compounds HN-2, KB-16 and HN-3, Field Tests in 105-mm Shell in Comparison with HA and M1. Chemical Warfare Service.

18. Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10583, Shell, Chemical, for 105 MM Howitzer – Approval for Setting Up Military Requirements (Read for Record). March 30.

19. Ordnance Committee. 1942. Ordnance Committee Meeting, OCM Item # 18159, Shell, Smoke, Base Ejection, 105 mm, M84 – Clearance for Procurement and Classification as Standard, Read for Record. April 29.

20. Chemical Corps Technical Committee. 1944. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army. 30 May

21. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

22. Chemical Corps Technical Committee. 1949. CCTC Item # 2004, Specification Changes for Record. Department of the Army.

14.5 Projectile, 105-mm, Howitzer, M360 (T173)

Figures

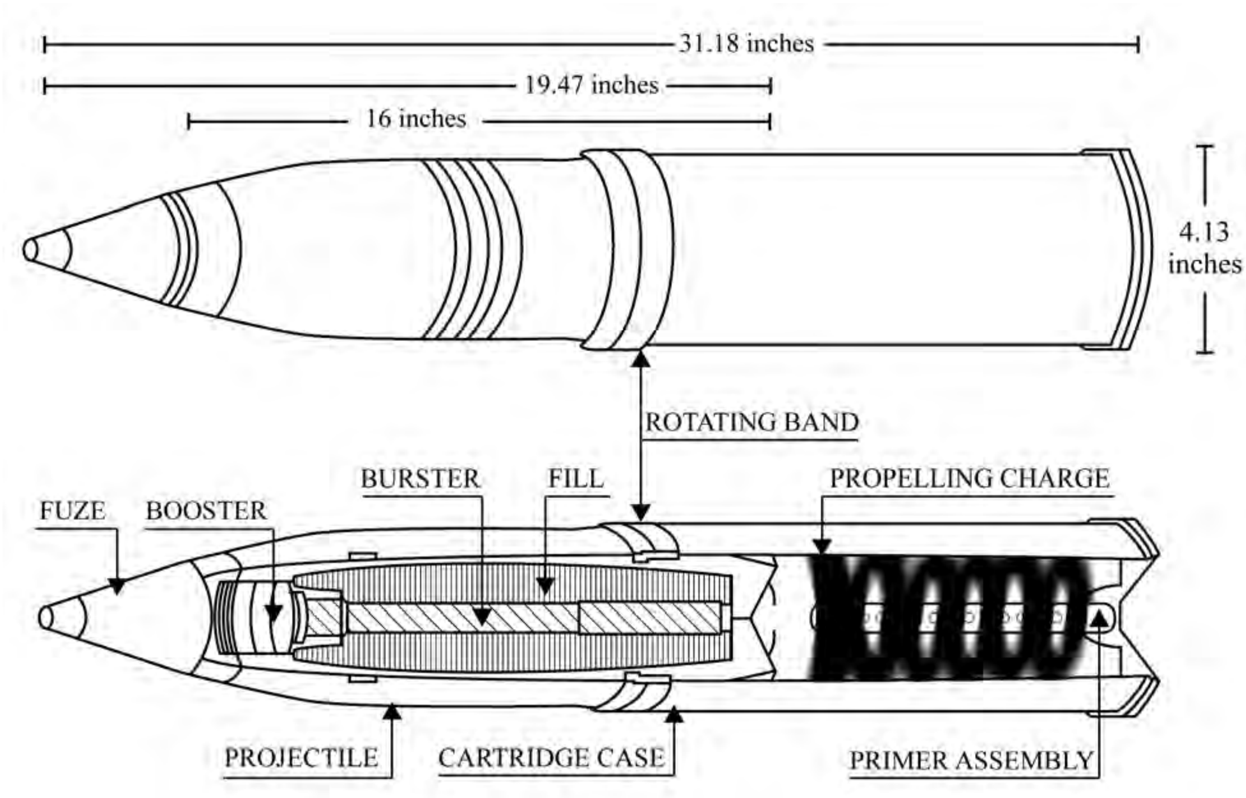

Figure 188: Projectile, 105-mm, Howitzer, M360 (T173) - Line Drawing

Figure 189: Projectile, 105-mm, Howitzer, M360 - Photograph - Top: Intact, Bottom: Cutaway View

Projectile, 105-mm, Howitzer, M360 (T173)

Specifications

Projectile, 105-mm, Howitzer, M360 (T173) - Specifications and Other Data		Citation
Historical Name	Cartridge, 105mm: Gas, Nonpersistent, GB, M360	1 (p. 36a)
Developmental Information	T173	11 (p. 5)
Type	Projectile	2 (p. 1-7, A-14)
Size	105-mm	1 (p. 36a), 3 (p. 4-123), 4 (p. 3-43), 5 (p. 5-4)
Conflict	Cold War	1 (p. 36a)
Service	Army, Marine Corps	3 (p. 4-123), 4 (p. cover), 5 (p. 5-4), 6 (p. iv)
Diameter	4.13 in. (10.5 cm)	2 (p. A-14), 3 (p. 4-124), 4 (p. 3-43), 5 (p. 5-4), 6 (p. 4-123)
Length	Projectile, Fuzed: 19.47 in. (49.45 cm) Projectile, Unfuzed: 16.0 in. (40.6 cm) Complete round: 31.18 in. (79.20 cm)	2 (p. A-14), 3 (p. 4-124), 4 (p. 3-44), 5 (p. 5-4), 6 (p. 4-123)
Other Engineering Data	Projectile weight: 35.6 lbs. (16.2 kg)	3 (p. 4-124)
Construction Material	Projectile: Steel, forged or bar Rotating band: gilding metal	4 (p. 3-44)
Propellant	M1: 2.75 lbs. (1.25 kg) M67: 2.83 lbs. (1.28 kg)	4 (p. 3-44), 5 (p. 5-4), 6 (p. 4-123), 7 (p. 8-7), 10 (p. 19.1)
Maximum Range	11,140-11,500 meters (12,183-12,590 yards)	4 (p. 3-44), 8 (p. 12)
Drawing	75-1-363	3 (p. 4-124), 5 (p. 5-4), 10 (p. 19)
NSN	1315-203-8985, 1315-640-8857, 1315-00-926-3952	9 (p. 32)

General Use and Description

The M360 howitzer cartridge was designed to provide toxic chemical offensive capability using GB (3 p. 4-123), (5 p. 5-4), (6 p. 4-122), (7 p. 8-6).

The cartridge was a semifixed, central burst GB gas round used for antipersonnel effects. The M360, which resembled the high explosive cartridge in external appearance, was boat-tailed, and the nose was ogival and threaded for an adapter. The projectile consisted of a hollow one-piece steel forging, press fitted with an M16 burster casing. The adapter provided a tight seal for the chemical contents, held the fuze, and provided a seat for the forward end of the burster tube. The burster casing was thin-walled steel tubing extending from the adapter to the rear of the round cavity. The cartridge was used with a point detonating fuze to provide superquick or delay action (3 p. 4-123), (4 p. 3-43), (5 p. 5-4), (6 p. 4-122).

Explosive Train

Projectile functioning was dependent on the fuze used that could function on impact, instantaneously or delay. The fuze could function above ground either at a predetermined height based upon time of flight or function in proximity with the target area. Fuze function detonated the burster charge rupturing the casing and dispersing the contents (3 p. 4-123), (4 p. 3-43), (5 p. 5-4), (6 p. 4-122).

Projectile, 105-mm, Howitzer, M360 (T173)

Fuzing

Projectile, 105-mm, Howitzer, M360 (T173) – Fuzing		
Fuze	**Notes**	**Citation**
M508	Point detonating	2 (p. A-14), 3 (p. 4-124), 5 (p. 5-4, 5-5), 6 (p. 4-123)
M51A4	Point detonating	3 (p. 4-124), 5 (p. 5-5), 6 (p. 4-123)
M51A5	Used with booster M21A4; 0.5 delay	3 (p. 4-124), 5 (p. 5-5), 6 (p. 4-123)
M557	-	10 (p. 19.1)
M57	-	3 (p. 4-124), 5 (p. 5-5), 6 (p. 4-123)
M739	-	10 (p. 19.1)

Booster, Adapter-Booster, or Burster

Projectile, 105-mm, Howitzer, M360 (T173) – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M16 burster casing	N/A	N/A	-	3 (p. 4-124)
M40	1.12 lbs. (0.51 kg)	Tetrytol	Weight range of 1.12-1.9 lbs. (0.50-0.86)	2 (p. A-14), 3 (p. 4-124), 11 (p. 7)
M40A1 Burster	1.12 lbs. (0.51 kg)	Composition B	-	2 (p. A-14)

Fills

Projectile, 105-mm, Howitzer, M360 (T173) – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	1.63-1.80	0.73-0.81	44.6	20.2	44.6 lbs./20.2 kg (Complete)	3 (p. 4-123), 5 (p. 5-4), 6 (p. 4-123), 7 (p. 8-6), 8 (p. 16)

Shipping/Packing

The M360 were packed one cartridge in a fiber container and two containers in a wooden box. The box weighed 117 pounds, was 37.25 inches by 11.1 inches by 7.59 inches and was 2 cubic feet (4 p. 3-44).

Miscellaneous Information

The M360 was used with the M2A1, M2A2, M4, M4A1, and M49 howitzer (3 p. 4-124).

Key Dates

Projectile, 105-mm, Howitzer, M360 (T173) – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1951	OCM 33567 (Initiation of development)	-
Developed	1954	OCM 33567 (T173)	11 (p. 2)
Standardized	1954	CCTC 2932, OCM 35516 (GB-fill Standard-A)	11 (p. 8)
Standardized	1959	OCTM 37119	4 (p. 3-43)

Sources

1. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.

2. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.

3. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

4. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. U.S. Government Printing Office.

5. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

6. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

7. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.

8. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

9. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.

10. Army Materiel Command. 1985. Army Materiel Command Pamphlet, AMC-P 700-3-3, Logistics, Complete Round Charts, Artillery Ammunition. U.S. Army.

11. Chemical Corps Technical Committee. 1954. CCTC Item # 2932, Shell, Chem, 105-MM, M360 (T173): Casing, Burster, M16 (T27E1); Charge, Burster, M40 (T67) Classified as Standard. Department of the Army.

14.6 Projectile, 105-mm, T4, T4E1

Figures

No images were found in available references.

Specifications

Projectile, 105-mm, T4, T4E1 – Specifications and Other Data		Citation
Historical Name	105-mm Chemical Shell T4, 105-mm Howitzer Chemical Shell T4E1	1 (p. 1), 2 (p. 1), 3 (p. 1), 5 (p. 2)
Type	Projectile	1, 2, 3, 4, 5
Size	105-mm	1 (p. 1), 2 (p. 1), 3 (p. 1), 5 (p. 2)
Other Engineering Data	Weight, Empty: 27-28 lbs. (12.2-12.7 kg)	1 (p. 3, 4)
Drawing	P-20768	1 (p. 1)

General Use and Description

Available references did not provide this information.

Explosive Train

Available references did not provide this information.

Fuzing

Projectile, 105-mm, T4, T2E1 – Fuzing		
Fuze	**Notes**	**Citation**
M39A2	Point detonating, prepared for static firing – used with T4	1 (p. 2), 2 (p. 2)
T18E2	Point detonating, arranged for static firing with booster T8E1 - used with T4E1	4 (p. 2), 5 (p. 2)

Booster, Adapter-Booster, or Burster

Projectile, 105-mm, T4, – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Bursting charge- not designated	75 grams	Tetryl	T4	1 (p. 2), 2 (p. 1), 3 (p. 1)
Bursting charge- not designated	85 grams	Tetryl	T4E1	2 (p. 2), 5 (p. 2)
Bursting charge- not designated	100 grams	Tetryl	T4	1 (p. 2), 2 (p. 1), 3 (p. 1)
Bursting charge- not designated	117 grams	Tetryl	T4E1	4 (p. 2), 5 (p. 2)
T8E1 Booster	N/A	N/A	T4E1	4 (p. 2)

Fills

Projectile, 105-mm, T4, T2E1 – Fill Types and Weights					
Chemical	**Fill Weight**		**Gross Weight**		**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**	
FS	4.56-4.77	2.01-2.16	31.9-32.1	14.5-14.6	1 (p. 4), 5 (p. 2, 12)
HS	3.3-3.44	1.49-1.56	38.7	17.6	2 (p. 10), 3 (p. 2, 3, Appendix A p. 5), 5 (p. 3)
HS simulated	2.64-3.00	1.19-1.36	29.8-30.4	13.5-13.8	1 (p. 4), 5 (p. 2, 13)
WP	4.09-4.61	1.86-2.09	31.5-31.9	14.3-14.5	1 (p. 3), 4 (p. 2), 5 (p. 2, 11)

Shipping/Packing

Available references did not provide this information.

Projectile, 105-mm, T4, T4E1

Key Dates

Available references did not provide this information.

Sources

1. Woodberry, D.L. 1936. Technical Division Memorandum Report, TDMR 67, Report of the Static Firings of Twenty (20) 105-mm Chemical Shell T4, May 21, 1936. Edgewood Arsenal.
2. Woodberry, D.L. 1937. Technical Division Memorandum Report, TDMR 107. Report of the Test of 105-mm Chemical Shell, T4, HS-Filled, Fired for Impact Burst, May 24, 1937. Edgewood Arsenal.
3. Macintire, B.G. 1939. Technical Division Memorandum Report, TDMR 203, Report of Test of 105-mm Shell, TF, HS-Filled, June 9 to September 21, 1937. Chemical Warfare Service Technical Command.
4. Woodberry, D.L. 1940. Technical Division Memorandum Report, TDMR 216, Chemical Fillings for Artillery Shell, Static Tests of 105-mm (How,) Chemical Shell T4E1, Filled with WP and Simulated HS. February 8, 1940. Chemical Warfare Service Technical Command.
5. Woodberry, D.L. 1940. Technical Division Memorandum Report, TDMR 238, Chemical Filling for Artillery Shell Static Test of 105-mm (How.) Chemical Shell T4E1, Filled with WP, FS, HS and Simulated HS, June 20, 21, 25, 27 and 28, 1940. Chemical Warfare Service Technical Command.

14.7 Projectile, 4.7-inch, Common Steel, MK II, MK V

Figures

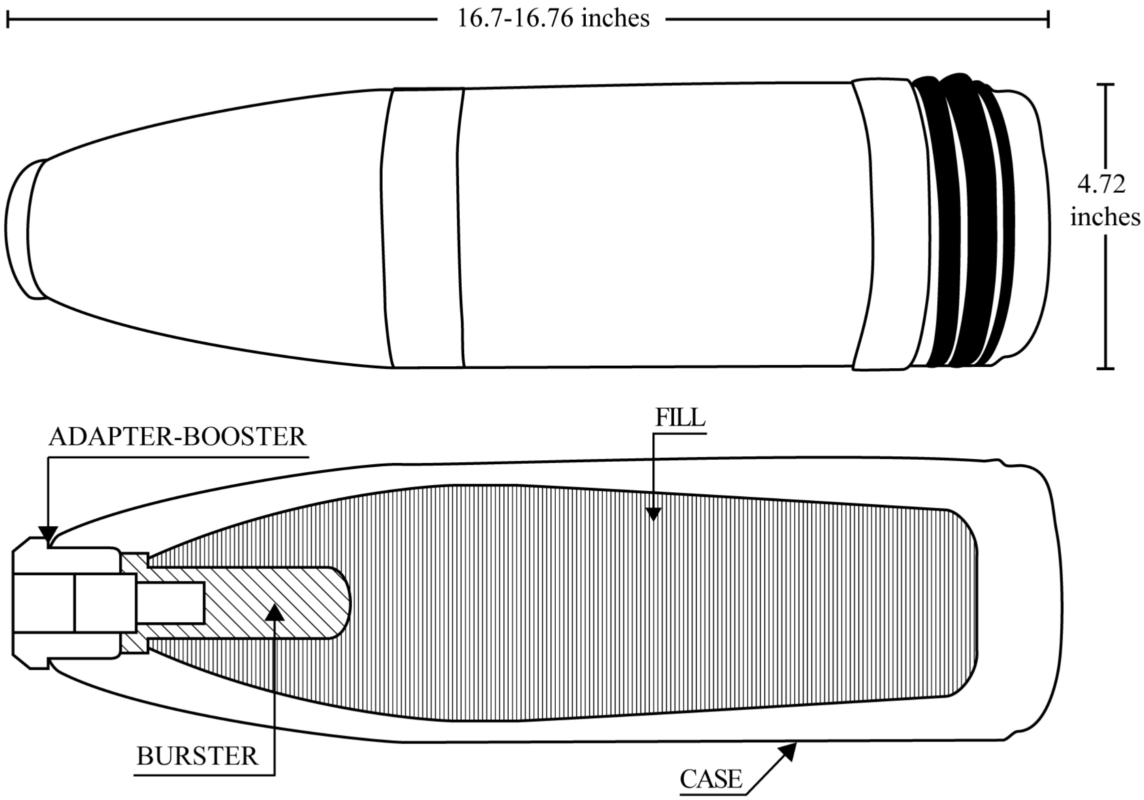

Figure 190: Projectile, 4.7-inch, Common Steel, MK II, MK V - Line Drawing

Figure 191: Projectile, 4.7-inch, Common Steel, MK II - Photograph

Projectile, 4.7-inch, Common Steel, MK II, MK V

Specifications

Projectile, 4.7-inch, Common Steel, MK II, MK V - Specifications and Other Data		Citation
Historical Name	4.7-Inch, Common Steel Shell, MK II, MK V (gas)	1 (p. 46-47), 4 (Table 16, p. 140)
Type	Projectile	1 (p. 46)
Size	4.7-inch	1 (p. 46)
Conflict	WWI	1
Diameter	4.72 in. (11.99 cm)	1 (p. 46, 47)
Length	Projectile, Unfuzed :16.7 in. (42.4 cm)	1 (p. 46, 47), 4 (Table 16, p. 140)
Wall Thickness	0.45 in. (1.14 cm)	1 (p. 47)
Construction Material	MK II - Steel MK V - Semi-steel Rotating band - Copper	1 (p. 46), 4 (Table 16, p. 140)
Drawing	75-2-172 (MK II) 75-2-186 (MK V)	2 (p. 40)

General Use and Description

When the United States entered WWI, it was decided to adopt types of artillery in use by the Allies to facilitate early quantity production and to secure as much uniformity in artillery materiel as possible. Accordingly, U.S. artillery was equipped with 4.7-inch guns. The shell body of the 4.7-inch gas shell is identical to the point-fuzed high explosive shell, Mark I, but the fuze hole is tapered to receive the adapter making a gastight seal. The common steel shell was provided with an ogival head and was fitted with a copper rotating band. Chemical shells were provided with pipe-threading securing a gastight closure between the gaine and the projectile body. A 4.7-inch semi-steel shell MK V was also developed which differed from the steel shell only in that the net capacity was reduced from 92.4 cubic inches to 90.9 cubic inches (1 p. 46), (2 p. 42).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Projectile, 4.7-inch, Common Steel, MK II, MK V - Fuzing		
Fuze	**Notes**	**Citation**
French Model 1915	Point detonating, superquick	1 (p. 34, 46)
French Model 1916	Point detonating, superquick	1 (p. 34, 46)
French R.Y. Model 1917	Point detonating, superquick; only to be used if other fuzes were unavailable	1 (p. 38, 46)
Modified British No. 106	Point detonating, superquick	1 (p. 42, 46)
U.S. Mark III	Point detonating, superquick	1 (p. 34, 46), 4 (p. 138)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Projectile, 4.7-inch, Common Steel, MK II, MK V

Fills

Projectile, 4.7-inch, Common Steel, MK II, MK V - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	6.36-6.75	2.88-3.06	43.8	19.8	-	1 (p. 24, 46), 5 (p. 6)
CA	4.44-5.73	2.01-2.59	41.8-45.0	18.9-20.4	-	1 (p. 24, 46), 3
CG	4.27-5.04	1.93-2.28	41.7-45.0	18.9-20.4	-	1 (p. 24, 46), 2 (p. 42), 3, 5 (p. 4)
FM	5.53-6.50	2.00-2.94	42.9-45.0	19.4-20.4	-	1 (p. 24, 46), 3
H	4.38-4.73	1.98-2.14	41.8-45.0	18.9-20.4	-	1 (p. 24, 46), 3
NC	5.62-6.47	2.54-2.93	43.0-45.0	19.5-20.4	-	1 (p. 24, 46), 3, 5 (p. 3)
PS	5.30-6.16	2.40-2.79	42.7-45.0	19.3-20.4	-	1 (p. 24, 46), 3
WP	6.14-6.98	2.78-3.16	43.5-45.0	19.9-20.4	-	1 (p. 24, 46), 3, 5 (p. 6)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.

2. Army Ordnance. 1921. No. 1939, History of Artillery Projectiles, 1917-1919. Government Printing Office.

3. Edgewood Arsenal. 1921. Weight of Chemical Fillings (NARA II. RG 175. E 1 (P1-8). Box 520.). Mechanical Division.

4. Office, Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. November. Government Printing Office.

5. War Department 1918. Office of Chief of Ordnance, Trench Warfare Section, Memorandum to Colonel Walker, Subject Munitions to be Filled and Approximate Fill Weight. March 9.

14.8 Projectile, 5-inch, Common Steel, MK VI

Figures

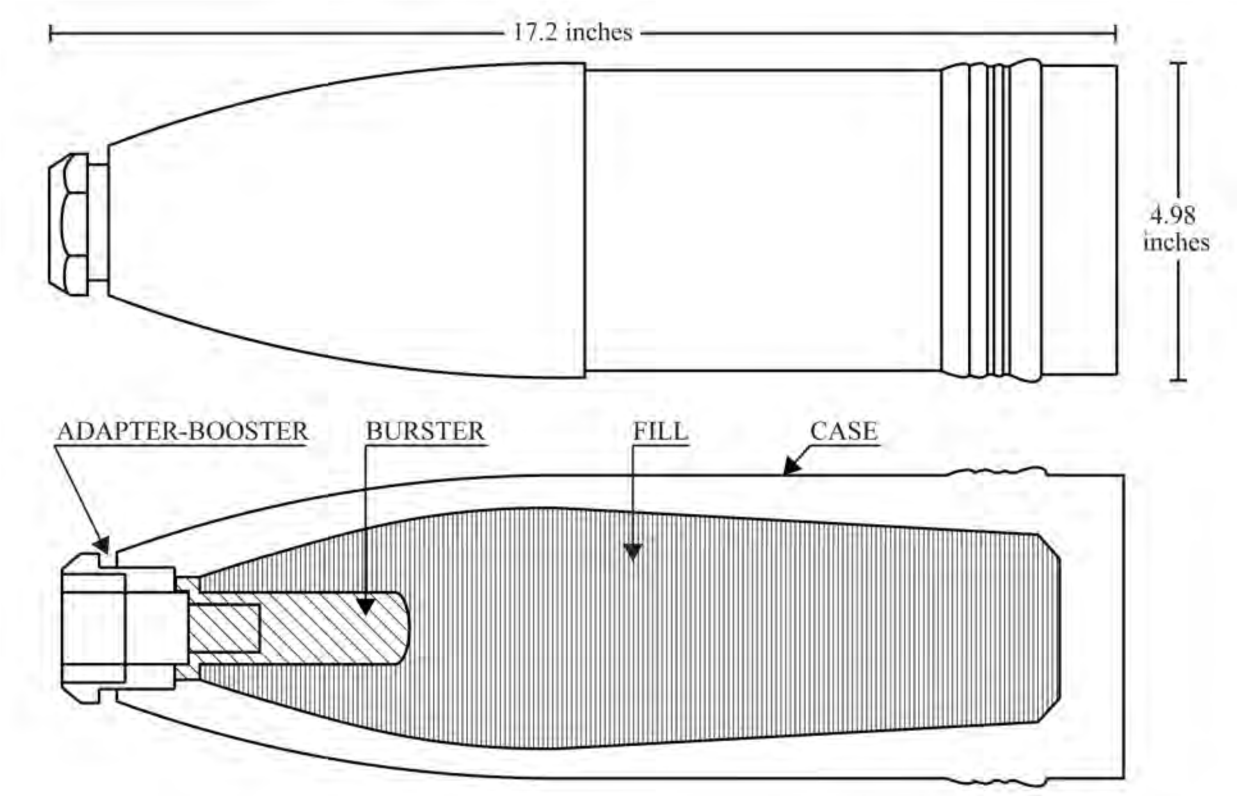

Figure 192: Projectile, 5-inch, Common Steel, MK VI - Line Drawing

Specifications

Projectile, 5-inch, Common Steel, MK VI - Specifications and Other Data		Citation
Historical Name	5-Inch, Common Steel Shell, MK VI (gas)	1 (p. 48, 49), 2 (Table 16)
Type	Projectile	1 (p. 24)
Size	5-inch	1 (p. 49)
Conflict	WWI	1 (p. 48)
Diameter	4.98 in. (12.7 cm)	1 (p. 48)
Length	Projectile, Unfuzed: 17.2 in. (43.7 cm)	1 (p. 48), 2 (Table 16)
Wall Thickness	0.48-in. (1.22 cm)	1 (p. 48)
Other Engineering Data	Weight, Empty Shell: 42.84 lbs. (19.43 kg)	1
Construction Material	Projectile: Steel Rotating band: Copper	1 (p. 48-49)

General Use and Description

The 5-inch, Mark VI shell was designed for use with the wheel mount, seacoast gun (2, Table 16).

When the United States entered WWI, it was decided to adopt types of artillery in use by the Allies to facilitate early quantity production and to secure as much uniformity in artillery materiel as possible.

Accordingly, U.S. artillery was equipped with 5-inch guns. The common steel shell was provided with an ogival head and was fitted with a copper rotating band. Chemical shells were pipe-threaded to ensure a gastight closure between the gaine and the projectile body. A 5-inch semi-steel shell was also developed, which differed from the steel projectile only in the reduced internal cavity (1 p. 49).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Projectile, 5-inch, Common Steel, MK VI - Fuzing		
Fuze	**Notes**	**Citation**
French I. A. L. Model 1916	Point detonating, superquick	1 (p. 34, 49)
French I. A. Model 1915	Point detonating, superquick	1 (p. 34, 49)
French R.Y.	Point detonating, superquick; only to be used if other fuzes were unavailable	1 (p. 34, 49)
Mark III	Point detonating, superquick	1 (p. 34, 49), 2 (p. 138)
Modified British No. 106	Point detonating, superquick	1 (p. 34, 49)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Projectile, 5-inch, Common Steel, MK VI - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	7.75	3.51	N/A	N/A	-	3 (p. 6)
CG	5.58	2.53	N/A	N/A	-	3 (p. 4)
FM	6.79	3.07	49.6	22.5	Without fuze.	1 (p. 49), 3
H	5.38	2.44	48.2	21.8	Without fuze.	1 (p. 49)
NC	5.58	2.53	N/A	N/A	-	3 (p. 3)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.
2. Office, Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. November. Government Printing Office.
3. War Department 1918. Office of Chief of Ordnance, Trench Warfare Section, Memorandum to Colonel Walker, Subject Munitions to be Filled and Approximate Fill Weight. March 9.

14.9 Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0

Figures

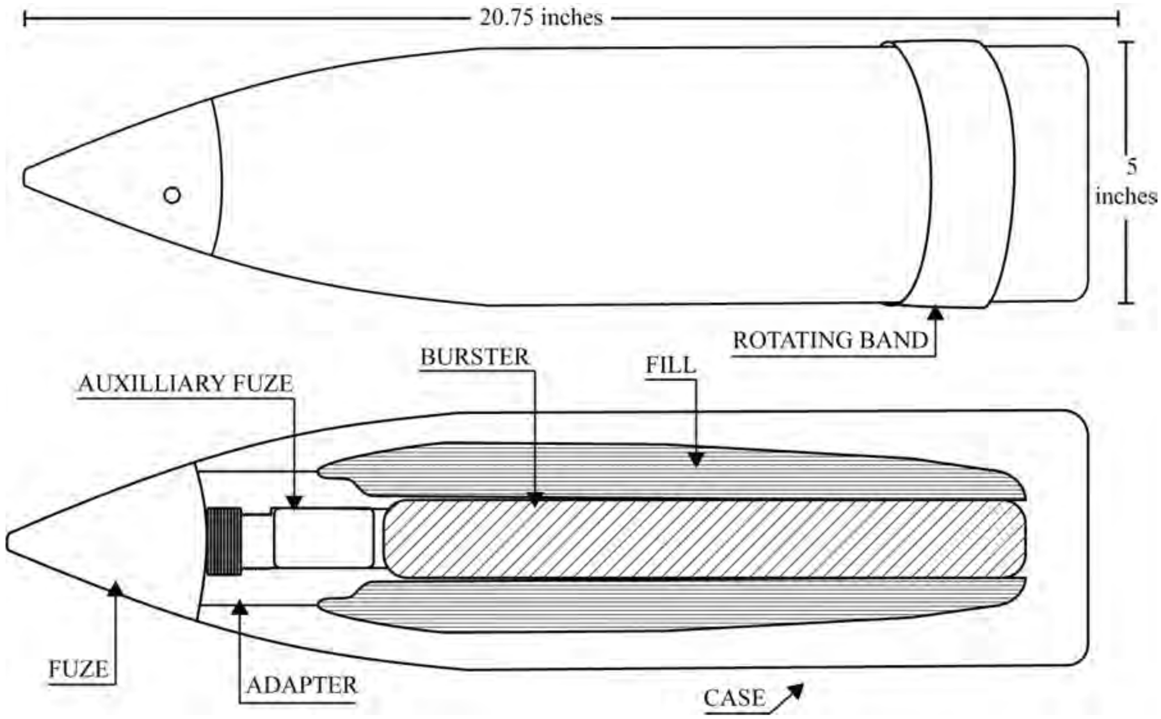

Figure 193: Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 - Line Drawing

Figure 194: Projectile, 5-inch/.38 Caliber, Gun, EX34 - Photograph – Cutaway View

Specifications

Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 - Specifications and Other Data		**Citation**
Historical Name	Projectile, Gun, 5-Inch/38, Gas (GB), MK 53 Mod 0	1 (p. 4-135)
Type	Projectile	1 (p. 4-135), 2 (p. 1)
Size	5-inch/.38 Caliber	1 (p. 4-135), 3 (p. 16), 4 (p. 4-136)
Service	Navy	2 (p. 1), 3 (p. 16), 4 (p. 4-136)
Diameter	5 in. (12.7 cm)	1 (p. 4-136), 2 (p. 2), 4 (p. 4-137)
Length	Fuzed: 20.75 in. (52.7 cm)	1 (p. 4-136), 2 (p. 2), 4 (p. 4-137)

Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0

Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 - Specifications and Other Data		Citation
Propellant	MK5 Mod 0	1 (p. 4-136), 4 (p. 4-137), 5 (p. 6-7)
Other Engineering Data	Weight, Empty: 42.59 lbs. (19.32 kg) EX34 Mod 0	5 (p. 6-4)
Range	17,280-18,044 yards (15,800-16,500 meters)	2 (p. 2), 4 (p. 4-137)
Drawing	329674 (BuOrd), 289029, 1381146 (load)	4 (p. 4-137), 5 (p. 6-11)

General Use and Description

The MK 53 was used for antipersonnel effects. This was a modification of the Mark 49 high explosive projectile for chemical filling (5 p. 6-2).

The MK 53 was a semifixed, central burst gas projectile loaded with GB and used for antipersonnel effects. A central burster tube extended the full length of the projectile cavity and was press fit into the fuze adapter. A one-piece forging eliminated joints and minimized leakage possibilities.

The projectile has a hollow steel body of varying thickness. It has an opening at the nose for filling and for installing the burster well and burster. At the nose opening, the body is internally threaded to hold a threaded fuze adapter and the fuzes (5 p. 6-4).

Explosive Train

A point detonating fuze was centrifugally armed. The detonation of the point detonating fuze set off the auxiliary detonating fuze functioned to initiate the burster charge to explode the projectile and release the chemical agent fill (5 p. 6-7).

Fuzing

Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 - Fuzing		
Fuze	**Notes**	**Citation**
MK54 Mod 0	Auxiliary	4 (p. 4-137), 5 (p. 6-6), 6 (p. 16)
AD-MK54 Mod 1	Auxiliary	1 (p. 4-136), 4 (p. 4-137), 5 (p. 6-6)
MK29 Mod3	Point detonating	1 (p. 4-136), 5 (p. 6-6)

Booster, Adapter-Booster, or Burster

Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	1.5 pounds	Explosive D	-	1 (p. 4-136), 2 (p. 2), 4 (p. 4-137)
Not designated	1.5 pounds	Composition B	EX 38 Mod 0	5 (p. 6-5)

Fills

Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	3.25-3.30	1.47-1.49	55.2-56.3	25.0-25.5	-	1 (p. 4-136), 2 (p. 2, 13)
HD	4.1	1.86	55.8	25.31	EX 34 Mod 0	2 (p. 2), 5 (p. 6-2), 7

Shipping/Packing

Projectiles were shipped with nose shipping plug in the nose opening. The bodies were protected during shipment with grommets placed about the rotating bands. Alternatively, the projectiles could be shipped two per crate. Cartridge cases were shipped separately. The auxiliary detonating fuze is shipped either threaded and staked in the projectile or in a separate fuze container. The nose fuze is shipped in a separate fuze container. The cartridge and projectile were to be assembled immediately prior to firing (5 p. 6-7, 6-9).

Miscellaneous Information

The MK 53 Mod 0 was designated EX 34 during development (1 p. 4-136).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
2. Pascazio, A.J., & Norton, J.E. 1957. CWL Technical Memorandum 30-17, Navy Gas Projectile, 5”/38, EX 34, Mod 0, Development of (U). Chemical Warfare Laboratories.
3. Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. Department of the Army.
4. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). White Oak: Department of the Navy. 1 January.
5. Army Chemical Center. 1955. ORD 2509, Preliminary Manuscript, Naval Chemical Munitions, Chemical Corps Medical Laboratories. 14 April.
6. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
7. Harris, R. W., 1953. Ground Munitions Branch, Munitions Division, Chemical Corps Chemical & Radiation Laboratories, Memorandum to: Commanding Officer, Chemical Corps Chemical & Radiation Laboratories, Subject: Report of Conference on Navy Gas Munitions. June 25.

14.10 Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0

Figures

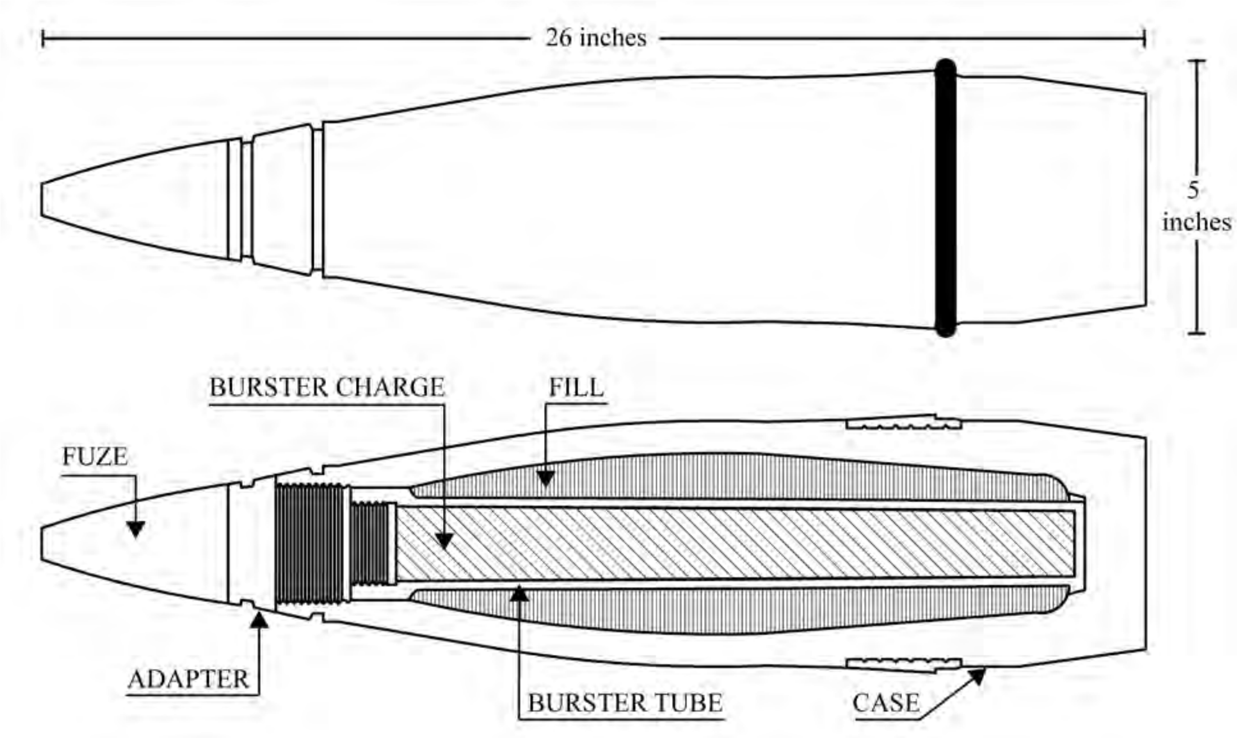

Figure 195: Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0 - Line Drawing

Specifications

Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0 - Specifications and Other Data		**Citation**
Historical Name	Projectile, Gun, Gas, Nonpersistent, GB, 5-Inch/54, MK 54 Mod 0	1 (p. 4-140)
Developmental Information	EX 36	1 (p. 4-141), 2 (p. 3), 3 (p. 4-140)
Type	Projectile	1 (p. 4-140), 3 (p. 4-139, 4-140)
Size	5-Inch/.54 Caliber	1 (p. 4-140), 2 (p. 3)
Service	Navy	3 (p. 4-139), 4 (p. 16)
Diameter	5 in. (12.7 cm)	3 (p. 4-140)
Length	26 in. (66.04 cm)	3 (p. 4-140)
Construction Material	Steel alloy	2 (p. 8)
Range	21,000 yards (19,202 meters)	5 (p. 16)
Drawing	75-4-85	-

General Use and Description

The MK 54 Mod 0 projectile was designed to provide ships with toxic chemical offensive capability (3 p. 4-139).

This was a semifixed, central burst projectile loaded with GB and used for antipersonnel effects. The projectile was unique in that the stress figures for the metal components were markedly more robust than for other projectiles due to the high acceleration required to reach the desired muzzle velocity. One-piece forged construction and accurately machined press fit closures eliminated joints, minimized leakage possibilities, and provided maximum safety. A burster tube extended the entire length of the projectile cavity and was press fit into the fuze adapter (3 p. 4-139).

Explosive Train

A point detonating fuze with auxiliary booster was located on the forward end, which on functioning initiated the burster charge to explode the projectile and release the chemical agent fill (3 p. 4-139).

Fuzing

Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0 - Fuzing		
Fuze	**Notes**	**Citation**
MK 30 Mod 3	Point detonating	3 (p. 4-140), 5 (p. 16, 17)
MK 30 Mod 4	Point detonating, used with fuze auxiliary detonator MK 43	2 (p. 8)
MK 43-AD	Auxiliary detonator	2 (p. 8), 3 (p. 4-140)

Booster, Adapter-Booster, or Burster

Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	1.75 lbs. (0.79 kg)	Explosive "D"	-	2 (p. 8), 3 (p. 4-140)

Fills

Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	4.20-4.75	1.90-2.15	64.0	29.0	-	2 (p. 8), 3 (p. 4-140), 4 (p. 16)
HD	N/A	N/A	N/A	N/A	Experimental	6

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The flight characteristics of the MK 54 were similar to the MK 41 HC projectile, which was used for prototype design (2 p. 8), (3 p. 4-139).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Dugway Proving Ground. 1960. Dugway Proving Ground Report, DPGR 245, Final Engineering Testing of the 5"/54 Gas Projectile (Navy) (U), Volume I: Physical and Dissemination Testing. U.S. Army Chemical Corp Research and Development Command.
3. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
4. Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. Department of the Army.

5. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

6. Harris, R. W., 1953. Ground Munitions Branch, Munitions Division, Chemical Corps Chemical & Radiation Laboratories, Memorandum to: Commanding Officer, Chemical Corps Chemical & Radiation Laboratories, Subject: Report of Conference on Navy Gas Munitions. June 25.

14.11 Projectile, 6-inch, Common Steel, MK III

Figures

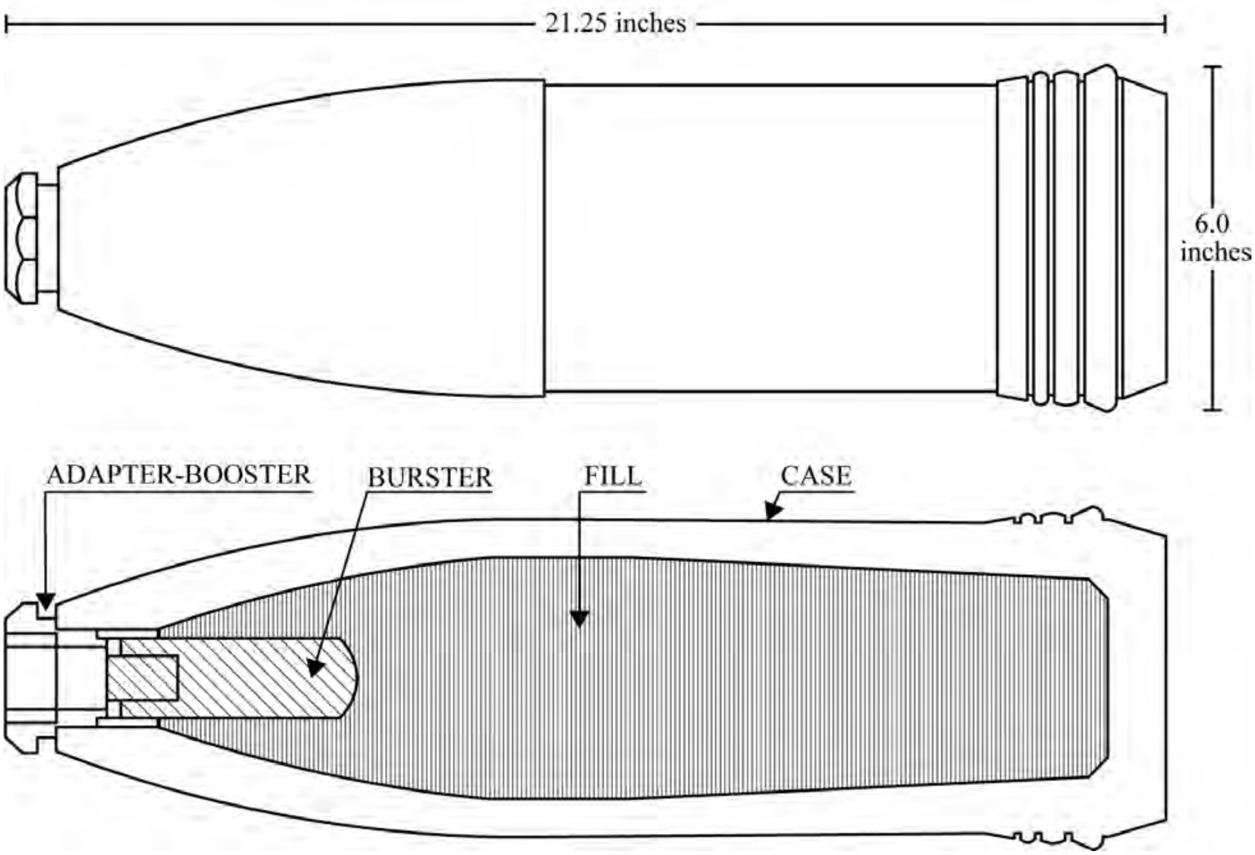

Figure 196: Projectile, 6-inch, Common Steel, MK III - Line Drawing

Specifications

Projectile, 6-inch, Common Steel, MK III - Specifications and Other Data		Citation
Historical Name	6-Inch Common Steel Shell, MK III (gas)	1 (p. 50, 51), 2 (Table 16)
Type	Projectile	1 (p. 50)
Size	6-inch	1 (p. 50)
Conflict	WWI	1 (p. 50)
Diameter	6 in. (15.2 cm)	1 (p. 50-51)
Length	Projectile, Unfuzed: 21.25 in. (53.9 cm)	1 (p. 50-51), 2 (Table 16)
Wall Thickness	0.58-in. (1.473 cm)	1 (p. 50-51)
Other Engineering Data	Weight, Empty: 74.95 lbs. (34.01 kg)	1
Construction Material	Steel	1 (p. 51)

General Use and Description

The main objective of the MK III was to produce a cloud of the highest possible initial concentration that would drift downwind and completely envelop the position attacked. The shell was used in the wheel mount, seacoast gun (1 p. 50), (2 Table 16).

The MK III, 6-inch gas shell consisted of the projectile body that contained the chemical agent, the gaine tube (adapter and booster casing), which screwed into the nose of the shell and contained the bursting charge. The bursting charge consisted of a small quantity of HE sufficient to open the projectile, and, in some cases, to atomize the liquid contents.

A six-inch semi-steel projectile was developed which differed from the steel projectile only in reduced capacity (1 p. 50).

Explosive Train

Upon impact, the point detonating fuze would function. The fuze would detonate the burster, split the shell, and spread the chemical agent fill.

Fuzing

Projectile, 6-inch, Common Steel, MK III - Fuzing		
Fuze	**Notes**	**Citation**
French I.A. Model 1915	Point detonating, superquick	1 (p. 34, 50)
French I.A.L. Model 1916	Point detonating, superquick	1 (p. 34, 50)
French R.Y. Model 1917	Point detonating, superquick; only to be used if other fuzes were unavailable	1 (p. 38, 50)
Mark III	Point detonating, superquick	1 (p. 34, 50), 2 (p. 138)
Modified British No. 106	Point detonating, superquick	1 (p. 42, 50)

Booster, Adapter-Booster, or Burster

Projectile, 6-inch, Common Steel, MK III - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	N/A	Adapter-booster and bursting charge were noted; however, no details were provided in available references.	1 (p. 50)

Fills

Projectile, 6-inch, Common Steel, MK III - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	15.1	6.84	N/A	N/A	-	3 (p. 6)
CG	10.1	4.57	N/A	N/A	-	3 (p. 4)
FM	13.2	5.98	87.4	39.6	Without fuze	1 (p. 50), 3
H	10.5	4.76	84.6	38.3	Without fuze	1 (p. 50)
NC	10.8	4.89	N/A	N/A	-	3 (p. 3)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.

2. Office, Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. November. Government Printing Office.

3. War Department 1918. Office of Chief of Ordnance, Trench Warfare Section, Memorandum to Colonel Walker, Subject Munitions to be Filled and Approximate Fill Weight. March 9.

14.12 Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1

Figures

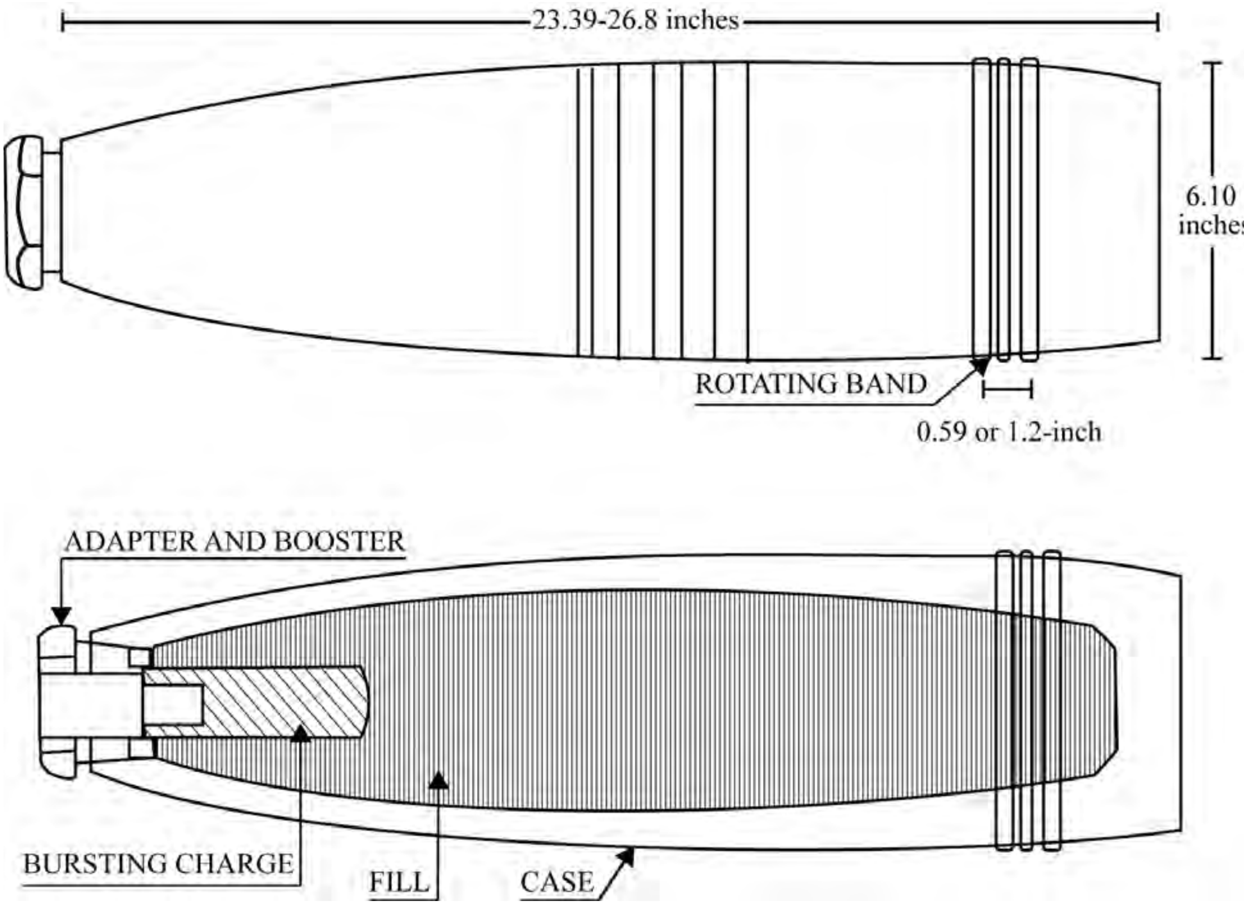

Figure 197: Projectile, 155-mm, MK II - Line Drawing, without fuze

Figure 198: Projectile, 155-mm, MK IIA1 - Photograph

Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1

Specifications

Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1 - Specifications and Other Data		**Citation**
Historical Name	Shell, Gas Persistent, H, Mk. IIA1 and Mk. IIA1-Mod. 1 155-mm Howitzer	1 (p. 194), 2 (p. 115 - 117)
Type	Projectile	1 (p. 194, 195), 3 (p. 1)
Size	155-mm	1 (p. 195), 3 (p. 1), 4 (p. 1), 5
Conflict	Other, WWII	1 (p. 194), 4
Service	Army	1
Diameter	6.1 in. (15.5 cm)	1 (p. 194)
Length	MK II, unfuzed: 26.1 in. (66.3 cm) (with eyebolt lifting plug) MK II, unfuzed: 23.39 in. (59.41 cm) MK IIA1, unfuzed: 26.82 in. (68.1 cm) (with eyebolt lifting plug)	1 (p. 194, 195), 2 (p. 115 - 117), 6 (Table 16)
Width	MK II Rotating band: 0.6 or 1.2-in. (1.52 or 3.04 cm)	1 (p. 194, 195), 7 (p. 7)
Wall Thickness	0.615 in. (1.56 cm)	5 (p. 52)
Other Engineering Data	Weight, Empty, MK II: 77.10 lbs. (34.97 kg) Used in howitzer 1917, 1917A1, 1917A2, 1918	2 (p. 115), 7 (p. 4), 8 (p. 17)
Construction Material	Steel	8 (p. 17)
Propellant	M1A1, M2, M2A1	1 (p. 370), 2 (p. 115 - 117), 8 (p. 17)
Maximum Range	MK II: 12,295 yards (11,242 meters) MK IIA1: 12,400 yards (11,338 meters)	1 (p. 194), 2 (p. 115 - 117)
Drawing	MK II: 75-4-27 MK IIA1: 75-4-85 MK IIA1, Mod 1: 75-4-102	4 (p. 5), 8 (p. 17), 10 (p. 10)
Specification	MK IIA1: 196-131-38 (HS-fill)	4 (p. 6)
Stock No.	MK IIA1: 333220 (CNS) MK IIA1: 213220 (FS) MK IIA1: 213120 (WP)	9 (p. IV-5)

General Use and Description

A military requirement for a 155-mm chemical shell was established in 1922. The MK II (howitzer) and MK VII (gun) shell with MK VIB adapter and booster we adopted as standard in 1923. HS was adopted as the persistent chemical fill for these shells in 1928 (4 p. 1).

The MK II gas and smoke projectile was adapted for the point detonating M46 fuze. It had tapered or pipe threads and did not contain a base cover. The adapter-booster was tightly screwed into place, which formed a gastight seal for the filler. The MK IIA1 was a modification of the MK II projectile; it had a burster extending from the nose to the base of the shell and used the point detonating M51 fuze and modifications. The MK IIA1 Mod. 1 was a modification of the MK VII Projectile for the 155-mm Guns M1917-17Al-18MI. The modification consisted of machining down the forward rotating band to the diameter of the shell body. Dimensions and data were the same as for the MK IIA1 Shell (1 p. 194, 195).

The MK II shell only slightly differed from the MK I high explosive shell. The difference was the threads in the nose for the adapter and booster and in that it does not contain a base cover. The threads of the MK II chemical shell are tapered or pipe threads (7 p. 9).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1 - Fuzing		
Fuze	**Notes**	**Citation**
French I.A. Model 1915	Superquick	5 (p. 34, 53)
French I.A.L. Model 1916	Superquick	5 (p. 34, 53)
French R.Y. Model 1917	Superquick; only to be used if other fuzes were unavailable	5 (p. 38, 53)
M46	Point detonating, superquick	1 (p. 195, 370), 2 (p. 115)
M51A4	Point detonating, superquick	1 (p. 370, 371), 2 (p. 115 - 117)
Modified British No. 106	Superquick	5 (p. 42, 53)
U.S. Mark III	Point detonating, superquick	5 (p. 34, 53)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M6 Burster	0.36 lbs. (0.16 kg)	Tetryl	20.67 in. (52.5 cm) long. Used in MK IIA1 and MK IIA1 Mod 1.	1 (p. 370, 371), 2 (p. 116, 117)
MK VIB Burster	0.56 lbs. (0.25 kg)	TNT	Used in MK II.	1 (p. 370), 2 (p. 115), 7 (p. 18)
N/A	0.06 lbs. (0.03 kg)	Tetryl	Auxiliary booster for MK II	7 (p. 18)

Fills

Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	16.4	7.43	97.2	44.1	Fill weights are approximate.	5 (p. 53)
CA	12.1	5.48	93.0	42.1	-	5 (p. 53)
CG	11.0-11.3	4.98-5.12	91.8-92.1	41.6-41.8	-	5 (p. 53), 11 (p. 75)
CNS	13.9	6.30	99.2	44.9	MK IIA1, MK IIA1 Mod 1	1 (p. 371), 2 (p. 117), 9 (p. IV-5)
FM	14.3-14.4	6.48-6.53	95.1-96.1	43.1-43.6	MK II	1 (p. 370), 2 (p. 115), 5 (p. 53)
FS	16.2	7.34	99.1-100	44.9-45.3	MK II, MK IIA1	1 (p. 194, 370), 2 (p. 115), 8 (p. 17), 9 (p. IV-5)
H	10.4-11.8	4.71-5.35	92.6-97.1	42.0-44.0	-	1 (p. 194, 370), 2 (p. 115 - 117), 5 (p. 53), 11 (p. 75)
L	N/A	N/A	N/A	N/A	-	9 (p. IV-5)
NC	14.5-15.4	6.58-6.99	95.3	43.2	-	5 (p. 53), 11 (p. 75)
PS	13.6	6.16	94.5	42.8	-	5 (p. 53)
WP	14.8-15.8	6.71-7.16	96.0-98.8	43.5-44.8	MK II, MK IIA1	1 (p. 194, 371), 2 (p. 115 - 116), 9 (p. IV- 5), 5 (p. 53)

Shipping/Packing

The MK II shells were issued unfuzed with an adapter plug assembled in the fuze seat. The shells were shipped two per wooden box early on but were later shipped uncrated (2 p. 115-117), (7 p. 3).

Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1

Miscellaneous

In April 1932, there were 7,223 MK II, HS-filled shells on hand for war reserve (4 p. 1), (12 p. 24).

Key Dates

Projectile, 155-mm, MK II, MK IIA1, MK IIA1-Mod 1 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1923	OCM 3344 MK II	10 (p. 10)
Other	1930	CCTC 1930-04 MK II (WP-fill Specification)	13
Standardized	1933	CCTC 1933-02 (Howitzer HS, CG, WP, and FM-fill and Gun HS-fill)	14 (p. 3)
Standardized	1941	OCM 16681, 16766 MK IIA1 (Howitzer HS-fill)	4 (p. 7), 15
Standardized	1941	OCM 16681, 16766 MK II (Standard to Limited Standard)	15 (p. 44)
Standardized	1941	OCM 16758 MK IIA1 (Standard to Limited Standard)	16 (p. 33)
Cancellation	1949	CCTC 2004 (Cancellation of Specifications for FS, H, and WP Fills)	17 (p. 119)

Sources

1. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
2. War Department. 1946. Field Manual, FM 3-5, Characteristics and Employment of Ground Chemical Munitions. War Department.
3. Woodberry, D.L. 1940. Technical Division Memorandum Report, TDMR 241, Chemical Filling for Artillery Shell Static Test of 155-mm. (How.) Chemical Shell MKII A1, Filled with WP, FS, and HS. Chemical Warfare Service.
4. Rouiller, C.A. 1942. Edgewood Arsenal Technical Report, EATR 297, 155-MM Chemical Shell MK. IIA1 and MK. VIIA1, HS-Filled. Final Report on Projects A 1.1-1b and A 1.1-1c. War Department.
5. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.
6. Office, Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. November. Government Printing Office.
7. War Department 1927. Technical Regulations, TR 1355-155A, Mobile Artillery Ammunition, Ammunition For 155-MM Howitzers, M 1917 (French) and M1918 (American). November 23.
8. Anonymous. 1941. Complete Round Charts, issued and revised various dates (RMA barcode GE104415 GE028220-1). War Department.
9. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. Mechanical Division. 15 September.
10. Ordnance Committee. 1923. Ordnance Committee Meeting, OCM Item # 3344, Standardization of Chemical Shell and Boosters. November 1.
11. Edgewood Arsenal 1919. An Historical Sketch of Edgewood Arsenal. March 1.
12. Ordnance Committee. 1932. Ordnance Committee Meeting, OCM Item # 9758, Shell, 155 MM, Chemical [Mark II Shell, HS-filled, and 75 MM, Mark II Shell, NC-filled] – War Reserve Test to Determine Serviceability and to Establish Data for Efficient Use. April 28.
13. Chemical Corps Technical Committee. 1930. CCTC Item # 1930-04, Specifications: Valves, Check; Deflectors, Gas Mask Face Piece, and Filling, 155 mm Shell MK II (Howitzer) and MK VII (Gun), White Phosphorus (WP). Chemical Warfare Service.
14. Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. Department of the Army.

15. Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16766, Shell, Chemical, 155 MM MK IIA1 for Howitzer, M1918 and Chemical, 155 mm, MK VIIA1 for Gun, M1917 and M1918 – Classified as Standard, Read for Record. May 22.
16. Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16758, Shell, Chemical, 155 MM, M105 for the 155 MM Howitzer, M1918 and Shell, Chemical, 155 MM, M104 for Gun M1917-1918M1 – Classified as Standard. Shell, Chemical, 155 mm, MK IIA1 and MK VIIA1 Transferred from Standard to Limited Standard. May 22.
17. Chemical Corps Technical Committee. 1949. CCTC Item # 2004, Specification Changes for Record. Department of the Army.

14.13 Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1

Figures

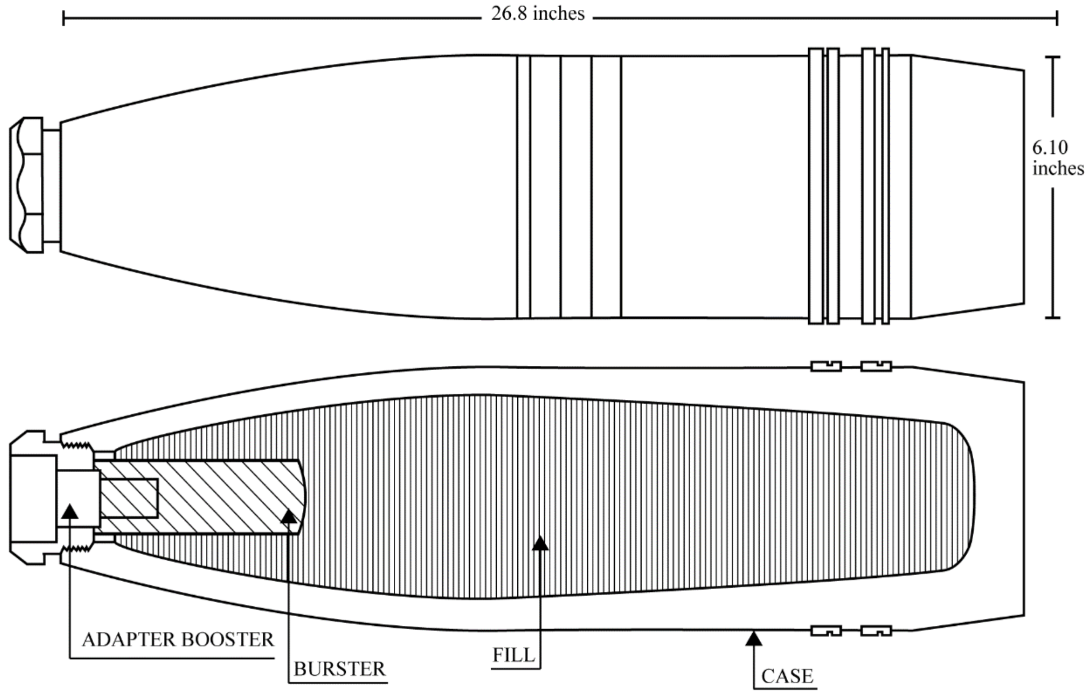

Figure 199: Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1 - Line Drawing, without fuze

Figure 200: Projectile, 155-mm, Howitzer and Gun, VII - Photograph

Specifications

Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1 - Specifications and Other Data		Citation
Historical Name	Shell, MK VII, MK VIIA1, Gas and Smoke	1 (p. 200, 201)
Type	Projectile	1 (p. 200, 201)
Size	155-mm	1 (p. 200, 201)
Conflict	WWI, WWII	1, 5
Diameter	6.10 in. (15.5 cm)	1 (p. 200, 201)
Length	26.8 in. (68.1 cm)	1 (p. 201)
Width	Rotating band: MK VII: 2 in. (5.08 cm) Rotating band: MK VII A1- 2 each 0.59 in. (1.49 cm)	1 (p. 201)
Construction Material	Steel	2 (p. 57)
Propellant	M1917-18, M1, M1A1	1 (p. 374)
Maximum Range	20,247 yards (18,514 meters)	3 (p. 112)
Drawing	75-4-42 (MK VII)	5 (p. 10)

Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1

General Use and Description

Available references did not provide information on specific use.

The MK VII had tapered or pipe threads and did not have a base cover. The adapter-booster was tightly screwed into place forming a gastight seal for the chemical agent fill. The MK VII A1 were modifications of the MK VII shell, the adapter was changed to take the point detonating M51 fuze and modifications (1 p. 200, 201).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1 - Fuzing		
Fuze	**Notes**	**Citation**
French I.A. Model 1915	Point detonating, superquick	2 (p. 34, 57)
French I.A.L. Model 1916	Point detonating, superquick	2 (p. 34, 57)
French R.Y. Model 1917	Point detonating; superquick; used only if other fuzes unavailable.	2 (p. 38, 57)
M46	Superquick, adapted for point detonating	1 (p. 201, 374)
M51 and modifications	Point detonating	1 (p. 200, 374)
Modified British No. 106	Point detonating, superquick	2 (p. 38, 57)
U.S. MK III	Point detonating, superquick	2 (p. 34, 57)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M6	0.36 lbs. (0.16 kg)	Tetryl or tetryl and TNT mixture	MK VII	1 (p. 336, 374)
MK VIB Adapter-booster	N/A	Tetryl	MK VII, MK VIIA1	1 (p. 339, 374), 5 (p. 10)

Fills

Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	16.4	7.43	95.9	43.5	Approximate fill weight	2 (p. 57)
CA	12.2	5.53	91.6	41.5	Approximate fill weight	2 (p. 57)
CG	11.0	4.98	90.5	41.0	Approximate fill weight	2 (p. 57)
FM	14.3	6.48	93.8	42.6	-	2 (p. 57)
FS	16.2	7.34	99.7	45.2	MK VIIA1.	1 (p. 200, 374)
H	11.3-11.4	5.12-5.17	93.5-94.9	42.4-43.0	MK VII and MK VIIA1	1 (p. 200, 374), 2 (p. 57), 4 (p. 13, 102)
NC	14.5	6.57	94.0	42.6	Approximate fill weight	2 (p. 57)
PS	13.7	6.21	93.1-3.10	42.2	Approximate fill weight	2 (p. 24, 57)
WP	14.8-15.9	6.71-7.21	97.6-98.3	44.2-44.6	MK VII and MK VIIA1	1 (p. 200, 201, 374), 2 (p. 57)

Shipping/Packing

Available references did not provide this information.

Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1

Key Dates

Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1923	OCM 3344 MK VII	5 (p. 10)
Other	1930	CCTC 1930-04 MK II (WP-fill Specification)	6
Standardized	1941	OCM 16681, 16766 MK VIIA1 (Standard to Limited Standard)	7 (p. 44)
Standardized	1941	OCM 16681, 16766 MK VII (Standard to Limited Standard)	7 (p. 44)
Cancellation	1949	CCTC 2004 (Cancellation of Specifications for FS, H, and WP fills)	8 (p. 119)

Sources

1. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.

2. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.

3. War Department. 1946. Field Manual, FM 3-5, Characteristics and Employment of Ground Chemical Munitions. War Department.

4. War Department. 1942. Field Manual, FM 3-5, Chemical Warfare Service Field Manual: Tactics of Chemical Warfare. War Department.

5. Ordnance Committee. 1923. Ordnance Committee Meeting, OCM Item # 3344, Standardization of Chemical Shell and Boosters. November 1.

6. Chemical Corps Technical Committee. 1930. CCTC Item # 1930-04, Specifications: Valves, Check; Deflectors, Gas Mask Face Piece, and Filling, 155 mm Shell MK II (Howitzer) and MK VII (Gun), White Phosphorus (WP). Chemical Warfare Service.

7. Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16766, Shell, Chemical, 155 MM MK IIA1 for Howitzer, M1918 and Chemical, 155 mm, MK VIIA1 for Gun, M1917 and M1918 – Classified as Standard, Read for Record. May 22.

8. Chemical Corps Technical Committee. 1949. CCTC Item # 2004, Specification Changes for Record. Department of the Army.

14.14 Projectile, 155-mm, Artillery, E15 Series

Figures

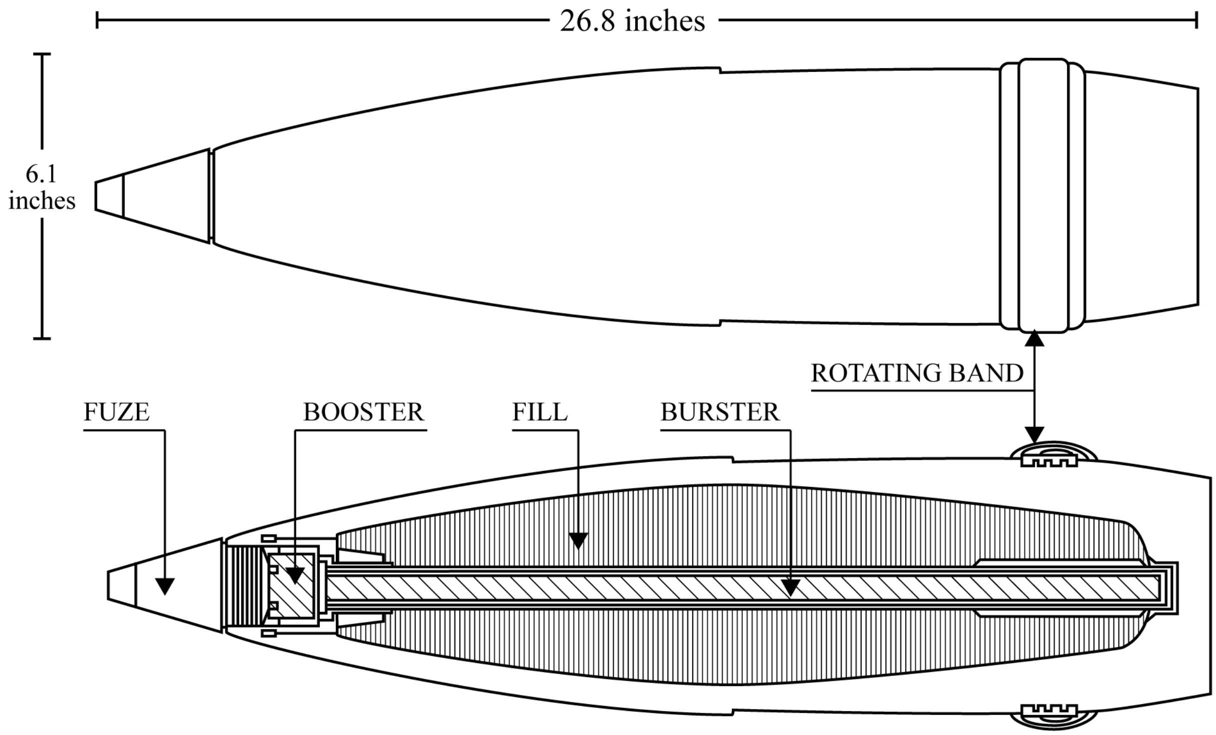

Figure 201: Projectile, 155-mm, Artillery, E15 - Line Drawing

Specifications

Projectile, 155-mm, Artillery, E15 Series - Specifications and Other Data		**Citation**
Historical Name	Artillery Shell, E15, E15R1, E15R2, E15R3, E15R3	1 (p. 1)
Type	Projectile	1 (p. 1)
Size	155-mm	1 (p. 1)
Service	Army	1 (p. 1)
Diameter	6.10 in. (15.5 cm)	1 (p. 1)

General Use and Description

These projectiles were used for field tests of artillery shells for dispersing GB. These projectiles provided preliminary information on the size of cloud and magnitude of dosages produced by different burster to agent (i.e., GB) ratios (1 p. 6, 7).

The E15 series projectiles were modified M110 155 mm artillery shells. These projectiles were used to test dispersion rates of different agent to burster ratios (1 p. 6).

Explosive Train

The burster was initiated by electric means to measure dissemination rates among the four projectiles (1 p. 6).

Fuzing

Projectile, 155-mm, Artillery, E15, E15R1, E15R2, E15R3 - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Munitions were fired electronically	1 (p. 6)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, Artillery, E15, E15R1, E15R2, E15R3 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	3.15 lbs. (1.43 kg)	N/A	E15	1 (p. 1)

Fills

Projectile, 155-mm, Artillery, E15, E15R1, E15R2, E15R3 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	6.30-7.80	2.85-3.53	N/A	N/A	-	1 (p. 1)

Shipping/Packing

Available references did not provide this information.

Key Dates

Projectile, 155-mm, Artillery, E15, E15R1, E15R2, E15R3 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Field Testing	1950	Project- 4-04-15-12	1

Sources

1. Milly, George H., & Cave, Clearburn B. 1950. Technical Command Informal Report, TCIR 570, Report of Field Test 299 Static Test of Modified 155mm Artillery Shell, E15, E15R1, E15R3, E15R3, Filled GB (CBRNIAC-CB-110590). U.S. Army Chemical Corps Research and Development Command.

14.15 Projectile, 155-mm, M104

Figures

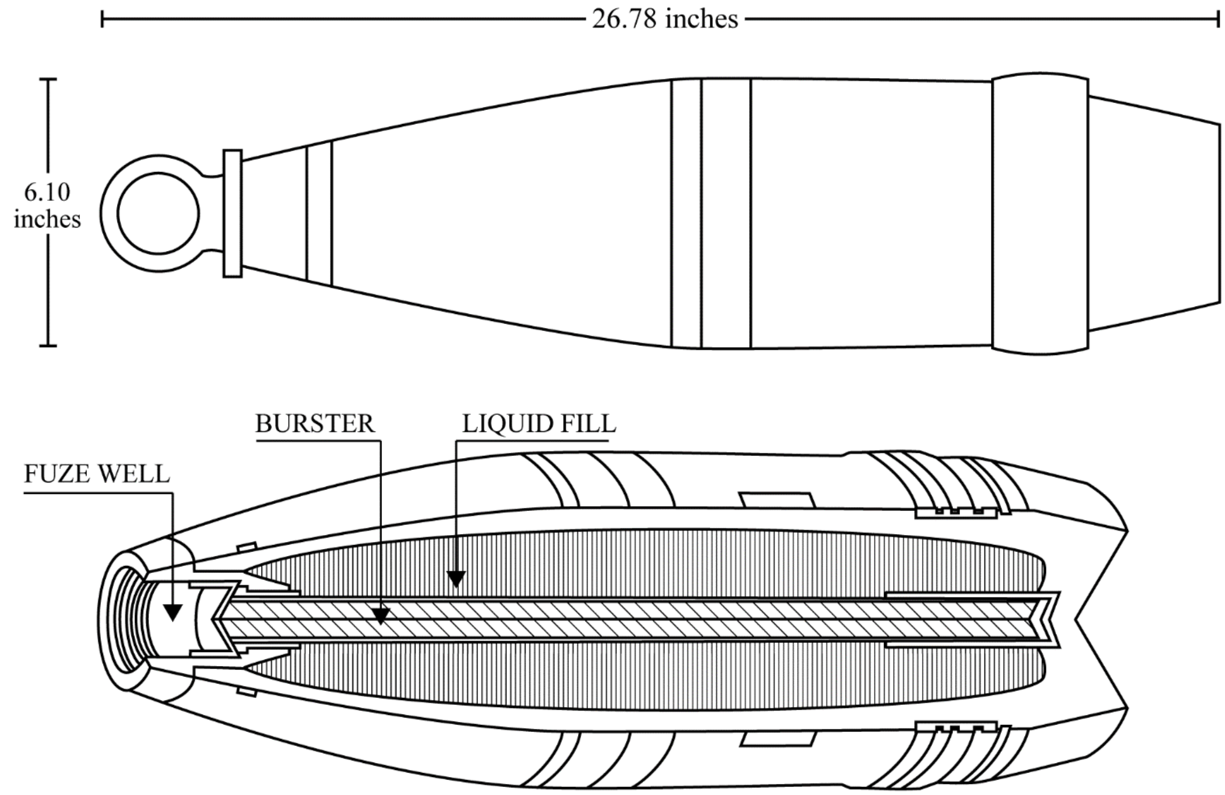

Figure 202: Projectile, 155-mm, M104 - Line Drawing, without fuze

Figure 203: Projectile, 155-mm, M104 - Image

Projectile, 155-mm, M104

Specifications

Projectile, 155-mm, M104 - Specifications and Other Data		Citation
Historical Name	Shell, Gas, Persistent, H, M104	1 (p. 200)
Type	Projectile	2 (p. 8-22), 3 (p. A-13), 4 (p. 36a)
Size	155-mm	1 (p. 200), 3 (p. A-13), 4 (p. 36a)
Conflict	WWII	5 (p. 545)
Service	Marine Corps	6 (p. 16)
Diameter	6.1 in. (15.5 cm)	3 (p. 111)
Length	Projectile, With lifting plug: 26.78 in. (68.02 cm) Projectile, Fuzed: 27.54 in. (69.95 cm)	1 (p. 200), 2 (p. 8-23), 3 (p. A-13), 5 (p. 545)
Other Engineering Data	Primer- Mk. IIA4, 17 grains; M82, Mk. 15, Mk. 34	1 (p. 373), 2 (p. 8-23), 5 (p. 545)
Construction Material	Forged steel	2 (p. 8-22)
Propellant	M1917-18, M1 and M1A1: 26.17 lbs. (11.87 kg) M1 and M1A1: 32.23 lbs. (14.62 kg)	1 (p. 200, 373)
Maximum Range	25,940 yards (23,719 meters)	1 (p. 200)
Drawing	75-14-296	2 (p. 8-22)
NSN	1320-00-529-7350	2 (p. 8-22)

General Use and Description

The M104 projectile was used to produce a toxic effect on personnel and to contaminate habitable areas (2 p. 8-22).

The M104 gas and smoke projectile consisted of a forged steel body that contained a filler and a M6 burster. The burster was housed in the M1 burster casing, which extended the full length of the projectile. The burster casing was assembled after the projectile cavity was filled. A threaded adapter was press fitted to the forward end of the burster casing, which sealed the nose end of the projectile. The projectile was issued unfuzed, with an eyebolt lifting plug threaded in the fuze adapter. A point detonating fuze was normally used with this projectile. A rotating band encircled the projectile body near the base and was protected by a grommet which was removed before loading the projectile in the weapon (1 p. 200), (2 p. 8-22).

Explosive Train

The point detonating fuze functioned on impact to explode the burster. The burster would rupture the projectile case and disperse the chemical agent fill (1 p. 200), (2 p. 8-22).

Fuzing

Projectile, 155-mm, M104 - Fuzing		
Fuze	**Notes**	**Citation**
M51	Point detonating	1 (p. 200)
M51A1	Point detonating	7 (p. 16)
M51A3	Point detonating	5 (p. 545)
M51A4	Point detonating	1 (p. 373)
M51A5	Point detonating	6 (p. 16)
M520	Mechanical time, superquick	2 (p. 8-23)
M557	Point detonating (modification)	2 (p. 8-23)
M564	Mechanical time, superquick (modification)	2 (p. 8-23)

Projectile, 155-mm, M104

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, M104 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M22 Booster	N/A	N/A	-	5 (p. 545)
M6 Burster	0.41-0.83 lbs. (0.19-0.38 kg)	Tetrytol	Thin steel or aluminum tube	1 (p. 373), 2 (p. 8-23), 3 (p. A-13), 5 (p. 545)

Fills

Projectile, 155-mm, M104 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
FS	14.2-16.9	6.44-7.66	99.7-100	45.2-45.3	-	1 (p. 373), 5 (p. 545), 8 (p. 5), 9 (p. 51)
H	9.6-11.7	4.35-5.30	94.4-94.8	42.8-43.0	48 grams of hexamine added to fill	1 (p. 373), 5 (p. 545), 8 (p. 5), 9 (p. 47)
HD	9.40-11.7	4.26-5.31	94.6	42.9	-	2 (p. 8-22), 4 (p. 36a), 6 (p. 16), 8 (p. 5), 9 (p. 47)
HN-1	N/A	N/A	N/A	N/A	Possible fill	9 (p. 47)
L	N/A	N/A	N/A	N/A	Possible fill	9 (p. 48)
WP	14.0-15.7	6.35-7.12	98.2-98.4	44.5-44.6	-	1 (p. 373), 5 (p. 545), 8 (p. 5), 9 (p. 48)

Shipping/Packing

The projectiles were packed eight per pallet, and the pallet weighed approximately 797 pounds (2 p. 8-22).

Key Dates

Projectile, 155-mm, M104 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1941	OCM 16758	10 (p. 33)
Standardized	1944	CCTC 1049, 1094 (HD-fill Standard, H-fill Substitute Standard)	11 (p. 25, 26), 12 (p. 101)
Standardized	1958	OTCM 36841 (HD-fill Standard-B)	4 (p. 36a)

Sources

1. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
2. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
3. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.
4. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.
5. Technical Division. 1944. Catalogue of Standard Ordnance Items, Second Edition 1944, Volume III. Office Chief of Ordnance.
6. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

7. Anonymous. 1941. Complete Round Charts, issued and revised various dates (RMA barcode GE104415 GE028220-1). Department of the Army.

8. Department of Defense 1957. Military Specification, MIL-P-11807C, Projectiles, 155-MM Gun and Howitzer, M104 and M110; WP, FS, HD, and H Filling Assemblies. 6 June.

9. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.

10. Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16758, Shell, Chemical, 155 MM, M105 for the 155 MM Howitzer, M1918 and Shell, Chemical, 155 MM, M104 for Gun M1917-1918M1 – Classified as Standard. Shell, Chemical, 155 mm, MK IIA1 and MK VIIA1 Transferred from Standard to Limited Standard. May 22.

11. Chemical Corps Technical Committee. 1944. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.

12. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

14.16 Projectile, 155-mm, M105

Figures

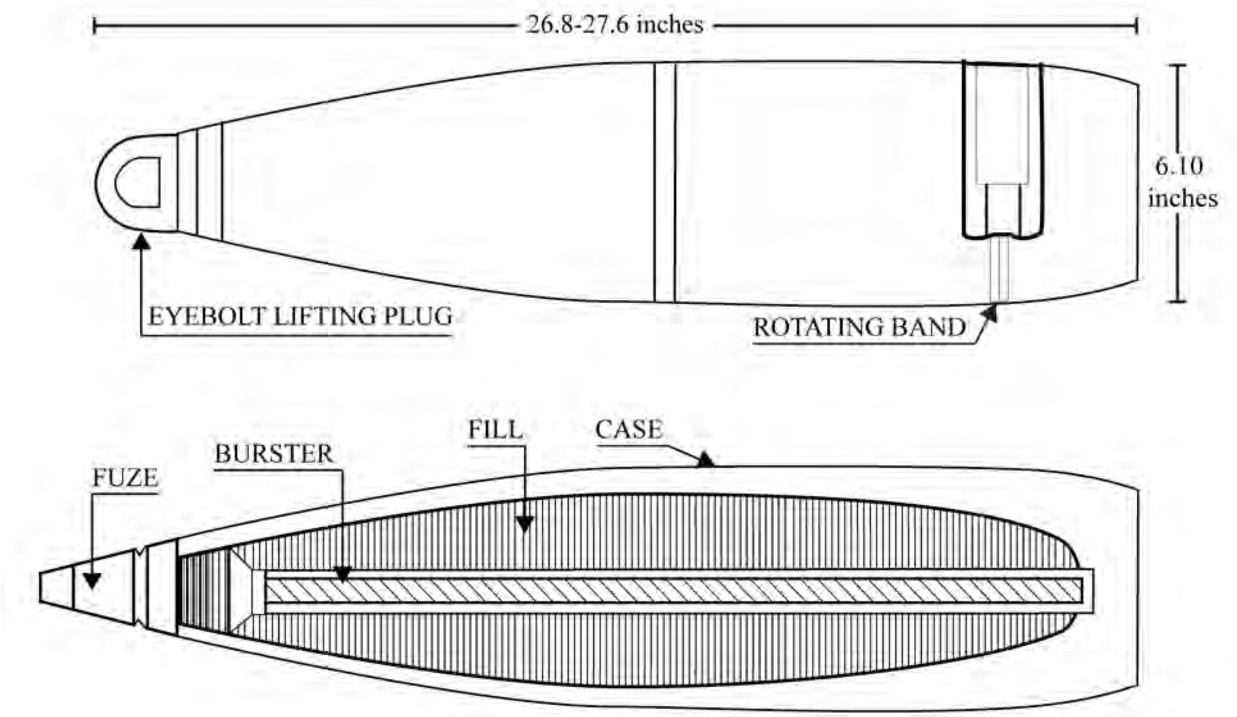

Figure 204: Projectile, 155-mm, M105 - Line Drawing (Note: top drawing is unfuzed)

Figure 205: Projectile, 155-mm, M105 - Photograph

Specifications

Projectile, 155-mm, M105 - Specifications and Other Data		Citation
Historical Name	Shell, M105 Gas and Smoke	1 (p. 222), 2 (p. 193)
Type	Projectile	-
Size	155-mm	2 (p. 193)
Diameter	6.10 inches (15.5 cm)	2 (p. 193)
Length	With eyebolt lifting plug 26.78-27.56 in. (68.02-70.0 cm)	1 (p. 223), 2 (p. 193), 3, 4 (p. 113)
Width	Rotating band: 0.6 in. (1.52 cm)	1 (p. 222), 2 (p. 193)
Other	Rotating band located 3.5 in. (8.89 cm) from base of projectile. Used in howitzers: M1917, M1917A1, and M1918	2 (p. 193), 3, 4 (p. 113), 5 (p. 17)

Projectile, 155-mm, M105

Projectile, 155-mm, M105 - Specifications and Other Data		Citation
Construction Material	Steel	2 (p. 193), 5 (p. 17)
Propellant	M1A1: 4.22 lbs. (1.91 kg) M2A1: 8.64 lbs. (3.92 kg)	2 (p. 371), 3, 4 (p. 113)
Maximum Range	Range varied depending on propelling charge. 4,157-12,791 yards (3,801-11,696 meters)	3, 4 (p. 113), 11 (p. 59)
Drawing	75-14-293 (WP-fill), 75-14-294 (FS-fill) 75-14-295 (HS-fill)	5 (p. 17)

General Use and Description

Available references did not provide information on specific use.

The 155-mm M105 was similar to the M110 chemical round and superseded the MK IIA1. The body was a relatively thin-walled, steel shell with a nose formed to a long ogive and threaded to hold a point detonating fuze. The projectile had a single rotating band (2 p. 193).

Explosive Train

The explosive charge of the burster, which was contained in a cardboard or thin aluminum casing, was held in place in the casing by the fuze well cup. One end of the burster casing was fastened to an adapter in the nose cavity. The projectile was adapted for the point detonating M51 Fuze, and modifications (3).

Fuzing

Projectile, 155-mm, M105 - Fuzing		
Fuze	**Note**	**Citation**
M51 series	Point detonating. Used with booster M20 or M21	2 (p. 189, 371), 3, 4 (p. 113), 5 (p. 17)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, M105 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M6 Burster	N/A	Tetryl	Length: 20.7 in. (52.6 cm)	2 (p. 371), 3, 4 (p. 113)

Fills

Projectile, 155-mm, M105 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
FS	16.9	7.66	99.2-107	44.9-48.5	-	2 (p. 193), 3, 5 (p. 17), 11 (p. 59)
H	11.7	5.30	93.7-101	42.5-45.8	-	2 (p. 371), 3, 5 (p. 17), 11 (p. 59)
HD	11.1	5.04	95.1	43.1	-	4 (p. 113)
L	N/A	N/A	N/A	N/A	-	6 (p. IV-5)
WP	15.6	7.07	97.6-105	44.2-47.6	-	2 (p. 371), 3, 5 (p. 17), 11 (p. 59)

Shipping/Packing

Available references did not provide this information.

Projectile, 155-mm, M105

Key Dates

Projectile, 155-mm, M105 – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1941	OCM 16758 (M105)	7 (p. 33)
Standardized	1944	CCTC 1049, 1094 (HD-fill Standard, H-fill Substitute Standard)	8 (p. 25, 26), 9 (p. 101, 102)
Standardized	1958	OTCM 36841 (HD-fill Standard-B)	10 (p. 32)

Sources

1. Department of the Army. 1950. Technical Manual, TM 9-1901, Artillery Ammunition. U.S. Government Printing Office.
2. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
3. Technical Division. 1944. Catalogue of Standard Ordnance Items, Second Edition 1944, Volume III. Office Chief of Ordnance.
4. War Department. 1946. Field Manual, FM 3-5, Characteristics and Employment of Ground Chemical Munitions. War Department.
5. Anonymous. 1941. Complete Round Charts, issued and revised various dates (RMA barcode GE104415 GE028220-1). War Department.
6. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. War Department.
7. Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16758, Shell, Chemical, 155 MM, M105 for the 155 MM Howitzer, M1918 and Shell, Chemical, 155 MM, M104 for Gun M1917-1918M1 – Classified as Standard. Shell, Chemical, 155 mm, MK IIA1 and MK VIIA1 Transferred from Standard to Limited Standard. May 22.
8. Chemical Corps Technical Committee. 1944. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.
9. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.
10. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
11. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.

14.17 Projectile, 155-mm, Howitzer and Gun, M110 Series

Figures

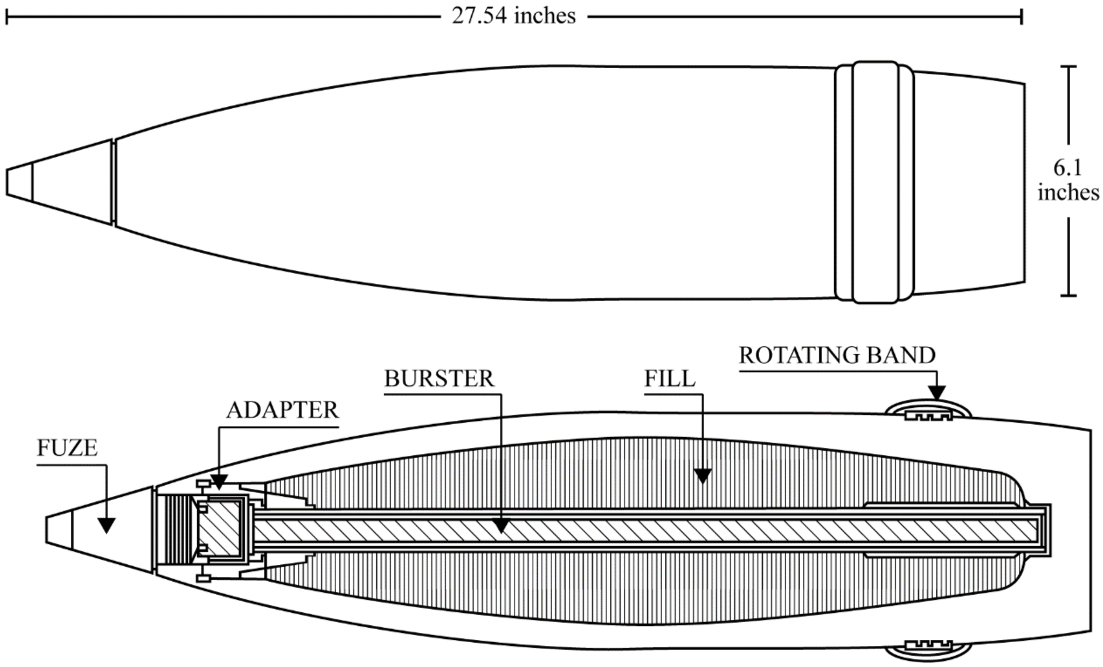

Figure 206: Projectile, 155-mm, Gun or Howitzer, M110 Series - Line Drawing

Figure 207: Projectile, 155-mm, Gun or Howitzer, M110 – Photograph - Cutaway

Specifications

Projectile, 155-mm, Gun or Howitzer, M110 Series - Specifications and Other Data		Citation
Historical Name	Projectile, 155-mm, Gas, Persistent, HD, M110	2 (p. 5-12), 14 (p. 36a)
Developmental Information	M110E1: M110 M110E2: M110A1 M110E3: M110A2	7 (p. B-10)
Type	Projectile	2 (p. 5-12), 3 (p. 4-150)
Size	155-mm	2 (p. 5-12), 4 (p. 16)
Service	Army, Marine Corps	3 (p. 4-150), 4 (p. 16), 5 (p. 4-149)

Projectile, 155-mm, Gun or Howitzer, M110 Series - Specifications and Other Data		Citation
Diameter	6.1 in. (15.5 cm)	2 (p. 5-12), 3 (p. 4-151), 5 (p. 4-150)
Length	With locking bolt: 26.78 in. (69.95 cm) Fuzed: 27.54 in. (68.02 cm)	2 (p. 5-12), 3 (p. 4-152), 5 (p. 4-149, 4-151), 7 (p. 3-85)
Other Engineering Data	Primer: MK IIA4 Weight, Empty: 98.49 lbs. (44.67 kg)	8 (p. 371), 9 (p. 32)
Construction Material	Thin-walled steel or forged steel	2 (p. 5-12), 5 (p. 4-149), 6 (p. 8-25), 7 (p. 3-86)
Propellant	M1A1: 4.22 lbs. (1.91 kg) M2A1: 8.64 lbs. (3.92 kg) M3: 5.5-5.94 lbs. (2.49-2.69 kg) M4A1: 13.19 lbs. (5.98 kg)	2 (p. 5-12), 3 (p. 4-152), 5 (p. 4-149), 6 (p. 8-26), 8 (p. 371)
Maximum Range	16,404 yards (15,000 meters)	3 (p. 4-151)
Drawing	Assembly: 75-14-317 Load: 73-1-179, 73-1-264 75-14-293	5 (p. 4-150, 4-152), 6 (p. 8-25), 7 (p. 3-82), 9 (p. 32)
Specification	MIL-S-12846	9 (p. 32)
NSN	1320-00-096-3067 1320-00-301-1824 13200-00-529-7352 13200-00-529-7352	6 (p. 8-25), 10 (p. 34)

General Use and Description

The M110 series was designed to provide toxic chemical offensive capability, or incendiary, spotting, and screening effects (2 p. 5-12), (3 p. 4-150, 4-152), (5 p. 4-149, 4-151), (6 p. 8-25), (7 p. 3-81, 3-85, 3-89).

The projectile was a separate loaded, central burst gas shell used for antipersonnel effects. It was similar to the standard HE round except for the filling burster tube, and burster charge. The burster charge, contained in a thin tube, was held in place in the burster casing by a fuze well cup. The forward end of the burster casing was assembled to the adapter in the nose of the round and extended the full length of the projectile. The adapter was threaded to receive a point detonating fuze. The body was of thin-walled steel with a nose formed to a long ogive. A single rotating band was located about 3.5 inches in front of the base (2 p. 5-12), (3 p. 4-150), (5 p. 4-149, 4-151), (6 p. 8-25), (7 p. 3-85, 3-89), (8 p. 189 - 191).

The M110 body is similar to that of the M105 but with a rotating band the same as the one used with the M107 high explosive shell (15 p. 5).

Explosive Train

The point detonating fuze functioned on impact to explode the burster. The burster ruptured the projectile case and dispersed the chemical agent fill (6 p. 8-25), (7 p. 3-85).

Fuzing

Projectile, 155-mm, Gun or Howitzer, M110, (M110E1), M110A1 (M110E2), M110A2 (M110E3) - Fuzing		
Fuze	**Notes**	**Citation**
M51A3	Point detonating	11 (p. 549)
M51A4	Point detonating	2 (p. 5-12), 3 (p. 4-153), 5 (p. 4-150, 4-152), 8 (p. 371)
M51A5	Point detonating	2 (p. 5-12), 3 (p. 4-153), 5 (p. 4-150, 4-152), 6 (p. 8-25)
M55	Time, superquick	2 (p. 5-12), 3 (p. 4-153), 5 (p. 4-152)

Projectile, 155-mm, Gun or Howitzer, M110, (M110E1), M110A1 (M110E2), M110A2 (M110E3) - Fuzing		
Fuze	**Notes**	**Citation**
M557	Point detonating	6 (p. 8-26), 7 (p. 3-86, 3-90, B-4)
M564	Mechanical time, superquick	6 (p. 8-26), 7 (p. 3-86, 3-90, B-4)
M582	Mechanical time, superquick	7 (p. 3-86, 3-90. B-4)
M67	Time, superquick	2 (p. 5-12), 3 (p. 4-153)
M739	Point detonating	7 (p. 3-86, 3-90, B-4)
M767	Electronic Time	7 (p. 3-86, 3-90, B-4)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, Gun or Howitzer, M110, (M110E1), M110A1 (M110E2), M110A2 (M110E3) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M20 or M21 series Booster	N/A	Tetryl	Used with M51 series fuzes.	8 (p. 189, 328, 339), 11 (p. 549)
M54A1 Burster	N/A	Composition B	Used with M110A1 (M110E2) and M110A2 (M110E3).	7 (p. 3-89)
M6	0.36-0.83 lbs. (0.16-0.78 kg)	Tetrytol or tetrytol and TNT mixture	Used with M1 burster casing and M21A2 booster.	2 (p. 5-12), 7 (p. 3-85), 8 (p. 336, 371), 11 (p. 549)

Fills

Projectile, 155-mm, Gun or Howitzer, M110, (M110E1), M110A1 (M110E2), M110A2 (M110E3) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CNS	13.8	6.25	97.3	44.1	-	8 (p. 371), 16 (p. 50)
FS	14.2-16.9	6.44-7.66	99.4-99.7	45.0-45.2	-	8 (p. 371), 12 (p. 5) 16 (p. 51)
H	9.6-11.7	4.35-5.30	93.1-95.2	42.2-43.2	48 grams hexamine added to shell	5 (p. 4-152), 7 (p. 3-82), 8 (p. 371), 12 (p. 5)
HD	9.40-11.7	4.26-5.31	92.5-94.5	41.9-42.8	-	3 (p. 4-153), 5 (p. 4-152), 6 (p. 8-25, 8-26), 7 (p. 3-82), 12 (p. 5)
WP	14.0-15.6	6.35-7.07	97.5-98.4	44.2-44.6	-	3 (p. 4-151), 5 (p. 4-150), 7 (p. 3-86, 3-90), 8 (p. 371), 9 (p. 32), 12 (p. 5), 16 (p. 52)

Shipping/Packing

A lifting plug was installed in the nose fuze cavity for use in shipping and handling, A rotating band encircles the projectile case near the base and was protected by a grommet to be removed before loading the projectile in the weapon. Eight projectiles were packed on a pallet that weighed 797 pounds and was approximately 27 by 14 inches (7 p. 3-82, 3-86, 3-90).

Miscellaneous Information

In 1955, HN-1 and L were identified as possible fills. The M110 was used with M1, M1A1, and M45 howitzers 155-mm or M2, M2A1 and M46 Gun 155-mm (5 p. 4-150, 4-152), (16 p. 47, 48).

Key Dates

Projectile, 155-mm, Gun or Howitzer, M110, (M110E1), M110A1 (M110E2), M110A2 (M110E3) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1941	OCM 17402 (H-fill)	15 (p. 6)
Standardized	1944	CCTC 1049, 1094 (HD-fill Standard, H-fill Substitute Standard)	17 (p. 25), 18 (p. 101)
Standardized	1944	OCM 23555, 23318 (WP 155-mm M110 for howitzer M1)	13 (p. 27, 93)
Standardized	1958	OCM 36841 (HD-fill Standard-A)	14 (p. 36a)
Standardized	1972	AMCTC 9019 (WP-fill M110A2)	7 (p. 3-89)

Sources

1. Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. War Department.
2. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
3. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
4. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
5. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
6. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
7. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. U.S. Government Printing Office.
8. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
9. Army Materiel Command. 1985. Army Materiel Command Pamphlet, AMC-P 700-3-3, Logistics, Complete Round Charts, Artillery Ammunition. U.S. Army.
10. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
11. Technical Division. 1944. Catalogue of Standard Ordnance Items, Second Edition 1944, Volume III. Office Chief of Ordnance.
12. Department of Defense. 1957. Military Specification, MIL-P-11807C; Projectiles, 155-MM. Gun And Howitzer, 104 AND M110; WP, FS, HD, and H Filling Assemblies. U.S. Government Printing Office.
13. Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 23555, Shell, Smoke (WP), 155 MM M110, for the 155 MM Howitzer, M1 - Standardization Approved.
14. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.
15. Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 17402, Shell, Chemical, 155 MM, M110 (Persistent Gas Filler) for 155 MM Howitzer, M1 – Classified as Standard. November 6.
16. Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. U.S. Government Printing Office.
17. Chemical Corps Technical Committee. 1944. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.
18. Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

14.18 Projectile, 155-mm, Howitzer, M121, M121A1 (T77)

Figures

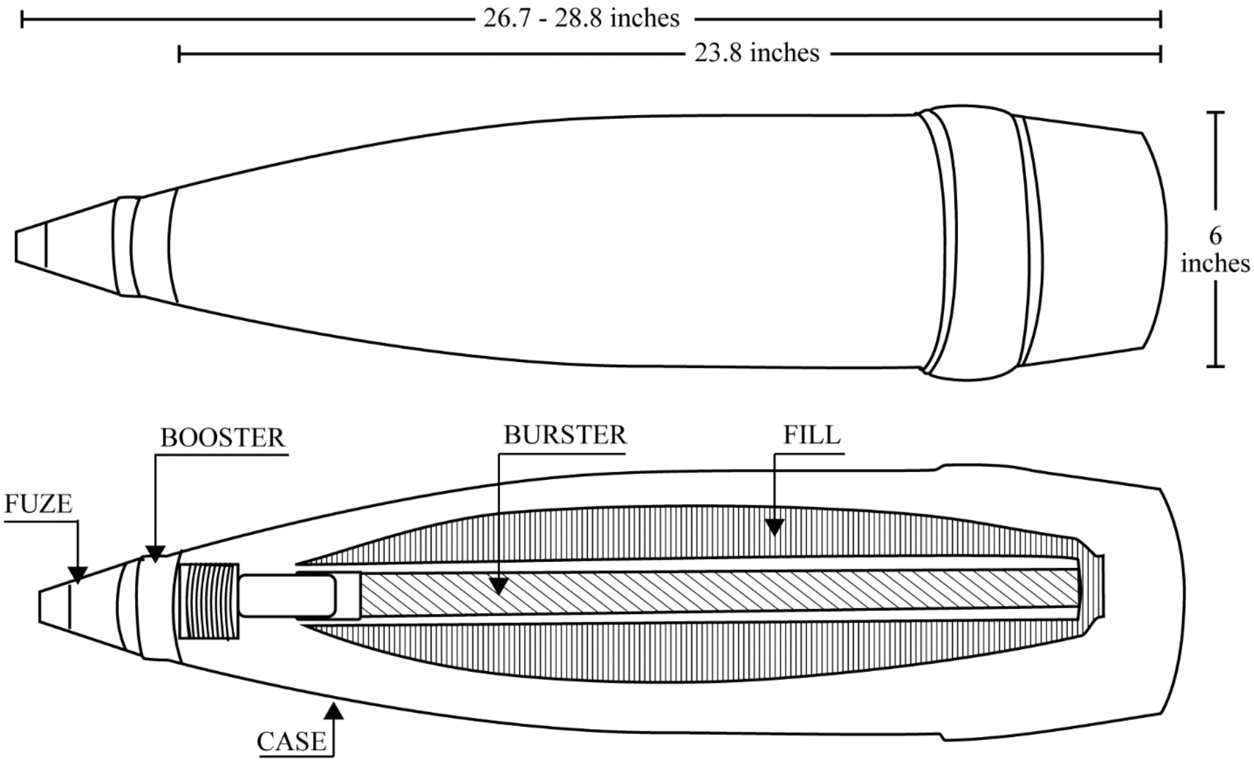

Figure 208: Projectile, 155-mm, Howitzer, M121, M121A1 (T77) - Line Drawing

Figure 209: Projectile, 155-mm, Howitzer, M121 - Photograph - Top: Intact (Note: lug inserted), Bottom: Cutaway View

Projectile, 155-mm, Howitzer, M121, M121A1 (T77)

Specifications

Projectile, 155-mm, Howitzer, M121, M121A1 (T77) - Specifications and Other Data		Citation
Historical Name	Projectile, 155mm: VX (Persistent) or GB (Non-persistent): M121A1	1 (p. 3-105)
Developmental Information	T77	12 (p. 82)
Type	Projectile	1 (p. 3-105), 2 (p. 5-8), 3 (p. 32)
Size	155-mm	1 (p. 3-105), 3 (p. 32), 4 (p. 4-145)
Service	Army, Marine Corps	2 (p. 5-8), 4 (p. 4-145), 5 (p. 4-146)
Diameter	6.1 in. (15.5 cm)	2 (p. 5-8), 4 (p. 4-146), 5 (p. 4-147), 7 (p. 8-29, 8-32), 8 (p. A-9, A-11)
Length	Fuzed: 26.7-28.8 in. (67.8-73.2 cm) Unfuzed: 23.8 in. (60.45 cm)	1 (p. 3-106), 2 (p. 5-8), 4 (p. 146), 5 (p. 4-147, 4-149), 7 (p. 8-32), 8 (p. A-9, A-11)
Other Engineering Data	Primer: MK 2A4.	5 (p. 4-147, 4-149)
Construction Material	Forged, thin-walled steel	5 (p. 4-146, 4-148), 10 (p. 29.1)
Propellant	M3: 5.5 lbs. (2.49 kg) M4A1: 13.19 lbs. (5.98 kg)	2 (p. 5-8), 4 (p. 4-146), 5 (p. 4-147, 4-149)
Maximum Range	16,316-16,355 yards (14,920-14,955 meters) with M4A1 propelling charge	4 (p. 4-146, 4-148), 5 (p. 4-147), 7 (p. 8-29, 8-32)
Drawing	75-14-656, 73-1-264, 8861031, 8861030, 8861029	1 (p. 3-106), 2 (p. 5-8, 5-10), 5 (p. 4-147, 4-149), 7 (p. 8-28, 8-31), 10 (p. 29)
NSN	1320-00-892-4186, 1320-059-3536, 1320-143-7009, 1320-028-4890, 1320-529-7346, 1320-567-7909, 1320-00-756-2888, 1320-059-3535, 1320-756-2888	7 (p. 8-28, 8-31)

General Use and Description

The M121, and M121A1, were designed to provide toxic chemical offensive capability (1 p. 3-106), (2 p. 5-8, 5-10), (4 p. 4-145, 4-147), (5 p. 4-146, 4-148), (7 p. 8-28, 8-31).

The projectile was a separate loaded, central burst VX- or GB-filled projectile, which could be used for antipersonnel effects. It was similar to the HE round except for the filling and the burster. The burster casing was one-piece, extending the full length of the projectile cavity and was a press fit into the body sealing the agent cavity. The burster charge was contained in a thin tube and was held in the burster casing by the fuze well cup.

The adapter on the forward end was screwed into the body and was threaded to receive the point detonating fuze. The body was thin-walled steel with a nose formed to a long ogive.

The M121A1 differed from the M121 in that the M121A1 fill was VX or GB while the M121 fill was only GB. In addition, the M121 used the M37 burster while the M121A1 used the M71. The early M121 shells had an open-ended burster container and used a tetrytol (70% tetryl and 30% TNT) burster charge (1 p. 3-106), (2 p. 5-8, 5-10), (4 p. 4-145, 4-147), (5 p. 4-148), (7 p. 8-28, 8-31), (11 p. 92).

Explosive Train

A point detonating or proximity fuze was installed before use of the M121. When equipped with a proximity fuze, the supplementary charge was removed. When the point detonating fuze was used, the fuze detonated the supplementary charge on impact. The supplementary charge detonated the burster which ruptured the projectile case and heated the agent so that dispersal was in the gaseous state. When a proximity fuze was employed, detonation of the burster tube resulted directly from the action of the fuze booster and occurred on approach to the target (1 p. 3-105), (7 p. 8-28, 8-31).

Fuzing

Projectile, 155-mm, Howitzer, M121, M121A1 (T77) - Fuzing		
Fuze	**Notes**	**Citation**
M508	Point detonating	2 (p. 5-8, 5-10), 4 (p. 4-146, 4-147), 5 (p. 4-147)
M514	Proximity	2 (p. 5-10), 7 (p. 8-29)
M514A1	Proximity (VX-fill)	2 (p. 5-10), 5 (p. 4-149)
M557	Point detonating	1 (p. 3-106), 7 (p. 8-29)
M728	Proximity	1 (p. 3-106), 7 (p. 8-29)
M732	Proximity	1 (p. 3-106)
M739	Point detonating	1 (p. 3-106)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, Howitzer, M121, M121A1 (T77) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M15 casing	2.72 lbs. (1.23 kg)	Composition B	-	2 (p. 5-10)
M37 Burster	2.72 lbs. (1.23 kg)	Composition B	Used with M15 casing in M121. Weight range 2.0-2.72 pounds.	2 (p. 5-10), 5 (p. 4-149)
M71 Burster	2.45 lbs. (1.11 kg)	Composition B	Used in M121A1. Supplemental charge: 0.3-pound Tetrytol.	1 (p. 3-105), 8 (p. A-9), 10 (p. 29)

Fills

Projectile, 155-mm, Howitzer, M121, M121A1 (T77) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	M121: 6.50 M121A1: 6.0	M121: 2.95 M121A1: 2.72	98.9-101	44.8-45.8	-	1 (p. 3-106), 2 (p. 5-8), 3 (p. 32), 4 (p. 146), 5 (p. 4-147), 7 (p. 3-105), 8 (p. A-9)
VX	6.00-6.50	2.72-2.95	98.9-101	44.8-45.8	-	1 (p. 3-106), 2 (p. 5-10), 3 (p. 34), 4 (p. 146), 5 (p. 4-149), 7 (p. 8-32), 8 (p. A-11)

Shipping/Packing

For shipping and handling, an adapter-type lifting plug was installed in the fuze cavity, and a grommet protected the rotating band. The projectiles were packed eight on a pallet with a total weight of 831 pounds (1 p. 3-105, 3-106), (8 p. A-9, A-11).

Miscellaneous Information

The M121 and M121A1 were used with the M1, M1A1, and M45 howitzer. The M121 VX Chemical Projectile with the M514A1 proximity fuze had the same exterior contour and as fired weight as the 155-mm HE, MI07 shell.

Projectile, 155-mm, Howitzer, M121, M121A1 (T77)

As of September 1961, there were 41,000 serviceable and 2,000 unserviceable GB-filled M121 projectiles in stock (5 p. 4-147, 4-149), (11 p. 90).

It was expected that with the fielding of the 155 mm M687, that the 155 mm M121A1 would be retained as Standard Logistics Control Code B (13 p. 129).

Key Dates

Projectile, 155-mm, Howitzer, M121, M121A1 (T77) – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1948	OCM 32335, 32413 (T77, Initiation of Development)	-
Standardized	1954	CCTC 2933 (M121 GB-fill)	12 (p. 88)
Standardized	1961	CCTC 3924, OCM 37870 (M121A1 GB & VX-fill Standard-A, M121 GB-fill Standard-B)	11 (p. 92)
Standardized	1977	MSR 01776009 (M121A1 GB-filled Standard-B)	13

Sources

1. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. U.S. Government Printing Office.
2. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
3. Department of the Army. 1967. Field Manual, FM 3-8, Chemical Reference Handbook. U.S. Government Printing Office.
4. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
5. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
6. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
7. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
8. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.
9. Ordnance Technical Committee. 1954. OTCM Item # 35517, Shell, Chem, 155-mm, M121 (T77): Casing, Burster, M15 (T29E1), Charge, Burster, M37 (T69) - Classified as Standard Type. Department of the Army.
10. Army Materiel Command. 1985. Army Materiel Command Pamphlet, AMC-P 700-3-3, Logistics, Complete Round Charts, Artillery Ammunition. U.S. Army.
11. Chemical Corps Technical Committee. 1961. CCTC Item # 3924, Classification of Projectile, 155-mm, Gas, Nonpersistent GB, M121A1 (M121E1) & Projectile, 155-mm, Gas, Persistent VX, M121A1 (M121E1) as Standard-A, Types & Reclassification of the M121 GB. Department of the Army.
12. Chemical Corps Technical Committee. 1954. CCTC Item # 2933, Shell Chem, 155-MM, M121 (T77): Casing, Burster, M15 (T29E1), Charge, Burster, M37 (T69) - Classified as Standard Type. Department of the Army.
13. U.S. Army Armament Command. 1977. Materiel Status Record Submission 01776009, Projectile, 155mm, Lethal Binary, GB2, XM687.

14.19 Projectile, 155-mm, Gun, M122 (T179)

Figures

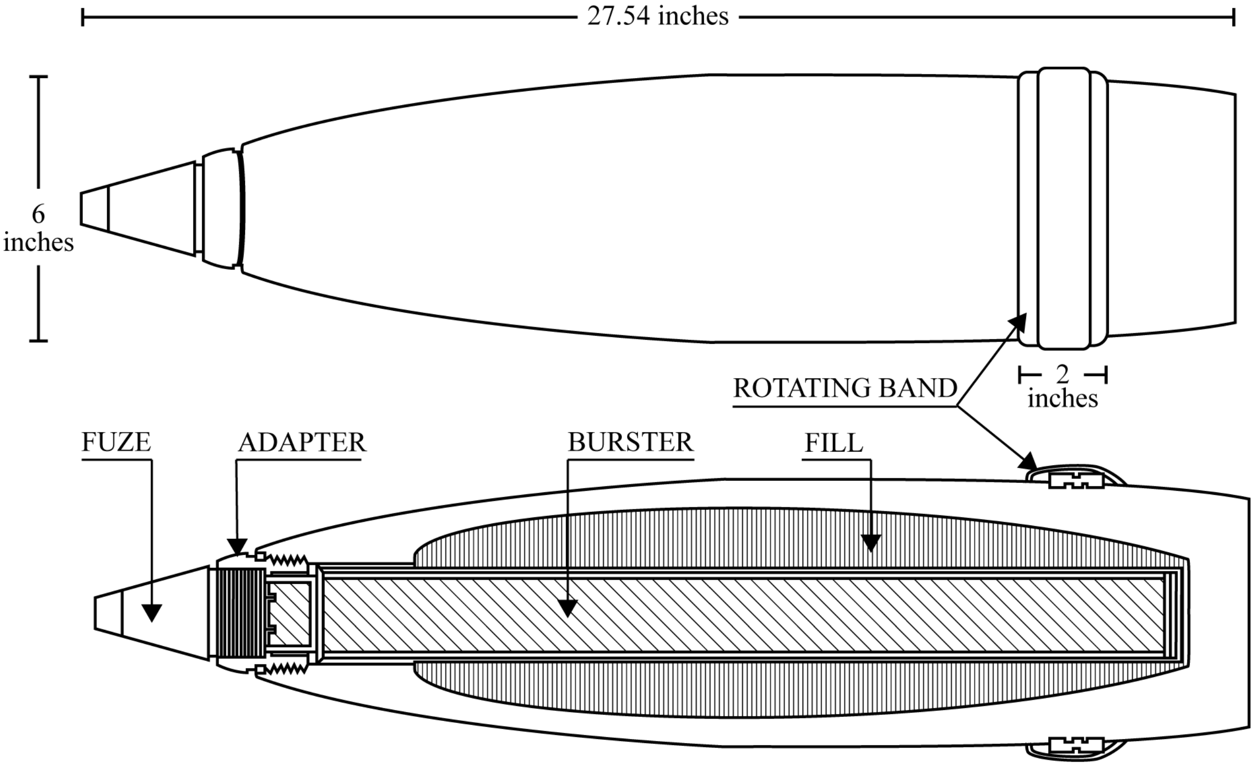

Figure 210: Projectile, 155-mm, Gun, M122 (T179) - Line Drawing

Specifications

Projectile, 155-mm, Gun, M122 (T179) - Specifications and Other Data		**Citation**
Historical Name	Projectile, 155mm: Gas, Nonpersistent GB, M122 (T179)	1 (p. 36a)
Developmental Information	T179	1 (p. 36a)
Type	Projectile	2 (p. 8-34), 3 (p. 4-158), 4 (p. A-10)
Size	155-mm	2 (p. 8-34), 4 (p. 1-7, A-10), 5 (p. 5-14)
Service	Army, Marine Corps, Navy	3 (p. 4-158), 5 (p. 5-14), 6 (p. 4-157)
Diameter	6.1 in. (15.5 cm)	2 (p. 8-35), 3 (p. 4-159), 5 (p. 5-14), 6 (p. 4-158)
Length	Fuzed: 27.5 in. (69.9 cm) Unfuzed: 26.7 in. (67.8 cm)	2 (p. 8-35), 3 (p. 4-159), 4 (p. A-10), 5 (p. 5-14), 6 (p. 4-158)
Width	Rotating band: 2 in. (5.08 cm)	2 (p. 8-34), 5 (p. 5-14), 6 (p. 4-157)
Construction Material	Forged steel	2 (p. 8-34), 7 (p. 29.1)
Propellant	Charge: M19 M6 Propellant: 31.6 lbs. (14.3 kg)	2 (p. 8-35), 5 (p. 5-14), 7 (p. 29.1)
Maximum Range	25,678-25,715 yards (23,480-23,514 meters)	2 (p. 8-35), 5 (p. 5-14), 6 (p. 4-185), 7 (p. 29.1)
Drawing	75-14-704, 9241805	2 (p. 8-34), 5 (p. 4-159), 6 (p. 4-158), 7 (p. 29)
Specification	MIL-S-12846	7 (p. 29)
NSN	1320-00-592-9034	2 (p. 8-34)

Projectile, 155-mm, Gun, M122 (T179)

General Use and Description

The M122 was designed to provide toxic chemical offensive capability using GB (2 p. 8-34), (3 p. 4-158), (5 p. 5-14), (6 p. 4-157).

The M122 consists of forged steel body containing a filler of GB and a burster charge of 4.7 pounds of HE. The burster charge is contained in an aluminum burster tube that extends the full length of the projectile cavity. The burster tube is supported at the forward end by an adapter which holds the point detonating fuze. A two-inch wide rotating band encircles the projectile body near the base and is protected by a grommet which is removed before loading the projectile in the weapon.

The T179 is the same as the shell, chemical, 155-mm, T77 except for the size of the rotating band (2 p. 8-34), (3 p. 4-158), (5 p. 5-14), (6 p. 4-157), (8 p. 91).

Explosive Train

Upon impact, the point detonating fuze detonates the burster which ruptures the projectile case and heats the chemical agent fill so that dispersal is in the gaseous state (2 p. 8-34), (3 p. 4-158), (5 p. 5-14), (6 p. 4-157).

Fuzing

Projectile, 155-mm, Gun, M122 (T179) - Fuzing		
Fuze	**Notes**	**Citation**
M508	Point detonating	2 (p. 8-35), 3 (p. 4-159), 5 (p. 5-14), 6 (p. 4-158)
M557	Point detonating	7 (p. 29.1)
M728	Variable time	7 (p. 29.1)
M739	Point detonating	7 (p. 29.1)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, Gun, M122 (T179) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M16 Burster	4.7 lbs. (2.13 kg)	N/A	Used with M37 burster charge	2 (p. 8-34, 8-35)
M17 (T32) Burster casing	N/A	N/A	-	8 (p. 94)
M37 Burster	2.75 lbs. (1.25 kg)	Tetrytol	Supplemental charge: 0.3-lb. (0.14 kg) TNT	4 (p. A-10), 7 (p. 29)

Fills

Projectile, 155-mm, Gun, M122 (T179) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	6.50	2.94	97.7-100	44.3-45.4	-	2 (p. 8-34), 3 (p. 4-159), 4 (p. A-10), 5 (p. 5-14), 6 (p. 4-158)

Shipping/Packing

The projectile is packed eight per pallet. The filled pallet weighs approximately 804 pounds (2 p. 8-34), (4 p. A-10).

Miscellaneous Information

The M122 projectile was used with M2, M2A1 and M46 (T80) 155-mm gun (5 p. 5-14).

Projectile, 155-mm, Gun, M122 (T179)

Key Dates

Projectile, 155-mm, Gun, M122 (T179) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1951	OCM 33567 (T179, Initiation of Development)	-
Standardized	1954	CCTC 2934 (GB-fill Standard)	8 (p. 97)

Sources

1. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.
2. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
3. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
4. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.
5. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
6. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
7. Army Materiel Command. 1985. Army Materiel Command Pamphlet, AMC-P 700-3-3, Logistics, Complete Round Charts, Artillery Ammunition. U.S. Army.
8. Chemical Corps Technical Committee. 1954. CCTC Item # 2934, Shell, Chem, 155-mm, M122; Casing, Burster, M17 (T32) – Classified as Standard. U.S. Army.

14.20 Projectile, 155-mm, M687

Figures

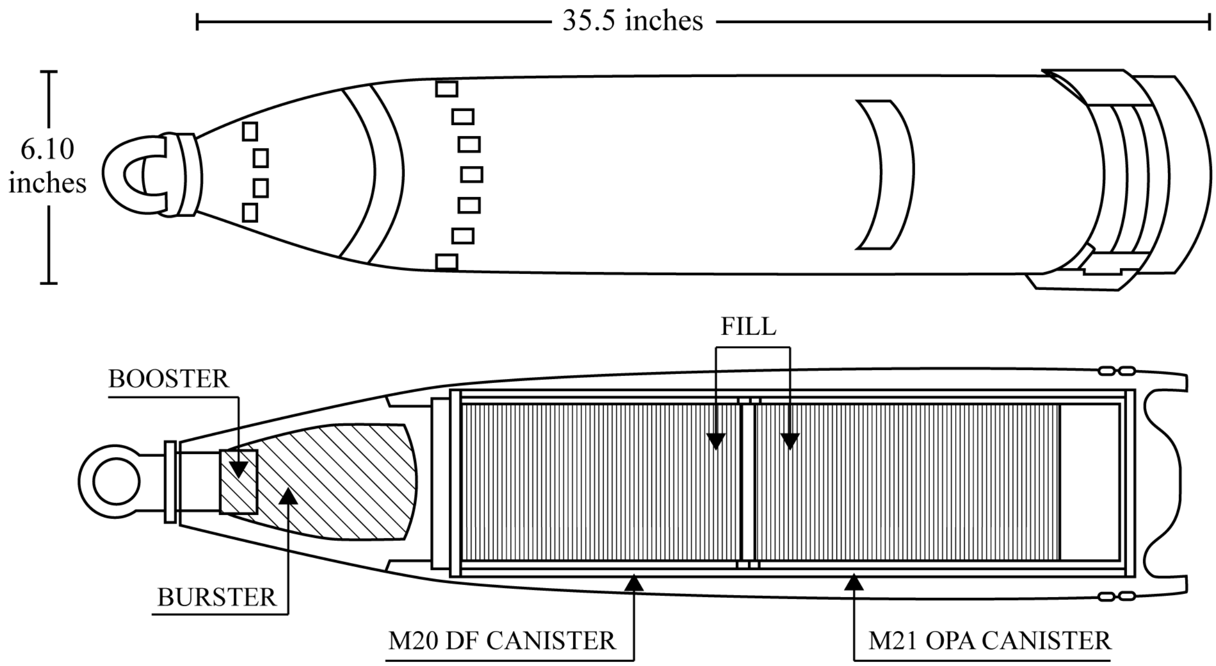

Figure 211: Projectile, 155-mm, M687 - Line Drawing

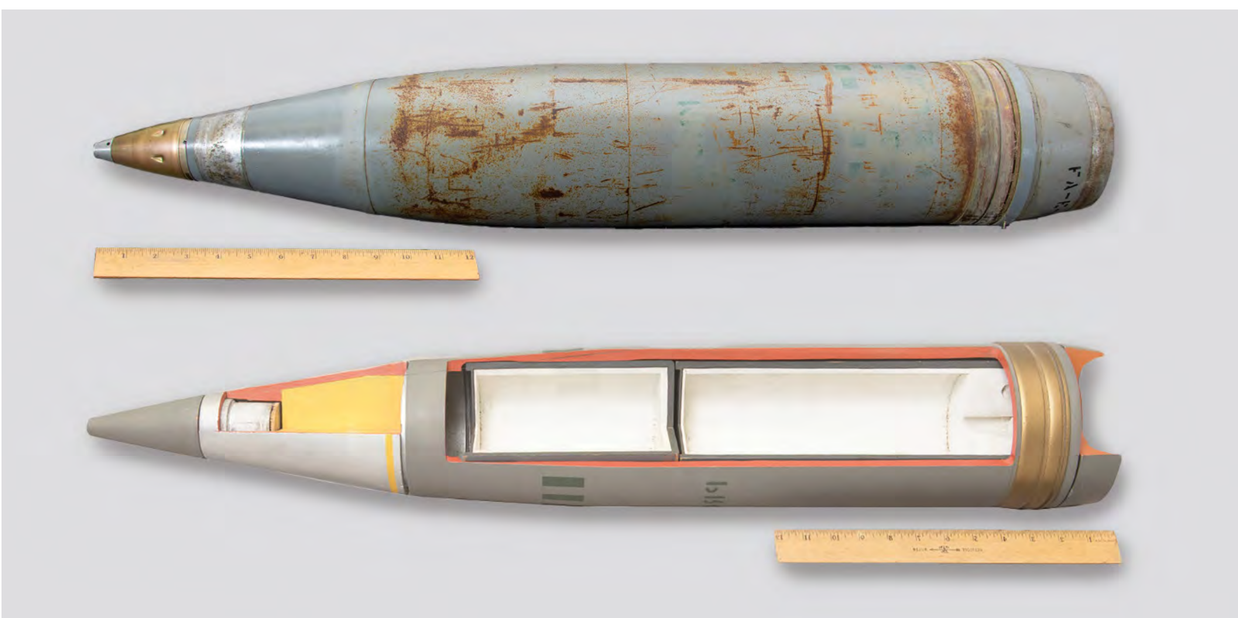

Figure 212: Projectile, 155-mm, M687 - Photograph - Top: Intact, Bottom: Model, Cutaway

Projectile, 155-mm, M687

Specifications

Projectile, 155-mm, M687 - Specifications and Other Data		**Citation**
Historical Name	Projectile, 155mm, Gas, GB2, Binary, M687	1 (p. 8-37)
Developmental Information	XM687E1	5 (p. 133)
Type	Projectile	1 (p. 8-37), 2 (p. 3-125)
Size	155-mm	1 (p. 8-37), 2 (p. 3-125)
Conflict	Cold War	7 (p. 129)
Service	Army, Navy	2 (p. 3-125)
Diameter	M687: 6.1 in. (15.5 cm) M20/M21 canisters: 5.0 in. (12.7 cm)	1 (p. 18-38), 2 (p. 3-125), 3 (p. 2-10.2), 4 (p. 1-9)
Length	Projectile, Unfuzed: 35.5 in. (90.2 cm) Projectile, Fuzed: 37.0 in. (93.98 cm) M20 DF canister: 7.82 in. (19.87 cm) M21 OPA canister: 13.87 in. (35.23 cm)	1 (p. 8-38), 2 (p. 3-125), 3 (p. 2-10.2), 4 (p. 1-9)
Construction Material	Steel	1 (p. 8-37), 2 (p. 3-125)
Propellant	Propelling charges: M3 Series, M4 Series, M119 Series, M203 Series	2 (p. 3-126), 5 (p. 133)
Drawing	M687: E15-12-330 M20 Canister: D15-12-61 M21 Canister D15-12-62	2 (p. 3-126)
NSN	1320-00-431-6249 D594	3 (p. 2-10.2), 4 (p. 1-9)

General Use and Description

The M687 Binary 155 mm projectile was intended to provide a lethal agent retaliatory capability commensurate with existing system that would not present a lethal agent hazard during storage and handling (1 p. 8-37), (3 p. 2-10.1), (4 p. 1-1).

The M687 projectile consisted of a modified M485A1 steel projectile body with two separate canisters containing two relatively non-toxic chemicals, an aluminum closed bottom ogive, and a domed steel base. The two canisters combine during functioning to produce the lethal agent GB2 for release on target. The closed bottom ogive contained the explosive burster (Composition B/Oxamide), the projectile body was internally keyed to prevent relative spin of the canister during launch and flight. The improved domed steel base allowed firing with the M203/M203A1 propelling charge in the M198 howitzer (1 p. 8-37), (2 p. 3-125), (3 p. 2-10.1), (4 p. 1-1).

The M121 would be prepared for firing at a chemical ammunition supply point. During preparation, a cover was removed from the broken green band marking and the second canister necessary for creation of the GB2 in flight was installed (2 p. 3-125).

Explosive Train

When the weapon was fired, the burning propellant charge generated rapidly expanding gases to propel the projectile through the barrel with the velocity required to reach to target. Setback forces ruptured the adjacent rupture disks, which allowed the methylphosphonic difluoride (DF) in the M20 canister and an isopropyl alcohol and isopropylamine solution (OPA) in the M21 canister to combine. The in-flight spin aided in the mixing of DF and OPA; the chemical reaction from the two chemicals would produce the lethal agent GB2. The fuze used would start the chain reaction of exploding the M687 projectile, which would then release the lethal agent into the atmosphere (1 p. 8-37), (2 p. 3-125), (3 p. 2-10.1), (4 p. 1-1).

Projectile, 155-mm, M687

Fuzing

Projectile, 155-mm, M687 - Fuzing		
Fuze	**Notes**	**Citation**
M557	Point detonating	1 (p. 8-38), 2 (p. 3-126, B-4), 3 (p. 2-10.1), 4 (p. 1-1), 5 (p. 133)
M572	Point detonating	2 (p. B-4)
M739	Point detonating	2 (p. 3-126, B-4), 3 (p. 2-10.1), 4 (p. 1-1)
M739A1	Point detonating	2 (p. 3-126), 3 (p. 2-10.1)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, M687 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M57 Burster	N/A	Composition B/oxamide	Weight range 2.20-2.27 lbs. (0.99-1.03 kg)	1 (p. 8-38), 2 (p. 3-125), 3 (p. 2-10.2)

Fills

Projectile, 155-mm, M687 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	24.2-24.6	10.9-11.1	93.0	42.2	Agent GB2 (binary sarin). Forward container held 10.1 lbs. (4.58 kg) of DF. Rear container held 14.5 lbs. (6.58 kg) of OPA.	1 (p. 8-38), 2 (p. 3-125), 3 (p. 2-10.2), 4 (p. 1-9)

Shipping/Packing

For safety reasons, the M687 projectiles were shipped and stored with only the aft M21 OPA canister in place and a forward and aft spacer filling the cavity provided for the M20 DF canister. The M20 DF canisters were individually packed in a fiberboard container with eight canisters in packed in a separate wooden shipping and storage container.

Eight projectiles were packed and stored horizontally on a pallet. Loaded pallets were 784 pounds and were packed per 36 x 32 x 25 inches (2 p. 3-126), (4 p. 1-1).

Miscellaneous Information

The M687 projectile was delivered by an M185 cannon on the M109A2 and M109A3 howitzer; the M199 cannon on the M198 howitzer; or the M1A2 cannon on the M114A2 howitzer (2 p. 3-126), (3 p. 2-10.1), (4 p. 1-1).

Key Dates

Projectile, 155-mm, M687 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1977	MSR 01776009 (Standard)	5 (p. 129)

Sources

1. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
2. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. U.S. Government Printing Office.

3. Department of the Army. 1982. Technical Manual, TM 43-0001-26-2, Army Equipment Data Sheets, Chemical Weapons and Munitions. U.S. Government Printing Office.

4. Headquarters, Department of the Army. 1989. Technical Manual, TM 3-1320-242-10, Operators Manual Projectile, 155-millimeter: GB2, M687 NSN 1320-00-431-6249. Department of the Army.

5. U.S. Army Armament Command. 1977. 1977, Materiel Status Record Submission 01776009, Projectile, 155mm, Lethal Binary, GB2, XM687.

14.21 Projectile, 155-mm, T6, T6E1

Figures

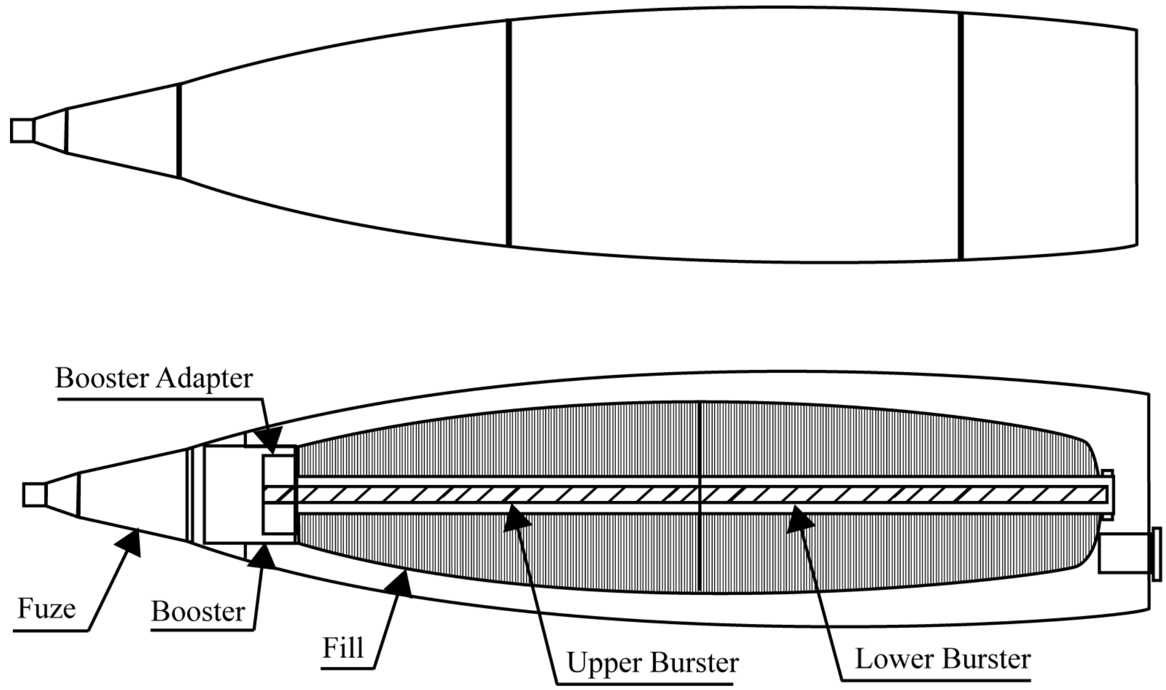

Figure 213: Projectile, 155-mm, T6, T6E1 – Line Drawing

Specifications

Projectile, 155-mm, T6, T6E1 – Specifications and Other Data		Citation
Historical Name	155-mm Chemical Shell T6, T6E1	1 (p. 6), 2 (p. 2), 3 (p. 1), 4 (p. 1)
Type	Projectile, Howitzer	1 (p. 6), 2 (p. 2), 4 (p. 1)
Size	155-mm	1 (p. 6), 2 (p. 2), 3 (p. 1), 4 (p. 1)
Diameter	6.1 in. (15.5 cm)	1 (p. 6), 2 (p. 2), 3 (p. 1), 4 (p. 1)
Other Engineering Data	Weight, Empty: 78.9-80.6 lbs. (35.85-36.6 kg)	2 (p. 3)
Drawing	P-20846, C15-2-6	1, 2 (p. 2)

General Use and Description

To test a 155-mm chemical shell suitable for nonpersistent agent, the MKII was initially used but it was determined that it was necessary to have a bursting charge extend the full length of the shell to fragment it properly. A modified the standard 155-mm howitzer chemical shell MKII, and a redesign of the burster and components became the 155-mm. Chemical Shell T6 (2 p. 1, 2).

Explosive Train

Available references did not provide this information.

Fuzing

Projectile, 155-mm, T6, T6E1 – Fuzing		
Fuze	**Notes**	**Citation**
M39A2	Point detonating (T6)	1 (p. 7)
MK III	Point detonating	2 (p. 3)
T18	Point detonating (T6E1)	3 (p. 1), 4 (photo 8081)

Projectile, 155-mm, T6, T6E1 – Fuzing		
Fuze	**Notes**	**Citation**
T18E2	Point detonating (T6E1)	3 (p. 1)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, T6, T6E1 – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M20E1 booster (modified)	N/A	N/A	T6; used with M39A2 fuze	1 (p. 7)
M21 booster	N/A	N/A	T6E1	4 (photo 8081)
MK III booster	N/A	Tetryl	–	2 (p. 3)
MK VI-B adapter and booster	N/A	N/A	–	2 (p. 3)
T10 booster	N/A	N/A	T6E1	3 (p. 1)
T12 burster casing	N/A	N/A	T6E1	3 (p. 1)
T2 burster charge	N/A	N/A	T6E1	3 (p. 1)
T9 burster	0.30 lbs. (0.135 kg)	Tetryl	48 grams upper 98 grams lower	1 (p. 6, 7, 166), 2 (p. 2)
Burster- not designated	0.43 lbs. (0.195 kg)	Tetryl	T6E1	4 (p. 1)

Fills

Projectile, 155-mm, T6, T6E1 – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	5.5	2.49	N/A	N/A	–	1 (p. 6)
CG	11	4.99	N/A	N/A	Experimental	1 (p. 7)
FS	N/A	N/A	N/A	N/A	–	3 (p. 1)
HS simulated	9.37-9.88	4.25-4.48	88.9-89.9	40.3-40.8	–	2 (p. 2, 3), 3 (p. 1), 4 (p. 2)
WP	13.9-15.0	6.30-6.82	93.9-95	42.6-43.1	–	2 (p. 2, 3), 3 (p. 1), 4 (p. 2)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not provide this information.

Sources

1. White, S.A. Lt. Colonel. 1939. Edgewood Arsenal Technical Report, EATR 299, Hydrocyanic Acid. Field Tests (Static and Artillery Fire) of HCN in 155-mm Shell. Chemical Warfare Service.
2. Woodberry, D.L. 1939. Technical Division Memorandum Report, TDRM 176, Chemical Filling for Artillery Shell, Static Tests of 155-mm (How.) Chemical Shell MK. II, Filled with Simulated HS and WP, and Equipped with Special Bursters Developed by the Ordnance Department, July 12, 1939. Chemical Warfare Service Technical Command.
3. Avery, R.L. Colonel. 1939. Memorandum to Chief, Chemical Warfare Service. Subject: 155-mm Chemical Shell T6E1 (Project B2). August 15. Chemical Warfare Service, Edgewood Arsenal.
4. Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 215, Chemical Fillings for Artillery Shell Static Tests of 155-mm. (How.) Chemical Shell T6E1, Filled with WP and Simulated HS, February 7, 1940. February. Chemical Warfare Service Technical Command.

14.22 Projectile, 155-mm, Howitzer, T387

Figures

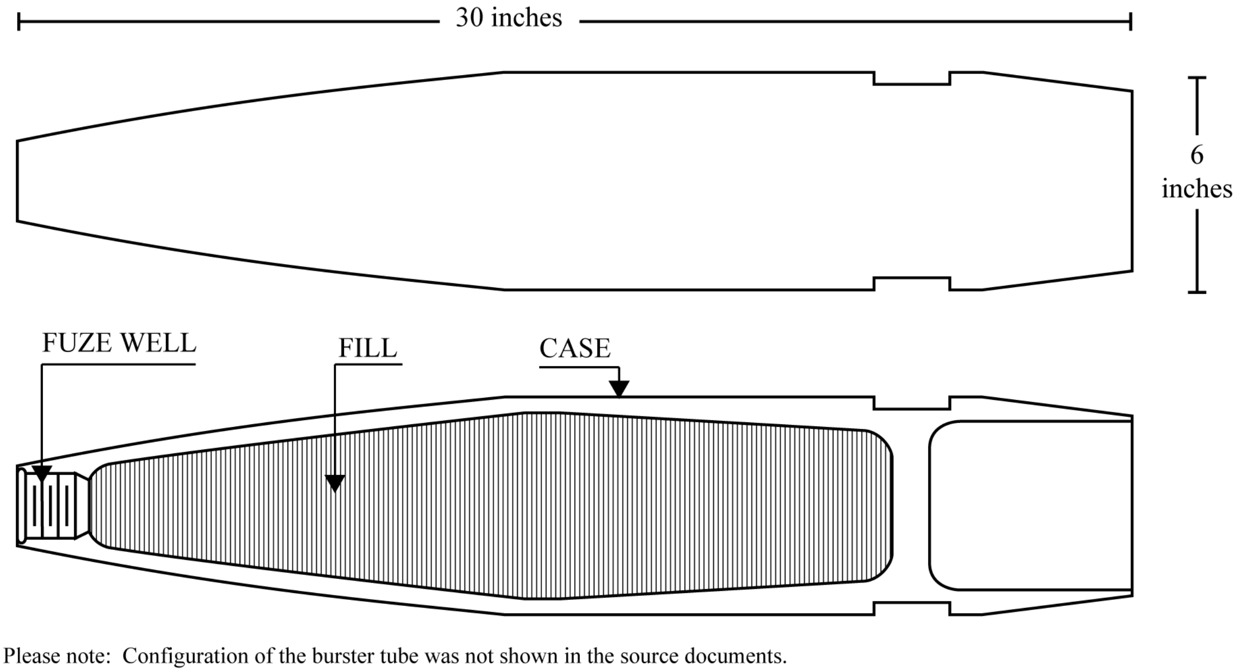

Figure 214: Projectile, 155-mm, Howitzer, T387 - Line Drawing (Note: unfuzed)

Specifications

Projectile, 155-mm, Howitzer, T387 - Specifications and Other Data		Citation
Historical Name	Projectile, Howitzer, Gas, Persistent, VX, 155mm, T387	1 (p. 4-160)
Type	Projectile	2 (p. 4-159)
Size	155-mm	2 (p. 4-159)
Service	Navy	2
Diameter	6.1 in. (15.5 cm)	1 (p. 4-161), 2 (p. 4-160)
Length	Projectile, fuzed: 30.04 in. (76 cm)	1 (p. 4-161), 2 (p. 4-160)
Other Engineering Data	Primer T106 was used and was to be replaced by XM82	1 (p. 4-161), 2 (p. 4-160)
Propellant	T34: 15 lbs. (6.08 kg)	1 (p. 4-161), 2 (p. 4-160)
Maximum Range	2,642-20,013 yards (2,416-18,300 meters)	1 (p. 4-161), 2 (p. 4-160)
Drawing	FD 21551	1 (p. 4-161), 2 (p. 4-160)

General Use and Description

The T387 projectile was designed to provide a long range toxic chemical offensive capability (1 p. 4-160), (2 p. 4-159).

This was a thin-walled, extended range, projectile that held approximately 50% more agent than the M121. It was a separate loaded, central burst round filled with VX for antipersonnel effects. It was similar to the HE round except for the filling and the burster. The burster charge, contained in a thin metal tube, was held in place in the burster casing by a fuze well cup.

The forward end of the burster casing was assembled to the adapter in the nose of the round and extended the full length of the cavity. The adapter was thin-walled steel with a nose formed to a long ogive. A single rotating band was located near the base of the projectile.

The T387 was used with the M1, M1A1 and M45 howitzers 155-mm (1 p. 4-159, 4-160), (2 p. 4-159).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Projectile, 155-mm, Howitzer, T387 - Fuzing		
Fuze	**Notes**	**Citation**
M513	Variable time	1 (p. 4-161), 2 (p. 4-160)
M514	Point detonating	1 (p. 4-161), 2 (p. 4-159, 4-160)

Booster, Adapter-Booster, or Burster

Projectile, 155-mm, Howitzer, T387 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	1.25 lbs. (0.57 kg)	HE	-	1 (p. 4-161), 2 (p. 4-160)

Fills

Projectile, 155-mm, Howitzer, T387 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
VX	9.50	4.30	95.0	43.0	-	1 (p. 4-160), 2 (p. 4-159)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Miscellaneous

The expectation was that the T387 would be replaced by the XM82 (1 p. 4-161).

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

14.23 Projectile, 175-mm, Gun, T223

Figures

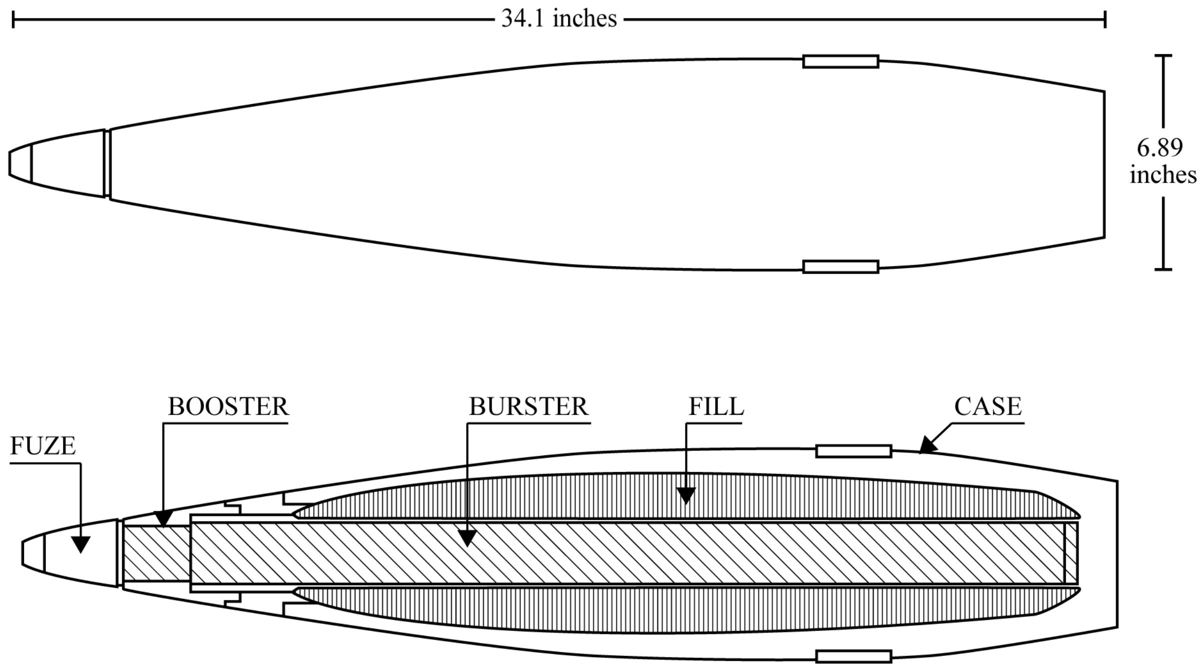

Figure 215: Projectile, 175-mm, Gun, T223 - Line Drawing

Specifications

Projectile, 175-mm, Gun, T223 - Specifications and Other Data		Citation
Historical Name	Projectile, 175mm, Gun (GB) T223	1 (p. 4-163)
Type	Projectile	2 (p. 4-164)
Size	175-mm	1 (p. 4-163), 2 (p. 4-164)
Service	Navy	1 (p. 4-163)
Diameter	6.89 in. (17.5 cm)	1 (p. 4-164), 2 (p. 4-165)
Length	34.1 in. (86.7 cm)	1 (p. 4-164), 2 (p. 4-165)
Other Engineering Data	Used with 175-mm gun T145 or T256. The T223 was not standardized.	1 (p. 4-164), 2 (p. 4-165)
Maximum Range	31,500-35,000 yards (28,803-32,400 meters)	1 (p. 4-164), 3 (p. 16)

General Use and Description

The T223 was designed to provide a toxic chemical offensive capability for an antipersonnel effect (1 p. 4-163), (2 p. 4-164).

The T223 was a separate loaded, central burst munition that was used for antipersonnel effects. A single rotating band was located near the base of the projectile. The base was boat-tailed. An adapter at the forward end of the projectile held the point detonating fuze and supported the burster tube, which extended the full length of the cavity (1 p. 4-163), (2 p. 4-165).

Explosive Train

Available references did not provide specific information on explosive train.

Projectile, 175-mm, Gun, T223

Fuzing

Projectile, 175-mm, Gun, T223 - Fuzing		
Fuze	**Notes**	**Citation**
Not designated	Point detonating	1 (p. 4-163), 2 (p. 4-164)
M514A1	Proximity	3 (p. 16-17)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Projectile, 175-mm, Gun, T223 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	14.6-14.7	6.66-6.68	146-147	66.6-66.8	-	1 (p. 4-164), 2 (p. 4-164), 3 (p. 16-17)
VX	13.3	6.04	147	66.8	-	3 (p. 16-17)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The T223 was a non-standard item that was undergoing engineering tests in the 1960s (1 p. 4-163), (2 p. 4-164).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

3. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

14.24 Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III

Figures

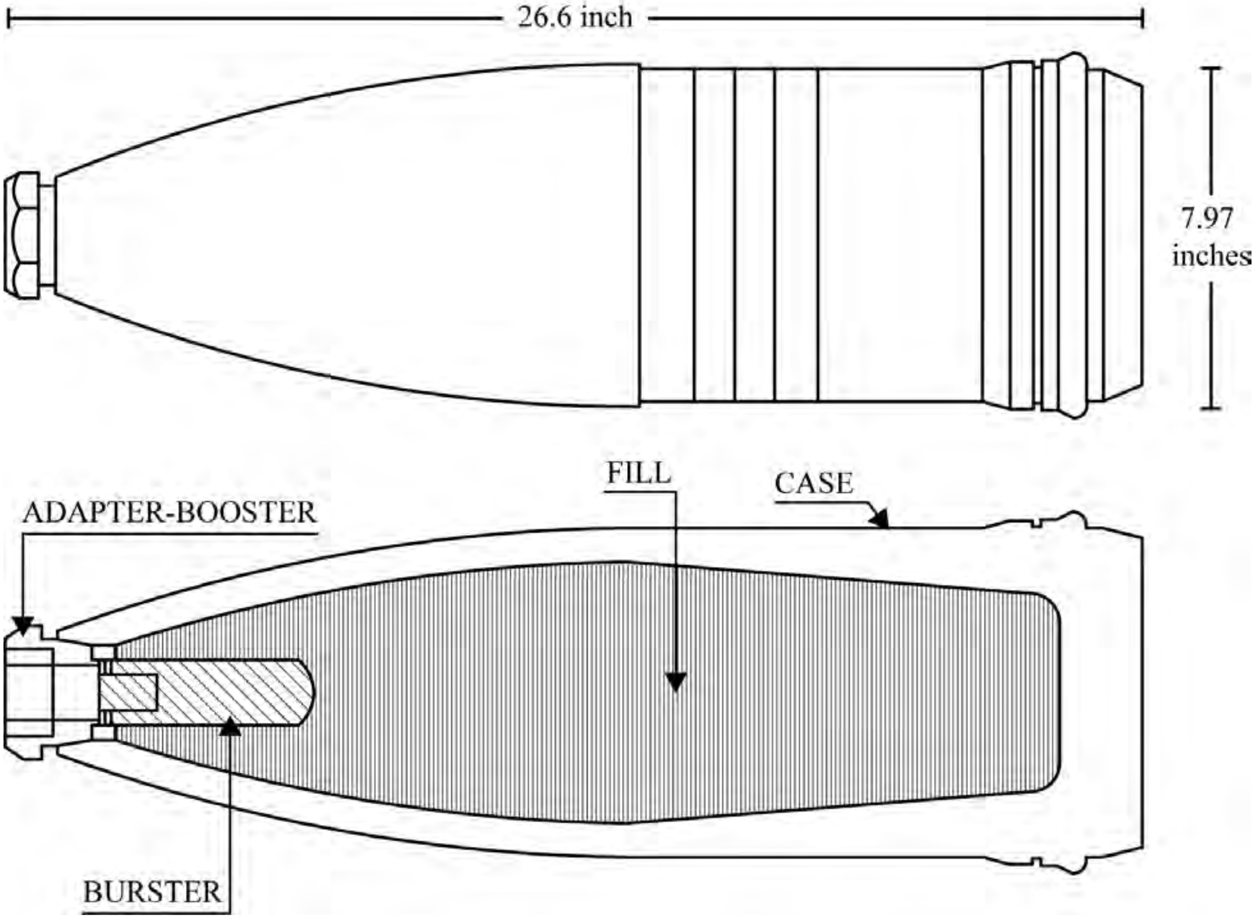

Figure 216: Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III - Line Drawing

Figure 217: Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III - Photograph

Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III

Specifications

Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III - Specifications and Other Data		Citation
Historical Name	8-Inch, Common Steel Shell, MK III (gas)	1 (p. 60), 2 (Table 16)
Type	Projectile	1 (p. 60)
Size	8-inch	1 (p. 60)
Conflict	WWI	1
Diameter	7.97 in. (20.3 cm)	1 (p. 61)
Length	Unfuzed: 26.6 in. (67.5 cm)	1 (p. 61), 2 (Table 16)
Other Engineering Data	Weight, Empty: 169.75 lbs. (76.99 kg)	1
Construction Material	Semi-steel, steel	1 (p. 60)
Drawing	75-4-32	3 (p. 10)

General Use and Description

The main objective of the MK III was to produce a cloud of the highest possible initial concentration of chemical agent, which would drift downwind and completely envelop the position attacked (1 p. 12-16).

The MK III, 8-inch gas shell consisted of the projectile body that contained the chemical agent, the gaine tube (adapter and booster casing), which screwed into the nose of the shell and contained the bursting charge. The bursting charge consisted of a small quantity of HE sufficient to open the shell, and, in some cases, to atomize the liquid contents.

An 8-inch semi-steel shell was also developed, which differed from the steel shell only in reduced internal capacity (1 p. 60).

Explosive Train

Upon impact, the point detonating fuze functioned. The fuze detonated the burster, which would split the shell and spread the chemical agent fill (1).

Fuzing

Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III - Fuzing		
Fuze	**Notes**	**Citation**
French I.A. Model 1915	Point detonating, superquick	1 (p. 34, 60)
French I.A.L. Model 1916	Point detonating, superquick	1 (p. 34, 60)
French R.Y. Model 1917	Point detonating, superquick; only to be used if other fuzes were unavailable	1 (p. 38, 60)
Modified British No. 106	Point detonating, superquick	1 (p. 42, 60)
U.S. MK III	Point detonating, superquick	1 (p. 34, 60), 2 (p. 138)

Booster, Adapter-Booster, or Burster

Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
MK VIIB	N/A	N/A	Adapter-booster.	3 (p. 10)

Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III

Fills

Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	32.6-32.8	14.7-14.8	202	91.6	Without fuze	1 (p. 24, 60), 4 (p. 6)
CA	24.2	10.9	193	87.5	Without fuze	1 (p. 24, 60)
CG	22.0-23.6	9.97-10.7	191	86.6	Without fuze	1 (p. 24, 60), 4 (p. 4), 5 (p. 75)
FM	28.4-29.1	12.8-13.1	198	89.8	Without fuze	1 (p. 24, 60), 4
HS	21.6-22.4	9.79-10.1	191	86.6	Without fuze	1 (p. 24, 60), 5 (p. 75)
NC	28.9-30.3	13.1-13.7	198	89.8	Without fuze	1 (p. 24, 60), 4 (p. 3), 5 (p. 75)
PS	27.2	12.3	196	88.9	Without fuze	1 (p. 24, 60)
WP	31.5	14.2	201	91.1	Without fuze	1 (p. 24, 60)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

Only the HS and FM fillings were to be used in the gun; all other fillings were to be used in the howitzer (1 p. 60).

Key Dates

Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1923	OCM 3344 (Howitzer)	3 (p. 10)

Sources

1. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.
2. Office, Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. November. Government Printing Office.
3. Ordnance Committee. 1923. Ordnance Committee Meeting, OCM Item # 3344, Standardization of Chemical Shell and Boosters. November 1.
4. War Department 1918. Office of Chief of Ordnance, Trench Warfare Section, Memorandum to Colonel Walker, Subject Munitions to be Filled and Approximate Fill Weight. March 9.
5. Edgewood Arsenal 1919. An Historical Sketch of Edgewood Arsenal. March 1.

14.25 Projectile, 8-inch, Howitzer, M426 (T174 Series)

Figures

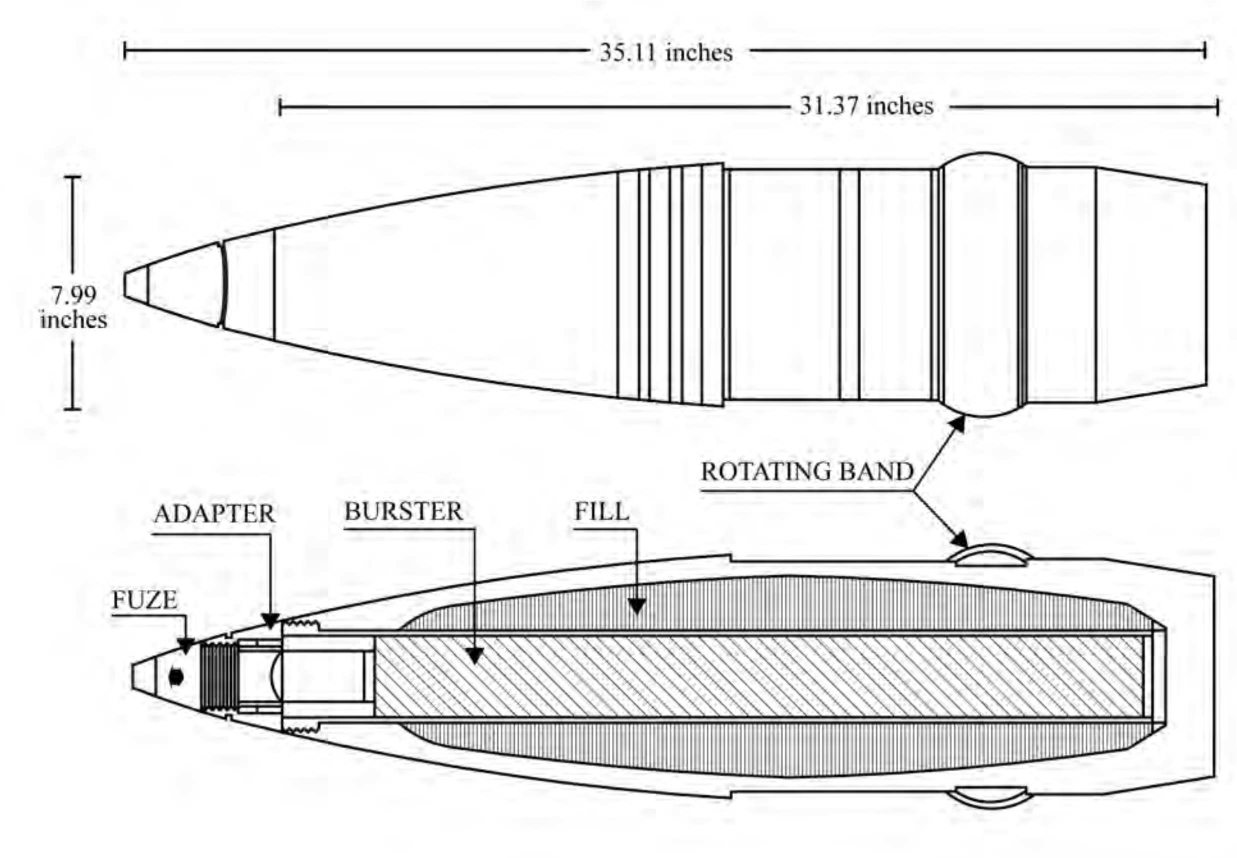

Figure 218: Projectile, 8-inch, Howitzer, M426 - Line Drawing

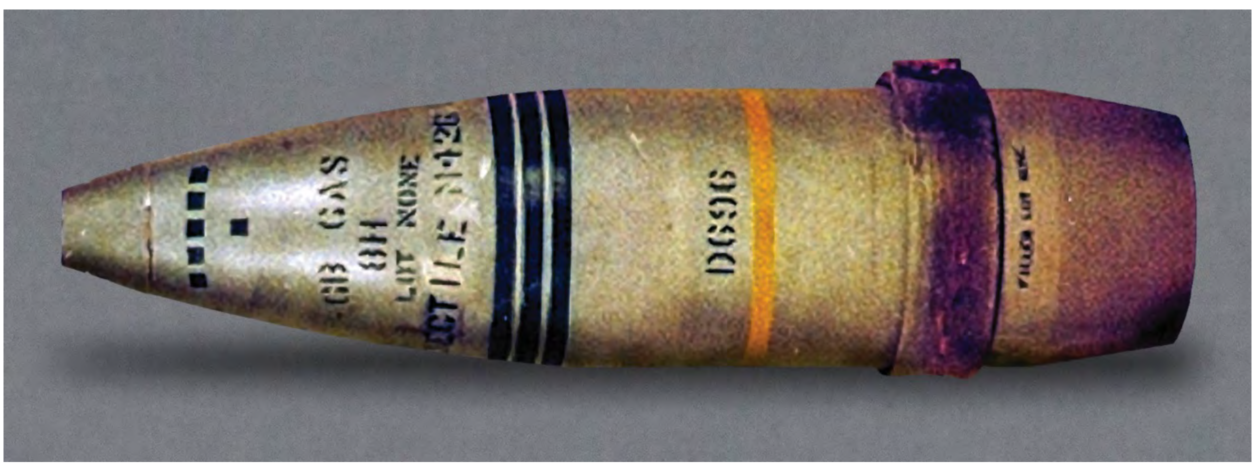

Figure 219: Projectile, 8-inch, Howitzer, M426 – Photograph

Projectile, 8-inch, Howitzer, M426 (T174 series)

Specifications

Projectile, 8-inch, Howitzer, M426 (T174 series) - Specifications and Other Data		**Citation**
Historical Name	Projectile, 8-Inch: Agent, GB (non-persistent) and VX (persistent), M426	1 (p. 3-179)
Developmental Information	T174	2 (p. 4-165), 5 (p. 4-167)
Type	Projectile	2 (p. 4-165), 3 (p. 5-16)
Size	8-inch	3 (p. 5-16)
Conflict	Cold War	4 (p. 29)
Service	Army, Marine Corps	3 (p. 5-19), 5 (p. 4-166, 4-168), 6 (p. 16)
Diameter	7.99 in. (20.29 cm)	1 (p. 3-179), 3 (p. 5-16, 5-18), 5 (p. 4-167, 4-169), 7 (p. 8-41)
Length	Projectile, fuzed: 35.11 in. (89.18 cm) Projectile, unfuzed: 31.37 in. (79.68 cm)	1 (p. 3-179, 3-180), 3 (p. 5-16, 5-18), 5 (p. 4-167, 4-169), 7 (p. 8-41)
Construction Material	Projectile: Forged Steel Rotating band: Gilding metal	1 (p. 3-180), 7 (p. 8-40)
Propellant	M1: 13.3 lbs. (6.03 kg) M2: 28.3 lbs. (10.80 kg)	1 (p. 3-180), 3 (p. 5-16, 5-18), 5 (p. 4-167)
Maximum Range	18,482 yards (16,900-16,916 meters)	2 (p. 4-166), 3 (p. 5-16, 5-18), 7 (p. 8-40, 8-44)
Drawing	GB: 8860620-1 VX: 8860620-2	1 (p. 3-179), 7 (p. 8-40, 8-43)
NSN	GB: 1320-00-892-4305, 1320-00-763-6879 VX: 1320-00-892-4306, 1320-00-892-4306	7 (p. 8-40, 8-43), 8 (p. 33, 34)

General Use and Description

The M426 was developed to provide a toxic agent-filled round designed for the 8-Inch howitzer, which would match the standard HE, M106 shell. The M426 projectile was used in 8-inch howitzers to deliver and disperse casualty producing agents. When filled with VX agent, the projectile was also designed to contaminate habitable areas and thus deny such areas to the enemy (1 p. 3-179), (2 p. 4-165, 4-166), (3 p. 5-16, 5-18), (5 p. 4-166, 4-167), (7 p. 8-40, 8-43).

The T174 was a one-piece separate loaded central burst gas round for GB or VX agent. It was similar to the M106 HE round in external configuration but had a burster tube, burster charge, and a supplemental charge. The burster tube extended the full length of the cavity and was press fit. A single rotating band was located about 6.06 inches from the base and had two cannelures or grooves.

The T174 and T174E1 projectiles were identical from a ballistic point of view, but the T174 had a brazed-on nosepiece whereas the T174E1 was of one-piece construction. The T174E1 design differed from the T174E2 projectile only in that an “O” ring was added at the joint between the fuze adapter and projectile body in the T174E2 projectile. The T174E2 became the M426.

The M426 projectile was ballistically similar to the standard HE projectile M106. A tubular burster casing that contained a Composition B burster, occupied the center of the projectile and sealed in the fill. The remainder of the interior space was filled with liquefied GB nonpersistent, or VX persistent agent. A threaded steel adapter provided a receptacle for a point detonating or proximity fuze (1 p. 3-179, 3-180), (3 p. 5-16, 5-18, 5-19), (4), (5 p. 4-166 - 4-169), (7 p. 8-40, 8-43).

Explosive Train

A point detonating or proximity fuze was located on the forward end, which on functioning initiated the burster charge to explode the projectile and release the filling agent.

When a point detonating fuze was employed, impact caused the fuze to detonate the supplementary charge and the supplementary charge detonated the burster tube. The burster ruptured the projectile case and released the fill. The liquefied agent expanded to a gaseous state by heating from the burster charge. If a proximity fuze was fitted, action on the burster tube was direct from the booster element of the fuze, and projectile rupture occurred on approach to the target (1 p. 3-179), (2 p. 4-167), (7 p. 8-40, 8-43).

Fuzing

Projectile, 8-inch, Howitzer, M426 (T174 series) - Fuzing		
Fuze	**Notes**	**Citation**
M508	Point detonating (GB-fill)	4 (p. 32)
M514 series	Proximity	7 (p. 8-41)
M514A1	Proximity (VX-fill)	4 (p. 32)
M51A5	Nose- point detonating	2 (p. 4-166, 4-168), 3 (p. 5-16, 5-18), 5 (p. 4-167, 4-169), 6 (p. 16)
M557	Point detonating	1 (p. 3-180), 7 (p. 8-41)
M728	Proximity	1 (p. 3-180), 7 (p. 8-41)
M739	Point detonating	1 (p. 3-180)
T2061	Variable time (VX-fill)	6 (p. 16)

Booster, Adapter-Booster, or Burster

Projectile, 8-inch, Howitzer, M426 (T174 series) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M83	6.95 lbs. (3.15 kg)	Composition B	Central bursting, supplemental charge 0.3-lb. (0.13 kg) TNT	2 (p. 4-166, 4-168), 3 (p. 5-16, 5-18), 9 (p. A-16)

Fills

Projectile, 8-inch, Howitzer, M426 (T174 series) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	14.5-15.9	6.57-7.21	200	90.7	-	1 (p. 3-179), 2 (p. 4-166), 3 (p. 5-16), 5 (p. 4-166), 7 (p. 8-41)
VX	14.1-14.5	6.39-6.57	200	90.7	-	1 (p. 3-179), 2 (p. 4-168), 3 (p. 5-18), 5 (p. 4-169), 7 (p. 8-44)

Shipping/Packing

For shipment and handling, an eyebolt lifting plug was installed in the fuze cavity of the adapter. A rotating band of gilding metal encircled the casing near the rear and was protected by a grommet. The projectile was packed six per pallet. The filled pallet weighed approximately 1,253 pounds (1 p. 3-180), (7 p. 8-40, 8-43), (9 p. A-16).

Miscellaneous Information

The M426 was used with M2 and M2A1 8-inch howitzers, as well as the M47 8-inch cannon (3 p. 5-16, 5-18), (5 p. 4-167, 4-169).

Projectile, 8-inch, Howitzer, M426 (T174 series)

Key Dates

Projectile, 8-inch, Howitzer, M426 (T174 series) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Developed	1958	CCTC 3434 (Initiate development of 8-inch VX-filled shell)	10
Military Characteristics	1958	CCTC 3464	11
Standardized	1961	CCTC 3911, OCM 37838 (GB and VX-fill, Standard-A)	4, 10

Sources

1. Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. U.S. Government Printing Office.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
3. U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.
4. Chemical Corps Technical Committee. 1961. CCTC Item # 3911, Classification of Projectile, 8-Inch, Gas Nonpersistent GB, M426 (T174E2) & Projectile, 8-Inch, Gas Persistent VX, M426 (T172E2) as Standard-A Types. Department of the Army.
5. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
6. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
7. Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. Naval Sea Systems Command.
8. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
9. Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. PEO-PM Cml Demil.
10. Chemical Corps Technical Committee. 1958. CCTC Item # 3434, Development of VX Chemical Shell. Department of the Army.
11. Chemical Corps Technical Committee. 1958. CCTC Item # 3464, Military Characteristics for V-Agent 155-mm Howitzer Shell, 8-inch Howitzer Shell, & 115-mm Rocket. Chemical Warfare Service.

14.26 Projectile, 8-inch, T19 Series

Figures

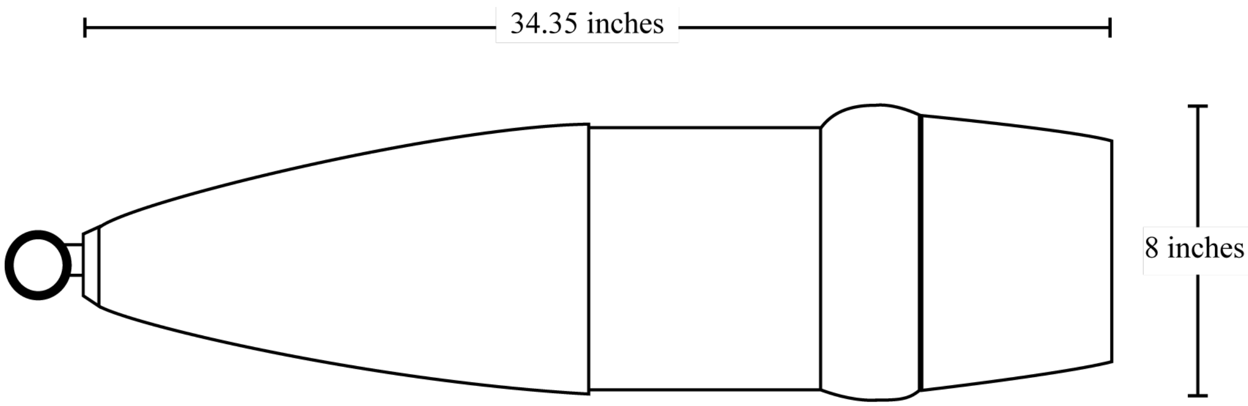

Figure 220: Projectile, 8-inch, T19 Series – Line Drawing

Specifications

Projectile, 8-inch, T19 Series – Specifications and Other Data		Citation
Historical Name	8-inch Howitzer Shell, T19 Series	1 (p. 1)
Type	Projectile	2 (p. 229), 3 (p. J2)
Size	8-inch	1 (p. 1, 7)
Conflict	Cold War	3 (p. J1, J4)
Service	Army	3 (p. J4)
Diameter	8.28 in. (21 cm)	4 (p. 3-132)
Length	34.35 in. (87.25 cm)	2 (p. 230), 4 (p. 3-132)
Construction Material	Steel	4 (p. 3-132)

General Use and Description

The T19 was developed to provide a persistent gas (e.g., HD) shell for use in the 8-inch howitzer as an interdiction weapon against small area targets such as bridges, road junctions, and caves or a localized deterrent to inflict casualties and delays. The standard M106 8-inch howitzer shell was used in development (3 p. J4, J5). The T19 series was fired from the M2 8-inch howitzer and was designed based on the M106 artillery shell (1 p. 9), 3 (p. J5), (5, p. iii, 1).

Explosive Train

Available references did not provide this information.

Fuzing

Projectile, 8-inch, T19 Series – Fuzing		
Fuze	**Notes**	**Citation**
M51A5	–	1 (p. 9)
M54	–	5 (p. 1)

Booster, Adapter-Booster, or Burster

Projectile, 8-inch, T19 Series – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Burster- not designated	0.50 lbs. (0.23 kg)	Tetrytol	–	5 (p. 8)

Projectile, 8-inch, T19 series

Fills

Projectile, 8-inch, T19 Series – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
HD	22.5-26.8	10.2-12.2	198	89.8	-	1 (p. 9), 3 (p. J1), 5 (p. iii, 8)
VX	N/A	N/A	N/A	N/A	Experimental	6
WP	N/A	N/A	N/A	N/A	-	5 (p. 1)

Shipping/Packing

Available references did not provide this information.

Key Dates

Projectile, 8-inch, T19 Series – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1944	OCM 23758, 23930 (Initiation of development project for T19 smoke)	-
Initiation	1953	CCTC Item 2741 (OCM 34933) HD filling	3 (p. J1)

Sources

1. Bode, Donald D. 1955. Dugway Proving Ground Report, DPGR 211, Dynamic Tests of the 8-inch Howitzer Shell, T19 Series, HD Filled, With 12 50 1 Agent-to-Burster Ratio, Part II. Dugway Proving Ground.
2. Department of the Army. 1950. Technical Manual, TM 9-1901, Artillery Ammunition. U.S. Government Printing Office.
3. Chemical Corps Technical Committee. 1955. CCTC Item # 3122, Establishment of Subproject 4-04-15-028-09, HD 8-inch Howitzer Shell. Department of the Army.
4. Department of the Army. 1979. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. April. U.S. Government Printing Office.
5. Pickett, Edward M. 1955. Special Report CRLR 577, A Series of Static Tests of Single 8-inch HD-Filled Artillery Shells with Agent/Burster Rations of 53.8/1 and 12/1. Chemical Corps Chemical and Radiological Laboratories.
6. Tidwell, J.S. LT Col. 1958. Memorandum From: Traffic Consultant OCCm10. To: Chief of Transport. Attention: Freight Movements Division. Subject: Request for Airlift. Date. 26 March 1958.

14.27 Projectile, 8-inch, XM736

Figures

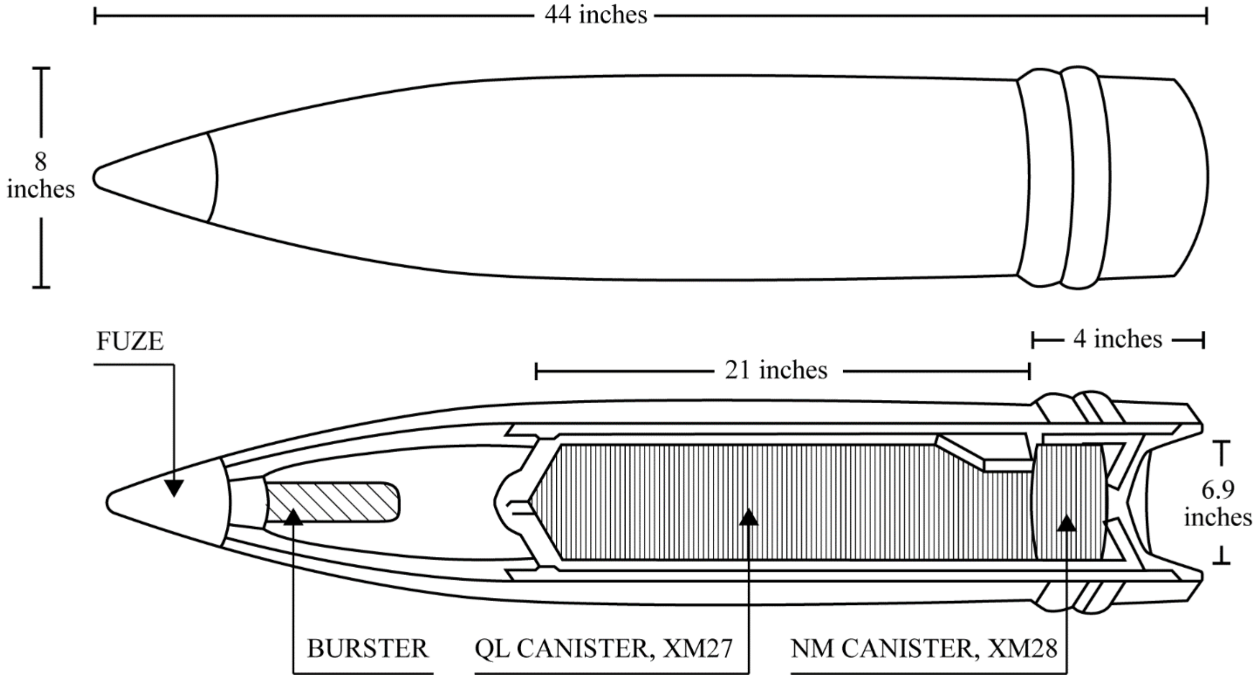

Figure 221: Projectile, 8-inch, XM736 - Line Drawing

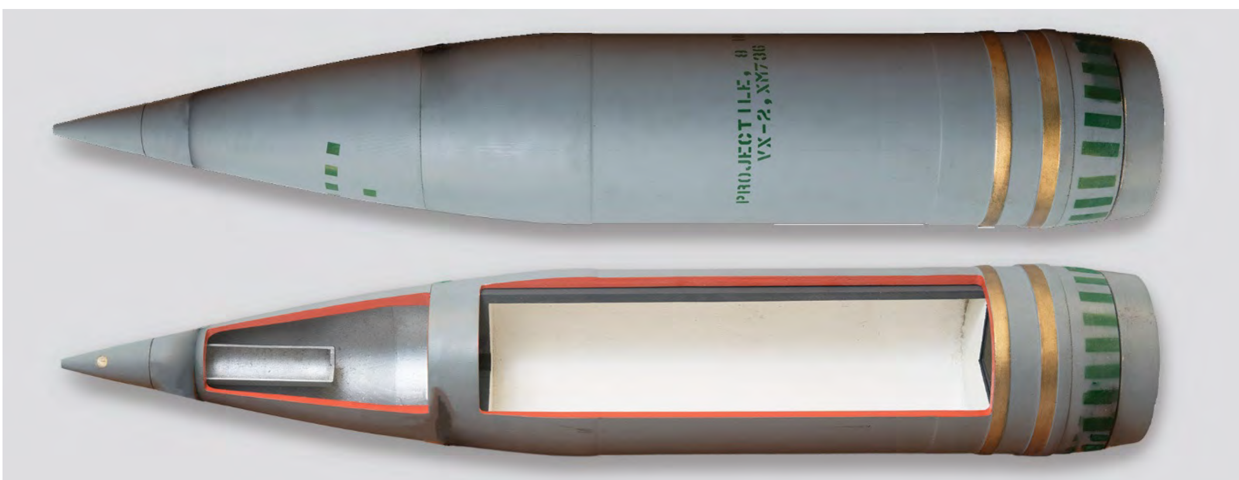

Figure 222: Projectile, 8-inch, XM736 - Photograph - Top: Model, Intact, Bottom: Model, Cutaway View

Specifications

Projectile, 8-inch, XM736 - Specifications and Other Data		**Citation**
Historical Name	Projectile, 8-Inch, VX-2, XM736	1
Type	Projectile	2 (p. 7), 3 (p. 4)
Size	8-inch	1, 2 (p. 7)
Service	Army	2
Diameter	Canisters: 6.9 in. (17.5 cm)	3 (p. 5)
Length	Complete round: 44 in. (111-112 cm) XM28 canister: 4 in. (10.2 cm) XM27 canister: 21 in. (53.3 cm)	1, 3 (p. 5)
Construction Material	Steel	1, 2 (p. 7)
Propellant	M2	1, 3 (p. 4)

Projectile, 8-inch, XM736

General Use and Description

Munitions, including the XM736, filled with lethal chemical agents were required by the military for a retaliatory chemical capability. The XM736 consisted of a steel body that contained a dual canister payload, an expulsive charge assembly, an aluminum ogive, and a steel projectile base. Each canister contained a nonlethal, liquid chemical intermediate: one with ethyl-2-diisopropylaminoethyl-methylphosphonite (QL) (canister XM27), and one with polymethylsulfide (NM) (canister XM28). When the NM reacted with QL, the two formed the agent VX. The canisters were designed with a burst disk at one end so that upon projectile firing, the adjacent ends were ruptured by setback forces. The two chemicals combined, and the chemical mixing was enhanced by in-flight spin on the way to the target (1), (2 p. 7), (3 p. 4).

The XM27 canister contained 14.8 pounds of QL and the XM28 contained 2.8 pounds of NM (2 p. 79, 80).

Explosive Train

The mechanical time and superquick fuze would initiate the expulsive charge (XM172) over the targeted area that ejected the canisters from the rear of the projectile body and disseminated the thickened agent in droplet form (1).

Fuzing

Projectile, 8-inch, XM736 - Fuzing		
Fuze	**Notes**	**Citation**
M577	Mechanical time, superquick	1, 2 (p. 7, 8), 3 (p. 4)
M73	Dummy	1

Booster, Adapter-Booster, or Burster

Projectile, 8-inch, XM736 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
XM 172 Expelling Charge	0.29 lbs. (0.13 kg)	M10 flake propellant	-	1, 2 (p. 8), 4 (p. 5)

Fills

Projectile, 8-inch, XM736 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
VX2	17.6	7.98	204	92.5-92.5	-	1, 2 (p. 80), 3

Shipping/Packing

The normal mode of shipping consists of six XM736 projectiles per side-loading pallet with a single XM27 reactant canister installed in each projectile and the XM28 canister packed separately, six per box. The palletized projectiles were equipped with live, XM172 expulsion charges and lifting plugs (3 p. 4), (4 p. 4).

Miscellaneous Information

The XM736 program was terminated. During development, test firings of the XM736 Projectile, observations along the projectile's trajectory were interpreted as evidence of leakage of the liquid payload. These observations contributed to the termination of the program. When the XM736 program was canceled, emphasis was shifted to the Bigeye Bomb (BLU-80/B) (1), (2 p. 10).

Projectile, 8-inch, XM736

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Vavra, B.L., & Oaks, S.A. 1976. Engineer Design Test, Phase IV (In-flight mixing) of Projectile, 8-Inch, VX-2, XM736. Department of the Army.
2. Jackson, A., & Gadde, K., & Goheen, J., & Semiatin, W. 1987. Chemical Research, Development & Engineering Center, CRDEC-TR-87042, Fill, Close, Load, Assemble, and Packout Technology for the 8-Inch, VX-2, XM736 Projectile and the Bigeye Bomb (BLU-80/B). Chemical Research, Development & Engineering Center.
3. Spitler, Joseph, Jr. 1976. Letter Report, Engineer Design Test (Air Transport/Airdrop) of Projectile, 8-Inch, VX2, XM736, TECOM Project No. 2-MU-003-736-019. Department of the Army.
4. Chemical Systems Laboratory. 1979. Final Report Engineer Design Test of Projectile, 8-inch: VX-2, XM736 (RDTE Project No. 1X464610DF94, TECOM Project No. 2-MU-003-736-032, Test Agency Report No. APG-MT-5274). U.S. Army.

14.28 Projectile, 9.2-inch, MKI

Figures

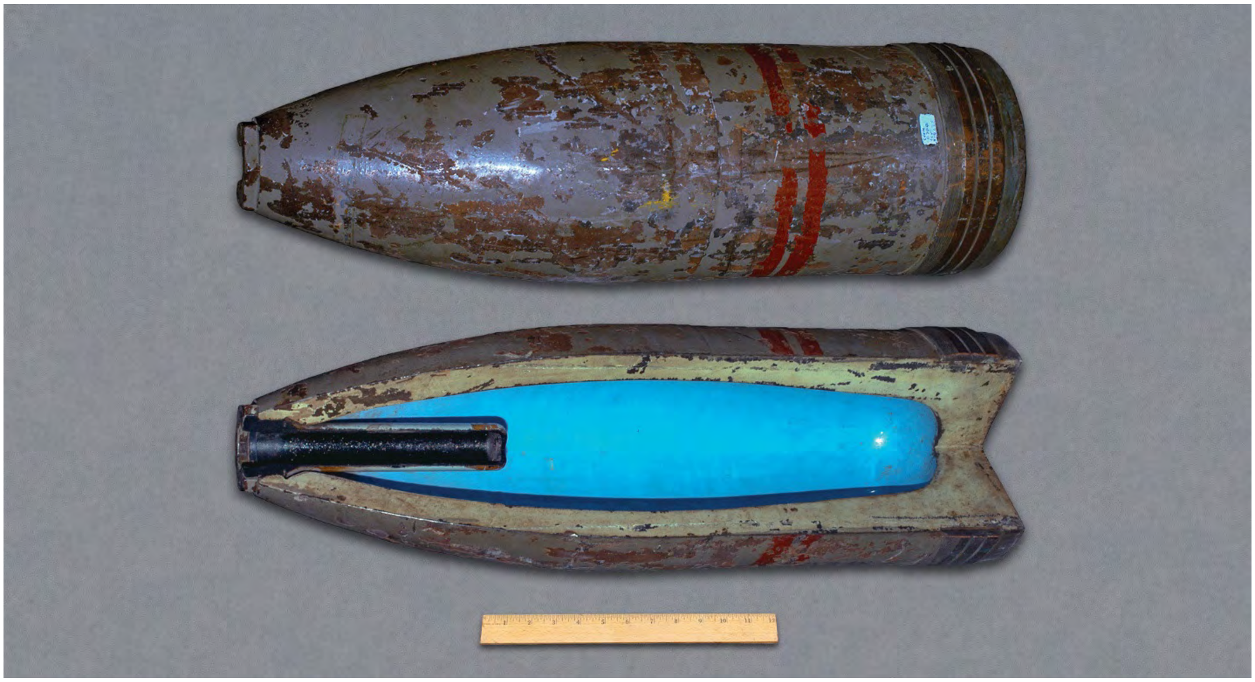

Figure 223: Projectile, 9.2-inch, MKI - Photograph - Top: Intact, Bottom: Cutaway View

Specifications

Projectile, 9.2-inch - Specifications and Other Data		**Citation**
Historical Name	9.2-Inch Chemical Shell	1 (p. 62)
Type	Projectile	2 (p. 57)
Size	9.2-inch	1 (p. 62), 2 (p. 12)
Conflict	WWI	2
Other	Available references did not provide information on the dimensions of the projectile	-
Construction Material	Steel and semi-steel	1 (p. 62)

General Use and Description

The 9.2-inch MKI howitzer ammunition provided portability between field artillery and heavy seacoast artillery. The 9.2-inch howitzer ammunition had the advantage over those of smaller calibers in its longer range and the increased capacity of agent it could hold. The United States did not adopt the 9.2-inch caliber until 1917 after joining with the Allies (2 p. 56).

In general, the chemical shell was similar to the HE shell. The projectile consisted of the shell body, which contained chemical agent or smoke, and the gaine tube (adapter and booster casing), which screwed into the nose of the shell and contained the bursting charge. The bursting charge consisted of a small quantity of HE sufficient to open the shell, and to atomize the liquid contents (1), (3).

Explosive Train

Available references did not provide specific information on explosive train.

Projectile, 9.2-inch, MKI

Fuzing

Projectile, 9.2-inch - Fuzing		
Fuze	**Notes**	**Citation**
French I.A. Model 1915	Point detonating, superquick	1 (p. 60, 62)
French I.A.L. Model 1916	Point detonating, superquick	1 (p. 60, 62)
French R.Y.	Point detonating, superquick; only used if other fuzes unavailable.	1 (p. 60, 62)
Modified British No. 106	Point detonating, superquick	1 (p. 42, 62)
U.S. MK III	Point detonating, superquick	1 (p. 36, 62)

Booster, Adapter-Booster, or Burster

Projectile, 9.2-inch - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
MK VII	N/A	HE	Adapters and boosters.	2 (p. 58)

Fills

Projectile, 9.2-inch - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	42.8	19.4	295	120	Volume was based on HE shell. Gross weight is the shell and fill without fuze.	1
CA	31.7	14.4	284	128	Volume is based on HE shell.	1
CG	28.7	13.0	281	127	Volume is based on HE shell.	1
FM	37.2	16.9	289	131	Volume is based on HE shell.	1
HS	29.5	13.4	282	128	Volume is based on HE shell.	1
NC	37.8	17.1	290	131	Volume is based on HE shell.	1
PS	35.6	16.1	288	130	Volume is based on HE shell.	1
WP	41.3	18.7	294	133	Volume is based on HE shell.	1

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

Through late 1918, no 9.2-inch gas munitions were loaded (2 p. 61).

As of late 1919, the Office of the Chief of Ordnance reported that there were no machined or filled 9.2-inch gas shells on hand and it was recommended that none be produced until further information on need was available. In 1920, the 9.2-inch gun was dropped from the chemical program (4 p. 2) (5 p. 2, 3).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.
2. Army Ordnance. 1921. No. 1939, History of Artillery Projectiles, 1917-1919. Government Printing Office.
3. Prentiss, Augustin M. 1937. Chemicals in War: A Treatise on Chemical Warfare. McGraw-Hill Book Company, Inc.

4. Office of the Chief of Ordnance 1919. Memorandum from Board of Officers to Chief of Ordnance, Subject: Fifth Preliminary Report, a Study of the 8”, 9.2” and 240 m/m Howitzer Ammunition Situation, November 11.

5. Chemical Corps Technical Committee. 1920. CCTC Item # 1920-07-03, Project Program for the Development of Chemical Warfare Materiel, Project 1. Gas Shell. Chemical Warfare Service. October 13.

14.29 Projectile, 240-mm, Field Artillery, Howitzer, M1918

Figures

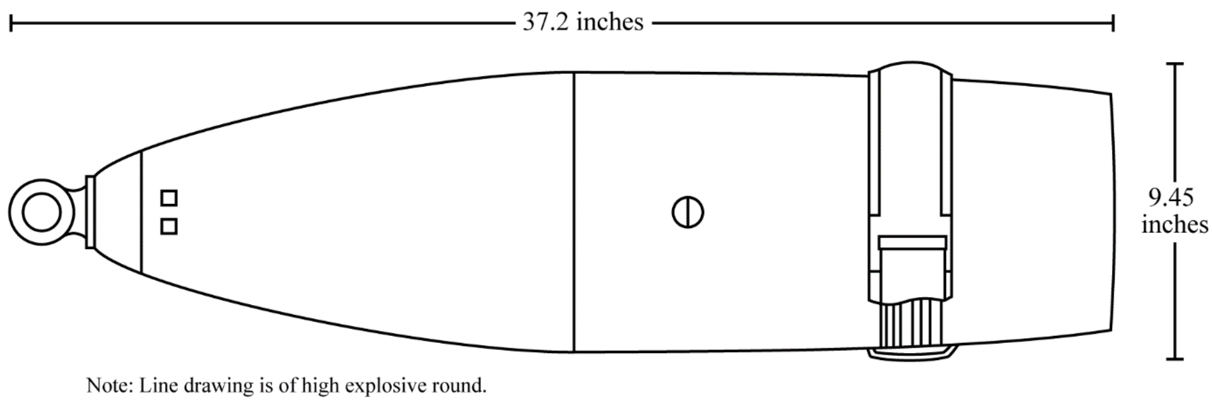

Figure 224: Projectile, 240-mm, Field Artillery, Howitzer, M1918 - Line Drawing

Specifications

Projectile, 240-mm, Field Artillery, Howitzer, M1918 - Specifications and Other Data		**Citation**
Historical Name	240-mm Chemical Shell	3 (p. 62)
Type	Projectile	1 (p. 462)
Size	240-mm	1 (p. 477), 2 (p. 208), 3 (p. 62)
Conflict	WWI	1 (p. 462, 477), 3 (p. 26)
Diameter	9.45 in. (24.0 cm)	2 (p. 209)
Length	Unfuzed with eyebolt: 37.2 in. (94.49 cm)	2 (p. 209)
Other Engineering Data	boat-tailed	2 (p. 209)

General Use and Description

Available references did not provide information on specific use.

When the United States entered WWI, it was decided to adopt types of artillery in use by the Allies to facilitate early quantity production and to secure as much uniformity in artillery materiel as possible. Accordingly, the United States was equipped with the 240-mm heavy howitzer. Chemical shells were approved for this caliber; however, no available information suggests that chemical fills were implemented (1 p. 495), (2 p. 208-209).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Projectile, 240-mm, Field Artillery, Howitzer, M1918 - Fuzing		
Fuze	**Notes**	**Citation**
French I. A. Model 1915	Point detonating, superquick	3 (p. 34)
French I.A.L. Model 1916	Point detonating, superquick	3 (p. 34)
French R.Y. Model 1917	Point detonating; only to be used if other fuzes were unavailable	3 (p. 34)
Modified British No. 106	Point detonating, superquick	3 (p. 34)
U.S. Mark III	Point detonating, superquick	3 (p. 34)

Projectile, 240-mm, Field Artillery, Howitzer, M1918

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Projectile, 240-mm, Field Artillery, Howitzer, M1918 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
BA	54.4	24.6	356	161	Chemical fill volumes were based on the HE shell. (Approved, but not fielded)	1 (p. 462), 3 (p. 24)
CA	40.4	18.3	343-342	155	Approved, but not fielded	1 (p. 462), 3 (p. 24)
CG	36.5	16.5	340	154	Approved, but not fielded	1 (p. 462), 3 (p. 24)
FM	47.4	21.5	350	159	Approved, but not fielded	1 (p. 462), 3 (p. 24)
H	37.5	17.0	341	155	Approved, but not fielded	1 (p. 462), 3 (p. 24)
HE	49.8	22.6	345	156	-	1 (p. 495), 3 (p. 24)
NC	48.2	21.8	351	159	Approved, but not fielded	1 (p. 462), 3 (p. 24)
PS	45.3	20.5	348	157	Approved, but not fielded	1 (p. 462), 3 (p. 24)
WP	52.6	23.8	356	161	Approved, but not fielded	1 (p. 462), 3 (p. 24)

Shipping/Packing

Available references did not provide this information.

Miscellaneous

As of late 1919, the Office of the Chief of Ordnance reported that there were no machined or filled 240 mm gas shells on hand (5 p. 2). A 1927 Technical Regulation indicates that only high explosive ammunition was provided for use in the M1918 howitzer (6 p. 1). The military requirement for 240 mm chemical ammunition was eliminated in 1931 (7 p. 6).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Prentiss, Augustin M. 1937. Chemicals in War: A Treatise on Chemical Warfare. McGraw-Hill Book Company, Inc.
2. War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. War Department.
3. American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. War Department.
4. Army Ordnance. 1921. No. 1939, History of Artillery Projectiles, 1917-1919. Government Printing Office.
5. Office of the Chief of Ordnance 1919. Memorandum from Board of Officers to Chief of Ordnance, Subject: Fifth Preliminary report, a Study of the 8”, 9.2” and 240 m/m Howitzer Ammunition Situation, November 11.
6. War Department. 1927. Technical Regulation, TR 1355-240A, Mobile Artillery Ammunition, Ammunition for 240mm Howitzer, M1918 (Schneider). November.
7. Ordnance Department. 1931. Ordnance Committee Meeting, OCM Item # 8996, Chemical Ammunition for 240 mm Howitzer – Elimination of Military Requirement, Read for Record.

15 Warhead, Missile, and Rocket

The warhead section of both missiles and rockets contains the agent fill, either in an agent carrying container, or bomblets.

A missile is a self-propelled precision-guided munition system. Missiles have four system components: targeting or missile guidance, flight system, engine, and warhead. Missiles come in types adapted for different purposes: surface-to-surface and air-to-surface missiles (e.g., ballistic, cruise, anti-ship, anti-tank), surface-to-air missiles (and anti-ballistic), air-to-air missiles, and anti-satellite weapons.

The first missiles were developed by the Germans at the end of WWII. U.S. forces studied the basic principles of agent dispersal by missile warhead following the war (Davis, 1968).

A rocket is a self-propelled, unguided weapon system powered by a rocket motor. A rocket primarily differs from a missile by its lack of an active guidance system. Rockets can be surface-to-surface or air-to-surface.

In the subsection below, if the munition is a rocket or missile system as a whole, the subsection will begin with rocket or with missile. If the warhead is the munition, the subsection will begin with warhead and be followed by rocket or missile, as appropriate.

15.1 Missile, 250-pound, Warhead, Bullpup

Figures

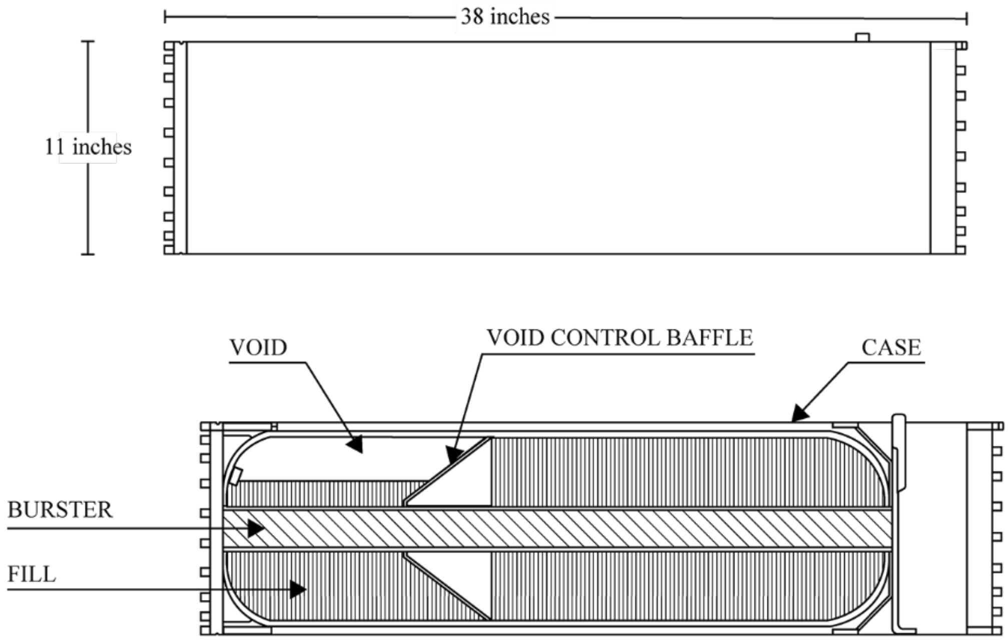

Figure 225: Warhead, 250-pound, Bullpup - Line Drawing

Figure 226: Missile, 250-pound, Warhead, Bullpup - Photograph

Missile, 250-pound, Warhead, Bullpup

Specifications

Missile, 250-pound, Warhead, Bullpup - Specifications and Other Data		Citation
Historical Name	Warhead, Bullpup Missile, (GB) (250-Pound)	1 (p. 4-73)
Type	Missile	2 (p. 4-72)
Size	250-pound	1 (p. 4-73), 2 (p. 4-72), 3 (p. 10)
Conflict	Cold War	3 (p. 1)
Service	Navy	2 (p. 4-72)
Diameter	Warhead: 11 in. (27.6 cm)	1 (p. 4-74), 2 (p. 4-73), 3 (p. 8)
Length	Complete Missile: 126 in. (320 cm) Warhead: 37.9-38.4 in. (96.3-97.5 cm)	1 (p. 4-74), 2 (p. 4-73), 3 (p. 7, 8)
Width	Wingspan: 37.9 in. (96.2 cm)	1 (p. 4-74), 2 (p. 4-73), 3 (p. 7)
Wall Thickness	0.188 in. (0.478 cm)	2 (p. 4-73)
Other Engineering Data	Fuel: 103 lbs. (46.7 kg) Weight: Missile Gross 570 lbs. (258 kg) Burnout 467 lbs. (212 kg)	1 (p. 4-74), 2 (p. 4-73), 3 (p. 5, 7)
Construction Material	Mild steel	1 (p. 4-74), 2 (p. 4-73), 3 (p. 8)

General Use and Description

The Bullpup guided missile system was used with attack type aircraft in support of ground troops and for use against small tactical targets (1 p. 4-73), (2 p. 4-72), (3 p. 5).

The Bullpup was a massive type warhead, air-to-surface, that was carried by a variety of Naval aircraft.

The warhead consisted of a cylindrical agent container with a central burster for explosive dissemination and was housed in the missile center section. It was interchangeable with other warheads that were used with the Bullpup Missile. A relatively thick casing of mild steel was used, which could withstand severe handling loads. Ballast was necessary to obtain the correct weight. The missile was radio controlled to the target and could be used against small crafts, tanks, vehicles, and buildings (1 p. 4-73), (2 p. 4-72), (3 p. 8).

Explosive Train

Available references did not provide specific information on explosive train.

Fuzing

Missile, 250-pound, Warhead, Bullpup - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Impact	1 (p. 4-74), 2 (p. 4-73)

Booster, Adapter-Booster, or Burster

Missile, 250-pound, Warhead, Bullpup - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	3-10.5 lbs. (1.34-4.5 kg)	N/A	Central burster	3 (p. 10)

Missile, 250-pound, Warhead, Bullpup

Fills

Missile, 250-pound, Warhead, Bullpup - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	100-105	45.3-47.6	250	113	Weight is for the warhead.	1 (p. 4-74), 3 (p. 10)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The Bullpup can utilize any 250-pound bomb, without tail fins, as a warhead. VX was considered for use with this warhead 1 (p. 4-74), 3 (p. 3).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

3. Walton, Ralph & Kratzer, John. 1959. Chemical Warfare Laboratory, CWL Technical Memorandum 30-47, Preliminary Chemical Warhead Study for the Bullpup Missile (U). Army Chemical Warfare Laboratories.

15.2 Missile, Warhead, Pershing

Figures

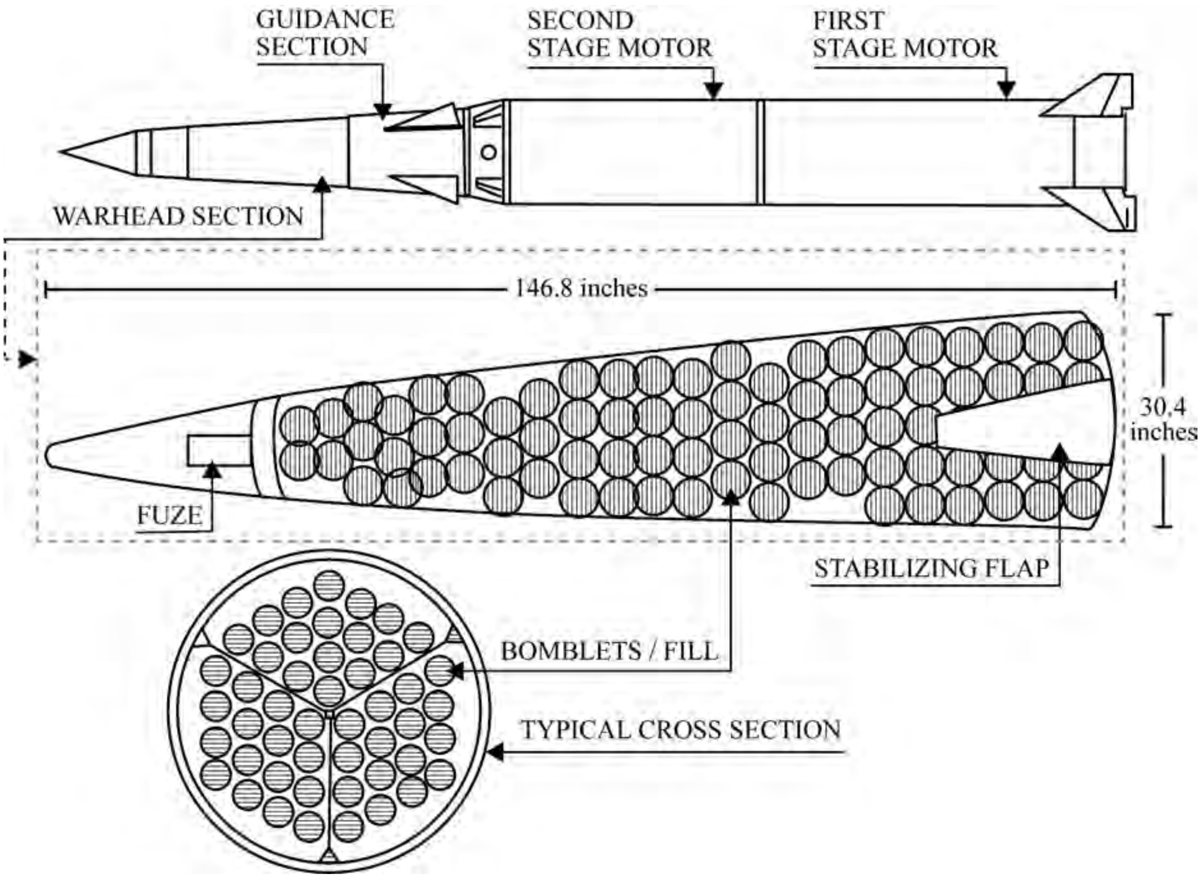

Figure 227: Missile, Warhead, Pershing - Line Drawing

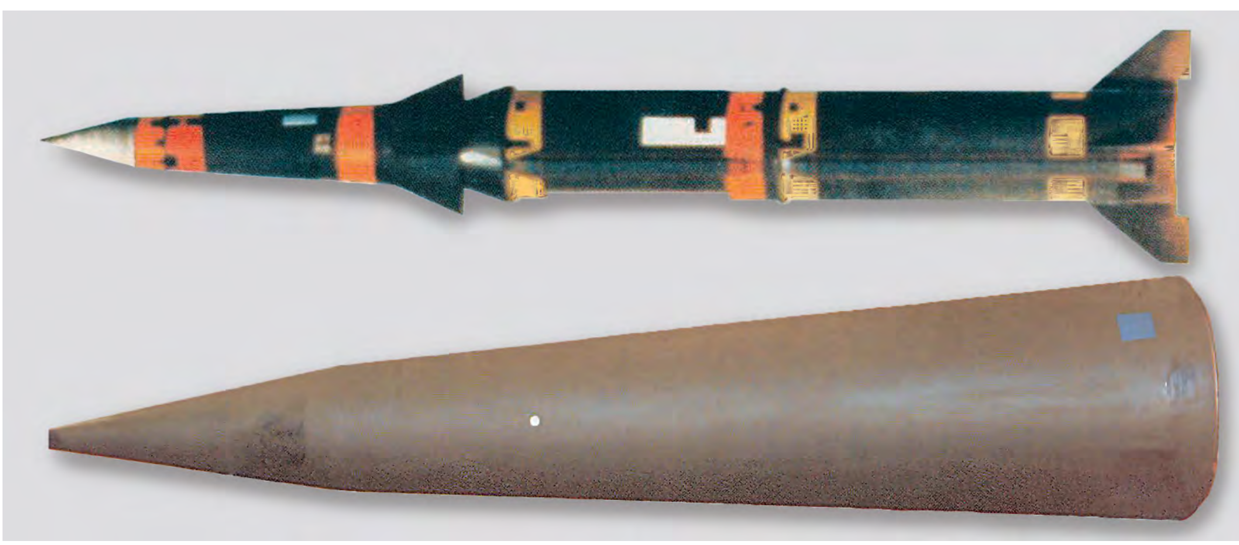

Figure 228: Missile, Warhead, Pershing - Photograph - Top: Missile System, Bottom: Warhead

Specifications

Missile, Warhead, Pershing - Specifications and Other Data		**Citation**
Historical Name	Warhead, Pershing Missile (GB-VX)	1 (p. 4-85)
Type	Missile	1 (p. 4-85)
Diameter	Warhead: 30.4 in. (77.22 cm)	3 (p. 59)
Length	Warhead: 146.8 in. (372.87 cm)	3 (p. 59)
Range	100-300 nautical miles	1 (p. 4-86)

General Use and Description

The Pershing missile was a surface-to-surface missile designed for dissemination of chemical agents (1 p. 4-85), (4 p. 4-86).

The chemical warhead for the Pershing missile was based on the utilization of self-dispersing munitions, or bomblets, clustered within the missile nose section. The clustering of the bomblets required a special warhead system design, which would release the bomblets into the airstream at a predetermined altitude upon receipt of a fuzing signal. The ground impact pattern could be increased in size by increasing the altitude of bomblet release, or vice versa.

The payload compartment was divided longitudinally into three equal sections. The proposed method of skin separation utilized three explosive longerons within which are housed a linear-shaped charge (1 p. 4-85), (2 p. 4-86).

Explosive Train

At a predetermined altitude the payload compartment would be opened by explosive means, which allowed the bomblets to release into the airstream allowing the bomblets to function as designed (1 p. 4-85), (2 p. 4-86).

Fuzing

Missile, Warhead, Pershing - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Barometric	1 (p. 4-86), 4 (p. 4-87)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Missile, Warhead, Pershing - Bomblet Filling											
Bomblet	**Agent**	**Fill Weight per Bomblet**		**Bomblets per Warhead**	**Fill Weight per Warhead**		**Warhead Gross Weight**		**Cross-Reference**	**Citation**
		lbs.	**kg**		**lbs.**	**kg**	**lbs.**	**kg**	**Section (Page #)**	
E130R2	GB	1.10	0.49	537	590	267	1,900	861	7.3 (p. 120)	1 (p. 4-85), 2 (p. 4-87)
E130R2	VX*	N/A	NA	537	N/A	N/A	1,900	861	7.3 (p. 120)	1 (p. 4-85), 2 (p. 4-87)

*experimental fill

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The warhead was used with E130R2 bomblets. Approximately 537 bomblets (2.4 pounds each with 1.3 pounds of agent) were used in the warhead (1 p. 4-85), (2 p. 4-86).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
3. U.S. Army Missile Command. 1988. Pershing, Intermediate-Range and Shorter-Range Missile, Escort Officer's Equipment Information Guide. June. Science Applications International Corporation.

15.3 Rocket, 2.36-inch, M10 Series, M26

Figures

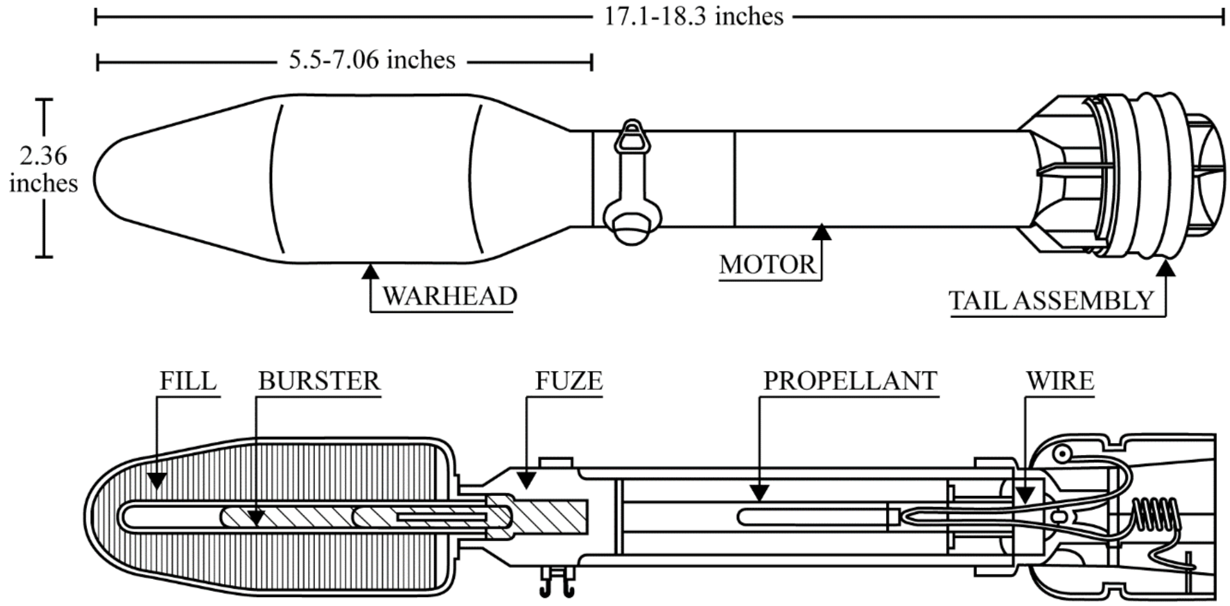

Figure 229: Rocket, 2.36-inch, M10 Series, M26- Line Drawing - M10

Figure 230: Rocket, 2.36-inch, M10 - Photograph

Specifications

Rocket, 2.36-inch, M10 Series, M26 - Specifications and Other Data		**Citation**
Historical Name	2.36-Inch, Gas M26 and 2.36-Inch, Smoke (WP) M10	1 (p. 151, 152)
Developmental Information	T26E2: M10 T73, E22: M26	1, 2, 3 (p. 2)
Type	Rocket	1 (p. iii)
Size	2.36-inch	1 (p. 151, 152)
Service	Army	1 (p. 151, 152)
Diameter	2.36 in. (5.99 cm)	1 (p. 151)
Length	M10 Rocket: 17.1 in. (43.43 cm) M26 Rocket: 17.66 in. (44.85 cm)	1 (p. 151, 152), 2, 3 (p. 2)

Rocket, 2.36-inch, M10 Series, M26 - Specifications and Other Data		Citation
	Warhead, M10 Series: 5.5 in. (13.97 cm) Warhead, T73 (M26): 7.06 in. (17.93 cm)	
Wall Thickness	0.049 in. (0.124 cm)	3 (p. 2)
Other Engineering Data	Launcher: M1A1, M9, or M9A1 (bazooka) Rocket motor: M6A3	1 (p. 152), 2
Propellant	T1E1 salted powder, M7 Powder	1 (p. 152)
Range	M10 Rocket: 600 yards (549 meters) (estimated)	2

General Use and Description

This rocket was designed as both a screening agent and a causality agent (1 p. 151).

The components of the rocket were the motor and the head assembly. The head assembly consisted of a container for the chemical fill with a long burster well containing PETN inserted from the aft end. A collar was soldered to the base of the container. The spacer slipped over the threads of the collar and was held against the flat surfaces of the collar by the fuze body. The M10A1 and M10A2 differed from the M10 in the type of propellant used. Except for its increased length, the 2.36-inch gas rocket M26 was structurally identical to the 2.36-inch M10A2 (1 p. 151, 152).

Explosive Train

After the safety pin was removed, the firing pin would overcome the spring upon impact and detonate the burster, expelling the chemical filler (1 p. 151).

Fuzing

Rocket, 2.36-inch, M26, M10, M10A1, M10A2, M10A3 - Fuzing		
Fuze	**Note**	**Citation**
M400 series	-	1 (p. 152)

Booster, Adapter-Booster, or Burster

Rocket, 2.36-inch, M26, M10, M10A1, M10A2, M10A3 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M10 Burster	1.3 grams	Hexanitromannite and PETN	-	3 (p. 3)
Not designated	4 grams	PETN	-	1 (p. 151, 152), 3 (p. 3)

Fills

Rocket, 2.36-inch, M26, M10, M10A1, M10A2, M10A3 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CK	0.77	0.35	3.40	1.54	M26	1 (p. 152), 2
WP	0.89	0.40	3.40	1.54	M10-series	1 (p. 151), 2

Shipping/Packing

The rocket was packed fuzed, one rocket per fiber container, with 12 containers per wooden box (2).

Miscellaneous

In 1946, it was reported that although the Rocket, Gas, CK, 2.36-Inch, M26 had been standardized, none had been procured (6 p. 2).

Key Dates

Rocket, 2.36-inch, M26, M10, M10A1, M10A2, M10A3 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1944	OCM 24662, 24955 (Development of T73)	5 (p. 1)
Standardized	1944	OCM 24671 M10 (WP-filled Standard)	4 (p. 124)
Standardized	1945	M10 (Limited Standard)	4 (p. 124)
Standardized	1945	OCM 29535, 29903 (M26 CK-fill Standard)	5 (p. 1)
Obsoleted	1946	M26 CK-fill	5 (p. 2)

Sources

1. Bureau of Ordnance. 1947. Ordnance Pamphlet, OP 1664 (Vol. 1), U.S. Explosive Ordnance. Department of the Navy.
2. Office, Chief of Ordnance. 1944. Rocket Materiel. Research and Development Service. 1 December. (file name: CW pages from Rocket Materiel).
3. Briggs, D.A. 1945. Technical Division Memorandum Report, TDMR 1051, Development of 2.36 Inch Rocket E22 for CK Filling, Project B1.5-1. Chemical Warfare Service.
4. Finklestein, Leo. 1964. History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 - 31 December 1945) Screening Smokes Part III. Chemical Research and Development Laboratories (CRDL).
5. Office of Chief of Ordnance. 1946. Subcommittee on Rockets, Memorandum to Secretary of the Ordnance Technical Committee, Subject: Rocket, gas, CK, 2.36-Inch, M26 – Obsoletion. 3 December.

15.4 Rocket, 2.36-inch, T70, T71

Figures

No images were found in available references.

Specifications

Rocket, 2.36-inch, T70, T71 - Specifications and Other Data		Citation
Historical Name	2.36-Inch, Chemical Rocket, T70, T71 - Development Type	1
Type	Rocket	1
Size	2.36-inch	1
Service	Army	1
Diameter	2.36 in. (5.99 cm) Motor assembly: 1.25 in. (3.17 cm)	1
Length	Rocket: 17.5 in. (44.45 cm) Warhead: 6.3 in. (16.03 cm) Motor assembly: 8.22 in. (21 cm)	1
Other Engineering Data	Launchers: M1A1, M9, or M9A1 Rocket motor: M6A3	1
Construction Material	Steel tubing	1
Range	600 yards (548 meters) (estimated)	1

General Use and Description

The components of the rocket were the motor and the head assembly. The head assembly consisted of a container for the chemical fill. This was a development type item (1).

Explosive Train

The rocket motor was ignited by an electric squib in an aluminum case centered in the motor. It was expected that the round would use a detonator burster assembly to release the filler on impact (1).

Fuzing

Rocket, 2.36-inch, T70, T71 - Fuzing		
Fuze	**Note**	**Citation**
Unspecified	Base detonating- impact	1

Booster, Adapter-Booster, or Burster

Available references did not provide specific information.

Fills

Rocket, 2.36-inch, T70, T71 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	0.85	0.39	3.40	1.54	T71. Estimated fill weight	1
H	0.85	0.39	3.40	1.54	T70. Estimated fill weight	1

Shipping/Packing

Available references did not provide specific information.

Rocket, 2.36-inch, T70, T71

Key Dates

Available references did not provide specific information.

Sources

1. Office of Chief of Ordnance. 1944. Rocket Materiel. Research and Development Service. 1 December. (DENIX file name: CW pages from Rocket Materiel).

15.5 Rocket, 2.36-inch, T72, T73

Figures

No images were found in available references.

Specifications

Rocket, 2.36-inch, T72 - Specifications and Other Data		Citation
Historical Name	2.36-Inch, Chemical Rocket, T72 - Development Type 2.36-Inch, Chemical Rocket, T73 - Development Type	1
Type	Rocket	1
Size	2.36-inch	1
Service	Army	1
Diameter	Shell: 2.36 in. (5.99 cm) Motor Assembly: 1.25 in. (3.17 cm)	1
Length	Rocket: 18.3-20.3 in. (46.5-51.6 cm) Shell: 7.44-9.13 in. (17.9-23.18 cm) Motor assembly: 8.32 in. (21 cm)	1
Other Engineering Data	Launcher: M1A1, M9, or M9A1 Rocket motor: M6A3	1
Construction Material	Steel tubing	1
Range	500 yards (457 meters) (estimated)	1

General Use and Description

The components of the rocket were the motor and the head assembly. The head assembly consisted of a container for the chemical fill. This was a development type item (1).

Explosive Train

The rocket motor was ignited by an electric squib in an aluminum case centered in the motor. It was expected that the round would use a detonator burster assembly to release the filler on impact (1).

Fuzing

Rocket, 2.36-inch, T72 - Fuzing		
Fuze	**Note**	**Citation**
Unspecified	Base detonating- impact	1

Booster, Adapter-Booster, or Burster

Available references did not provide specific information.

Fills

Rocket, 2.36-inch, T72 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	0.6	0.27	3.4	1.54	Estimated fill weight	1
CK	0.8	0.36	3.4	1.54	Estimated fill weight	1

Shipping/Packing

Available references did not provide specific information.

U.S. Chemical Weapons and Related Materiel Reference Guide
Rocket, 2.36-inch, T72, T73

Key Dates

Available references did not provide specific information.

Sources

1. Office of Chief of Ordnance. 1944. Rocket Materiel. Research and Development Service. 1 December. (file name: CW pages from Rocket Materiel)

15.6 Rocket, 3.5-inch, Kit, E8

Figures

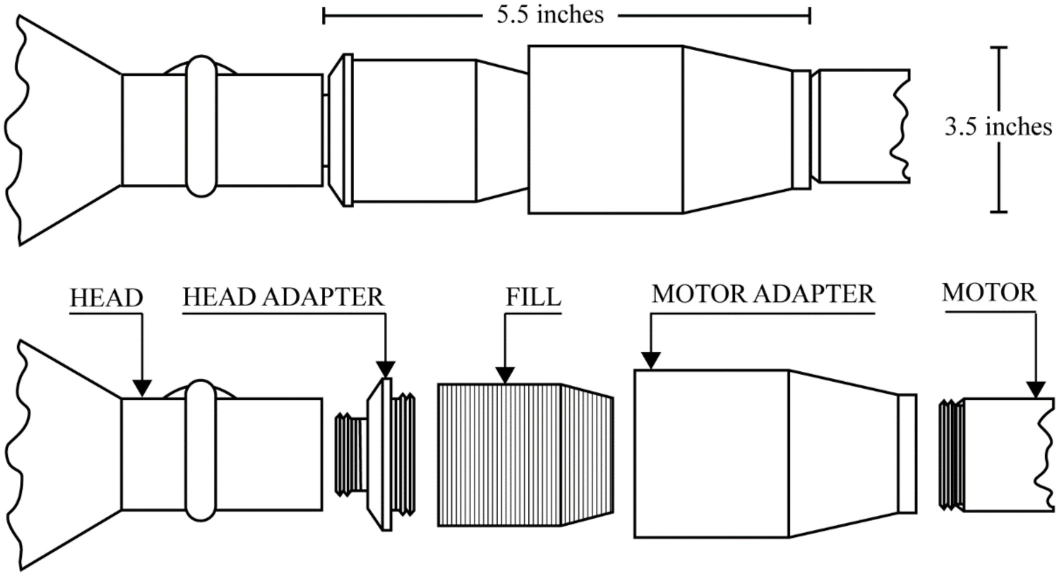

Figure 231: Rocket, 3.5-inch, Kit, E8 - Line Drawing

Figure 232: Rocket, 3.5-inch, Kit, E8 - Photograph

Specifications

Rocket, 3.5-inch, Kit, E8 - Specifications and Other Data		Citation
Historical Name	Kit, Agent, Toxic, GB, 3.5-Inch Rocket, E8	1 (p. 4-54)
Type	Rocket	2 (p. 4-53)
Size	3.5-inch	1 (p. 4-54)
Service	Marine Corps, Navy	1 (p. iv)
Diameter	3.5 in. (8.89 cm)	1 (p. 4-55)
Length	5.5 in. (13.79 cm)	1 (p. 4-55), 2 (p. 4-53, 4-54)
Other Engineering Data	Rocket motor: M28A2 Launchers: M20, M25, or M30	1 (p. 4-54, 4-55), 2 (p. 4-53, 4-54)

General Use and Description

The E8 kit was used to introduce a lethal dosage of toxic agent into a tank for neutralizing effect (1 p. 4-54), (2 p. 4-53).

Rocket, 3.5-inch, Kit, E8

The E8 toxic agent kit was designed to be adapted by the individual Soldier to the standard 3.5-inch high explosive anti-tank (HEAT) rocket M28A2. The kit consisted of a container and two component adapters. The two-component liquid adapter was made of aluminum and held the agent container between the motor and the rocket head. No special tools were required in the field, and it was fired from the standard 3.5-inch rocket launcher (1 p. 4-54), (2 p. 4-53, 4-54).

Explosive Train

Available references did not provide specific information on the explosive train.

Fuzing

Available references did not include information regarding fuzes for this item.

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Rocket, 3.5-inch, Kit, E8 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	0.40	0.18	1.25	0.56	-	1 (p. 4-55), 2 (p. 4-54)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

For more information see CWLR 2328 (1 p. 4-55), (2 p. 4-54).

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

15.7 Rocket, 4.5-inch, T160 Series

Figures

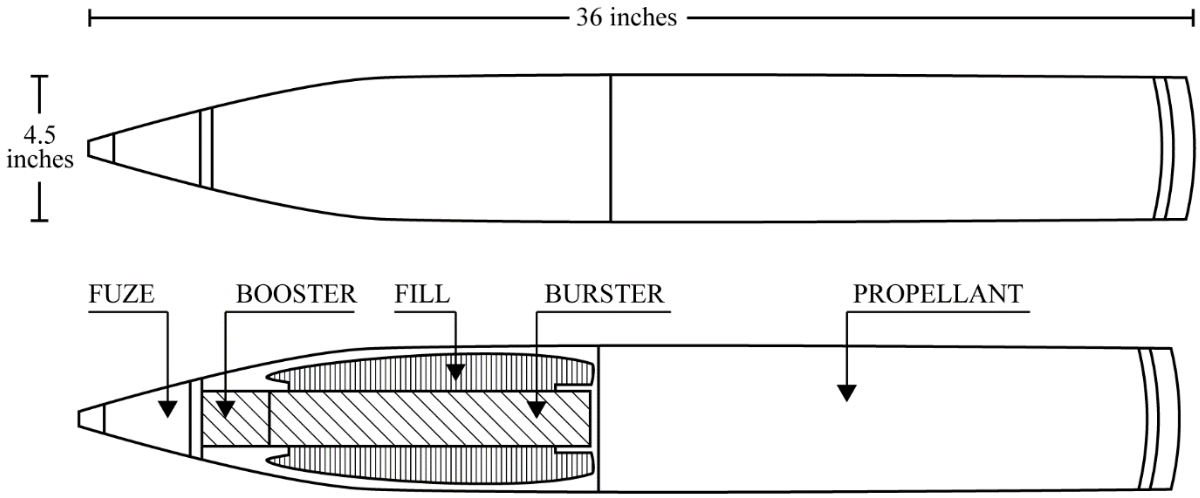

Figure 233: Rocket, 4.5-inch, T160 Series - Line Drawing

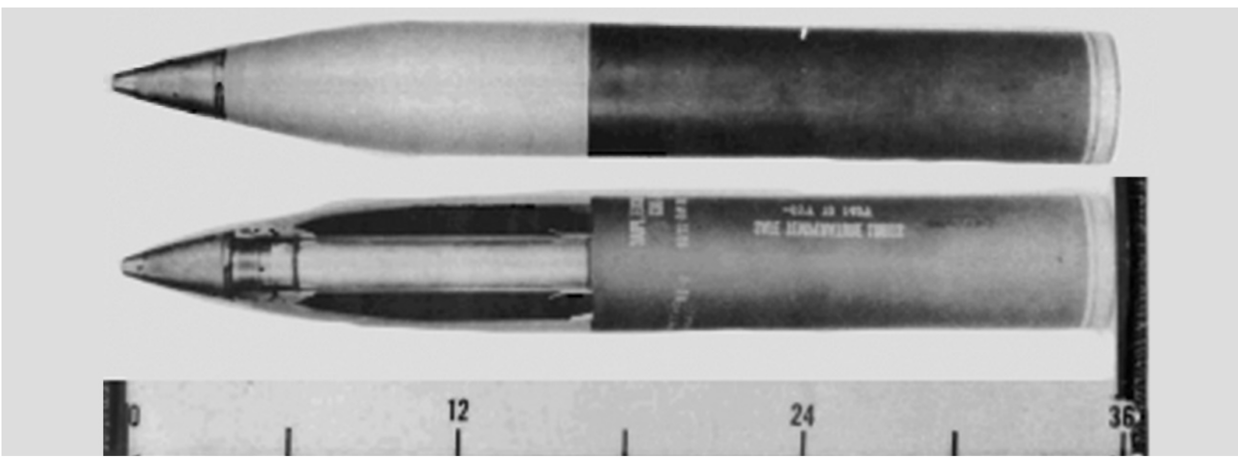

Figure 234: Rocket, 4.5-inch, T164 - Photograph - Top: Intact, Bottom: Cutaway View

Specifications

Rocket, 4.5-inch, T160 Series - Specifications and Other Data		Citation
Historical Name	Rocket, Smoke, WP, 4.5-Inch, T162; Rocket, Gas, GB, 4.5-Inch, T164; Rocket, Gas, HD, 4.5-Inch, T165, and T166; and Rocket, Chemical, 4.5-inch, T164	1 (p. 1), 2 (iii, Appendix A), 3 (p. 5), 4 (p. 2)
Type	Rocket	2
Size	4.5-inch	3 (p. 5)
Conflict	Cold War	2
Service	Marine Corps	3 (p. 6)
Diameter	4.5 in. (11.43 cm)	2, 4 (p. 1)
Length	~36 in. (91.44 cm)	1 (p. 44)
Other Engineering Data	Launcher: T123 T66 Multiple Launch Rocket System (MLRS)	3 (p. 5, 6, 20)
Drawing	P83460	2 (p. 2)

Rocket, 4.5-inch, T160 Series

General Use and Description

The T160 series chemical rocket was developed as an interim weapon for dissemination of toxic agents. Its purpose was to deliver a rapid and effective gas attack. The rockets were designed for multiple-tube rocket launchers which were suited for rapid dissemination of sufficient quantities of agent (2 Appendix A), (3 p. 7), (4).

The complete round consisted of the warhead, motor, burster charge, and fuze assembly (3 p. 14).

The T160 series 4.5-inch chemical rockets, T164, T165, and T166 were modifications of the T160E4 4.5-inch HE rocket. The rockets utilized the M81 standard artillery fuze with the M24 booster. The burster of the T164 and T165 rockets weighed approximately 1.5 pounds; the T166 burster well weighed approximately 1.0 pound (1 p. 16), (2 p. Appendix A).

Explosive Train

Upon impact, the point detonating fuze would be initiated. The fuze would set off the booster, which would initiate the burster. The burster would break the shell and disseminate the agent filler.

Fuzing

Rocket, 4.5-inch, T160 Series – Fuzing		
Fuze	**Note**	**Citation**
M81	Used with M24 booster	1 (p. 16), 2 (p. Appendix A)
M81A1	Point detonating	1 (p. iii), 2 (p. 11), 3 (p. 28)

Booster, Adapter-Booster, or Burster

Rocket, 4.5-inch, T160 Series – Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M24 booster	N/A	N/A	-	1 (p. 16)
Burster (T164)	1.45 lbs. (0.66 kg)	Tetryl	-	1 (p. 16), 2 (p. Appendix A)
Burster (T165)	1.45 lbs. (0.66 kg)	Tetryl	-	1 (p. 16), 2 (p. 1, Appendix A)
Burster (T166)	0.14 lbs. (0.06 kg)	Tetrytol	-	1 (p. 16), 2 (p. 1, Appendix A)

Fills

Rocket, 4.5-inch, T160 Series – Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	3.30	1.49	38.0-39.6	17.2-17.9	Weight is for T164.	1 (p. 16), 2 (Appendix A), 3 (p. 5)
HD	3.88	1.75	38.0	17.2	Weight is for T165.	1 (p. 16), 2 (Appendix A)
WP	N/A	N/A	N/A	N/A	T162	4 (p. 2)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The agent to burster ratio was as follows:

- T164: 2.3 to 1,
- T165: 2.68 to 1, and
- T166: 40 to 1 (1 p. 9).

Rocket, 4.5-inch, T160 Series

Key Dates

Rocket, 4.5-inch, T160 Series – Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics Approved	1951	CCTC 2233 (T165 and T166)	2 (Appendix A)
Other	1951	OCM 33910 (Initiation of development)	4

Sources

1. Test Division. 1953. Chemical and Biological Laboratories Report, CRLR 198, Final Engineering Test No. 37A, Rocket, Gas, GB, 4.5-Inch, T164. Test Division, Chemical Corps Chemical and Radiological Laboratories.

2. Liberman, David S. 1954. Final Engineering Test, No. 37B - Rocket, Nonpersistent Gas, HD, 4.5-Inch, T165E1, No. 37C - Rocket, Persistent Gas, HD, 4.5 Inch, T166E1. Chemical Corps, Chemical and Radiological Laboratories, Army Chemical Center.

3. Gibby, I., Layton, L., Stone, W., & Clay, J. 1953. Dugway Proving Ground Report, DPGR 117, 4.5-Inch Chemical Rocket Evaluation: operational evaluation of the rocket, chemical, 4.5-inch, T164; DPG CW 6-52. Chemical Warfare Division.

4. Subcommittee on Rockets and Launchers. 1951. Ordnance Committee Item, OCM Item # 33910, 4.5-Inch Chemical Rockets - Initiation of Development. 8 August.

15.8 Rocket, 115-mm, M55 (T238), Bolt

Figures

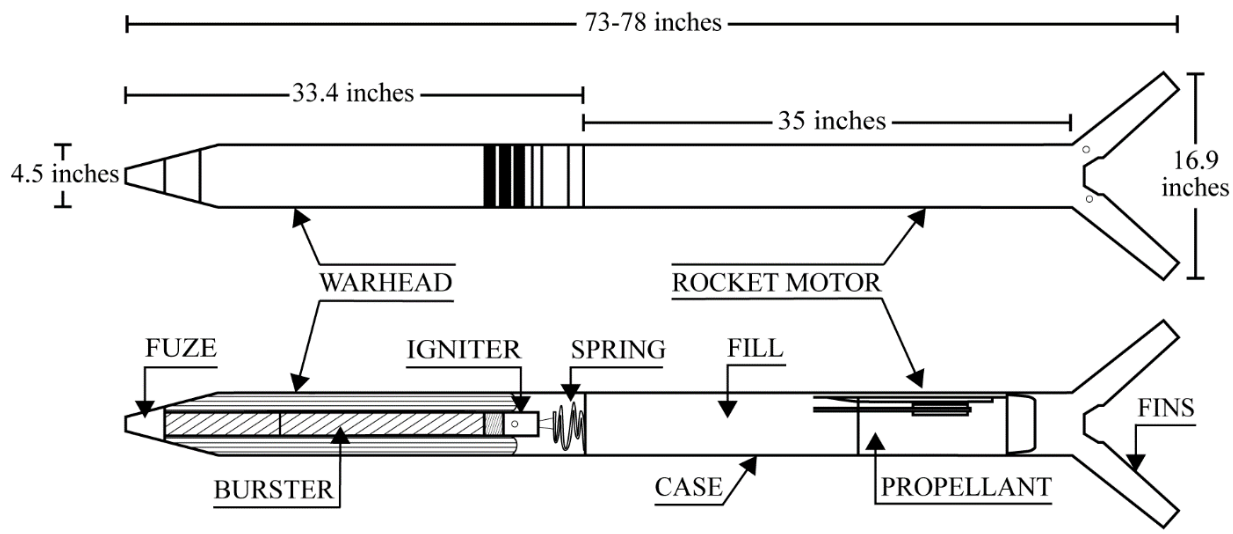

Figure 235: Rocket, 115-mm, M55 (T238), Bolt - Line Drawing

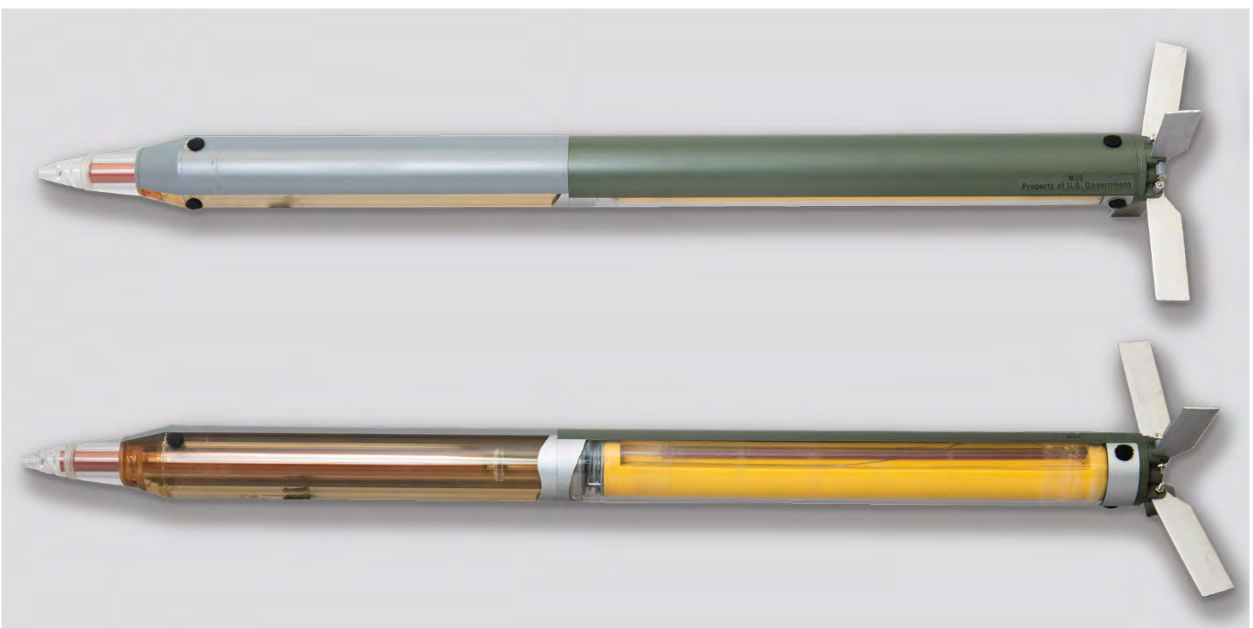

Figure 236: Rocket, 115-mm, M55, Bolt - Photograph - Top: Model, Intact, Bottom: Model, Cross Section

Specifications

Rocket, 115-mm, M55 (T238), Bolt - Specifications and Other Data		Citation
Historical Name	Rocket, Gas, Nonpersistent, GB, 115-mm, M55 (BOLT) Rocket, Gas, Persistent, VX, 115-mm, M55 (BOLT)	1 (p. 4-56, 4-57)
Developmental Information	T-238	1 (p. 4-57)
Type	Rocket	2 (p. 4-55)
Size	115-mm	2 (p. 4-55)
Service	Army, Marine Corps	1 (p. 4-56), 2 (p. 4-55), 3 (p. 16)

Rocket, 115-mm, M55 (T238), Bolt

Rocket, 115-mm, M55 (T238), Bolt - Specifications and Other Data		Citation
Diameter	4.5 in. (11.5 cm)	1 (p. 4-56), 2 (p. 4-55), 4 (p. 15), 5 (p. 83)
Length	Rocket: 73-78 in. (185-198 cm) Warhead: 33.4 in. (84.8 cm) Rocket Motor: 35.0-44.8 in. (88.9-114 cm)	1 (p. 4-57), 2 (p. 4-56), 4 (p. 15), 5 (p. 83), 6 (p. 65)
Width	Fins: 16.9 in. (42.9 cm)	5 (p. 83)
Other Engineering Data	Fin assembly: M150 Rocket motor: M67	1 (p. 4-57), 2 (p. 4-56, 4-58), 4 (p. 14)
Construction Material	Extruded aluminum	4 (p. 14)
Propellant	M28: 19.3 lbs. (8.75 kg)	1 (p. 4-57), 2 (p. 4-56)
Maximum Range	11,483-13,123 yards (10,500-12,000 meters)	1 (p. 4-57), 2 (p. 4-56), 4 (p. 15)
Drawing	E90-1-10	1 (p. 4-57), 2 (p. 4-56, 4-58)
FSN	GB-fill: 1340-716-1450 VX-fill: 1340-724-3567	6 (p. 67)

General Use and Description

The M55 rocket provided toxic chemical offensive capability for a large target area (1 p. 4-56), (2 p. 4-55).

It was a folding, fin stabilized, surface-to-surface rocket designed for the delivery of chemical agent against large targets. The major components were a warhead filled with agent, a point detonating fuze, burster, auxiliary burster, headspring, igniter, motor with fins, and propellant. The system could be air lifted by helicopter or could be fired from a truck or by ground emplacement. The launcher could deliver 45 rockets in 15 seconds and was loaded and operated by a crew of six. A battalion could fire 1,620 rounds in the first 30 seconds (1 p. 4-56), (2 p. 4-55).

Explosive Train

Upon impact, an anvil was driven against the firing pin to be driven into the detonator, which would function the lead and booster. The booster initiated the burster, which ruptured the warhead and dispersed the filler (5 p. 90).

Fuzing

Rocket, 115-mm, M55 (T238), Bolt - Fuzing		
Fuze	**Notes**	**Citation**
M417 (T2058)	Point detonating	1 (p. 4-57), 2 (p. 4-56, 4-58), 4 (p. 14)
T2061	Tests were also made with a VT fuze	1 (p. 4-59)

Booster, Adapter-Booster, or Burster

Rocket, 115-mm, M55 (T238), Bolt - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
M34	N/A	Composition B	-	1 (p. 4-57, 4-59)
M36 Auxiliary burster	N/A	Composition B	-	1 (p. 4-57, 4-59)

Rocket, 115-mm, M55 (T238), Bolt

Fills

Rocket, 115-mm, M55 (T238), Bolt - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	10.0-11.4	4.53-5.17	56.9-59.0	25.8-26.7	Burnout weight 39.7 lbs. (18.0 kg)	1 (p. 4-56, 4-57), 2 (p. 4-56), 3 (p. 16), 4 (p. 14)
VX	10.7-11.0	4.85-4.98	58.0-58.2	26.3-26.4	-	1 (p. 4-58, 4-59), 2 (p. 4-58), 3 (p. 16)
WP	17.5	7.93	65.0	29.4	-	1 (p. 4-60, 4-61)

Shipping/Packing

Fifteen rockets, in individual shipping and firing containers that were made of resin reinforced fiberglass, were packed in a wood crate. The shipping and firing containers were 82 inches long with a diameter of 4.9 inches, and weighed 16 pounds empty, 74 pounds with the rocket. The wood crate was 83 inches long, 30 inches wide, 28 inches high, and weighed 1,350 pounds loaded (4 p. 14 - 16).

Miscellaneous Information

The M56 warhead weighed 20.60 pounds (1 p. 4-57), (2 p. 4-56).

Key Dates

Rocket, 115-mm, M55 (T238), Bolt - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1958	CCTC 3464	9
Standardized	1960	CCTC 3704 (VX and GB-fill)	8 (p. 314)
Obsoleted	1981	MSR 09846001 (VX and GB-fill)	7 (p. 52)

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
3. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
4. Anderson, Andrew W. 1966. Technical Procedures, Disposal, Unserviceable M55 Rockets, GB Filled (U). Chemical Process Laboratory.
5. Secretary of the Army. 1967. Technical Manual, TM 9-1385-51, Identification of Ammunition (Conventional) for Explosive Ordnance Disposal. Department of the Army.
6. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.
7. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
8. Chemical Corps Technical Committee. 1960. CCTC Item # 3704, Classification of Rocket, Gas, 115-mm, M55 (T238) as a Standard-A Type & Authorization of Nonpersistent Agent, GB & Persistent Agent VX as Fillings Therefore (Popular Name-The Bolt). Department of the Army.
9. Chemical Corps Technical Committee. 1958. CCTC Item # 3464, Military Characteristics for V-Agent 155-mm Howitzer Shell, 8-inch Howitzer Shell, & 115-mm Rocket. Chemical Warfare Service.

15.9 Rocket, 115-mm, Dummy Training, M60 (E49)

Figures

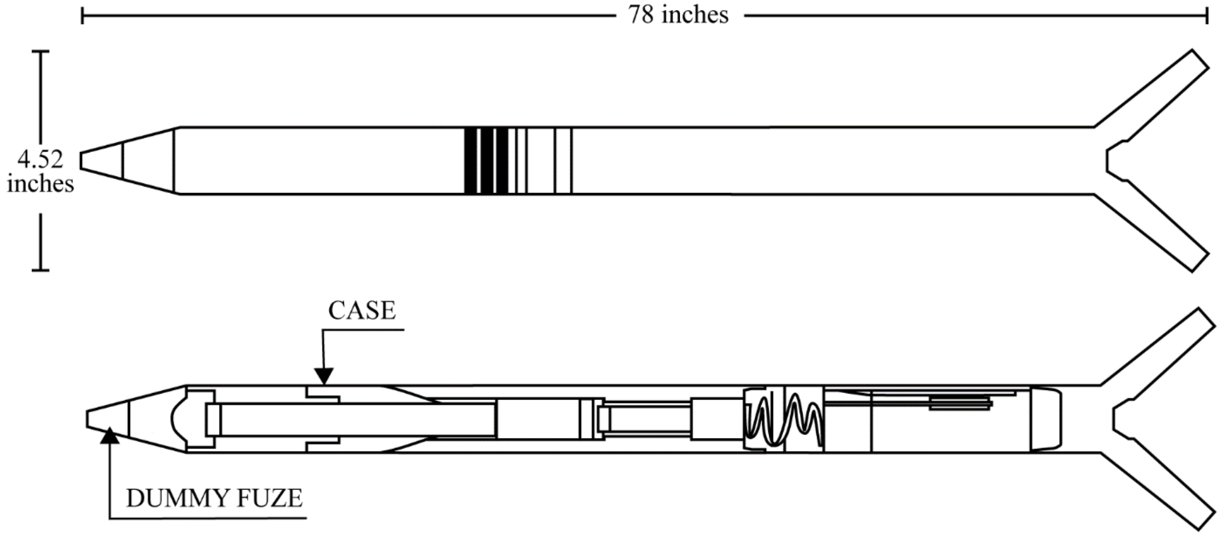

Figure 237: Rocket, 115-mm, Dummy Training, M60 (E49) - Line Drawing

Figure 238: Rocket, 115-mm, Dummy Training, M60 (E49) - Photograph

Specifications

Rocket, 115-mm, Dummy Training, M60 (E49) - Specifications and Other Data		Citation
Historical Name	Rocket, Training, Dummy, 115-mm, M60 (E49)	1 (p. 34a)
Developmental Information	E49	1 (p. 34a)
Type	Rocket	1 (p. 34a), 2 (p. 250), 3 (p. 52)
Size	115-mm	1 (p. 34a), 2 (p. 250)
Service	Army, Marine Corps	2 (p. 250), 4 (p. i)
Diameter	4.5 in. (11.5 cm)	2 (p. 250), 4 (p. 166)
Length	78 in. (198 cm)	2 (p. 250, 65, 67), 4 (p. 166)
Construction Material	Aluminum	4 (p. 166)
Spec/PD No	MIL-R-46986, PD 196-131-773	2 (p. 250)
FSN	1340-861-9817	2 (p. 250), 1 (p. 34a)

Rocket, 115-mm, Dummy Training, M60 (E49)

General Use and Description

The M60 115-mm dummy training rocket was used for training personnel in the techniques of loading rockets into the M91 multiple rocket launcher and preparing rockets for firing (2 p. 250), (4 p. 166).

The M60 115-mm dummy training rocket was identical to the M55 115-mm gas rocket except that it was a completely inert round. It was readily identified by a blue decal that contained its nomenclature affixed to the shipping and firing container (2 p. 250), (4 p. 166).

Explosive Train

This item required no explosive train.

Fuzing

Rocket, 115-mm, Dummy Training, M60 (E49) - Fuzing		
Fuze	**Note**	**Citation**
Not designated	Point detonating, dummy	4 (p. 166)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Fills

Rocket, 115-mm, Dummy Training, M60 (E49) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
EG (simulant agent for GB and VX)	N/A	N/A	55.0-58.0	24.9-26.3	-	2 (p. 250, 65), 4 (p. 166), 6 (p. 150)

Shipping/Packing

The rockets were packed 15 rounds per wood crate, which weighed between 1,340 and 1,400 pounds (1 p. 34a), (2 p. 250).

Key Dates

Rocket, 115-mm, Dummy Training, M60 (E49) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1961	CCTC 3933	5 (p. 34a), 6 (p. 152)
Obsoleted	1981	MSR 09846001	3 (p. 52)

Sources

1. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.

2. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.

3. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.

4. School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. U.S. Army Missile and Munitions Center.

5. Chemical Corps Technical Committee. 1955. Chemical Corps Book of Standards, 1955. Department of the Army.

6. Chemical Corps Technical Committee. 1961. CCTC Item # 3933, Classification of Rocket, Training, Dummy, 115-mm, M60 (E49) as a Standard-A Type. Department of the Army.

15.10 Rocket, 115-mm, Practice, M61 (E50)

Figures

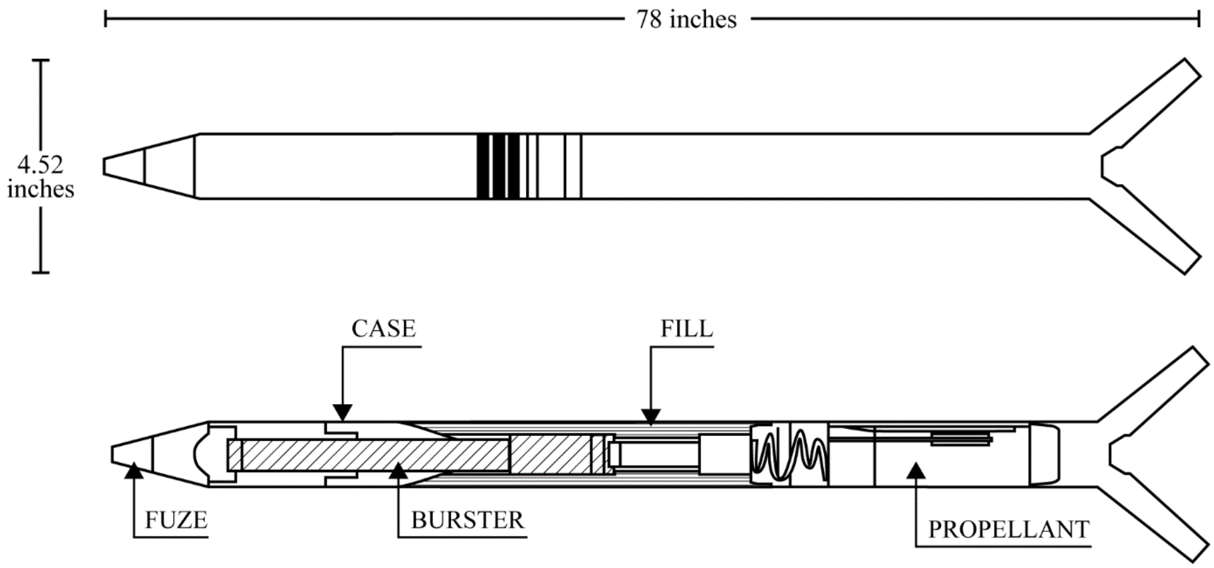

Figure 239: Rocket, 115-mm, Practice, M61 (E50) - Line Drawing

Specifications

Rocket, 115-mm, Practice, M61 (E50) - Specifications and Other Data		Citation
Historical Name	Rocket, Practice; Simulant EG, 115-mm, M61 (E50)	1 (p. 34a, 53d)
Type	Rocket	1 (p. 34a, 53d), 2 (p. 86)
Size	115-mm	1 (p. 34a, 53d), 3 (p. 251)
Service	Army	3 (p. 251)
Diameter	4.5 in. (11.5 mm)	2 (p. 86), 3 (p. 251), 4 (p. 165)
Length	Rocket, fuzed: 73-78 in. (185-198 cm) Fuze: 3.3 in. (8.38 cm) Warhead, fuzed: 33.4 in. (84.8 cm) Rocket motor: 35 in. (88.9 cm) Fins (extended) 4.6 in. (11.7 cm)	2 (p. 83), 3 (p. 251, 65, 67), 4 (p. 165)
Width	Fin: 16.9 in. (42.9 cm)	2 (p. 83)
Other Engineering Data	The rocket motor weighed 35 lbs. (15.9 kg).	2 (p. 89)
Construction Material	Rocket motor case: steel Fuze: steel Warhead: aluminum Fins: aluminum	2 (p. 83, 86, 89), 4 (p. 165)
Specification	MIL-R-46983	3 (p. 251)
Drawing	C90-1-17	3 (p. 251)
FSN	1340-858-5780	1 (p. 34a)

General Use and Description

The M61 115-mm simulant EG practice rocket was used for practice firing from the M91 multiple rocket launcher (3 p. 251).

Rocket, 115-mm, Practice, M61 (E50)

The M61 115-mm simulant EG practice rocket was identical to the M55-115 mm chemical agent rocket except that the warhead was filled with simulant EG. It was readily identified by a blue decal containing its nomenclature and one yellow band affixed to the shipping and firing container.

These rockets were folding fin stabilized, surface-to-surface type, fuzed with a point detonating fuze. The warhead contains a central burster that was threaded at one end to receive the fuze adapter. The rocket motor was threaded at the forward end to receive the warhead and at the rear end to receive the nozzle plate and fin-nozzle assembly. The fin-nozzle assembly contained a nozzle plate and four nozzles. Four folding fins were attached to the nozzle plate. The igniter lead wire passed through one of the four nozzles (2 p. 86, 87), (3 p. 251), (4 p. 165).

Explosive Train

Upon impact, the anvil was driven against the firing pin, which stripped the locking ring, that allowed the firing pin to be driven into the detonator to initiate the lead and booster. The booster initiated the burster which ruptured the warhead and dispersed the filler (2 p. 89).

Fuzing

Rocket, 115-mm, Practice, M61 (E50) - Fuzing		
Fuze	**Note**	**Citation**
M417	Point detonating, contained an M63 detonator and RDX booster	2 (p. 87), 3 (p. 251, 65, 67), 4 (p. 165)

Booster, Adapter-Booster, or Burster

Rocket, 115-mm, Practice, M61 (E50) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	1 lbs. (0.45 kg)	Composition B	Auxiliary burster	2 (p. 89)
Not designated	3 lbs. (1.36 kg)	Composition B	Burster.	2 (p. 89)

Fills

Rocket, 115-mm, Practice, M61 (E50) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
EG	10.0	4.53	58.0	26.3	EG is a simulant for GB and VX.	3 (p. 251), 4 (p. 165)

Shipping/Packing

The rockets were packed 15 rounds per wood crate, which weighed 1,400 pounds (1 p. 34a), (3 p. 252).

Rocket, 115-mm, Practice, M61 (E50)

Key Dates

Rocket, 115-mm, Practice, M61 (E50) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Classified	1962	CCTC 3961 (Limited Production Type)	6
Classified	1962	CCTC 4016, 4055	1 (p. 53d)
Standardized	1962	CCTC 4055 (Standard-A)	3 (p. 252)
Obsoleted	1981	MSR 09846001	5 (p. 52)

Sources

1. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.

2. Secretary of the Army. 1967. Technical Manual, TM 9-1385-51, Identification of Ammunition (Conventional) for Explosive Ordnance Disposal. Department of the Army.

3. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.

4. School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. U.S. Army Missile and Munitions Center.

5. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.

6. Chemical Corps Technical Committee. 1962. CCTC Item # 3961, Classification of Rocket, Practice, Simulant EG, 115-mm, E50 as a Limited Production Type. Department of the Army. 9 March.

15.11 Rocket, 5-inch, E43, E45

Figures

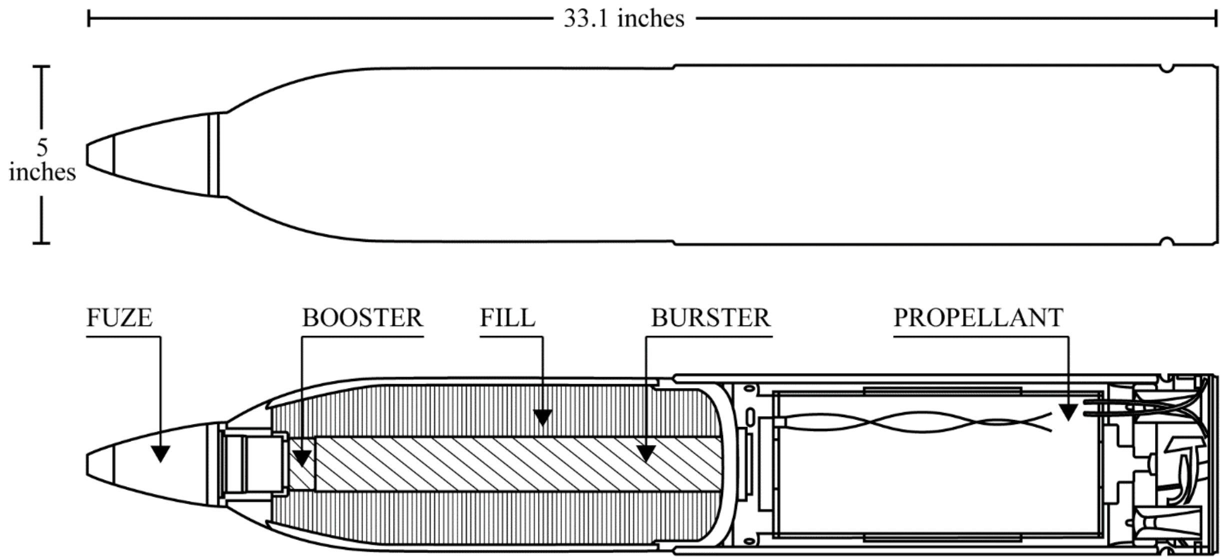

Figure 240: Rocket, 5-inch, E43, E45 - Line Drawing

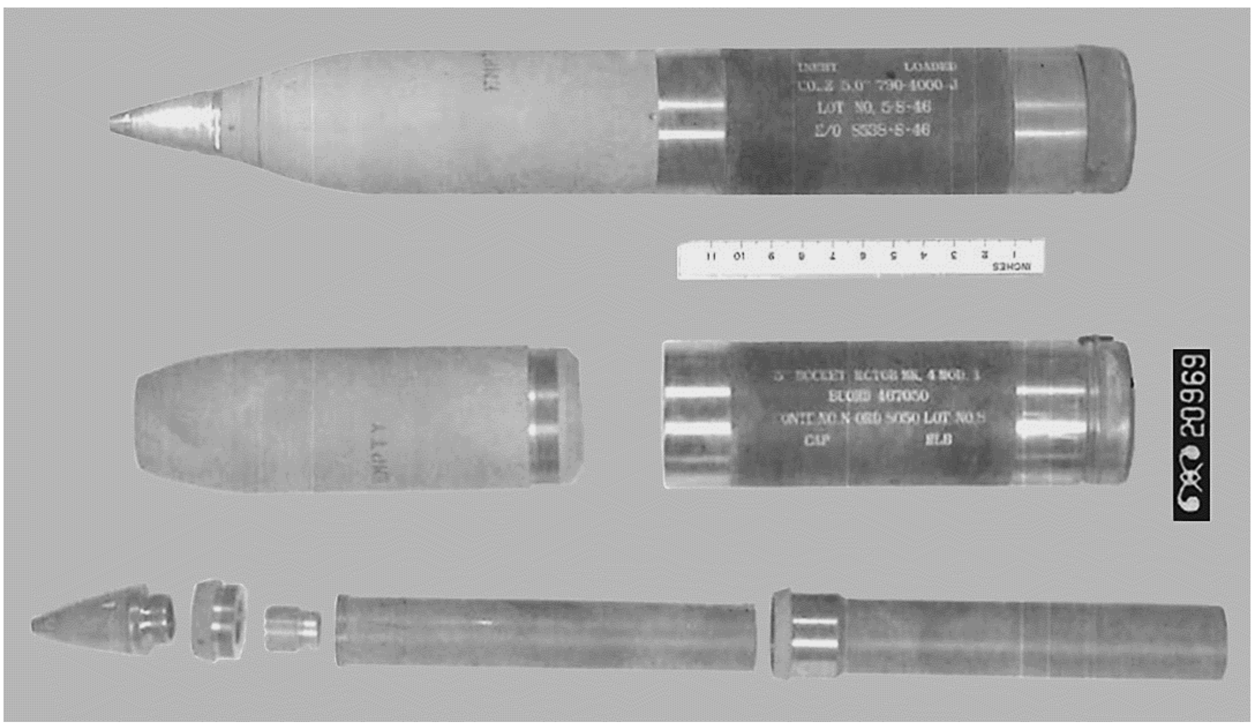

Figure 241: Rocket, 5-inch, E43, E45 - Photograph - Middle and Bottom: Rocket Components, Top: Complete Rocket

Rocket, 5-inch, E43, E45

Specifications

Rocket, 5-inch, E43, E45 - Specifications and Other Data		Citation
Historical Name	Rocket, Persistent Gas (HD), 5-Inch, E45	1 (p. 3)
Type	Rocket	1 (p. 3), 2 (p. 1)
Size	5-inch	1 (p. 3), 2 (p. 1)
Service	Navy	1 (p. 3)
Diameter	5 in. (12.7 cm)	1 (p. 3), 2 (p. 1), 3 (p. 7)
Length	Overall: 33.1 in. (84.07 cm) Rocket head, fuzed: 19.5 in. (49.5 cm) Rocket head, unfuzed: 15.8 in. (40.13 cm)	2 (p. 5, 10)
Other Engineering Data	Overall length of the E45 head was approximately $^{3}/_{16}$ inch shorter than the MK14 and $1^{1}/_{16}$ inches longer than the MK 10.	2 (p. 6)
Propellant	MK 4 Mod 1 spin-stabilized-rocket motor, or MK 4 Mod 4	2 (p. 64)
Maximum Range	3,600-3,700 yards (3,291-3,383 meters)	3 (p. 9)
Drawing	329675	2 (p. 4)

General Use and Description

The E43 and E45 rockets were developed to meet the requirement for a HD-filled warhead for the 5-inch spin-stabilized-rocket system. The primary purpose of this munition was for offshore bombardment of land targets within range of Naval gunfire with possible use against enemy surface forces (2 p. 2, 3, 64).

The E43 was patterned after the standard MK14, Mod 0 warhead. The E43 and E45 warheads were designed for use with Navy 5-inch spin-stabilized-rocket systems. The E43 and E45 rockets were identical except for the type of chemical filling employed. The E43 was GB-filled whereas the E45 was HD-filled.

The E45 used a modified MK14 Mod 0 rocket warhead during development. The rocket employed a conventional press fit burster well closure. The length of the burster well allowed the bottom of the well to seat on the base of the head (2 p. 3, 64).

Explosive Train

Upon impact, the point detonating fuze initiated the burster, which would break the shell and disseminate the filler (2 p. 58).

Fuzing

Rocket, 5-inch, E43, E45 - Fuzing		
Fuze	**Notes**	**Citation**
MK 30, Mod 13	Used with a MK 44 Mod 1 tetryl auxiliary detonating fuze	3 (p. 9)
MK 30, Mod 3	Used with a MK 44 Mod 1 tetryl auxiliary detonating fuze	2 (p. 2, 4)

Booster, Adapter-Booster, or Burster

Rocket, 5-inch, E43, E45 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	2.79-2.84 lbs. (1.27-1.29 kg)	Composition B	-	2 (p. 4), 3 (p. 9)

Rocket, 5-inch, E43, E45

Fills

Rocket, 5-inch, E43, E45 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	4.75-4.84	2.15-2.20	27.5-28.8	12.5-13.1	E43	2 (p. 3, 4), 3 (p. 9)
HD	5.64	2.55	28.3-29.6	12.8-13.4	E45, Gross weight is for the warhead.	1 (p. 3), 2 (p. 3, 4, 6)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

The E43 and E45 were designed to be fired from the MK102 rocket launcher (2 p. 3).

Key Dates

Rocket, 5-inch, E43, E45 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1952	CCTC 2661 (E43 GB-fill, E45 HD-fill)	2 (p. 2)

Sources

1. Edgewood Arsenal. 1959. Project and Associate Project Engineers EA. U.S. Army Chemical Corps.
2. Wagner, P., & Scherer, R., & LaMonica, V. 1956. Munitions Development Division, Technical Memorandum, TM 12, Development of Rocket, Non-Persistent Gas (GB), 5-Inch, E43 and Rocket, Persistent Gas (HD), 5-Inch, E45. Chemical Warfare Laboratories.
3. Dugway Proving Ground. 1958. Dugway Proving Ground Trial Record, DPGTR 231, CW 363 Dissemination Phase of the Final Engineering Testing of the Navy E-43, 5-Inch Spin-Stabilized, Agent-Filled, Rocket (U). U.S. Army, Chemical Corps Research and Development Command.

15.12 Warhead, Rocket, 5-inch, MK 40 Mod 0 (E43)

Figures

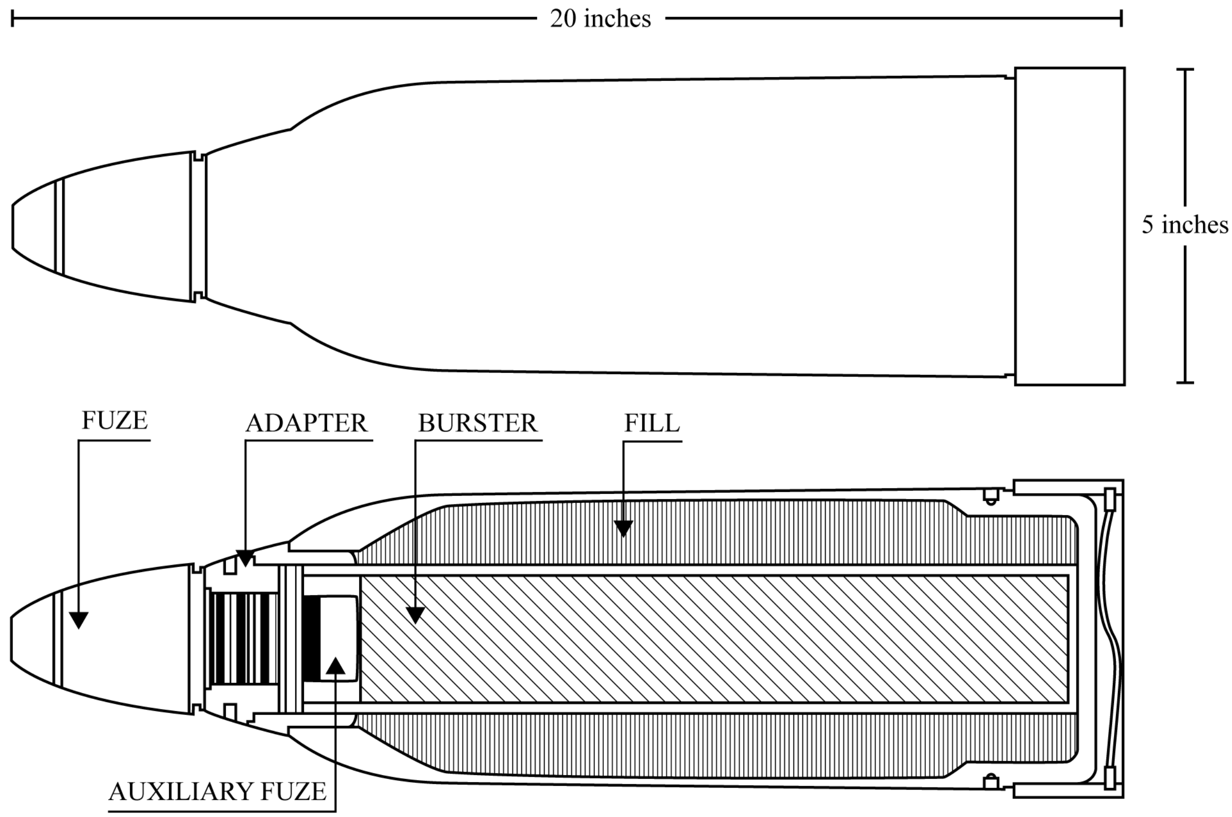

Figure 242: Warhead, Rocket, 5-inch, MK 40 Mod 0 - Line Drawing

Specifications

Warhead, Rocket, 5-inch, MK 40 Mod 0 - Specifications and Other Data		**Citation**
Historical Name	Warhead, 5-Inch Rocket, Gas, Nonpersistent, GB, Mk. 40 Mod 0	1 (p. 4-66)
Developmental Information	E43	(1 p. 4-66), (2 p. 4-65)
Type	Rocket	2 (p. 4-65)
Size	5-inch	1 (p. 4-66), 2 (p. 4-65), 3 (p. 16)
Service	Navy	2 (p. 4-65), 3 (p. 16)
Diameter	5.0 in. (12.7 cm)	1 (p. 4-67), 2 (p. 4-66)
Length	Rocket motor: 32.2 in. (81.79 cm) Warhead, fuzed: 20.0 in. (50.8 cm)	1 (p. 4-67), 2 (p. 4-66)
Other Engineering Data	Launcher: MK 50, MK 51, MK 52, MK 101, MK 105	1 (p. 4-67), 3 (p. 16)
Propellant	Rocket Motor: MK 4 Mod 4	1 (p. 4-67), 2 (p. 4-66)
Maximum Range	4,593 yards (4,200 meters)	3 (p. 16), 5 (p. 16, 17)
Drawing	1380991	1 (p. 4-67)

General Use and Description

The MK40 provided a toxic chemical offensive capability (1 p. 4-66), (2 p. 4-65).

Warhead, Rocket, 5-inch, MK 40 Mod 0

It was a spin-stabilized, surface-to-surface rocket warhead, which was developed to fulfill a Navy requirement for a chemical-filled 5-inch warhead for use in offshore bombardment. To afford interchangeability with existing 5-inch Naval rockets the MK 40 was patterned after the standard MK 14 Mod 0 warhead. The principal modifications of this head were an adaptation for a larger burster, providing for a nominal agent to burster ratio of 7:1, which provided better dissemination of the fill in aerosol form, and improved sealing of the burster well within the warhead to minimize leakage. The metal parts of the warhead were designed for use with standard Navy rocket motor and fuzes (1 p. 4-66), (2 p. 4-65).

Explosive Train

Upon impact, the point detonating fuze would function to set off the auxiliary fuze, which in turn ignited the burster charge to explode the munition and release the agent (1 p. 4-66), (2 p. 4-65).

Fuzing

Warhead, Rocket, 5-inch, MK 40 Mod 0 - Fuzing		
Fuze	**Notes**	**Citation**
MK 30 Mod 3	Point detonating	3 (p. 16), 5 (p. 16, 17)
MK 30 Mod 4	Point detonating	1 (p. 4-67), 2 (p. 4-66)
MK 44 Mod 2	Auxiliary	1 (p. 4-67)

Booster, Adapter-Booster, or Burster

Warhead, Rocket, 5-inch, MK 40 Mod 0 - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	2.80 lbs. (1.27 kg)	Composition "B"	-	1 (p. 4-67)

Fills

Warhead, Rocket, 5-inch, MK 40 Mod 0 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	4.80	2.17	50.5	22.9	-	1 (p. 4-66), 3 (p. 16)
HD	N/A	N/A	N/A	N/A	-	3 (p. 16), 5 (p. 16, 17)

Shipping/Packing

Available references did not provide this information.

Miscellaneous Information

During development, this item was designated E43 (1 p. 4-66), (2 p. 4-65).

Key Dates

Warhead, Rocket, 5-inch, MK 40 Mod 0 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Developed	1952	CCTC 2462	4 (p. X1, X2)

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

3. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

4. Chemical Corps Technical Committee. 1952. CCTC Item # 2462, Establishment of Projects 4-04-15-024, 5, 6. & 8-inch Gas Projectiles; 4-04-17-015, 5 & 6-inch Smoke Projectiles; 4-17-07-004, 5-inch Gas Rocket; & 4-17-07-005, 5-inch Smoke Rocket. Department of the Army.

5. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

15.13 Warhead, Missile, 6.5-inch, SS-11

Figures

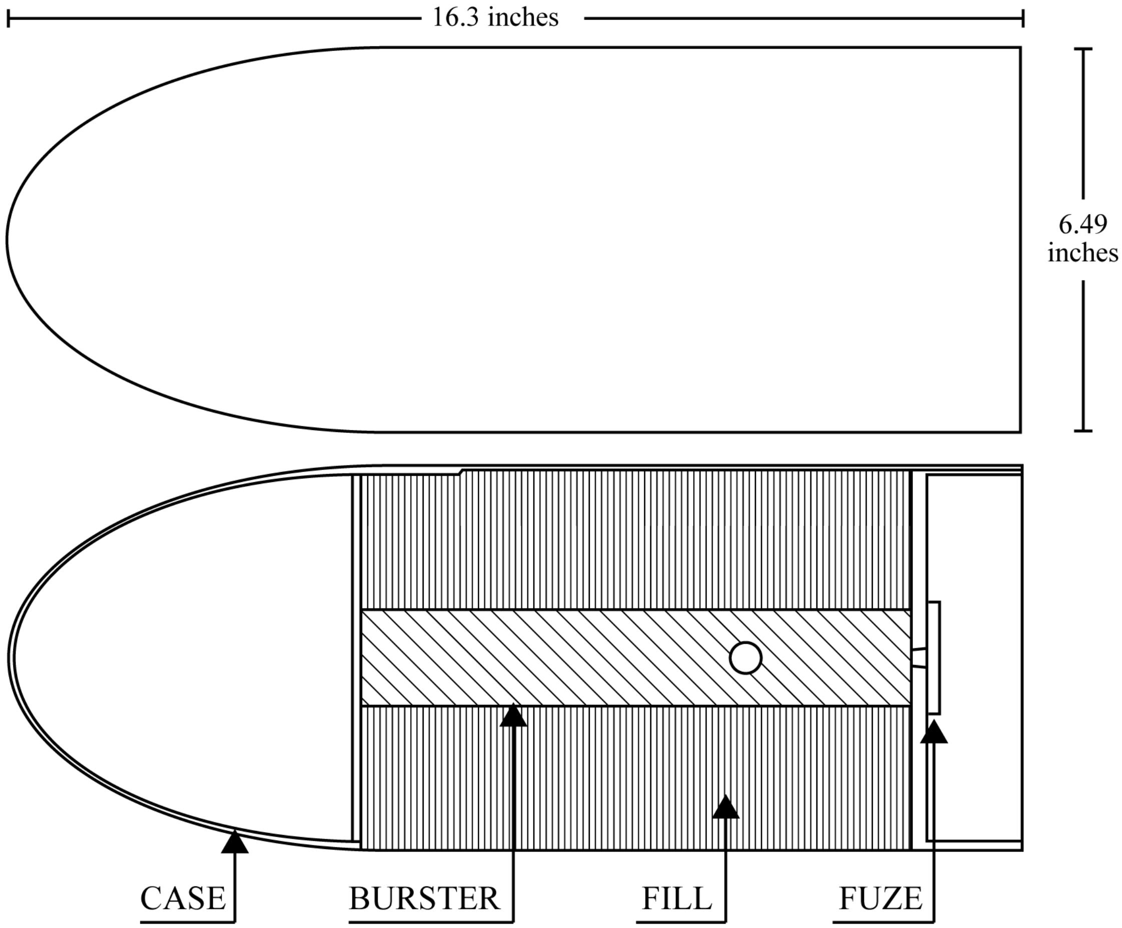

Figure 243: Warhead, Missile, 6.5-inch, SS-11 - Line Drawing

Figure 244: Warhead, Missile, 6.5-inch, SS-11 - Photograph - Model

Missile, 6.5-inch, Warhead, SS-11

Specifications

Warhead, Missile, 6.5-inch, SS-11 - Specifications and Other Data		**Citation**
Historical Name	Warhead, Missile, Chemical, (GB) SS-11	1 (p. 4-69)
Type	Missile	1 (p. 4-70)
Size	6.5-inch	2 (p. B-2)
Conflict	Cold War	-
Service	Army	-
Diameter	6.49 in. (16.5 cm)	1 (p. 4-70), 2 (p. 4-71)
Length	Missile: 42.5 in. (108 cm) Warhead: 16.3 in. (41.34 cm)	1 (p. 4-70), 2 (p. 4-71)
Width	Fin: 20 in. (50.8 mm)	1 (p. 4-70)
Other	Warhead skin thickness: 0.064 in. (0.16 cm)	1 (p. 4-70), 2 (p. 4-71)
Other Engineering Data	The missile had four fins.	1 (p. 4-70)
Maximum Range	3,510 meters	2 (p. 4-71)

General Use and Description

The SS-11 was antipersonnel and AT using chemical agents for use against small targets (1 p. 4-69), (2 p. 4-70).

The SS-11 was a light surface-to-surface missile propelled by two separate rocket motors: a booster for initial acceleration, and a sustainer for powered flight. Guidance commands were transmitted through two wires that unwound from the missile during flight. The missile was controlled and brought into alignment with the target during flight by means of a manual control stick located near the launch point. It was possible for one gunner to control a battery of six missiles. The missiles could be fired directly from their shipping containers. A small crew could set up the entire battery and ground station in about 15 minutes.

A cable allowed the gunner to select an observation point removed from the launch site. With the remote-controlled equipment, the gunner acquired the missile and guided it to the target. The best accuracy was attained at a maximum range.

The liquid fill was contained in the volume of cylindrical ogive nose between the skin and the burster tube (1 p. 4-69), (2 p. 4-70).

Explosive Train

Upon initiation of the fuze and consequent detonation of the burster at missile-target impact, the fill was disseminated as a cloud of vapor, aerosol, and liquid splash (1 p. 4-69), (2 p. 4-70).

Fuzing

Available references did not include information regarding fuzes for this item.

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Missile, 6.5-inch, Warhead, SS-11

Fills

Warhead, Missile, 6.5-inch, SS-11 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	7.00	3.17	13.0	5.89	Gross weight is for warhead.	1 (p. 4-70), 2 (p. 4-70)
VX	7.00	3.17	13.0	5.89	Gross weight is for warhead.	1 (p. 4-69), 2 (p. 4-71)

Shipping/Packing

Available references did not provide this information.

Key Dates

Available references did not include information regarding key dates for this item.

Sources

1. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.

2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.

15.14 Rocket, 7.2-inch, M25 (T21), M27 (T52)

Figures

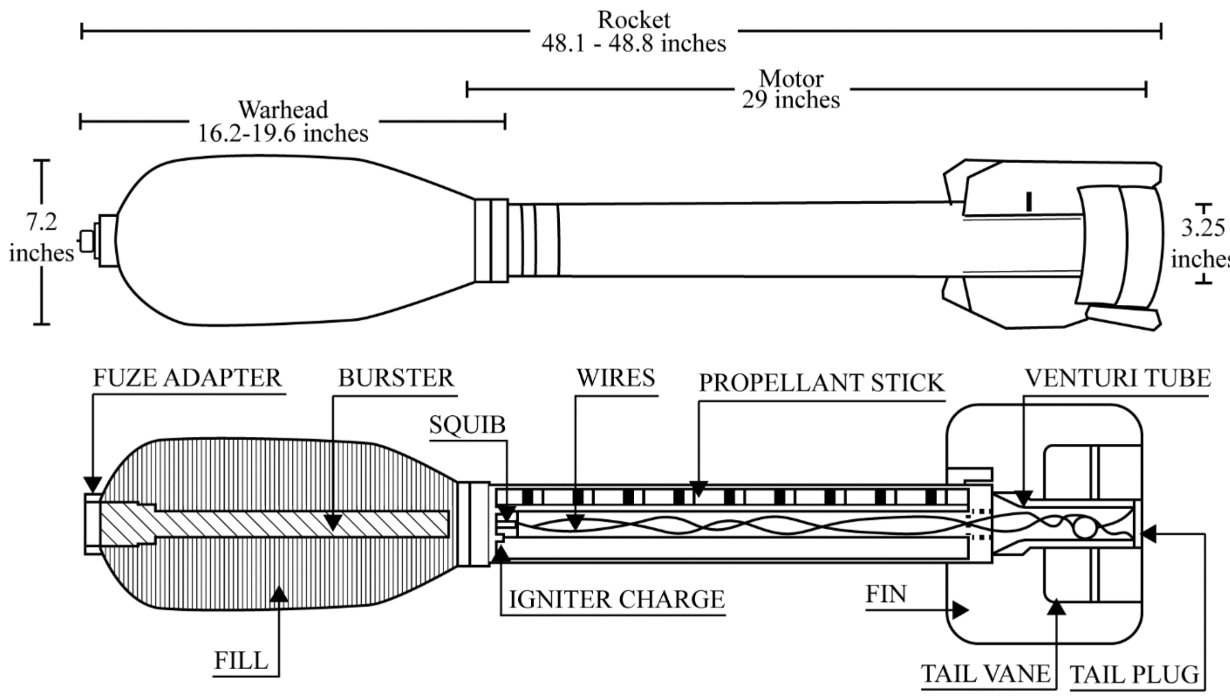

Figure 245: Rocket, 7.2-inch, M25, M27 - Line Drawing

Specifications

Rocket, 7.2-inch, M25 (T21), M27 (T52) - Specifications and Other Data		Citation
Historical Name	Rocket, Gas, CG, 7.2-Inch M25 (T21) Rocket, Gas, CK, 7.2-Inch, M27 (T52) Rocket, Chemical, 7.2-Inch, T52 Development Type	5 (p. 129, 130), 8 (p. 68 - 70), 9
Developmental Information	T21: M25 T52: M27	5 (p. 129, 130), 9
Type	Rocket	2 (p. 91), 8 (p. 68 - 70), 9
Size	7.2-inch	1 (p. 156), 8 (p. 68 - 70), 9
Service	Army, Marine Corps, Navy	1 (p. 156, 178), 3
Diameter	Warhead: 7.2 inches (18.3 cm) Rocket motor: 3.25 inches (8.26 cm)	1 (p. 178), 8 (p. 70), 9
Length	Overall: M25, M27: 48.1 in. (122 cm) T52: 48.8 in. (124 cm) Rocket motor: 29 in. (73.7 cm) Warhead: M25, M27: 16.2-18.8 in. (41.1-47.6 cm) T52: 19.6 in. (49.8 cm)	1 (p. 178), 8 (p. 70), 9
Other Engineering Data	Rocket motor: MK 5 Warhead: MK 7 Launchers: T28, T32, T40, T54, T64	1 (p. 178), 4, 5, 9, 10 (p. 43)
Construction Material	Steel	1 (p. 178)

Rocket, 7.2-inch, M25 (T21), M27 (T52) - Specifications and Other Data		**Citation**
Propellant	Navy: Grain MK 11 (single grain of solventless extruded ballistite) Army: four sticks of ballistite Weight: 5.25 lbs. (2.38 kg)	1 (p. 178), 9, 10 (p. 43), 12 (p. 78)
Range	3,300-3,430 yards (3,017-3,136 meters)	8 (p. 70), 9, 12 (p. 78)
Drawing	M25: 82-6-14 M27: 82-6-19	6 (p. 42)

General Use and Description

These rockets were used for disseminating chemical agent or for laying smoke screens. The rocket was fired from a 24-rail demountable, variable-elevation launcher carried in a 2.5-ton truck. The salvo was fired in 2.5 seconds, and the launcher could be reloaded in 1.5 minutes (1 p. 178), (10 p. 43).

The warhead container was a bulb-shaped steel tube open at both ends. The adapter fit inside the flange on the forward end of the container. The wide forward end of the adapter was internally threaded to seat the fuze. The burster tube, made of steel, fit inside the adapter, and extended downward into the container. The tube and the adapter were held together by a press fit and sealed with white lead paste. The rear end of the tube was closed. The motor was a steel tube, with the forward end externally threaded to screw into the connector of the head. The nozzle was slipped down through the open end of the motor body, and the end is welded to the inner edge of the motor body rim. The tail assembly had two tail vanes, a front shroud, and four fins spot-welded to the rear shroud. The forward shroud was riveted to the vanes but insulated from them. Four large fins were welded to the motor tube, passed over the forward shroud, and were welded to the rear shroud. The lead wires were connected to the two shrouds that served as contacts (1 p. 178) (10 p. 43).

The Navy C.W.R.-N rocket and Army T21 were identical and were produced by the Army using the Navy design and fuze. The only significant difference between the two was that the propellant for the Navy rocket consisted of a single grain of solventless extruded ballistite while the Army rocket used four grains of ballistite (10 p. 43).

The Army rocket M27 was structurally the same as the Navy rocket, but was filled with CK. The high explosive T24 rocket had a TNT filled MK 9 warhead, which was like the chemical MK 7 warhead. The T24 was fitted with the Fuze MK 147 (1 p. 178).

Explosive Train

When the propellant was ignited, the forward motion allowed the fuze to arm. On impact, the striker was driven into the lead azide detonator which initiated the burster tube, breaking open the warhead and ejecting the chemical filler (1 p. 178).

Fuzing

Rocket, 7.2-inch, M25 (T21), M27 (T52) - Fuzing		
Fuze	**Notes**	**Citation**
MK 137-1	-	10 (p. 43)
MK 147	Nose	1 (p. 178), 10 (p. 43)
MK 147 Mod 1	Nose - propeller-arming	1 (p. 178), 6 (p. 41), 9, 10 (p. 43), 12
MK137	Nose - point detonating	6 (p. 41), 7 (p. 5-57), 10 (p. 43)

Booster, Adapter-Booster, or Burster

Rocket, 7.2-inch, M25 (T21), M27 (T52) - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Not designated	N/A	N/A	Burster tube	8 (p. 68)

Fills

Rocket, 7.2-inch, M25 (T21), M27 (T52) - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
CG	20.0-20.6	9.07-9.34	51.8-53.2	23.5-24.1	M25, T21	2 (p. 91), 6 (p. 41), 8 (p. 70), 9
CK	18.5-20	8.39-9.07	51.8	23.5	M27, T52	1 (p. 178, 179), 6 (p. 41), 8 (p. 70), 9, 12 (p. 78)

Shipping/Packing

These rockets were issued as unassembled complete rounds: warhead, fuze and burster, and motor. Packed one round per wooden box. The fuze and burster were packed in a metal container in the wooden box (8 p. 68 - 70) (9).

Miscellaneous Information

Any chemical filler with specific gravity over 1.2 could be used as fill in the rocket. When CK became a limited standard item in 1951, there were no CK-filled 7.2-inch rockets on hand. When the M25 was recommended for obsoletion in 1955, there were no CG-filled 7.2-inch rockets on hand (1 p. 178), (11 p. 77), (13 p. 1, 2).

Key Dates

Rocket, 7.2-inch, M25 (T21), M27 (T52) - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1945	OCM 24660, 24850 (Initiation of development of T52, CK-filled)	12 (p. 77)
Standardized	1945	OCM 29817 (M25 with GG-fill)	13 (p. 1)
Standardized	1946	CCTC 1617 (M25 with GG-fill) CCTC 1618, OCM 28880 (M27 with CK-fill)	4 (p. 126), 5 (p. 129), 12 (p. 87)
Standardized	1951	CCTC 2289 (M27 CK-filled, Limited Standard)	11 (p. 76)
Obsoleted	1952	CCTC 2471 (M27 with CK-fill)	3 (p. 14)
Obsoleted	1955	OCM 35994 (M25 with GC-fill)	13 (p. 2)

Sources

1. Naval Sea Systems Command. 1969. Naval Sea Systems Command Ordnance Pamphlet, NAVSEA OP 1664, Change 1, U.S. Explosive Ordnance. U.S. Government Printing Office.

2. Department of the Army. 1956. Technical Manual, TM 3-300, Ground Chemical Munitions. U.S. Government Printing Office.

3. Chemical Corps Technical Committee. 1952. CCTC Item # 2471, Rocket, Gas, CK 7.2-inch, M27 – Classification as Obsolete Type. Department of the Army.

4. Chemical Corps Technical Committee. 1946. CCTC Item # 1617, Standardization of Rocket, Gas, CG 7.2-inch, M25 (T21). Department of the Army.

5. Chemical Corps Technical Committee. 1946. CCTC Item # 1618, Standardization of Rocket, Gas, CK 7.2-inch, M27 (T52). Department of the Army.

6. U.S. Army. 1954. Ammunition Complete Round Charts. Prepared by ORDBB-TG2.

7. Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Cancelled Fuzes, MIL-HDBK-146. Department of Defense.

8. Department of the Army. 1950. Technical Manual, TM 9-1950, Rockets. U.S. Government Printing Office. July.

9. Office of Chief of Ordnance. 1944. Rocket Materiel. Research and Development Service. 1 December. (DENIX file name: CW pages from Rocket Materiel)

10. U.S. Navy Bomb Disposal School. 1945. Rockets and Fuzes. 15 May.

11. Chemical Corps Technical Committee. 1951. CCTC Item # 2289, Reclassification of Cyanogen Chloride, CK to Limited Standard Type. Department of the Army.

12. Ordnance Committee. 1945. Ordnance Committee Meeting, OCM Item # 28880, Rocket, Gas, CK, M27 (T52) – Standardization Recommended. August 30.

13. Ordnance Committee. 1955. Ordnance Committee Meeting, OCM Item # 35994, Rocket, Gas, CG, M25 and Launcher, Rocket, Multiple, 7.2-Inch, M24 – Reclassification as Obsolete Types. November 3.

15.15 Rocket, 7.2-inch, T50, T51, T53

Figures

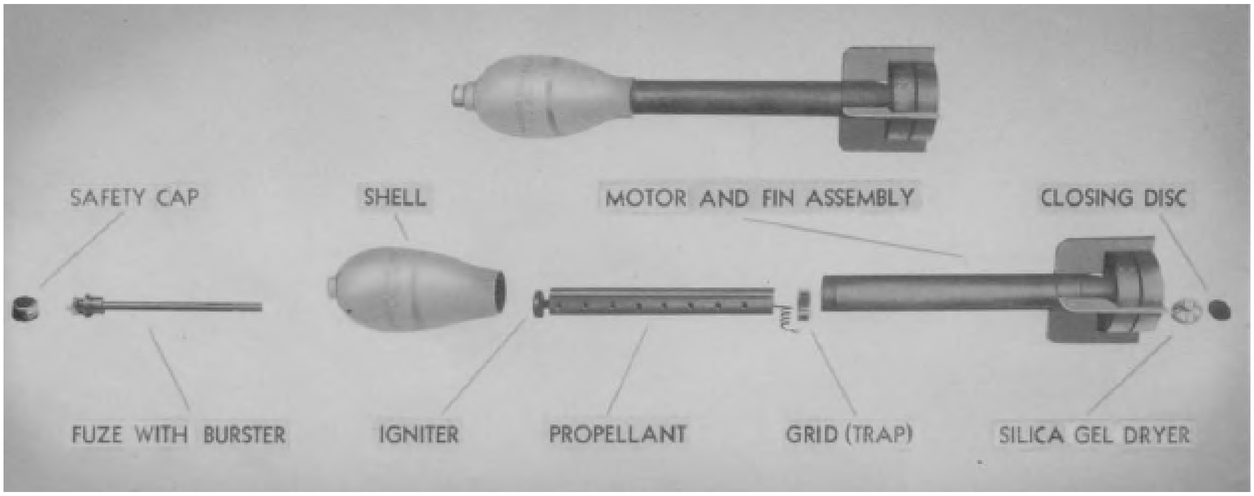

Figure 246: Rocket, 7.2-inch, T50 - Image

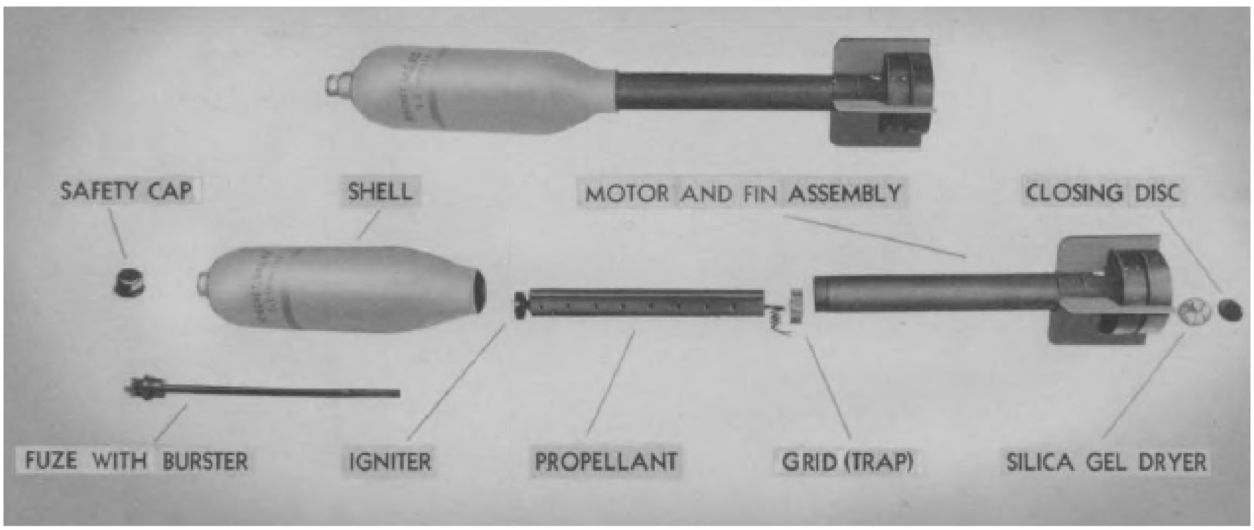

Figure 247: Rocket, 7.2-inch, T53 - Image

Figure 248: Rocket, 7.2-inch, T51 - Photograph

Rocket, 7.2-inch, T50, T51, T53

Specifications

Rocket, 7.2-inch, T50, T51, T53 - Specifications and Other Data		Citation
Historical Name	7.2-Inch, WP Smoke Rocket, T50 Development Type 7.2-Inch, FS Smoke Rocket, T51 Development Type 7.2-Inch, Chemical Rocket, T53 Development Type	1
Type	Rocket	1
Size	7.2-inch	1
Diameter	Warhead: 7.2 in. (18.3 cm) Rocket motor: 3.25 in. (8.26 cm)	1
Length	Overall: T50, T51: 44.1 in. (112 cm) T53: 55.9 in. (141.99 cm) Rocket motor: 29.2 in. (74.19 cm) Warhead: T50, T51: 15 in. (38.1 cm) T53: 26.7 in. (67.82 cm)	1
Other Engineering Data	Rocket motor: 3.25 in. (8.26 cm)	1
Propellant	5.25 lbs. (2.38 kg) solventless powder 2.57-in. (6.53 cm) outside diameter, 1-in. (2.54 cm) inside diameter, 20.1 in. (50.9 cm) long	1
Range	3,300 yards (3,017 meters)	1

General Use and Description

This rocket could be used for disseminating chemical agent. The shell was adapted to a 3.25-inch rocket motor (1).

Explosive Train

Available references did not provide this information.

Fuzing

Rocket, 7.2-inch, T50, T51, T53 - Fuzing		
Fuze	**Note**	**Citation**
MK 147 Mod 1	Nose- propeller-arming	1

Booster, Adapter-Booster, or Burster

Packed one round per wooden box. The fuze and burster were packed in a metal container in the wooden box (1).

Fills

Rocket, 7.2-inch, T50, T51, T53 - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
AC	14.9	6.75	51.7	23.4	T53	1
FS	19.4-21	8.49-9.52	51.8-53.2	23.4-24.1	T51	1, 3 (p. 178)
WP	21	9.52	51.75	23.4	T50	1

Shipping/Packing

Available references did not provide this information.

Key Dates

Rocket, 7.2-inch, T53 - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Other	1949	CCTC 2063 (Cancellation of Specification for AC-fill)	2

Sources

1. Office, Chief of Ordnance. 1944. Rocket Materiel. Research and Development Service. 1 December. (file name: CW pages from Rocket Materiel).

2. Chemical Corps Technical Committee. 1949. CCTC Item # 2063, Specification Changes for Record. Department of the Army.

3. Naval Sea Systems Command. 1969. Naval Sea Systems Command Ordnance Pamphlet, NAVSEA OP 1664, Change 1, U.S. Explosive Ordnance. U.S. Government Printing Office.

15.16 Warhead, Rocket, 318-mm, M206 (E20), Little John

Figures

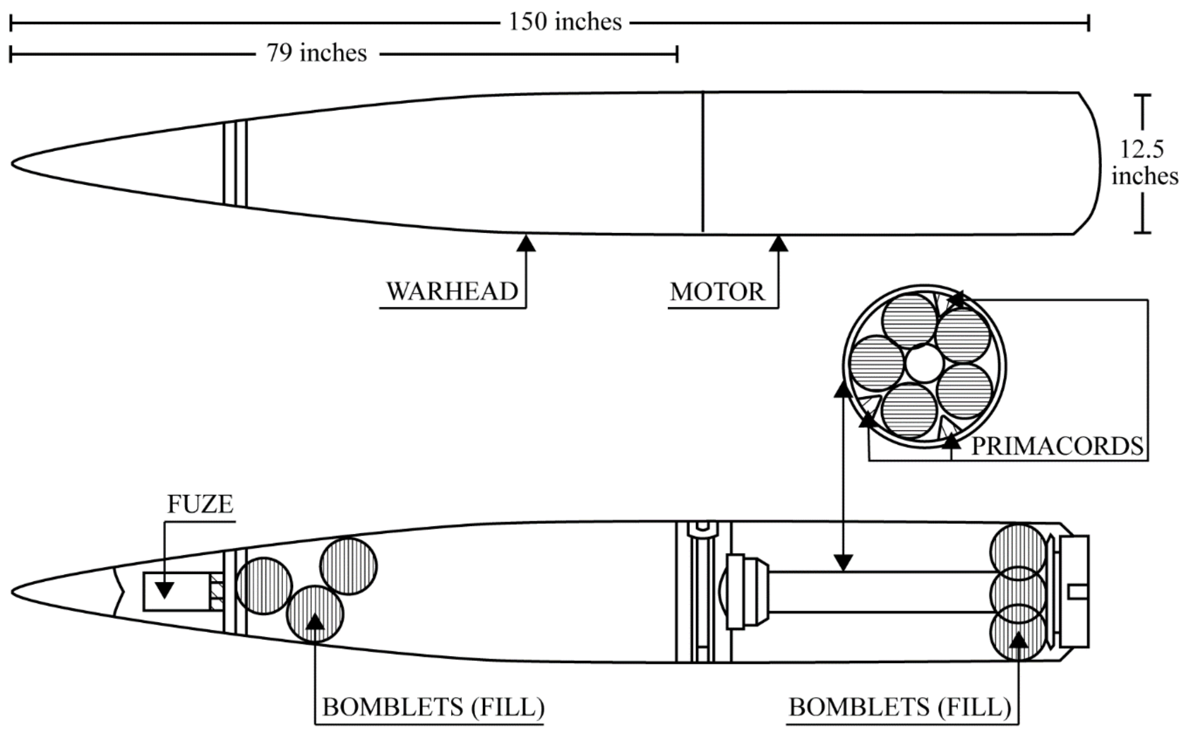

Figure 249: Warhead, Rocket, 318-mm, M206 (E20), Little John - Line Drawing

Figure 250: Warhead, Rocket, 318-mm, E20, Little John - Photograph

Specifications

Warhead, Rocket, 318-mm, M206 (E20), Little John - Specifications and Other Data		Citation
Historical Name	Warhead Section, 318mm Rocket, Gas, Nonpersistent, GB, M206 (E20) (Little John)	1 (p. 4-74), 2 (p. 52a), 3 (p. 4-75), 5 (p. 53), 6 (p. 125)
Developmental Information	E20	1 (p. 4-74)
Type	Rocket	2 (p. 52a), 3 (p. 4-75)
Size	318-mm	1 (p. 4-74), 2 (p. 52a)
Conflict	Cold War	3 (p. 4-75)
Service	Army, Navy	1 (p. iv), 4, 6 (p. 125)
Diameter	Warhead: 12.5 in. (31.8 cm)	1 (p. iv), 2 (p. 52a), 3 (p. 4-76)

Warhead, Rocket, 318-mm, M206 (E20), Little John - Specifications and Other Data		Citation
Length	Overall: 150 in. (381 cm) Warhead: 79 in. (200.66 cm)	1 (p. 4-75), 3 (p. 4-76), 5 (p. O-28b)
Wall Thickness	0.81 in. (2.06 cm)	3 (p. 4-75)
Other Engineering Data	Rocket: XM51, M51 Warhead: E20 Rocket motor: XM26E1 Launcher: XM34 Warhead weight, empty: 138 lbs. (62.6 kg)	1 (p. 4-75), 3 (p. 4-76), 5 (p. O-28b), 6 (p. 125)
Construction Material	Aluminum alloy	3 (p. 4-75), 5 (p. O-28b), 6 (p. 125)
Range	3,500-25,000 yards (3,200-22,860 meters)	1 (p. 4-75), 3 (p. 4-76)
Drawing	DL 90-11-133	6 (p. 125)
Specification	MIL-W-60074	5 (p. O-28b), 6 (p. 125)
FSN	1340-874-6611	5 (p. O-28b), 6 (p. 125)

General Use and Description

Little John provided toxic chemical offensive capability (1 p. 4-74), (3 p. 4-75).

Little John was a surface-to-surface warhead used to carry 52 each 4.5-inch M139 (E130R2) spherical bombs. The warhead for the Little John missile was based on a modification of the quadrant design and was helicopter transportable on its launching gear. It was sealed at three stations with gaskets to protect against any leakage that might occur. Two thrust cones aided the ejection of the bombs. The bombs in the lower part of the warhead were deflected outward by the upper thrust cone (1 p. 4-74), (3 p. 4-75).

Explosive Train

Three extruded longeron members were initiated through a detonator block. This block had a small central tetryl pellet into which a detonating cord was led and accepted the two flask tubes extending from the fuze. Upon functioning, the skin severed into three sections, aft and ram air pressure ejected the munitions (1 p. 4-74), (3 p. 4-75).

Fuzing

Warhead, Rocket, 318-mm, M206 (E20), Little John - Fuzing		
Fuze	**Notes**	**Citation**
M421 (T2075E1)	Mechanical time (warhead)	1 (p. 4-75), 3 (p. 4-76), 5 (p. O-28b), 6 (p. 125)
M912 (XM912)	Centrifugal, all-ways (bomblet)	1 (p. 4-75), 3 (p. 4-76), 5 (p. O-28b)

Booster, Adapter-Booster, or Burster

Rocket, 318-mm, Warhead, M206 (E20), Little John - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Primacord ™ Type I	N/A	N/A	Warhead opening	1 (p. 4-75), 3 (p. 4-76), 5 (p. O-28b)
M140 (E55)	N/A	N/A	Booster	5 (p. O-28b)
M45 (E20)	N/A	N/A	Burster	5 (p. O-28b)

Warhead, Rocket, 318-mm, M206 (E20), Little John

Fills

Bomblet	Agent	Fill Weight per Bomblet		Bomblets per Warhead	Fill Weight per Warhead		Warhead Gross Weight		Cross-Reference	Citation
		lbs.	kg		lbs.	kg	lbs.	kg	Section (Page #)	
E130R2	GB	1.3	0.59	52	67.6	30.6	262-265	118-120	7.6 (p. 128)	1 (p. 4-75), 2 (p. 52a), 3 (p. 4-76), 4 (p. 30), 6 (p. 126)
E130R2	VX*	N/A	N/A	52	N/A	N/A	262-265	118-120	7.6 (p. 128)	3 (p. 4-75), 4 (p. 30), 6 (p. 126)

*experimental fill

Shipping/Packing

The M206 was packed in a XM477 or M477 container that occupied 58 cubic feet. The shipping weight was 948 pounds (5 p. O-28b).

Miscellaneous Information

The M206 (E20) 318-mm warhead was filled with 52 each M139 (E130R2) bomblets, the rocket was generally referred to as Little John (1 p. 4-74, 4-75), (3 p. 4-75, 4-76).

Key Dates

Warhead, Rocket, 318-mm, M206 (E20), Little John - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Standardized	1964	CCTC 4185 (M206 Standard-A)	6 (p. 126)
Standardized	1964	AMCTC 2442 (M206 Standard-A)	2 (p. 52a)
Obsoleted	1969	AMCTC 7165, 7296 (Little John System)	2 (p. 52a), 7 (p. 54), 8

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. Department of the Army.
3. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
4. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
5. Chemical Corps Technical Committee. 1959. Chemical Corps Book of Standards, Edition of 25 November 1959. Department of the Army.
6. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. February. Department of the Army.
7. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
8. Subcommittee on Air Defense and Missiles. 1969. AMCTC Item # 7165, Reclassification of Rocket Weapon System, M318 (Little John) from Standard-A to Obsolete. U.S. Army Materiel Command.

15.17 Warhead, 762-mm, Rocket, M79 (E19R1), Honest John

Figures

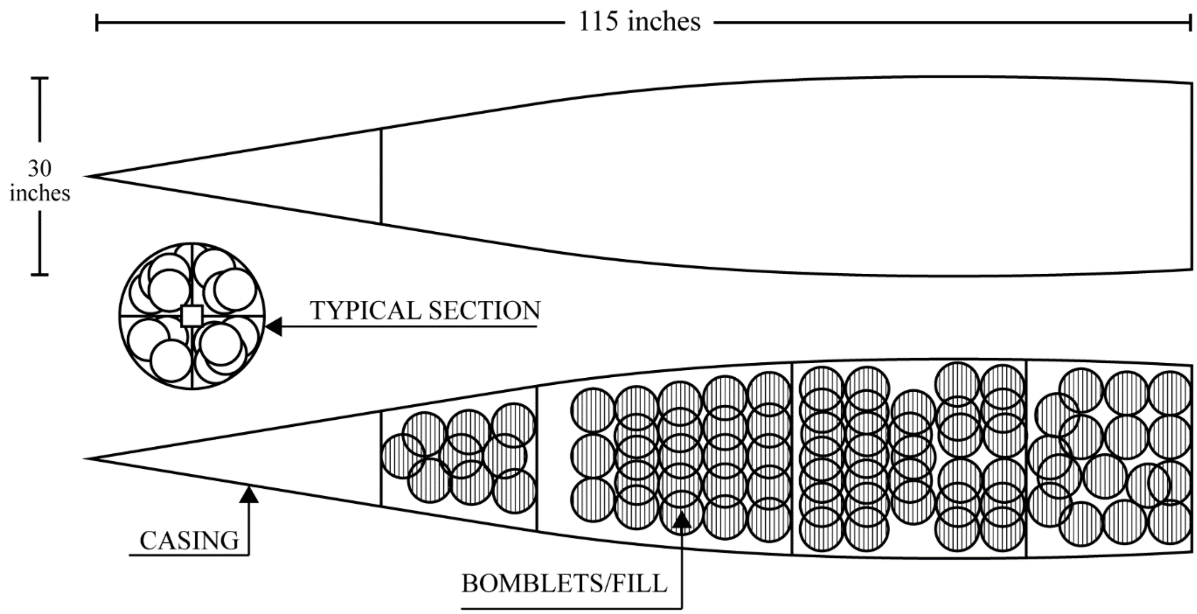

Figure 251: Warhead, 762-mm, Rocket, M79, Honest John - Line Drawing

Specifications

Warhead, 762-mm, Rocket, M79 (E19R1), Honest John - Specifications and Other Data		**Citation**
Historical Name	Warhead Section, 762mm Rocket, Gas, Nonpersistent, GB, M79 (Honest John)	1 (p. 4-80) 2 (p. 4-81)
Developmental Information	E19R1	1 (p. 4-81), 2 (p. 4-82), 7 (p. 516)
Type	Rocket	2 (p. 4-80), 2 (p. 4-81)
Size	762-mm	1 (p. 4-80), 2 (p. 4-81), 3 (p. 16)
Service	Army, Marine Corps	1 (p. 4-80), 2 (p. 4-81), 3 (p. 16)
Diameter	30 in. (76.2 cm)	1 (p. 4-81), 2 (p. 4-82)
Length	Warhead: 115 in. (292.1 cm)	1 (p. 4-81), 2 (p. 4-82)
Other Engineering Data	The complete rocket, including M79 warhead and M6A1 rocket motor, was M31A1C. Launchers: M386, M289, XM33	1 (p. 4-81), 2 (p. 4-82)
Construction Material	Aluminum alloy	1 (p, 4-80), 2 (p. 4-81)
Propellant	Rocket Motor: M6A1	1 (p. 4-81), 2 (p. 4-82)
Range	9,296-36,997 yards (8,500-33,830 meters)	1 (p. 4-81), 2 (p. 4-82), 3 (p. 16), 6 (p. 516), 7 (p. 516)
Drawing	D90-11-3	1 (p. 4-81), 2 (p. 4-82)
FSN	E19R1: 1340-716-1349 M79: 1340-716-1449	7 (p. 516, 524)

Warhead, 762-mm, Rocket, M79 (E19R1), Honest John

General Use and Description

The 762-mm rocket provided toxic chemical offensive capability for the M-31 series rockets (1 p. 4-80), (2 p. 4-81), (6 p. 516).

This concept was known as the quadrant warhead design and consisted of partitioning the missile nose cone casing into four longitudinal quadrants within which bomblets were packed. The warhead casing was made of an aluminum alloy sheet and was reinforced with internal structural members. A conical wedge was provided at the rear end of the warhead to assist in effecting clean ejection of the bomblets (1 p. 4-80), (2 p. 4-81).

Explosive Train

The fuze would function along the flight path, which in turn would detonate the detonating cord, separating the outer skin along the quadrant partitions thereby releasing the bomblets into the airstream. Upon impact, the fuzes within the individual bomblets would function to release the agent (1 p. 4-80), (2 p. 4-81).

Fuzing

Warhead, 762-mm, Rocket, M79 (E19R1), Honest John - Fuzing		
Fuze	**Notes**	**Citation**
T2075	Warhead, Mechanical time	1 (p. 4-81), 2 (p. 4-82), 3 (p. 16)
XM911	Munition, centrifugal arming, all-ways	1 (p. 4-81), 2 (p. 4-82)

Booster, Adapter-Booster, or Burster

Warhead, 762-mm, Rocket, M79 (E19R1), Honest John - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Primacord ™	N/A	Detonating cord	Warhead opening	1 (p. 4-81)

Fills

Bomblet	Agent	Fill Weight per Bomblet		Bomblets per Warhead	Fill Weight per Warhead		Warhead Gross Weight		Cross-Reference	Citation
		lbs.	kg		lbs.	kg	lbs.	kg	Section (Page #)	
M134, E130R2	GB	1.10	0.49	356	391-477	177-216	1,168-1,626	530-737	7.6 (p. 127)	1 (p. 4-81), 2 (p. 4-83)
M134, E130R2	VX*	N/A	N/A	356	N/A	N/A	N/A	N/A	7.6 (p. 127)	2 (p. 4-81, 4-85, 4-87), 3 (p. 4-82, 4-84)

*experimental fill

Miscellaneous Information

The M79 rocket was filled with 356 each M134 (E130R1) bomblets bombs (1 p. 4-81), (2 p. 4-82), (3 p. 16), (6 p. 516).

Key Dates

Rocket, 762-mm, Warhead, M79 (E19R1), Honest John - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1958	CCTC 3406 (M79)	5 (p. 78, 79)
Standardized	1960	CCTC 3694 (M79 Standard-B)	6 (p. 516), 7 (p. 524)
Obsoleted	1964	AMCTC 2621 (M79)	7 (p. 526)

Sources

1. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
3. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
4. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
5. Chemical Corps Technical Committee. 1958. CCTC Item # 3406, Revised Military Characteristics for GB Warhead for HONEST JOHN Rocket. Department of the Army.
6. Chemical Corps Technical Committee. 1962. CCTC Item # 4080, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. Department of the Army.
7. Chemical Biological Subcommittee. 1964. AMCTC Item # 2621, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. U.S. Army Materiel Command.

15.18 Warhead, 762-mm, Rocket, M190 (E19R2), Honest John

Figures

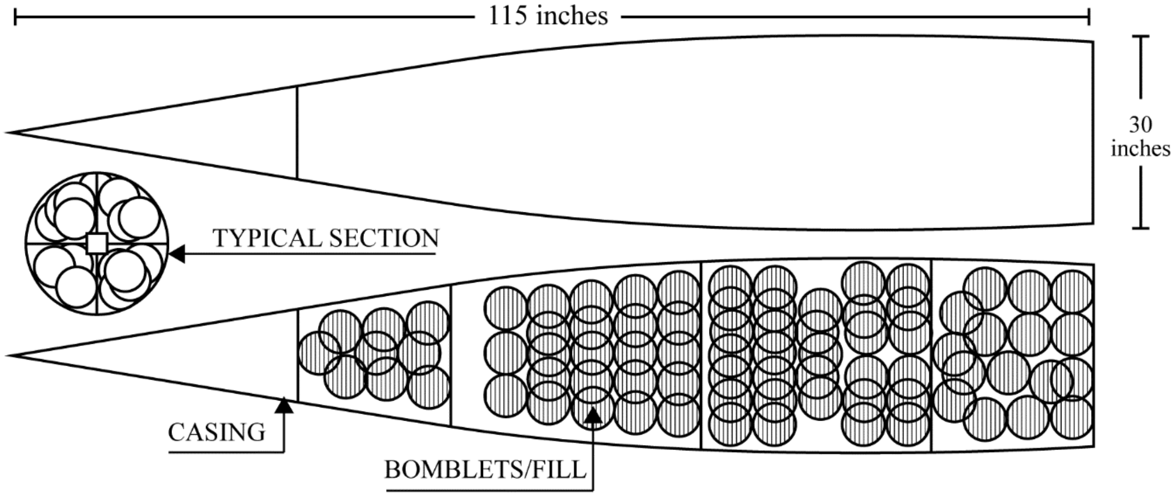

Figure 252: Warhead, 762-mm, Rocket, M190 (E19R2), Honest John - Line Drawing

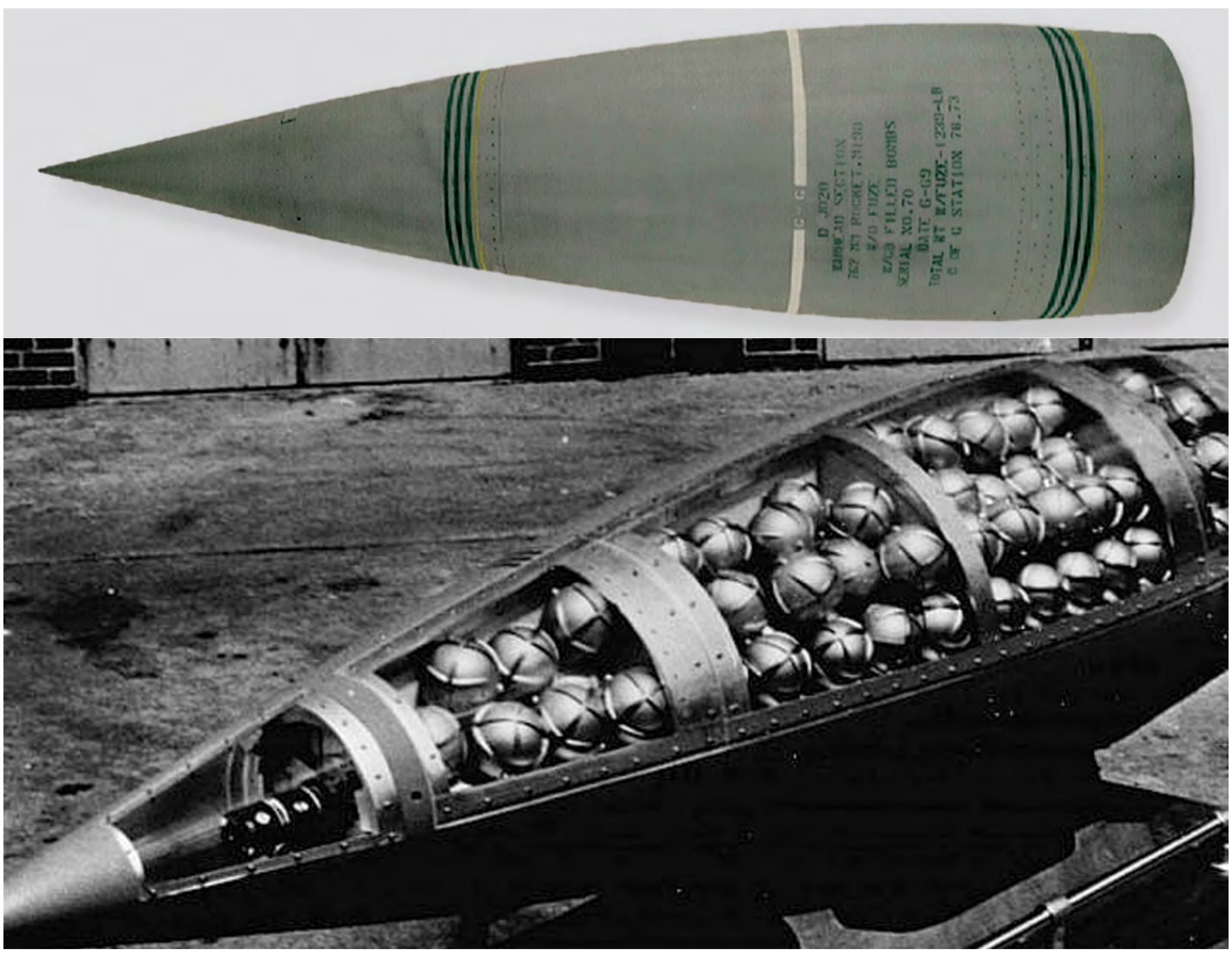

Figure 253: Warhead, 762-mm, Rocket, M190 - Photograph, Top: Intact, Bottom; Cutaway View

Specifications

Warhead, 762-mm, Rocket, M190 (E19R2), Honest John - Specifications and Other Data		**Citation**
Historical Name	Warhead Section, 762mm Rocket, Gas, Nonpersistent, GB M190 (Improved Honest John)	1 (p. 81), 2 (p. 4-82)
Developmental Information	E19R2	1 (p. 81), 2 (p. 4-82)
Type	Rocket	2 (p. 4-82)
Size	762-mm	3 (p. 4-83)
Service	Army, Marine Corps	2 (p. 4-80, 4-82, 4-84), 3 (p. 4-82), 4 (p. 16)
Diameter	30 in. (76.2 cm)	2 (p. 4-81, 4-83, 4-85), 3 (p. 4-82, 4-84)
Length	Warhead Length: 115 in. (292.1 cm)	2 (p. 4-81, 4-83, 4-85), 3 (p. 4-82, 4-84)
Other Engineering Data	The XM50 rocket consisted of an E19R2 warhead and an XM31 rocket motor.	1 (p. 4-27), 2 (p. 4-80, 4-82, 4-84), 3 (p. 4-82, 4-84)
Construction Material	Aluminum alloy	1
Propellant	Rocket motor XM-31 for E19R2 Rocket motor MGR-1A or MGR-1B for the M190	1 (p. 4-27), 2 (p. 4-80, 4-82, 4-84), 3 (p. 4-84)
Spec/PD No	MIL-W-46646	1 (p. 81), 7 (p. 3)
Drawing	DL90-11-8	1 (p. 81), 3 (p. 4-82)
FSN	1340-720-3763 (M190)	1 (p. 81)

General Use and Description

The 762-mm rocket provided toxic chemical offensive capability. The M190 was designed to provide a capability for the delivery of nonpersistent GB by the 762-mm (Honest John) rocket system (1 p. 81), (2 p. 4-80, 4-82, 4-84), (3 p. 4-81, 4-83, 4-85).

This concept was known as the quadrant warhead design and consisted of partitioning the missile nose cone casing into four longitudinal quadrants within which bomblets were packed. The warhead casing was made of an aluminum alloy sheet and was reinforced with internal structural members. A conical wedge was provided at the rear end of the warhead to assist in effecting clean ejection of the bomblets (1 p. 81), (2 p. 4-80), (3 p. 4-81).

Explosive Train

At a preset time along the flight path, the fuze would function, which in turn would detonate the detonating cord, separating the outer skin along the quadrant partitions thereby releasing the bomblets into the airstream. Upon impact, the fuzes within the individual bomblets would function to release the agent (1 p. 81), (2 p. 4-80, 4-82, 4-84), (3 p. 4-81, 4-83).

Fuzing

Warhead, 762-mm, Rocket, M190 (E19R2), Honest John - Fuzing		
Fuze	**Notes**	**Citation**
M421 (T2075E1)	Mechanical time	1 (p. 81)
T2075	Mechanical time	2 (p. 4-81)
XM 912	Centrifugal arming, all-ways impact, used with the E19R2	3 (p. 4-83)

Booster, Adapter-Booster, or Burster

Warhead, 762-mm, Rocket, M190 (E19R2), Honest John - Booster, Adapter-Booster, or Burster				
Type	**Explosive Weight**	**Explosive Type**	**Notes**	**Citation**
Primacord ™	N/A	Detonating cord	Warhead opening	3 (p. 4-84)

Fills

Warhead, 762-mm, Rocket, M190 (E19R2), Honest John - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	462-477	209-216	1,168-1,626	529-737	Agent weight and fill weight were dependent on type and quantity of bomblet used.	2 (p. 4-80), 3 (p. 4-83)

Shipping/Packing

The M190 warhead section was packaged in a heat-sealed barrier bag with five sampling ports. The warhead section in the barrier bag was secured on the cradle of an M480E2 shipping and storage container. The warhead section weighed approximately 1,240 pounds. The warhead section in the M480E2 shipping container had a gross weight of approximately 1,725 pounds and a cubage of 179 cubic feet (1 p. 82).

Miscellaneous Information

The M190 762-mm rocket warhead was used with 368 each M139 bomblets and was referred to as Honest John (2 p. 4-81, 4-85, 4-87), (3 p. 4-82, 4-84), (4 p. 16).

Key Dates

Warhead, 762-mm, Rocket, M79 (E19R1) and M190 (E19R2), Honest John - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1958	CCTC 3406	6
Standardized	1962	CCTC 4080 (M190 Standard-A)	7
Standardized	1964	AMCTC 2621 (M190 Standard-A)	8

Sources

1. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.
2. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
3. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
4. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
5. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
6. Chemical Corps Technical Committee. 1958. CCTC Item # 3406, Revised Military Characteristics for GB Warhead for HONEST JOHN Rocket. Department of the Army.
7. Chemical Corps Technical Committee. 1962. CCTC Item # 4080, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. Department of the Army.

8. Chemical Biological Subcommittee. 1964. AMCTC Item # 2621, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. U.S. Army Materiel Command.

15.19 Warhead, 787-mm, Missile, M212 (E21), Sergeant

Figures

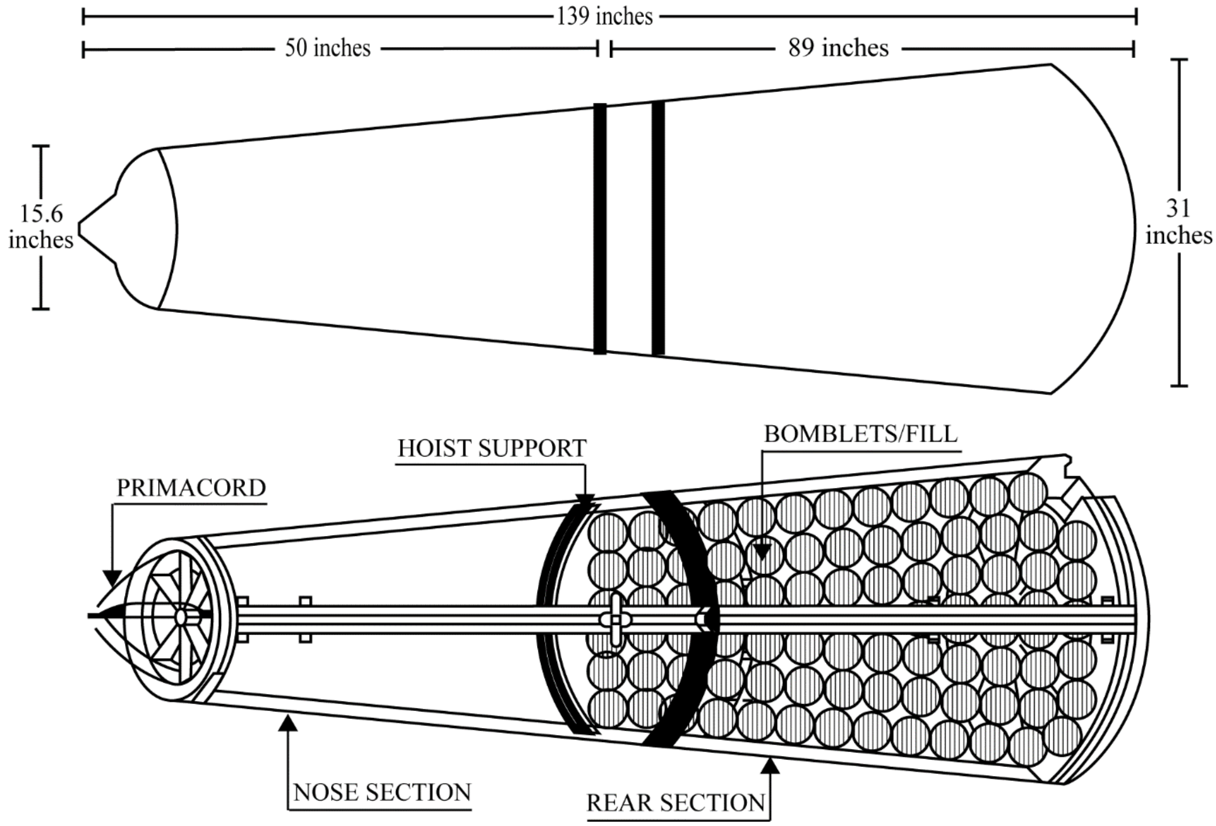

Figure 254: Warhead, 787-mm, Missile, M212 (E21), Sergeant - Line Drawing

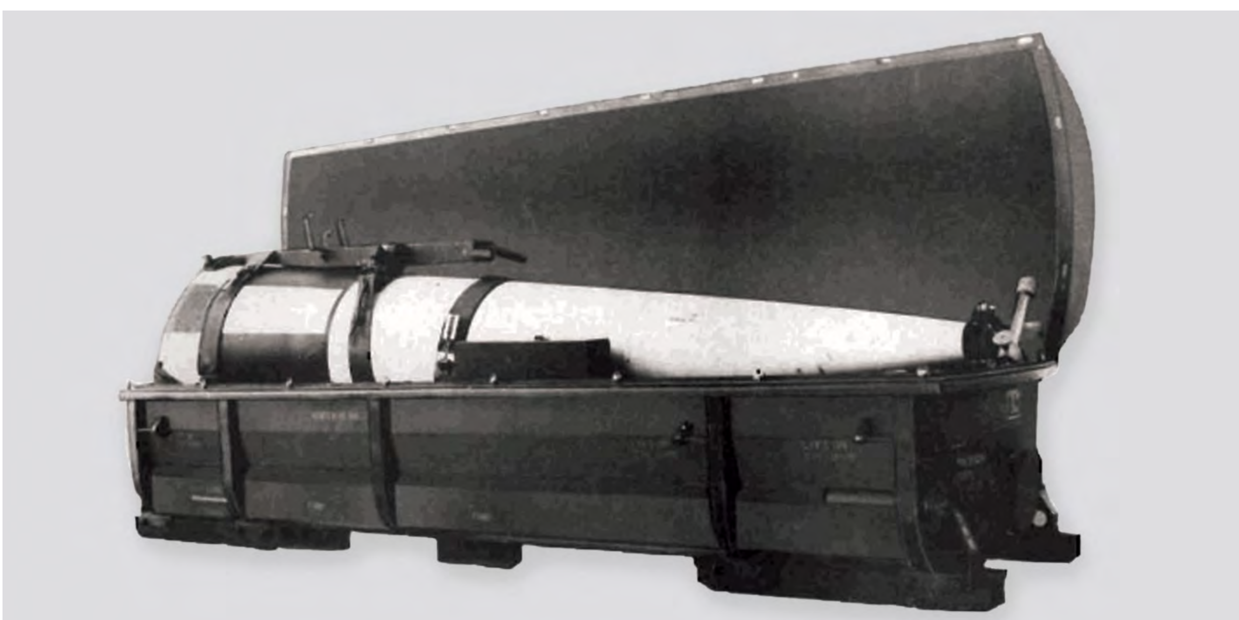

Figure 255: Warhead, 787-mm, Missile, M212, Sergeant – Photograph – Warhead in Shipping Container

Warhead, 787-mm, Missile, M212 (E21), Sergeant

Specifications

Warhead, 787-mm, Missile, M212 (E21), Sergeant - Specifications and Other Data		**Citation**
Historical Name	Warhead Section, Guided Missile, Gas, Nonpersistent GB, M212	1 (p. 78)
Developmental Information	E21	2 (p. 4-77), 3 (p. 4-76)
Type	Missile	2 (p. 4-77), 3 (p. 4-76)
Size	787-mm	2 (p. 4-77)
Service	Army, Navy	1 (p. 78), 2 (p. 4-77), 4 (p. 16)
Diameter	31 in. (78.74 cm)	2 (p. 4-78), 3 (p. 4-77)
Length	Nose section: 50 in. (127 cm) Rear section: 89 in. (226.06 cm) Warhead Length: 139 in. (353.06 cm)	2 (p. 4-47, 4-78), 3 (p. 4-46, 4-77)
Construction Material	Aluminum	1 (p. 78)
Propellant	Rocket Motor: XM-53	2 (p. 4-78), 3 (p. 4-77)
Spec/PD No	MIL-W-60081	-
Drawing	E123-1-41	1 (p. 78)
FSN	1336-764-5699 (Warhead)	1 (p. 78)

General Use and Description

Supersonic, bomblet loaded, surface-to-surface missile designed to provide toxic offensive capability.

The M212 nonpersistent GB gas guided missile warhead section was designed to provide a GB weapon for the Sergeant artillery guided missile system (1 p. 78), (2 p. 4-77), (3 p. 4-76).

The M212 was a surface-to-surface munition powered by a solid propellant rocket motor that burned to completion on each flight. The warhead was cone shaped with an aluminum skin, and was loaded with 330 bomblets (i.e., M139 [E130R20]) for GB or 720 bomblets (i.e., E134) for VX. The fuze was in the nose section.

Since the warhead compartment was volume limited, the fore and aft dividers were eliminated. Four longitudinal non-load carrying detonating cord back up bars were held tightly against the inside skin surface by clips and recessed into the forward and aft bulkheads. Detonating cord was also located circumferentially in these bulkheads (1 p. 78), (2 p. 4-77), (3 p. 4-76), (5 p. 3, 4).

Explosive Train

Upon functioning the warhead skin was split by the detonating cord and was peeled off, which would release the munitions (2 p. 4-77), (3 p. 4-76).

Fuzing

Missile, 787-mm, Warhead, M212 (E21), Sergeant - Fuzing		
Fuze	**Notes**	**Citation**
M17	Electric and barometric	1 (p. 78)
M71 (XM-71)	Electric and barometric	1 (p. 78), 2 (p. 4-78), 3 (p. 4-77), 5 (p. 5)

Booster, Adapter-Booster, or Burster

Available references did not include information regarding boosters, adapter-boosters, or bursters for this item.

Warhead, 787-mm, Missile, M212 (E21), Sergeant

Fills

Missile, 787-mm, Warhead, M212 (E21), Sergeant - Fill Types and Weights						
Chemical	**Fill Weight**		**Gross Weight**		**Notes**	**Citation**
	Pounds	**Kilograms**	**Pounds**	**Kilograms**		
GB	418-429	190-194	1,611-1,640	730-744	In M139 bomblets	1 (p. 78), 2 (p. 4-78), 3 (p. 4-77), 6 (p. 16-17)
VX	418	190	1,611-1,640	730-744	Experimental in E134 bomblets	2 (p. 4-78), 6 (p. 16), 8 (p. 16-17)

Shipping/Packing

The warhead was shipped in one M493 container, which weighed 3,061 pounds, and was 176.7 cubic feet (1 p. 78).

Miscellaneous Information

Thirteen warhead sections were fired during the development, engineering, and service test program. A missile with a chemical warhead tested in 1961 detonated about five seconds after launch. Although the M212 chemical warhead was classified as Standard-A in 1964, they were never approved for production (5 p. 7, 13), (8 p. 182, 193, 234).

It was used with M139 (E130R2) or E134 bomblets (2 p. 4-78), (3 p. 4-76).

Key Dates

Missile, 787-mm, Warhead, M212 (E21), Sergeant - Key Dates			
Activity	**Year**	**Notes**	**Citation**
Military Characteristics	1955	OCM 35863 (Sergeant Missile, XSSM-A-27)	8 (p, 259)
Military Characteristics	1958	CCTC 3467 (Chemical Warhead)	5 (p. 3)
Classified	1961	OCM 37042, 37867 (Sergeant Missile System, Limited Procurement Type)	5 (p. 2)
Standardized	1964	AMCTC 2874 (Standard-A)	5 (p. 11)
Obsoleted	1985	MSR 07796014 (GB-fill)	7 (p. 54)

Sources

1. Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. Department of the Army.
2. Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Department of the Navy.
3. Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). Department of the Navy.
4. Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. Department of the Army.
5. Chemical-Biological Subcommittee. 1964. AMCTC Item # 2874, Classification of Warhead Section, Guided Missile, Gas, Nonpersistent GB, M212 (E21) (SERGEANT) as a Standard-A Type. U.S. Army Materiel Command.
6. Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.
7. Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. U.S. Army Armament, Munitions & Chemical Command.
8. Cagle, M. T. 1971. History of Sergeant Weapon System, Historical Monograph Project Number: AMC: 55M. U.S. Army Missile Command. 28 January.

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16 Abbreviations and Acronyms

A

ABS	acrylonitrile-butadiene-styrene
AC	hydrogen cyanide
A.E.F.	American Expeditionary Forces
AMCTC	Army Materiel Command Technical Committee
AS	asbestine suspension
AT	anti-tank

B

BA	bromoacetone
BBC	bromobenzyl cyanide
BM	Berger mixture
BZ	3-quinuclidinylbenzilate

C

CA	bromobenzyl cyanide
CAIS	chemical agent identification set
CAITS	Chemical Agent Identification Training Set
CAS	Chemical Abstract Service
CB	chemical biological
CBU	cluster bomb unit
CC	cyanogen chloride
CCSD	Chemical Corps Safety Directive
CCTC	Chemical Corps Technical Committee
CG	phosgene
CK	cyanogen chloride
CL	chlorine
cm	centimeter(s)
CN	chloroacetophenone
CNB	chloroacetophenone solution (45% benzene + 10% chloroacetophenone + 45% carbon tetrachloride)

CNC	chloroacetophenone solution (70% chloroacetophenone + 30% chloroform)
CNS	chloroacetophenone solution (38.4% chloropicrin + 23% chloroacetophenone + 38.4% chloroform)
CRDL	Chemical Research and Development Laboratories
CRLR	Chemical and Biological Laboratories Report
CS	2-chlorobenzalmalononitrile
CWC	Chemical Weapons Convention
CWM	chemical warfare material
CWS	Chemical Warfare Service
CWTC	Chemical Warfare Technical Committee
CX	phosgene oxime

D

DA	diphenylchloroarsine
DC	District of Columbia
DF	methylphosphonic difluoride
DM	adamsite
DOD	Department of Defense
DP	diphosgene
DPG	Dugway Proving Ground
DPGLR	Dugway Proving Ground Letter Report
DPGMR	Dugway Proving Ground Memorandum Report
DPGR	Dugway Proving Ground Trial Report

E

EATR	Edgewood Arsenal Technical Report
ED	ethyldichloroarsine
EG	simulant agent for GB and VX
EOD	Explosive Ordnance Disposal

F

FM	titanium tetrachloride

FNH	flashless nonhygroscopic
FS	sulfur trioxide and chlorosulfonic acid
FSN	Federal Stock Number

G

g	gram
GA	tabun
GB	sarin
GB2	binary sarin
GF	cyclosarin

H

H	mustard
HC	zinc oxide and hexachloroethane
HCN	hydrocyanic acid
HD	distilled mustard
HDV	thickened distilled mustard
HE	high explosive
HEAT	high explosive anti-tank
HL	mustard-lewisite mixture
HN	nitrogen mustard
HN-1	nitrogen mustard (Ethyl)
HN-2	nitrogen mustard (Methyl)
HN-3	nitrogen mustard (Tri)
HP	solution of white phosphorous in distilled mustard with CS-2
HQ	mustard-sesquimustard (Q) mixture
HS	sulfur mustard
HT	distilled mustard and T-mixture
HV	thickened distilled mustard

I

IM	incendiary mixture (isobutyl methacrylate)

K

KCN	potassium cyanide
KJ	stannic chloride

L

L	lewisite
lb.	pound

M

M-1	lewisite
MD	methyldichloroarsine
Mk	Mark
mL	milliliter
MLRS	Multiple Launch Rocket System
mm	millimeter(s)
MR	molasses residuum
MSR	Materiel Status Record

N

N/A	information not available
NARA	National Archives and Records Administration
NAVORD	Naval Ordnance
NAVSEA	Naval Sea Systems Command
NAVWEPS	Bureau of Naval Weapons
NC	chloropicrin and stannic chloride
NM	polymethylsulfide
NP	napalm
NSCMP	Non-Stockpile Chemical Materiel Project
NSN	national stock number

O

OCM	Ordnance Committee Meeting

OP	Ordnance Pamphlet
OPA	isopropyl alcohol and isopropylamine solution
OPCW	Organisation for the Prohibition of Chemical Weapons
ORSD	Office of Scientific Research and Development

P

PD	phosgene plus diphenylchlorarsine (CG+DA)
PETN	pentaerythritol tetranitrate
PG	chloropicrin and phosgene
PIG	shipping container
PS	chloropicrin
psi	pounds per square inch
PT	oil and incendiary mixture/thickened fuel
PT-1	oil and incendiary mixture/thickened fuel
PWP	plasticized white phosphorus

Q

Q	sesquimustard
QL	ethyl-2-diisopropylaminoethyl-methylphosphonite

R

RCWM	recovered chemical warfare material
RDX	Royal Demolition Explosive (cyclonite - hexahydro-1,3,5-trinitro-1,3,5-triazine)

S

SA	arsine
SCAITS	Simulant Chemical Agent Identification Training Set

T

TB	Technical Bulletin
TCIR	Technical Command Informal Report
TCR	Technical Command Report

TDMR	Technical Division Memorandum Report
Th.	thermite
TH3	thermite
TM	Technical Manual
TNT	trinitrotoluene
TO	Technical Order
TR	Technical Regulation

U

USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USATECOM	U.S. Army Test and Evaluation Command
UXO	unexploded ordnance

V

VT	variable time
VX	O-Ethyl S(2-diisopropylaminoethyl) methylphosphonothioate

W

WP	white phosphorous
WW	World War

17 Definitions

Blood Agent: Most blood agents are cyanide-containing compounds, absorbed into the body primarily by breathing; AC and CK are the important agents in this group. Blood agents are highly volatile and, therefore, nonpersistent even at very low temperatures. These agents can be dispersed by artillery shell, mortar, rocket, aircraft spray, or bomb. At high concentrations, both compounds cause effects within seconds and death within minutes in unprotected individuals. The cyanides affect body functions by poisoning the cytochrome oxidase system; this poisoning prevents cell respiration and the normal transfer of oxygen from the blood to body tissues. Cyanogen chloride also acts as a choking agent. The standard protective mask gives adequate protection against field concentrations. (Departments of the Army, Navy, and Air Force, 1990 p. 25)

Blister Agent: Blister agents are also known as vesicants. All the blister agents are persistent, and all may be employed in the form of colorless gases and liquids. Blister agents damage any tissue that they contact. They affect the eyes and lungs and blister the skin. They damage the respiratory tract when inhaled and cause vomiting and diarrhea when absorbed. Vesicants poison food and water and make other supplies dangerous to handle. They may produce lethalities, but skin damage is their main casualty producing effect. The severity of a blister agent burn directly relates to the concentration of the agent and the duration of contact with the skin. In addition to casualty production, blister agents may also be used to restrict use of terrain, to slow movements, and to hamper use of materiel and installations. (Departments of the Army, Navy, and Air Force, 1990 p. 30)

Chemical Agent: An agent that, through its chemical properties, produces lethal or other damaging effects on human beings, except that such term does not include riot control agents, chemical herbicides, smoke, and other obscuration materials. (Title 50 U.S.C. § 1511 (2011 p. 303))

Choking Agents: Choking agents injure an unprotected person through the respiratory tract (i.e., nose, throat, and lungs). In extreme cases membranes swell, lungs become filled with liquid, and death results from lack of oxygen; thus, these agents “choke” an unprotected person. Fatalities of this type are called “dryland drownings.” (Departments of the Army, Navy, and Air Force, 1990 p. 14)

Chemical Agent Identification Set (CAIS): Defined in Part 179.3 of Title 32, CFR. For the purposes of this document and the RCWM Program, a site known or suspected to contain CAIS will be investigated and managed as a CWM Site. Until evaluated and identified, CAIS vials/bottles are managed as CWM. CAIS containing non-nerve agent, dilute CA or industrial chemicals are not considered CWM and once recovered are managed, transported, and disposed as hazardous substances/waste.

Chemical Warfare Material (CWM): Consistent with Section 179.3, items generally configured as a munition containing a chemical compound that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM includes V- and G-series nerve agents or H-series (mustard) and L-series (lewisite) blister agents in other-than-munition configurations; and certain industrial chemicals (e.g., AC, CK, or carbonyl dichloride [called phosgene or CG]) configured as a military munition. Due to their hazards, prevalence, and military-unique application, CAIS are also considered CWM (see definition of CAIS above for clarification). CWM does not include riot control devices; chemical defoliants and herbicides; industrial chemicals (e.g., AC, CK, or CG) not configured as a munition; smoke and other obscuration producing items; flame and incendiary producing items; or soil, water, debris, or other media contaminated with low concentrations of chemical agents where no CA hazards exist. Defined in DOD Directive 5101.17E

Industrial chemical: A non-military-unique chemical developed or manufactured for use in industrial operations or research, by industry, government, or academia. For example, AC, CK, CG are considered industrial chemicals.

Munitions and certain materials of interest: When recovered, includes munitions that contain an unknown liquid fill; certain materials (e.g., laboratory vials, closed cavity containers encountered at a CWM site) that contain an unknown liquid fill; and chemical agent identification sets. Defined in DOD Directive 5101.17E.

18 References

Aberdeen Proving Ground. 1942. Bomb Disposal Technical Data, 1064, Bomb Disposal Headquarters. Department of the Army.

Adams, A.S., Captain. 1944. Navy Toxic Gas Handler's Course (Officers), Edgewood Arsenal, Maryland – Revision of. September 16. Navy Department, Bureau of Naval Personnel. September 16.

Adams, C., M. Raila, E. Comings. 1945. Office of Scientific Research and Development, OSRD 6431, Development of an Experimental Thermal Generator Pot for Dispersing Mustard Gas as an Aerosol. December. Office of Scientific Research and Development. CBRNIAC-CB-051091.

Air Force Armament Center. 1954. Test of the E26R1 Spray Tank for Spraying Chemical Agents From F-84 and F-86 Type Aircraft Project "Work Horse". June. Air Research and Development Command.

American Expeditionary Forces. 1919. Gas Manual Part II, Use of Gas by the Artillery, A.E.F. No. 1475-2 G-5. March. War Department.

American Expeditionary Forces. 1919. Gas Manual Part III Use of Gas by Gas Troops A.E.F. No. 1475-3. March. War Department.

American Expeditionary Forces. 1919. Gas Manual Part IV, Use of Gas by Infantry, A.E.F. No. 1475-4 G-5. General Headquarters American Expeditionary Forces.

Anderson, Andrew W. 1966. Technical Procedures, Disposal, Unserviceable M55 Rockets, GB Filled (U). Chemical Process Laboratory.

Andrews, Lucius C. 1952. 4.2 inch Munitions Data DPG Addendum to DPG Field Tests 25a & b and 27-51. Technical Services Division.

Andrulis Research. 1984. Chemical Munitions/Airframes Compatibility, Technical Report (CBRNIAC-CB-005440). February. Department of Defense.

Anonymous. 1922. Drawing. Gas Container, 300-pound.

Anonymous. 1923. Yearly Report, Chemical Division.

Anonymous. 1941. Complete Round Charts, issued and revised various dates. RMA barcode GE104415 GE028220-1.

Army - MU(EA). 1995. Military Specification, MIL-B-600731(MU), Bomb, Nonpersistent Gas, Spherical, 4.5 Inch, M139; Filling and Assembly. December. Department of the Army.

Army Chemical Center. 1955. ORD 2509, Preliminary Manuscript, Naval Chemical Munitions, Chemical Corps Medical Laboratories. 14 April.

Army Chemical Center. 1957. Reclassifications, obsoletions, and related actions which have occurred since publication of EP 79, Chemical Corps Equipment Data Sheets. October. U.S. Army Chemical Corps Engineering Command.

Army Materiel Command. 1967. Technical Information Report 33.3.7.5, Chemical Agent Identification Training Set, M72 (E18), Interim Report. August.

Army Materiel Command. 1985. Army Materiel Command Pamphlet, AMC-P 700-3-3, Logistics, Complete Round Charts, Artillery Ammunition. November. U.S. Army.

Army Ordnance. 1921. No. 1939, History of Artillery Projectiles, 1917-1919. Government Printing Office.

Avery, R.L. 1939. 81-mm Chemical Shell, T9 (Project B2). Chemical Warfare Service. September 28.

Avery, R.L. Colonel. 1939. Memorandum to Chief, Chemical Warfare Service. Subject: 155-mm Chemical Shell T6E1 (Project B2). August 15. Chemical Warfare Service, Edgewood Arsenal.

Battelle, Columbus Laboratories. 1982. BZ Desk Reference, Contract DAAK 11-81-C-0080, Revised March 22. January. U.S. Army.

Berlin, A.S., & Kline, S.Q. 1948. Technical Command Report, TCR 12, Preliminary Investigation of 10-lb. Bomb for Persistent Agents. Technical Command.

Blandy, W.H.P. 1943. Preliminary Manuscript for Proposed Ordnance Pamphlet, Aircraft Chemical Smoke and Vesicant Spray, dated 1 July 1943. September 15. Navy Department, Bureau of Ordnance.

Bode, Donald D. 1955. Dugway Proving Ground Report, DPGR 211, Dynamic Tests of the 8-inch Howitzer Shell, T19 Series, HD Filled, With 12 50 1 Agent-to-Burster Ratio, Part II. Dugway Proving Ground.

Booz-Allen Applied Research. 1962. A Study of Biological and Chemical Warfare Target Effects. Volume II. Characteristics of Biological and Chemical Agents in Munitions. AD0350553.

Bouder, N.M., & Powell, H.C. 1931. Approximate Weights of Fillings in Chemical Munitions, Information Division. Edgewood Arsenal.

Briggs, D.A. 1945. Technical Division Memorandum Report, TDMR 1051, Development of 2.36 Inch Rocket E22 for CK Filling, Project B1.5-1. Chemical Warfare Service.

Brigham, C.E. 1930. Bomb, Aerial, General Design of, Chemical Filled. Chemical Warfare Service.

Brigham, C.E. 1930. Estimate for Bombs, Air Burst, Expulsion Type. Chemical Warfare Service. 3 December.

Brigham, C.E. Lt. Col. 1930. Memorandum to Chief, Chemical Warfare Service, Subject: 4” Stokes Mortar Shell and Fuze. Chemical Warfare Service. July 16.

Brigham, C.E. Lt. Col. 1931. Edgewood Arsenal Technical Report, EATR 50, Review of the Research Activities of the Chemical Division, Edgewood Arsenal, 1919-1928, Section 2. Chemical Warfare Service.

Brophy, L., Miles, W., & Cochrane, R. 1959. History of the Chemical Warfare Service, From Laboratory to Field. In S. Conn (Ed.), “United States Army in World War II.” U.S. Government Printing Office. Retrieved 2016, from http://www.history.army.mil/html/books/010/10-2/CMH_Pub_10-2.pdf

Bureau of Industry and Commerce. 2004. Introduction to Industry Implementation, Chemical Weapons Convention. May. Retrieved 2016, from United States Chemical Weapons Convention Website: http://www.cwc.gov/assets/pdf/outreach_industry_publications_cwc004.pdf

Bureau of Naval Weapons. 1960. NAVWEPS Ordnance Pamphlet, OP 2216, Aircraft Bombs, Fuzes and Associated Components. August. U.S. Government Printing Office.

Bureau of Naval Weapons. 1961. NAVORD Report 6954, Fourth Consolidated Report of BW/CW Study (U). Washington: Department of the Navy.

Bureau of Naval Weapons. 1966. NAVWEPS Report 8566, Characteristics of Biological and Chemical Munitions and Delivery Systems. Naval Ordnance Laboratory.

Bureau of Ordnance Publication. 1944. NAVORD Ordnance Data, OD 5603, Complete Round Chart for Aircraft Bombs. July. Department of the Navy.

Bureau of Ordnance. 1943. Ordnance Pamphlet, OP 1030, Nonpersistent Gas Munitions. Department of the Navy.

Bureau of Ordnance. 1947. Ordnance Pamphlet, OP 1664 (Vol. 1), U.S. Explosive Ordnance. May. Department of the Navy.

Bush, O.J. 1971. Edgewood Arsenal Technical Report, EATR 4476, Test and Evaluation of E27 Warhead Section (Lance) Safety Features Involving the Agent Hazard. January. U.S. Army Munitions Command.

Bush, O.J. 1972. Edgewood Arsenal Technical Report, EATR 4613, E27 Chemical Warhead Section Final Report (U). June. Department of the Army.

Cagle, M. T. 1971. History of Sergeant Weapon System, Historical Monograph Project Number: AMC: 55M. U.S. Army Missile Command. 28 January.

Campbell, D., & Seigh, J. 1964. CRDL Technical Memorandum 83-8, A Theoretical Study of the Area Coverage Potentials of the SUU-7A/A. SUU-13/A, and SUU-14/A Dispenser Systems (U). March. Chemical Research and Development Laboratories.

Carroll, Jos L. 1943. “L” Filled Shell and Bombs. October. Department of the Army.

Carter, J., & Wilson, B. 1957. Munitions Development Division Technical Memorandum, Development of E123 “Cube” Bomblet (U) (Project 4-04-15-029-01). Munitions Development Division.

Chemical Abstract Service. 2021. CAS Registry and CAS Registry Number FAQs. American Chemical Society. Retrieved July 2021, from CAS: https://www.cas.org/about/cas-content

Chemical Biological Subcommittee. 1964. AMCTC Item # 2621, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. U.S. Army Materiel Command.

Chemical Branch. 1964. Dugway Proving Ground Trial Record, DPGTR 394, Engineering Test of USAF Cluster, Aimable, 750-lb, Incapacitating, BZ, CBU-5/B (Dissemination Phase), 656B (U). APGC (PGKK) Eglin AFB

Chemical Corps School. 1948. Tentative Technical Manual, TM 3-300, Miscellaneous Chemical Munitions (for use at the Chemical Corps School. March. Army Chemical Center.

Chemical Corps Technical Committee. 1920. CCTC Item # 1920-07-03, Project Program for the Development of Chemical Warfare Materiel, Project 1. Gas Shell. Chemical Warfare Service. October 13.

Chemical Corps Technical Committee. 1927. CCTC Item # 1927-21, Adoption as to Type - (b) Chemical Warfare Service Sniffing Set.

Chemical Corps Technical Committee. 1928. CCTC Item # 1928-2-2, Adoption as to Type (b) Chemical Warfare Service Gas Service Sniffing Set.

Chemical Corps Technical Committee. 1930. CCTC Item # 1930-04, Specifications: Valves, Check; Deflectors, Gas Mask Face Piece, and Filling, 155 mm Shell MK II (Howitzer) and MK VII (Gun), White Phosphorus (WP). Chemical Warfare Service.

Chemical Corps Technical Committee. 1933. CCTC Item # 1933-02, Chemical Fillings for Munitions. January. Department of the Army.

Chemical Corps Technical Committee. 1933. CCTC Item # 1933-14, Standardization of Candle, Irritant, CN-DM, Fast, MI, [redesignated Grenade, Hand, Irritant, CN-DM, M6 when transferred to the Ordnance Dept. as recorded on OCM 10598, 6 Apr 33] approved 21 January. Chemical Warfare Service.

Chemical Corps Technical Committee. 1933. CCTC Item # 1933-44, Limited Procurement of Set, Gas Identification, Detonation. Chemical Warfare Service. October 3.

Chemical Corps Technical Committee. 1935. CCTC Item # 1935-14, Set, Gas Identification, Detonation, M1 - Standardization of, 24 Dec 34, approved 28 Mar 35. March.

Chemical Corps Technical Committee. 1935. CCTC Item # 1935-23, Set, Gas Identification, Instructional – Recommendation of Classification and Basis of Issue.

Chemical Corps Technical Committee. 1938. CCTC Item # 1938-07, Airplane Chemical Spray Tank E6R9 – Classification of. Department of the Army.

Chemical Corps Technical Committee. 1938. CCTC Item # 1938-20, Mine, Land, Chemical – Subcommittee Report on Recommendation for Standardization. CWS 470.6/235. Department of the Army.

Chemical Corps Technical Committee. 1939. CCTC Item # 54, 4.2-inch Chemical Mortar Shell - Subcommittee Report on Standardization. Department of the Army.

Chemical Corps Technical Committee. 1940. CCTC Item # 0281, Standardization of Type 1 and Type 2 Airplane Smoke Tanks. Department of the Army.

Chemical Corps Technical Committee. 1941. CCTC Item # 0353, Cancellation of Obsolete Specifications - Subcommittee Report for Approval. (CWS 400.114/1916). Department of the Army. July 22.

Chemical Corps Technical Committee. 1942. # 19301, Chemical Corps Technical Committee Action. December. Department of the Army.

Chemical Corps Technical Committee. 1942. CCTC Item # 0567, Subcommittee Report – Standardization of Set, Gas, Toxic, M1, Military Requirement and Military Characteristic. Department of the Army.

Chemical Corps Technical Committee. 1943. CCTC Item # 0697, Classification of E5 Chemical Bomb. Chemical Warfare Service.

Chemical Corps Technical Committee. 1943. CCTC Item # 0881, Classification of Fillings for Chemical Munitions. October. Department of the Army.

Chemical Corps Technical Committee. 1943. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 0902, Reclassification of Fillings for Grenade, Frangible, M1. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 0959, Reclassification of Fillings for Grenade, Frangible, M1. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 1033, Obsoletion of 4-inch Chemical Mortar Equipment. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 1049, Standardization of Persistent Agent, HD. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 1065, Obsoletion of Livens Projector Equipment. Department of the Army. 7 July.

Chemical Corps Technical Committee. 1944. CCTC Item # 1092, Subject: Standardization of Tank, Airplane Smoke, M33A1. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 1094, Standardization of Persistent Agent, HD. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 1183, Standardization of Kit, Gas Identification, Instructional, M2. October 26.

Chemical Corps Technical Committee. 1944. CCTC Item # 1240, Obsoletion of Grenade, Frangible (IM), M1; Grenade, Frangible (NP), M1 and Igniter, Frangible Grenade, M3. Department of the Army.

Chemical Corps Technical Committee. 1944. CCTC Item # 1291, Standardization of Kit, Gas Identification, Instructional, M2. Department of the Army.

Chemical Corps Technical Committee. 1944. Chemical Corps Book of Standards.

Chemical Corps Technical Committee. 1945. CCTC Item # 1145, Obsoletion of Livens Projector Equipment. Department of the Army.

Chemical Corps Technical Committee. 1945. CCTC Item # 1342, Standardization of Persistent Agent, HT. Department of the Army.

Chemical Corps Technical Committee. 1945. CCTC Item # 1348, Standardization of Bomb, Incendiary, 100-lb., AN-M47A3. Department of the Army.

Chemical Corps Technical Committee. 1945. CCTC Item # 1420, Classification of CK as Standard Filling for 4.2-inch Chemical Mortar Shell. Department of the Army.

Chemical Corps Technical Committee. 1945. CCTC Item # 1461, Classification of Persistent Agent Fillings for Chemical Bombs. Chemical Warfare Service.

Chemical Corps Technical Committee. 1945. CCTC Item # 1527, Cancellation of the Authorization to Use Cl as a Chemical Warfare Agent Filling. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1545, Subject: Obsoletion of Cylinders, Portable, Chemical, MI, MIA1, MIA2 and Apparatus, Charging, Portable Chemical Cylinder, MI. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1565, Standardization of Screening Smoke, PWP, 100-lb, M47A4. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1601, Obsoletion of Simulated Mustard AS. March. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1614, Subject: Obsoletion of Cylinders, Portable, Chemical, MI, MIA1, MIA2 and Apparatus, Charging, Portable Chemical Cylinder, MI. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1617, Standardization of Rocket, Gas, CG 7.2-inch, M25 (T21). Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1618, Standardization of Rocket, Gas, CK 7.2-inch, M27 (T52). Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1653, Cancellation of CNS as an Authorized Filling for the Airplane Smoke Tank. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1672, Cancellation of Experimental Type Bombs and Clusters. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1673, Standardization of Bomb, incendiary, 100-lb, M47A4. Department of the Army.

Chemical Corps Technical Committee. 1946. CCTC Item # 1681, Cancellation of Miscellaneous Experimental Munitions and Weapons. October 23.

Chemical Corps Technical Committee. 1946. CCTC Item # 1683 Cancellation of Miscellaneous Experimental Items. Department of the Navy.

Chemical Corps Technical Committee. 1946. CCTC Item # 2471, Rocket, Gas, CK 7.2-inch, M27 – Classification as Obsolete Type. Department of the Army.

Chemical Corps Technical Committee. 1947. CCTC Item # 1772 Obsoletion of Tank, Airplane Smoke, M33. Department of the Army.

Chemical Corps Technical Committee. 1948. CCTC Item # 1830, Cancellation of Inactive Limited Procurement and Service Test Items. Chemical Warfare Service.

Chemical Corps Technical Committee. 1948. CCTC Item # 1866, Specification Changes. Chemical Warfare Service.

Chemical Corps Technical Committee. 1948. CCTC Item # 1881, Subject: Obsoletion of Tanks, Airplane Smoke, M10, AN-M33A1, M40 and Accessory Equipment. Chemical Corps.

Chemical Corps Technical Committee. 1948. CCTC Item # 1913, Subject: Obsoletion of Tanks, Airplane Smoke, M10, AN-M33A1, M40 and Accessory Equipment. May. Chemical Corps.

Chemical Corps Technical Committee. 1949. CCTC Item # 1946, Subject: Obsoletion of Tanks, Airplane Smoke, M10, AN-M33A1, M40 and Accessory Equipment.

Chemical Corps Technical Committee. 1949. CCTC Item # 1953, Standardization Bomb, Gas, Persistent; HD, 125-lb, M113 (T3E2). Department of the Army.

Chemical Corps Technical Committee. 1949. CCTC Item # 1988, Authorization of Incendiary Mixture, PT1 as a Filling for 100-lb. Incendiary Bombs. Department of the Army.

Chemical Corps Technical Committee. 1949. CCTC Item # 2000, Incorporation of Gas and Smoke Bombs in Chemical Corps Records. Department of the Army. June 15.

Chemical Corps Technical Committee. 1949. CCTC Item # 2004, Specification Changes for Record. Department of the Army. (FG)

Chemical Corps Technical Committee. 1949. CCTC Item # 2045, Reclassification of Irritant Agents, CNS, CNB, PS and Standardization of CNC. Department of the Army. (DC)

Chemical Corps Technical Committee. 1949. CCTC Item # 2063, Specification Changes for Record. Department of the Army.

Chemical Corps Technical Committee. 1949. CCTC Item # 2085, Chemical Corps Technical Committee Action Item. March. Department of the Army.

Chemical Corps Technical Committee. 1950. CCTC Item # 2155, Subject: Designation of Components of Bomb, Gas, Persistent; HD 125-lb., M113 (T3E2). July. Department of the Army.

Chemical Corps Technical Committee. 1951. CCTC Item # 2289, Reclassification of Cyanogen Chloride, CK to Limited Standard Type. Department of the Army.

Chemical Corps Technical Committee. 1951. Chemical Corps Book of Standards. Department of the Army.

Chemical Corps Technical Committee. 1952. CCTC Item # 2462, Establishment of Projects 4-04-15-024, 5, 6. & 8-inch Gas Projectiles; 4-04-17-015, 5 & 6-inch Smoke Projectiles; 4-17-07-004, 5-inch Gas Rocket; & 4-17-07-005, 5-inch Smoke Rocket. Department of the Army.

Chemical Corps Technical Committee. 1952. CCTC Item # 2471, Rocket, Gas, CK 7.2-inch, M27 – Classification as Obsolete Type. Department of the Army.

Chemical Corps Technical Committee. 1952. CCTC Item # 2527, Obsoletion of Bombs, Smoke, WP, 100-lb, AN-M47A1 and AN-M47A2. Department of the Army.

Chemical Corps Technical Committee. 1952. CCTC Item # 2576, Obsoletion of Tank, Airplane Smoke, AN-M33A1, M40 and Related Accessories. Department of the Army.

Chemical Corps Technical Committee. 1952. CCTC Item # 2579, Development Procurement of Set, Gas Identification, Detonation, E7. Department of the Army.

Chemical Corps Technical Committee. 1954. CCTC Item # 2930, Items Type-Classified by the Air Force (Read for Record). Department of the Army.

Chemical Corps Technical Committee. 1954. CCTC Item # 2932, Shell, Chem, 105-MM, M360 (T173): Casing, Burster, M16 (T27E1); Charge, Burster, M40 (T67) Classified as Standard. July. Department of the Army.

Chemical Corps Technical Committee. 1954. CCTC Item # 2933, Shell Chem, 155-MM, M121 (T77): Casing, Burster, M15 (T29E1), Charge, Burster, M37 (T69) - Classified as Standard Type. Department of the Army.

Chemical Corps Technical Committee. 1954. CCTC Item # 2934, Shell, Chem, 155-mm, M122; Casing, Burster, M17 (T32) – Classified as Standard. August.

Chemical Corps Technical Committee. 1954. CCTC Item # 2947, Classification of Clusters, Gas Bomb, GB, 1000-lb., M34 (E101R3) & M34A1 (E101R5) as Limited Standard and Standard Types, Respectively. Department of the Army.

Chemical Corps Technical Committee. 1955. CCTC Item # 3010, Cancellation of Army Requirements for Sets, Gas Identification, Instructional, MI & M2 (Sniff Sets).

Chemical Corps Technical Committee. 1955. CCTC Item # 3011, Status of One Ton Containers, Types A, D & E for Storage & Shipment of Chemical Agents, Read for Record. Department of the Army. 1 April.

Chemical Corps Technical Committee. 1955. CCTC Item # 3115, Obsoletion of Bomb, Gas, Persistent, HD, 125-lb., M113. October. Department of the Army.

Chemical Corps Technical Committee. 1955. CCTC Item # 3122, Establishment of Subproject 4-04-15-028-09, HD 8-inch Howitzer Shell. Department of the Army.

Chemical Corps Technical Committee. 1955. Chemical Corps Book of Standards, 1955. Department of the Army.

Chemical Corps Technical Committee. 1956. CCTC Item # 3188, Reduction of Chemical Corps Items in the Supply System.

Chemical Corps Technical Committee. 1956. CCTC Item # 3193, Obsoletion of of Clusters, Incendiary Bomb, 500-lb, M20, M20A1, M21, M22; & Bombs, Incendiary, 100-lb, AN-M47A3 & M47A4. Department of the Army.

Chemical Corps Technical Committee. 1957. CCTC Item # 3286, Subject: Incorporation of Fin Assemblies, Bomb, AN-M128 & AN-M129; Fuzes, Bomb Tail, M175 & M176; & Arming Wire Assembly, M13 as Standard Components of the AN-M78 & AN-M79 500-lb. & 1000-lb. Gas Bombs. Department of the Army.

Chemical Corps Technical Committee. 1958. CCTC Item # 3406, Revised Military Characteristics for GB Warhead for HONEST JOHN Rocket. Department of the Army.

Chemical Corps Technical Committee. 1958. CCTC Item # 3408, Revised Type Classifications & Modernization Codes for Chemical Corps Items. Department of the Army.

Chemical Corps Technical Committee. 1958. CCTC Item # 3434, Development of VX Chemical Shell. June. Department of the Army.

Chemical Corps Technical Committee. 1958. CCTC Item # 3450, Reclassification of 22 Standard-B Items to Standard-A Based on Revised Interpretation of Definitions Thereof. June. Department of the Army.

Chemical Corps Technical Committee. 1958. CCTC Item # 3464, Military Characteristics for V-Agent 155-mm Howitzer Shell, 8-inch Howitzer Shell, & 115-mm Rocket. Chemical Warfare Service.

Chemical Corps Technical Committee. 1958. CCTC Item # 3483, Subject: Use of Airplane Smoke Tank M10 on L19 and L20 Aircraft. August. U.S. Army Chemical Center and Chemical Corps Materiel Command.

Chemical Corps Technical Committee. 1958. CCTC Item # 3524, Subject: Classification of Bomb, Gas, Nonpersistent GB, 750 lbs., MC-1 as Standard-A, USAF Type. Department of the Army.

Chemical Corps Technical Committee. 1958. CCTC Item # 3525, Reclassification of Development and Limited Standard items in Accordance with Revised AR 705-6. Department of the Army.

Chemical Corps Technical Committee. 1959. Chemical Corps Book of Standards, Edition of 25 Novemeber 1959. November. Department of the Army.

Chemical Corps Technical Committee. 1960. CCTC Item # 3686, Obsoletion of Bomb, Gas, Nonpersistent AC, 1000-lb., AN-M79 & Quick-acting Hydrogen Cyanide, AC Quick-Acting Hydrogen Cyanide, AC. Department of the Army.

Chemical Corps Technical Committee. 1960. CCTC Item # 3704, Classification of Rocket, Gas, 115-mm, M55 (T238) as a Standard-A Type & Authorization of Nonpersistent Agent, GB & Persistent Agent VX as Fillings Therefore (Popular Name-The Bolt). Department of the Army.

Chemical Corps Technical Committee. 1961. CCTC Item # 3788, Chemical Corps Items Designated ABC-Army Standard. January. Department of the Army.

Chemical Corps Technical Committee. 1961. CCTC Item # 3911, Classification of Projectile, 8-Inch, Gas Nonpersistent GB, M426 (T174E2) & Projectile, 8-Inch, Gas Persistent VX, M426 (T172E2) as Standard-A Types. November. Department of the Army.

Chemical Corps Technical Committee. 1961. CCTC Item # 3924, Classification of Projectile, 155-mm, Gas, Nonpersistent GB, M121A1 (M121E1) & Projectile, 155-mm, Gas, Persistent VX, M121A1 (M121E1) as Standard-A, Types & Reclassification of the M121 GB. Department of the Army.

Chemical Corps Technical Committee. 1961. CCTC Item # 3933, Classification of Rocket, Training, Dummy, 115-mm, M60 (E49) as a Standard-A Type. Department of the Army.

Chemical Corps Technical Committee. 1962. CCTC Item # 3960, Classification of Cluster, Bomb, Incapacitating BZ, 750-lb., M43 (E153); Cluster Generator, Incapacitating BZ, 175-lb, M44 ([E]154); and Incapacitating Agent, BZ as Standard-B Types. March. Department of the Army.

Chemical Corps Technical Committee. 1962. CCTC Item # 3961, Classification of Rocket, Practice, Simulant EG, 115-mm, E50 as a Limited Production Type. Department of the Army. 9 March.

Chemical Corps Technical Committee. 1962. CCTC Item # 4080, Classification of Warhead Section, 762-mm Rocket, Gas, Non-persistent GB M190 (E19R2) as a Standard-A Type & Obsoletion of the Superseded M79 Warhead. Department of the Army.

Chemical Corps Technical Committee. 1963. CCTC Item # 4139, Obsoletion of Bombs, Gas, Persistent H & HD, l15-1b., M70 and M70A1. Department of the Army.

Chemical Corps Technical Committee. 1963. CCTC Item # 4141, Subject: Obsoletion of Bombs, Gas, Nonpersistent CG & CK, 500-lb., AN-M78; & Bombs, Gas, Nonpersistent CG & CK, 1000-lb., AN-M79 (U). September. U.S. Army Materiel Command.

Chemical Corps Technical Committee. 1969. Chemical Corps Book of Standards, 2nd Abridged Edition, Revision No. 29. October. Department of the Army.

Chemical Corps. 1944. Chemical Corps Technical Committee CCTC 1009 Military Requirement and Military Characteristics for a Thermal Generator Type Bomb for Mustard Vapor. Department of the Army.

Chemical Corps. 1947. Chemical Corps Technical Committee CCTC 1835 Termination of Project B6.7-3 (4-04-15-03), 10-lb. Chemical Bomb, Thermal Generator. October. Department of the Army.

Chemical Corps. 1949. Chemical Corps Tentative Specification No. 196-61-22, Container, One-Ton, Type D.

Chemical Corps. 1952. Quarterly Historical Report, 1 April - 30 June 1952. Chemical and Radiological Laboratories.

Chemical Corps. 1953. Dugway Proving Ground Report, DPGR 137, Assessment of a CW Cluster: assessment of the cluster, nonpersistent gas bomb, 1000-lb, E101R3, CW 7-53. December. U.S. Army.

Chemical Materials Agency. 2004. William Brankowitz, Deputy Product Manager for Non-Stockpile Chemical Materiel, Memorandum to Commander, U.S. Army Engineering and Support Center, Huntsville, Subject: Accounting for K945 Chemical Agent Identification Sets (CAIS). January 5.

Chemical Research and Development Center. 1985. Data Book on Type Classification/Standard Chemical Agents, Weapons and Defense Materiel, CRDC-SP-85009. September. U.S. Army Armament, Munitions & Chemical Command.Chemical Systems Laboratory. 1978. Proposal for Demilitarization of Incapacitating Agent BZ and Munitions. Aberdeen Proving Ground.

Chemical Systems Laboratory. 1979. Final Report Engineer Design Test of Projectile, 8-inch: VX-2, XM736 (RDTE Project No. 1X464610DF94, TECOM Project No. 2-MU-003-736-032, Test Agency Report No. APG-MT-5274). July. U.S. Army.

Chemical Warfare Board, 1943. Grenade, Frangible, M1, Project No. 365. 29 December.

Chemical Warfare Center. 1942. Field Manual, FM 3-5 (Tentative), Chemical Warfare Service Field Manual, Tactics of Chemical Warfare. June. Chemical Warfare Service.

Chemical Warfare Industrial Division. 1942. Production Data Sheets (Items Presenting Procurement Problems). September 25.

Chemical Warfare Laboratories. 1956. Test Division Field Trials Report No. 11, Summary Report of Trials of the E5 Land Mine Detonation with Side and Bottom-attached Firing Devices and By Action on the Pressure Plate. June. Army Chemical Center.

Chemical Warfare School 1935. Pamphlet No 37, Instructions for Using Gas Identification Sets. Edgewood Arsenal. June.

Chemical Warfare School 1940. Pamphlet No 4, Instructions for Using Gas Identification Sets. Edgewood Arsenal. April.

Chemical Warfare Service 1930. Circular No. 2, Adoption as to Type and Standardization of Chemical Warfare Service Equipment. March 3.

Chemical Warfare Service 1943. F.C. Boston, Cannon & Ammunition Section Memorandum to Chief, Munitions Development Division, Subject: Static Tests of Chemical Bombs, M67, Filled with (a) Frozen M1, (b) Unfrozen M1, Using E.C. Propellant Powder as Booster and Ejection Charges, March 12.

Chemical Warfare Service. 1943. Chemical Warfare Service Field Materiel Data. July. U.S. Government Printing Office.

Chemical Warfare Service. 1943. Chemical Warfare Service Specification No. 196-31-64, Container, One-Ton, Type E. July. Chemical Warfare Procurement.

Chemical Warfare Service. 1945. Army Service Forces Catalog CW 11-1, Chemical Warfare Supply Catalog, Ammunition, 4.2-Inch Chemical Mortar (Including Propelling Charges, Fuzes and Other Components). March. Army Service Forces.

Chemical Warfare Service. 1945. Report of Production 1 January 1940 through 31 December 1945. Production Branch, Procurement Division.

Chemical Warfare Service. 1946. Report of Activities of the Technical Division during World War II. January.

Chemical Warfare Technical Committee. 1942. CCCTC Item # 495, Subcommittee Report – Standardization of HCN Filling for Grenade, Frangible, M1.

Chemical Warfare Technical Committee. 1942. CCTC Item # 548, Standardization of HCN Filling for Grenade, Frangible, M1. June 3. Chemical Warfare Service.

Chemical Warfare Technical Committee. 1942. CWTC Item # 529, Standardization of 6-lb. Oil Incendiary Bomb and 500-lb. Cluster Adapter. Chemical Warfare Service.

Chemical Warfare Technical Committee. 1944. CCTC Item # 938, Obsoletion of 4-inch Chemical Mortar Equipment. Department of the Army.

Chemical Warfare Technical Committee. 1944. CCTC Item # 1187, Obsoletion of Grenade, Frangible (IM), M1; Grenade, Frangible (NP), M1 and Igniter, Frangible Grenade, M3. October 26.

Chemical Warfare Technical Committee. 1944. CWTC Item # 998, Standardization of Bomb, Fuze, M1. Chemical Warfare Service.

Chemical Warfare Technical Committee. 1944. CWTC Item # 1033, Obsoletion of 4-inch Chemical Mortar Equipment. Department of the Army.

Chemical Warfare Technical Committee. 1944. CWTC Item # 1050, Standardization of Bomb, Chemical, 10-lb. (PT1, M74; Bomb, Chemical, 10-lb. (NP), M74). Department of the Army.

Chemical Warfare Technical Committee. 1944. Item # 899, Reclassification of airplane smoke tanks M20, M20A1, M21 and M21Al. January 21.

Chemical Warfare Technical Committee. 1944. Item # 0971, Reclassification of airplane smoke tanks M20, M20A1, M21 and M21Al, March 17.

Chemical Warfare Technical Committee. 1944. Item # 1129, Obsoletion of tanks, airplane, smoke, M20, M20Al, M21, M2lAl and related handling equipment. August 31.

Chemical Warfare Technical Committee. 1944. Memorandum to Chairman, Subject: Obsoletion of Grenade, Frangible (AC), M1.

Chemical Warfare Technical Committee. 1945. CWTC Item # 1268, Standardization of Bomb, Incendiary, Oil 6-lb., M69X. Chemical Warfare Service.

Chemical Warfare Technical Committee. 1945. CWTC Item # 1329, Standardization of Fuze, Bomb, M142A1. Chemical Warfare Service.

Chemical Warfare Technical Committee. 1952. CWTC Item # 2479, Classification of Fuze, Bomb, M2 (E18Rl); Bomb, Incendiary, Oil, 6-lb AN-M69Al; and Cluster, Aimable, Incendiary Bomb, 500-1b M19Al as Standard Types. Chemical Warfare Service.

Chemical-Biological Subcommittee. 1964. AMCTC Item # 2874, Classification of Warhead Section, Guided Missile, Gas, Nonpersistent GB, M212 (E21) (SERGEANT) as a Standard-A Type. October. U.S. Army Materiel Command.

Chemical-Biological-Nuclear Subcommittee. 1967. AMCTC Item # 5507, Reclassification of Training Set, Chemical Identification: M72 (XM72) (E18) (CAITS) from Development Type to Standard-A Type; Completion of RDT&E Task. U.S. Army Materiel Command.

Chemical-Biological-Nuclear Subcommittee. 1967. AMCTC Item # 5647, Minutes of ET/ST Review (IPR #5) on Training Set, Chemical Agent Identification: M72 (SM72) (E18) (CAITS) (Task 1B643606D02209) (AMCMS 5666.12.022.009). October. U.S. Army Materiel Command.

Chemical-Biological-Nuclear Subcommittee. 1969. AMCTC Item # 7028, Reclassification of Clusters, Gas Bomb, Nonpersistent GB, 1000-lb., M34 & M34A1 from Standard-A and Standard-C USAF-Types to Obsolete Types. June. U.S. Army Materiel Command.

Chemical-Biological-Nuclear Subcommittee. 1970. AMCTC Item # 7865, Obsoletion of Riot Control Agents, Diphenylaminechlorarsine: DM & DM1.; Grenades Hand: Riot, CN-DM, M6 & M6A1; and Grenade, Hand: Riot, DM1, ABC-M25A2. May. U.S. Army Materiel Command.

Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8441 (CBN Item #4862), Revised Nomenclatures for War Gas Identification Set, Instructional: Detonation, MI & AN-MlAl, and Toxic Gas Set: HD, M1 & M2. U.S. Army Materiel Command. 30 March.

Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8515, Reclassification of Toxic Gas Sets: M1 and M2 from Standard-B and Standard-A Types to Obsolete Types. U.S. Army Materiel Command.

Chemical-Biological-Nuclear Subcommittee. 1971. AMCTC Item # 8516 (CBN Item #4868), Reclassification of War Gas Identification Sets, Instructional; Detonation, M1 & AN-M1A1; and

Detonating Equipment, War Gas Identification: M1 from Standard-A/B Types to Obsolete Types. May. U.S. Army Materiel Command.

Chemical-Biological-Nuclear-Subcommittee. 1971. AMCTC Item # 8234, Reclassification of War Gas Identification Set, Instructional: Nondetonation, MI from Standard-B BuOrd Type to Obsolete Type. U.S. Army Materiel Command.

Chief of Ordnance. 1930. Technical Regulation, TR 1370-G, Miscellaneous Ammunition Bombs for Aircraft TR 1370-G. Washington: War Department.

Chief of Ordnance. 1942. Technical Manual, TM 9-1984, Disposal of American and Allied Bombs and Fuzes. November. War Department.

Chief of Ordnance. 1950. No. 5981, Complete Round Charts, Sheet No. 18. ORDIM.

Chief of the Bureau of Naval Weapons. 1964. NAVWEPS Ordnance Pamphlet, OP 3345, First Revision, Cluster Bomb Mark 15 Mod 0 (Sadeye Antipersonnel Weapon System), Description and Operation (U). Department of the Navy. 15 December.

Chief of the Bureau of Naval Weapons. 1966. NAVWEPS Ordnance Pamphlet, OP 1743, Second Revision, 81-mm Mortar Mark 2 Mod 0, Description, Operation, and Maintenance with Replaceable Parts Breakdown. 1 May.

Chu, S.C., Skinner, L.R., & Smith, W.H. 1987. Chemical Stockpile Disposal Program, Transportation of Chemical Agents and Munitions: A Concept Plan, Report No. SAPEO-CDE-IS-87003. June. PEO-PM Cml Demil.

Clay, J., & Stone, W. Jr. 1954. Dugway Proving Ground Trial Report, DPGTR 167. August.

Comings, E. 1943. Office of Scientific Research and Development, OSRD 3150, Progress Report: Development of the Thermal Generator Candle. January. National Defense Research Committee.

Comings, E.W. 1946. Office of Scientific Research and Development, OSRD No. 6574, Development of a Thermal Generator Bomb For Dispensing Concentrated Mustard Aerosol. February. National Defense Research Committee.

Control Division. 1946. Disposition of CWS-Owned Materiel. February 8. Chemical Warfare Service.

Cornell Aeronautical Laboratory 1961. Combat Surveillance Project, Notes for an Integrated AN/USD-5 Systems Test Plan. September 27.

Cornell Aeronautical Laboratory. 1967. Pop-Up Adapter for the M23 Chemical Land Mine. U.S. Army Chemical Research and Development Laboratory.

Coughlan, J.D., Major. 1931. 4” Stokes Mortar Shell and Fuzed – C.W.B. Project No. 126. Chemical Warfare Service.

Crawford, J.S. 1932. Memorandum to Chief, Chemical Warfare Service, Bomb, Chemical, 30-lg., M-1. Ordnance Department.

CW Branch. 1958. Dugway Proving Ground Report, DPGR 219, Final Development Testing of the MC-1 USAF 750-Pound Toxic Bomb (U). June. U.S. Army Chemical Corps Research and Development Command.

David, J.P. 1944. United States Bombs and Fuzes: Pyrotechnics, Land Mines, Firing Devices. U.S. Navy Bomb Disposal School. 1 June.

David, J.P. 1945. United States Bombs and Fuzes Pyrotechnics. U.S. Navy Bomb Disposal School. 1 September.

Davis, Captain M.H. and Woodberry, D.L. 1930. Report No. EATR 37, Development of Air-Burst Bomb (Expulsion-Type). Chemical Warfare Service.

Davis, Sherman L. 1968. GB Warheads for Army Balllistic Missiles 1950-1966 (U). Edgewood Arsenal. U.S. Army Munitions Command.

Defense Technical Information Center. 2016. Joint Publication, JP 1-02, Department of Defense Dictionary of Military and Associated Terms. February. Department of Defense.

Delancey, R. King, Colonel. 1946. Obsoletion of Drum 55 gallon. Chemical Warfare Service.

Department of Defense 1950. Military Specification, MIL-S-10333 (CmlC), Set, Gas, Toxic, M1. 31 May.

Department of Defense. 1957. Military Specification, MIL-P-11807C; Projectiles, 155-MM. Gun And Howitzer, 104 AND M110; WP, FS, HD, and H Filling Assemblies. June. U.S. Government Printing Office.

Department of Defense. 1982. Military Handbook, MIL-HDBK-146, Fuze Catalog Limited Standard, Obsolescent, Obsolete, Terminated, and Cancelled Fuzes, MIL-HDBK-146. October. Department of Defense.

Department of Defense. 2009. Military Standard, MIL-STD-709D, Department of Defense Design Criteria Standard, Ammunition Color Coding. U.S. Army.

Department of the Army. 1950. Technical Manual, TM 9-1901, Artillery Ammunition. U.S. Government Printing Office.

Department of the Army. 1950. Technical Manual, TM 9-1950, Rockets. U.S. Government Printing Office. July.

Department of the Army. 1955. Field Manual, FM 3-8, Chemical Corps Reference Handbook. February. U.S. Government Printing Office.

Department of the Army. 1956. Technical Manual, TM 3-300, Ground Chemical Munitions. August. U.S. Government Printing Office.

Department of the Army. 1957. Technical Manual, TM 3-250, Storage, Shipment Handling and Disposal of Chemical Agents and Hazardous Chemicals. February.

Department of the Army. 1961. Technical Manual, TM 3-500, Chemical Corps Equipment Data Sheets. April. U.S. Government Printing Office.

Department of the Army. 1962. Technical Bulletin, TB CML 117, Cluster, Generator, Incapacitating BZ, 175-lb, M44. December.

Department of the Army. 1964. Technical Bulletin, TB CML 111, One-Ton Containers. May.

Department of the Army. 1964. Technical Manual, TM 9-1345-200, Land Mines. U.S. Government Printing Office.

Department of the Army. 1966. Technical Bulletin, TB CML 73, Rocket, Training, Dummy, 155mm, M60. August.

Department of the Army. 1967. Dugway Proving Ground Letter Report, DPGLR C765, Limited Feasibility Test of the BLU-50/B Bomblet, USATECOM Project No. 5-7-5005-01 (U). September. USATECOM.

Department of the Army. 1967. Field Manual, FM 3-8, Chemical Reference Handbook. U.S. Government Printing Office.

Department of the Army. 1969. Technical Manual, TM 3-250, Storage, Shipment Handling and Disposal of Chemical Agents and Hazardous Chemicals. March. U.S. Government Printing Office.

Department of the Army. 1974. Materiel Status Record Submission, MSR 08746046, Type Reclassification of Grenade, Hand: Riot, CS, M47 (XM47E3) and Grenade, Hand: Red Smoke, RS, M48 (XM48E3) from Limited Procurement (LP) to Standard, and Type Reclassifications of Other Hand Grenades. Headquarters, United States Army Armament Command.

Department of the Army. 1977. Materiel Status Record Submission, MSR 08776018. August. U.S. Army Armament Command.

Department of the Army. 1979. Supply Bulletin, SB 742-1325-94-20, Ammunition Inspection Procedures for Chemical Bomb Mark 116 MOD 0. December.

Department of the Army. 1979. Technical Manual, TM 3-6910-227-10, Operators Manual Training Set, Chemical Agent Identification: Simulants, M72A2. March. U.S. Government Printing Office.

Department of the Army. 1979. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. April. U.S. Government Printing Office.

Department of the Army. 1980. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. April. U.S. Government Printing Office.

Department of the Army. 1982. Technical Manual, TM 43-0001-26-2, Army Equipment Data Sheets, Chemical Weapons and Munitions. Washington: U.S. Government Printing Office.

Department of the Army. 1985. Technical Manual, TM 3-6910-226-10, Operators Manual, M72A1 Simulants Chemical Agent Identification Training Set (NSN 6910-00-106-4800). Headquarters, Department of the Army.

Department of the Army. 1994. Technical Manual, TM 43-0001-28, Army Ammunition Data Sheets for Artillery Ammunition: Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes. April. U.S. Government Printing Office.

Department of the Army. 1997. Technical Manual, TM 43-0001-36, Army Ammunition Data Sheets for Land Mines (FSC 1345), Change 2. September. U.S. Government Printing Office.

Department of the Army. N.d. Photographs with captions. Photographs located at U.S. Chemical Corps Museum, Ft. McClellan, AL, File 1, Drawer 1.

Department of the Navy. 1945. Ordnance Pamphlet, OP 1447, Gas Identification Sets. June. Department of the Navy.

Department of the Navy. N.d. NAVWEPS Ordnance Pamphlet, OP 2212 Vol. 1 Aircraft Bombs, Fuzes and Associated Equipment.

Departments of the Army and Air Force. 1953. Technical Manual, TM 3-400/Technical Order, TO 39B-15C-1, Chemical Bombs and Clusters. April. Department of the Army.

Departments of the Army and Air Force. 1955. Technical Manual, TM 3-255/Technical Order, TO 11C8-1-1, Chemical Filling and Handling Equipment. September. Departments of the Army and Air Force.

Departments of the Army and Air Force. 1957. Technical Manual, TM 3-400/Technical Order, TO 11C2-1-1, Chemical Bombs and Clusters. May. Department of the Army.

Departments of the Army, Navy, and Air Force. 1966. Field Manual, FM 3-10, Employment of Chemical and Biological Agents. March. Department of the Army.

Departments of the Army, Navy, and Air Force. 1966. Technical Manual, TM 9-1325-200/Ordnance Pamphlet, OP 3530/Technical Order, TO 11-1-28, Bombs and Bomb Components. April. U.S. Government Printing Office.

Departments of the Army, Navy, and Air Force. 1976. Military Standard, MIL-STD-709C, Ammunition Color Coding. Washington : Department of Defense.

Departments of the Army, Navy, and Air Force. 1990. Army Field Manual, FM 3-9/Navy Publication No P-467/Air Force Manual No 355-7, Potential Military Chemical/Biological Agents and Compounds. U.S. Government Printing Office.

Deseret Test Center. 1972. Joint [Chemical- Biological] CB Technical Data Source Book (U), Volume II, Riot Control and Incapacitating Agents (U), Part Three: Agent BZ (U). February. U.S. Army.

Dickey, Dean M. 1975. Demilitarization and Disposal of Toxic Filled Munitions, Omnibus Plan. May. USAMC Program Manager for Demilitarization of Chemical Materiel.

Dole, Malcolm and Nolan, Jake, Captain. 1944. Dugway Proving Ground Memorandum Report, DPGMR 15, Florida Forest Field Trials of Non-Persistent and Persistent Agents. Chemical Warfare Service.

Dugway Proving Ground. 1945. Dugway Proving Ground Special Report, DPGSR No. 42, The Behavior of CNS Dispersed from M47A2 Bombs in Wooded Terrain Under Semi-Tropical Conditions. Chemical Warfare Service.

Dugway Proving Ground. 1953. Dugway Proving Ground Report, DPGR 121, Airplane Spray Tank Development Test: development test of the tank, airplane spray, E261R1, E28R1, and E28R2, DPG CW 8-52. March. Chemical Corps.

Dugway Proving Ground. 1953. Dugway Proving Ground Report, DPGR 124, Operational Evaluation of the Bomb (y) E2C, CW 12-52. Department of the Army.

Dugway Proving Ground. 1954. Dugway Proving Ground Trial Report, DPGTR 131. May. Technical Library.

Dugway Proving Ground. 1957. Dugway Proving Ground Report, DPGR 169, Tests of E11 Toxic Gas Set, CCB 3-55. 16 April. [DTIC AD127834]

Dugway Proving Ground. 1958. Dugway Proving Ground Trial Record, DPGTR 231, CW 363 Dissemination Phase of the Final Engineering Testing of the Navy E-43, 5-Inch Spin-Stabilized, Agent-Filled, Rocket (U). July. U.S. Army, Chemical Corps Research and Development Command.

Dugway Proving Ground. 1960. Dugway Proving Ground Report, DPGR 245, Final Engineering Testing of the 5”/54 Gas Projectile (Navy) (U), Volume I: Physical and Dissemination Testing. March. U.S. Army Chemical Corp Research and Development Command.

Edgewood Arsenal. 1918. Symbols for Chemicals.

Edgewood Arsenal. 1919. An Historical Sketch of Edgewood Arsenal. March 1.

Edgewood Arsenal. 1921. Weight of Chemical Fillings (NARA II. RG 175. E 1 (P1-8). Box 520.). October. Mechanical Division.

Edgewood Arsenal. 1959. Project and Associate Project Engineers EA. January. U.S. Army Chemical Corps.

EDO Corporation 1948. Survey of Aircraft Spray Equipment and Practice for Vesicants, Report No 2401. 31 August.

Engle, E.B. Major. 1943. Storage of 55-Gallon Drums for HS. Chemical Warfare Service.

Finklestein, Leo. 1964. CRDL Special Publication 1-42, History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 – 31 December 1945) Screening Smokes Part IV, CBRNIAC-CB-009967. June. Chemical Research and Development Laboratories (CRDL).

Finklestein, Leo. 1964. History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 - 31 December 1945) Screening Smokes Part III. June. Chemical Research and Development Laboratories (CRDL).

Fries, A. A., & West, C. J. 1921. Marking for American Shell. In *Chemical Warfare, First Edition, Second Impression* (First Edition ed.). London: McGraw-Hill Book Company.

Fries, Amos A.; West, Clarence J. 1921. Chemical Warfare, First Edition, Second Impression: Marking for American Shell. McGraw-Hill Book Company.

GA Technologies, Inc. n.d. Advanced Chemical Demil, Systems Development Design Report: M23 Land Mine Incorporation Special Study, Task I.

Gibby, I., Layton, L., Stone, W., & Clay, J. 1953. Dugway Proving Ground Report, DPGR 117, 4.5-Inch Chemical Rocket Evaluation: operational evaluation of the rocket, chemical, 4.5-inch, T164; DPG CW 6-52. March. Chemical Warfare Division.

Gibby, I., Layton, L., Stone, W., & Clay, J. 1953. Dugway Proving Ground Report, DPGR 129, Assessment of Hazard from Aerial Spray, DPG CW 3-53. September. Chemical Warfare Division.

Glendenning, Dennis E. (Weapons Development Department). 1963. NAVWEPS Report 8439, Aircraft Qualification Information Package Gladeye Weapon System (Bomb Dispenser MK 4 Mod 0 and Bomb Dispenser Canister MK 2 Mod 0). December. U.S. Naval Ordnance Test Station.

Gottlieb, B., & Reilly, W. 1945. Technical Command Informal Report, TCIR 232, Pilot Plant Filling of M47A2 with HP. January. Chemical Warfare Service.

Graham, M. M., Gregg, A. B., & Kriete, B. C. 1944. Technical Division Memorandum Report, TDMR 902, Comparison of the 125-LB., Chemical Bomb, T2, and the 115-LB. Chemical Bomb, M70; and Addendum. Chemical Warfare Service.

Greene, L.W. 1937. Edgewood Arsenal Technical Report, EATR 228, Portable Chemical Cylinder MIA2, Complete, Engineering Tests. September. War Department.

Greene, L.W. 1937. Edgewood Arsenal Technical Report, EATR 247, HS Chemical Land Mines E1 and E2, Engineering Tests, Project B 7.1-1. September. War Department.

Greene, L.W. 1938. Edgewood Arsenal Technical Report, EATR 282, Simulated HS, Engineering Tests on Molasses Residuum, Project A 9.2-1. December. Chemical Warfare Service.

Gregg, A., & Kriete, B. 1946. Technical Division Memorandum Report, TDMR 1277, Preliminary Tests of the 125-LB Chemical Bomb T3. Chemical Warfare Service.

Gual, A. and Finklestein, Leo. 1952. Chemical Research and Development Laboratories, History of Research and Development of the Chemical Warfare Service in World War II (1 July 1940 – 31 December 1945). Volume 18, Part V, Incendiaries. Project 4-72-05-005. AD0224098. Army Chemical Center. Army Chemical Center.

Hale, N.H. and H.E. Skipper 1942. Technical Division Memorandum Report, TDMR 431, A Memorandum Report, New Compounds HN-2, KB-16 and HN-3, Field Tests in 105-mm Shell in Comparison with HA and M1. Chemical Warfare Service.

Harris, R. W., 1953. Ground Munitions Branch, Munitions Division, Chemical Corps Chemical & Radiation Laboratories, Memorandum to: Commanding Officer, Chemical Corps Chemical & Radiation Laboratories, Subject: Report of Conference on Navy Gas Munitions. June 25.

Hawaiian Chemical Warfare Depot. 1940. Report on the Test of Five (5) Land Mines Filled with HS. August 31.

Headquarters Departments of the Army and the Navy. 1995. Technical Manual, TM 9-1330-200-12, Operators and Organizational Maintenance Manual for Grenades. June. Headquarters Departments of the Army and the Navy.

Headquarters, Department of the Army. 1989. Technical Manual, TM 3-1320-242-10, Operators Manual Projectile, 155 millimeter: GB2, M687 NSN 1320-00-431-6249. July. Department of the Army.

Headquarters, Department of the Army. 1994. Technical Manual, TM 43-0001-29, Army Ammunition Data Sheet for Grenades. June. Headquarters, Department of the Army.

Headquarters, San Jose Project Division. 1946. San Jose Project Report Number 56, SJPR 56, Assessment of Single M78 and M70, CG and CK Filled Bombs Functioned Statically in Jungle. 27 November.

Henry, S.I., & Flood, L. W. 1947. Metallurgical Research Department Report, Corrosion Inspection of Chemical Bombs After Exposure to “CC” Gas, MS-4195-3. December. A.O. Smith Corporation.

Hollingsworth, Henry L. 1943. Technical Division Memorandum Report, TDMR 626, 115-lb Chemical Bomb M70, ADB968653. April. Department of the Army.

Hollingsworth, Henry L., & Denues, Art 1st Lt. 1944. Technical Division Memorandum Report, TDMR 542, Functioning of M67 and M69 Bombs, HS Filled, Project B4.7, B6.7-2. July. Chemical Warfare Service.

Jackson, A., & Gadde, K., & Goheen, J., & Semiatin, W. 1987. Chemical Research, Development & Engineering Center, CRDEC-TR-87042, Fill, Close, Load, Assemble, and Packout Technology for the 8-Inch, VX-2, XM736 Projectile and the Bigeye Bomb (BLU-80/B). March. Chemical Research, Development & Engineering Center.

Johnston, H.F., Comings, E.W. 1943. Office of Scientific Research and Development, OSRD Informal Report No. 10.4-38, HE Generation and Use of Concentrated Mustard Vapor Clouds. National Defense Research Committee.

Johnstone, H.F.; Comings, E.W. 1943. Office of Scientific Research and Development, OSRD No. 3012 Progress Report: The Generation and Use of Concentrated Mustard Vapor Clouds. December. National Research Defense Research Committee. CBRNIAC-CB-180892.

Kabrich, W.C. Brigadier General. 1945. Frangible Grenade Filled with CK. Army Service Forces.

Kallal, R. J., Davis, R. W., & Johnstone, H. F. 1945. Office of Scientific Research and Development, OSRD No. 6300, Development of a Small Base Ejection Air-Burst Bomb for Dispersing Liquid Agents. Office of Scientific Research and Development.

Kay, Seymour. 1978. Encyclopedia of Explosives and Related Items PATR 2700, Volume 8. U.S. Army Research and Development Command.

Kelgard, Philip, E. 1956. Air Force Armament Center Test Report, AFAC-TR-56-21, Medium and High Altitude Functioning and Dispersion Tests of the E136R3 and E136R4 Type Clusters. May. United States Air Force.

Kribben, B.D., Captain. 1945. E29R1 Thermal Generator Bomb. November. Chemical Warfare Service.

Kriete, Bertrand and Gregg, Arthur. 1946. Technical Division Memorandum Report, TDMR 1193, Improved Ejection Charge and Dispersion Data of the 10-lb. Chemical Bomb, E5R8 H Filled. Chemical Warfare Service. 26 February.

Leighton, P.A.; Bogese, S; D’Ercole, A.D.; Lanier, H.; and Albert, L. 1946. A Special Report, Isokinetic Sampling of H Aerson (As produced by the Comings Candle). February. Dugway Proving Ground. CBRNIAC-CB-004085.

LeTourneau, R.L. 1944. Florida field trials on the Model F-6 and F-7 thermal generator candle. Chemical Warfare Service.

Liberman, David S. 1954. Final Engineering Test, No. 37B - Rocket, Nonpersistent Gas, HD, 4.5-Inch, T165E1, No. 37C - Rocket, Persistent Gas, HD, 4.5 Inch, T166E1. January. Chemical Corps, Chemical and Radiological Laboratories, Army Chemical Center.

Liebig, George F., Jr. 1924. Cylinders. Chemical Warfare School, Department of Technique.

Liebig, George F., Jr. 1924. Department of Technique, Book IV, Materiel, Cylinders. Chemical Warfare School, Department of Technique.

Loftin, J.C., Captain. 1944. Technical Command Informal Report, TCIR 162 Bomb, Thermal Generator – 10 lb., E29 Functioning Test. July. Chemical Warfare Service.

Loucks, Charles. 1942. Chemical Warfare Technical Bulletin No. 13-1-3, Airplane Smoke Tanks, Tanks M23 and M21 – Description, Assembly and Maintenance. July 18. War Department.

Macintire, B.G. 1939. Technical Division Memorandum Report, TDMR 203, Report of Test of 105-mm Shell, TF, HS-Filled, June 9 to September 21, 1937. Chemical Warfare Service Technical Command.

Macintire, B.G. 1942. Test of Coming's Candle with DM.

Macintire, B.G. 1943. Dugway Proving Ground Memorandum Report, DPGMR No. 3, Preliminary Tests of HCN in M70 and M47A1 Bombs (January 1, 1943 to January 14, 1943). Chemical Warfare Service. January 26.

MacIntire, R.G. 1930. Memorandum to: Chief, Engineering Division: Bomb, Chemical, 30-lb. Experimental Type E2R5, H.S., Booster charge 88.4 grams of Tetryl. Engineering Division. 28 March.

Macy, Dr.; Harris, Captain; Witten, Dr.. 1946. Monthly Progress Report – Historical Branch.

Macy, R. and T. P. Dawson. 1936. Edgewood Arsenal Technical Report, EATR 222, Instructional Gas Identification Set MI, Part I Replacement of Phosgene by Triphosgene, Part II Preparation of Triphosgene, Project D 4.4-1. War Department. March 31.

Marine Corps Schools. N.d. Hand Book of Chemical Weapons and Munitions.

Maxwell, E.C., Jr. 1968. APGC-TR-68-6, First Article Test of the CBU-30/A Munition (SUU-13/A Dispenser with BLU-39/B23 Bombs). January. U.S. Air Force.

Mayhew, Harry E., Jr. 1955. Plants Division Memorandum Report, Evaluation of High-Speed Filling Line Equipment for the E54R6 Bomb. August. Chemical Corps.

McCullough, G. 1941. Technical Division Memorandum Report, TDMR 311, Test of 81mm Mortar M1 Firing Shell M57, Phosgene Filled. CBRNIAC-CB-003529. August.

McCullough, G.E., Lt. 1942. Technical Division Memorandum Report, TDMR 345, Engineering Test of 4.2-In. Chemical Mortar Shell M2 Alternate Manufactured by the Scaife Company, January 31, 1942. February. Technical Division.

McGeorge, Harvey J. 1993. Operation Safe Removal: WWI Chemical & Explosive Munitions Identification Guide (CBRNIAC-CB-188036). January. Public Safety Group.

Michniewicz, Peter. 1971. Edgewood Arsenal Technical Report, EATR 4517, Final Flight Test Report of the E27 Warhead Section/ Lance Missile, O8L. May. Department of the Army.

Michniewicz, Peter. 1971. Edgewood Arsenal Technical Report, EATR 4529, Final Flight Test Report of the E27 Warhead Section/ Lance Missile, 12L. July. U.S. Army Munitions Command.

Milly, George H. 1948. Technical Command Informal Report, TCIR 426, Report of Field Test 111, Static Test of a Single E46R1, 115 LB. Chemical Bomb Filled with GB. Army Chemical Center: Technical Command.

Milly, George H. 1948. Technical Command Report, TCR 2, Static Test of 115-LB. Chemical Bomb E46 Filled with GA. October. Chemical Corps Technical Command.

Milly, George H. 1949. Technical Command Informal Report, TCIR 436, Report of the Field Test 112, Static Test of a Single E46R1, 115 lb. Chemical Bomb Filled with Water. September. Test Division, Technical Command.

Milly, George H. 1950. Technical Command Informal Report, TCIR 566, Report of Field Tests of G Agents at Dugway Proving Ground During Summer 1949. June. Technical Command.

Milly, George H. 1959. Chemical Warfare Laboratory, CWL Technical Memorandum 30-47, Preliminary Chemical Warhead Study for the Bullpup Missile (U). April. Army Chemical Warfare Laboratories.

Milly, George H., & Cave, Clearburn B. 1950. Technical Command Informal Report, TCIR 570, Report of Field Test 299 Static Test of Modified 155mm Artillery Shell, E15, E15R1, E15R3, E15R3, Filled GB (CBRNIAC-CB-110590). July. U.S. Army Chemical Corps Research and Development Command.

Mitchel, C. T. 1943. Technical Division Memorandum Report, TDMR 756, Development of Bomb, Chemical, 10-LB., E5. Chemical Warfare Center.

Montgomery, E. 1927. Report on Utility of Cylinders, Chemical Portable, Mark I. May. The Chemical Warfare Board.

Montgomery, E. Major. 1928. Chemical Warfare Board Project No. 5, System of Marking Chemical Warfare Munitions. Edgewood Arsenal. November 21.

Munitions Development Division. 1937. Photographs with captions. Photographs located at National Archives at College Park, Maryland. RG175_EUD-2A_Bx103. December. Edgewood Arsenal.

National Defense Research Committee. Undated. 1940s Filling Data on Large Chemical Bombs, Table III, K. National Defense Research Committee REEL 457, p. 16.

National Research Council. 1994. Recommendations for the Disposal of Chemical Agents and Munitions.

Naval Air Systems Command 1967. NAVAIR 11-5a-6, Handbook, Safety, Unpacking, Inspection and Assembly, CHEMICAL BOMB MK 116 MOD 0. 15 November.

Naval Ordnance Laboratory. 1963. NAVWEPS Ordnance Pamphlet, OP 3142, Characteristics of Biological and Chemical Munitions and Delivery Systems (U). White Oak: Department of the Navy.

Naval Ordnance Test Station 1965. NOTS-TP-3315 Rev 1, Universal Weapons Dispenser Mark 4 Mod 0 with Bomb Dispenser Canisters Mark 2 and Mark 3, Description and Operation (A preliminary Manual). March.

Naval Ordnance Test Station. 1964. NOTS-TP-3431-Revision 1, Cluster Bomb Mark 15 MOD 0 (Sadeye Weapon System), Description and Operation (A Preliminary Manual), AD361203. October. Bureau of Naval Weapons.

Naval Sea Systems Command. 1969. Naval Sea Systems Command Ordnance Pamphlet, NAVSEA OP 1664, Change 1, U.S. Explosive Ordnance. January. U.S. Government Printing Office.

Naval Surface Warfare Center. 1996. Technical Manual - Miscellaneous Chemical Munitions, NAVSEA SW073-AC-MMA-010, Change B 1 October 1996. October. Naval Sea Systems Command.

Neuberg, Gustav Lt. Colonel. 1945. Report of the Army Air Forces Board, Test of Bomb, Chemical, LC 50, 5-GAL. Capacity, H-Filled in E27R1 Cluster. ADB972784. Army Air Forces Board.

Office of the Chief Chemical Corps. 1946. Disposition of Chemical Corps Items, Department of the Army. Department of the Army.

Office of the Chief Chemical Corps. 1948. Disposition of Chemical Corps Items, Department of the Army. U.S. Government Printing Office. 15 September.

Office of the Chief of Gas Service. 1918. Memorandum for Colonel Fries: Marking of Chemical Projectiles. General Headquarters American Expeditionary Forces.

Office of the Chief of Ordnance. 1918. No. 1861, Handbook of Ordnance Data. November. Government Printing Office.

Office of the Chief of Ordnance. 1919. Memorandum from Board of Officers to Chief of Ordnance, Subject: Fifth Preliminary report, a Study of the 8”, 9.2” and 240 m/m Howitzer Ammunition Situation, November 11.

Office of the Chief of Ordnance. 1944. Rocket Materiel. Research and Development Service. 1 December. (file name: CW pages from Rocket Materiel).

Office of the Chief of Ordnance. 1946. Subcommittee on Rockets, Memorandum to Secretary of the Ordnance Technical Committee, Subject: Rocket, gas, CK, 2.36-Inch, M26 – Obsoletion. 3 December.

Office of the Commandant. 1932. Office of the Commandant, Maxwell Field Alabama, Memorandum to The Chief of the Air Corps, Washington DC. Subject: Bomb Chemical, 30-lb, M1 and Indorsements. Maxwell Field: Air Corps Tactical School.

Office of the Engineering Field Office. 1951. Report of Status and Progress on Air Force Projects at Army Chemical Center, MD. May. Army Chemical Center.

Office of the Engineering Field Office. 1999. 1999 Main Munition Table. Army Chemical Center.

OPCW. 1997. Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction. Technical Secretariat of the Organisation for the Prohibition of Chemical Weapons. Retrieved from https://www.opcw.org/fileadmin/OPCW/CWC/CWC_en.pdf

Ordnance Committee. 1923. Ordnance Committee Meeting, OCM Item # 3344, Standardization of Chemical Shell and Boosters. November 1.

Ordnance Committee. 1931. Ordnance Committee Meeting, OCM Item # 8932, Bomb, Redesign of Bomb, Chemical, 30-lb., M1. May 21.

Ordnance Committee. 1932. Ordnance Committee Meeting, OCM Item # 9758, Shell, 155 MM, Chemical [Mark II Shell, HS-filled, and 75 MM, Mark II Shell, NC-filled] – War Reserve Test to Determine Serviceability and to Establish Data for Efficient Use. April 28.

Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10598, Candles, Chemical – Transferred to the Chief of Ordnance for Procurement, Storage and Issue – Designation Changed to “Grenades”. April 6.

Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10651, Candles, Chemical – Approval for Transfer to the Chief of Ordnance for Procurement, Storage and Issue; and Change of Designation Changed to “Grenades” (Read for Record). April 27.

Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10898, 75MM Shell [MK II], N. C. Filled – Declared Obsolete and Authorized for Use in Target Practice. August 10.

Ordnance Committee. 1933. Ordnance Committee Meeting, OCM Item # 10583, Shell, Chemical, for 105 MM Howitzer – Approval for Setting Up Military Requirements (Read for Record). March 30.

Ordnance Committee. 1935. Ordnance Committee Meeting, OCM Item # 11935, Ammunition, Chemical, 75 mm Howitzer – Military Requirements Established (Read for Record). January 24.

Ordnance Committee. 1937. Ordnance Committee Meeting, OCM Item # 14005, Bomb, 100-lb Thin Case, Chemical – Approval of Military Characteristics (Read for Record). November 4.

Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15601, Bomb, Chemical, 30-lb. T2E1 with Fuze, Bomb, Nose, T21 – Classified as Standard; Bomb Designated Bomb, Chemical, 30-lb., M46; Fuze designated Fuze, Bomb, Nose, M108 – Bomb, Chemical, 30-lb., M1 – Reclassified from Standard to Limited Standard. February 8.

Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15627, Shell, 81 mm High Explosive and Chemical, T9, Adopted as Standard and Designated Shell, High Explosive, 81 mm, M56, Chemical Shell Designated Shell Chemical, 81 mm, M57; Shell High Explosive, 81 mm, M45 Reclassified From Standard to Limited Standard.

Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 15656, Bomb, Chemical, 30-lb. M46 and Fuze, Bomb, Nose, M108 – Clearance for Procurement and Classification as Standard, Read for Record. February 29.

Ordnance Committee. 1940. Ordnance Committee Meeting, OCM Item # 16059, Bomb, Chemical, 100-lb T6E1 - Classified as Standard and Designated Bomb, Chemical 100-lb. M47. August. Chemical Warfare Service.

Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16766, Shell, Chemical, 155 MM MK IIA1 for Howitzer, M1918 and Chemical, 155 mm, MK VIIA1 for Gun, M1917 and M1918 – Classified as Standard, Read for Record. May 22.

Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16767, Ammunition, Complete Round, Chemical for 75 mm Howitzer, Classified as Standard – Designation of Shell, Chemical 75 mm, T9, Changed to Shell, Chemical, 75 mm, M64, Read for Record. May 22.

Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 16758, Shell, Chemical, 155 MM, M105 for the 155 MM Howitzer, M1918 and Shell, Chemical, 155 MM, M104 for Gun M1917-1918M1 – Classified as Standard. Shell, Chemical, 155 mm, MK IIA1 and MK VIIA1 Transferred from Standard to Limited Standard. May 22.

Ordnance Committee. 1941. Ordnance Committee Meeting, OCM Item # 17402, Shell, Chemical, 155 MM, M110 (Persistent Gas Filler) for 155 MM Howitzer, M1 – Classified as Standard. November 6.

Ordnance Committee. 1942. Ordnance Committee Meeting, OCM Item # 18457, Bomb, Chemical, 30-lb. M46, M46A1, and M46A2 – Obsoletion Recommended. July 9.

Ordnance Committee. 1942. Ordnance Committee Meeting, OCM Item # 19301, BOMB, CHEMICAL, 115-lb, M70 – Recommendation for Adoption as Standard for HS filling; BOMB, CHEMICAL, 100-LB, M47A2 – Recommendation for Temporary Emergency Loading with HS and Subsequent Restriction to WP and Incendiary Filling; BOMB, CHEMICAL, 100-Lb, M47A1 – Recommendation for Restriction to WP and Incendiary Filling.

Ordnance Committee. 1942. Ordnance Committee Meeting, OCM Item # 18159, Shell, Smoke, Base Ejection, 105 mm, M84 – Clearance for Procurement and Classification as Standard, Read for Record. April 29.

Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 22844, Bomb, Chemical, 1000-LB., M79 (T3E1), Burster M16, and Valve, Needle M1: - Standardization. February. Ordnance Department.

Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 23555, Shell, Smoke (WP), 155 MM M110, for the 155 MM Howitzer, M1 - Standardization Approved. April.

Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 25172, Bomb, GP, 150 lb., T2 and Bomb, Gas, Persistent (H), 125 lb., T3 – Approved as Limited Procurement Types. Ordnance Department.

Ordnance Committee. 1944. Ordnance Committee Meeting, OCM Item # 16063, Ammunition, Complete Round, Chemical for 105 mm Howitzer, Classified as Standard - Designation of Shell, Chemical 105 mm, T4E1, Changed to Shell, Chemical, 105 mm, M60; Designation of Fuze PD T18E2 Changed to Fuze, PD, M-57; Designation of Booster, T8 Changed to Booster, M22. September.

Ordnance Committee. 1945. Ordnance Committee Meeting, OCM Item # 28880, Rocket, Gas, CK, M27 (T52) – Standardization Recommended. August 30.

Ordnance Committee. 1955. Ordnance Committee Meeting, OCM Item # 35994, Rocket, Gas, CG, M25 and Launcher, Rocket, Multiple, 7.2-Inch, M24 – Reclassification as Obsolete Types. November 3.

Ordnance Department. 1931. Ordnance Committee Meeting, OCM Item # 8996, Chemical Ammunition for 240 mm Howitzer – Elimination of Military Requirement, Read for Record.

Ordnance Department. 1944. OTCM Item # 25283, Read for Record Before Ordnance Committee 28 Sept 1944, Memorandum For: Secretary, Ordnance Technical Committee, Subject: Bomb, Chemical, 500 lb., AN-M78 - Standardized by the Joint Aircraft Committee. September. Ordnance Committee.

Ordnance Technical Committee. 1954. Ordnance Technical Committee. OTCM Item # 35517, Shell, Chem, 155-mm, M121 (T77): Casing, Burster, M15 (T29E1), Charge, Burster, M37 (T69) - Classified as Standard Type. September. Department of the Army.

Ortynsky, R.L., & Haiger, W.H. 1946. Technical Division Memorandum Report, TDMR 1236, Filling for the M47-A Type 100-LB Incendiary Bomb. April. Technical Division.

Pankey, A.V. n.d. Monograph on Hand Grenades, Volume 51. War Department American University Experiment Station Chemical Warfare Service.

Pascazio, A.J., & Norton, J.E. 1957. CWL Technical Memorandum 30-17, Navy Gas Projectile, 5”/38, EX 34, Mod 0, Development of (U). January. Chemical Warfare Laboratories.

Peake, M. 1944. Office Chief of Chemical Warfare Service, Memorandum to Commanding Officer, Dugway Proving Ground Mobile CWS Unit, Bushnell, FL. Subject: Field Test of HN-1. 19 December.

Perkins, George W. 1943. Chemical Warfare Board Project No. 362, Cylinder, Portable, Chemical M1A2. November. Chemical Warfare Board.

Pickett, E. 1958. CWL Technical Memorandum 33-7, A Series of Static Tests of GB-filled E118 and E130 Spherical Munitions When Equipped with Bursters of Various Configurations, AD221108. May.

Pickett, Edward M. 1955. Special Report CRLR 577, A Series of Static Tests of Single 8-inch HD-Filled Artillery Shells with Agent/Burster Rations of 53.8/1 and 12/1. Chemical Corps Chemical and Radiological Laboratories.

Pine Bluff Arsenal. 1945. List of Manufacturing Expenditure Orders. September. U.S. Army.

Planning and Evaluation Branch. 1952. Chemical and Radiological Laboratories Interim Report, CRLIR 80, Interim Report of Field Test 612 Dynamic Test of Multiple 4.2-Inch Gas Shell, T172, Filled GB, Fired to Impact on an Area of One Artillery Square. February. Test Division Chemical Corps.

Powell, Hartley C. 1934. Edgewood Arsenal Technical Report, EATR 169, Portable Chemical Cylinder MII, A Status Report. May. War Department.

Prentiss, Augustin M. 1937. Chemicals in War: A Treatise on Chemical Warfare. New York: McGraw-Hill Book Company.

Process Engineering Division. 1976. Work Plan, Demilitarization and Disposal BZ Agent and BZ Munitions at Pine Bluff Arsenal. Department of the Army.

Product Assurance Directorate. 1988. Special Surveillance Instructions 742-1325-94-304, Bomb, Binary Chemical BLU-80/B, w/o Ballonet (BIGEYE) and Ballonet, Cartridge Actuated MXU-695/B. U.S. Army Armament, Munitions and Chemical Command.

Program Manager for Non-Stockpile Chemical Materiel. 1993. Survey and Analysis Report. U.S. Army Chemical Materiel Destruction Agency.

Recovered Chemical Warfare Material Program. 2016. History of United State's Involvement in Chemical Warfare. Department of Defense. Retrieved from DENIX: http://www.denix.osd.mil/rcwmprogram/history/

Reed, Melvin. 1961. Chemical Corps Safety Directive (CCSD) No. 385-17, General Instructions for Disposal of Bulk Chemical Agents and Munitions. Department of the Army. 3 April.

Research & Development Department. 1942. Monthly Report, September 1942.

Rocky Mountain Arsenal and Army Materials and Mechanics Research Center. 1979. Investigation of Leaking Weteye Bombs, Report of the Weteye Reassessment Inspection Task Group. October.

Rouiller, C.A. 1934. 4-In. Chemical Mortar MI, Complete With Ammunition, Accessories and Transportation Equipment. May. War Department.

Rouiller, C.A. 1942. Edgewood Arsenal Technical Report, EATR 297, 155-MM Chemical Shell MK. IIA1 and MK. VIIA1, HS-Filled. Final Report on Projects A 1.1-1b and A 1.1-1c. War Department.

Safety and Fire Protection Committee. 1967. Chemical Safety Data Sheet SD-95, Properties and Essential Information of Safety Handling and Use of Phosgene. July. Manufacturing Chemists Association.

Scherr, H. 1945. Technical Division Memorandum Report, TDMR 1090, Set, Gas Identification, Instructional, M2, Project E 7a-1, Job 7. Chemical Warfare Service.School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. July. U.S. Army Missile and Munitions Center.

School Munitions Department Redstone Arsenal. 1976. Chemical Munitions EOD/TE Study Guide. U.S. Army Missile and Munitions Center.

SciTech Services, Inc. 1998. Old Chemical Weapons Reference Guide. May. U.S. Army.

Secretary of the Air Force. 1982. Liquid agent spray tank, TMU-28/B and shipping and storage container, CNU-77/E23. November. Secretary of the Air Force.

Secretary of the Army. 1962. Field Manual, FM 3-10, Chemical and Biological Weapons Employment. Department of the Army.

Secretary of the Army. 1967, February. Technical Manual, TM 9-1385-51, Identification of Ammunition (Conventional) for Explosive Ordnance Disposal. Department of the Army.

Secretary of the Army. 1967. Technical Manual, TM 750-5-15, Army Equipment Data Sheets, Chemical Weapons and Defense Equipment. February. Department of the Army.

Secretary of the Army. 1973. Technical Manual, TM 9-1300-251-20, Organizational Maintenance Manual Including Repair Parts and Special Tools List: Artillery Ammunition for Guns, Howitzers, Mortars, Recoilless Rifles and 40 MM Grenade Launchers. December. Department of the Army.

Secretary of War. 1942. Technical Manual, TM 3-215, Military Chemistry and Chemical Agents. War Department.

Secretary of War. 1942. Technical Manual, TM 3-300, Irritant Candles, Tear Pots, Smoke Pots, and Chemical Land Mines. April. War Department.

Secretary of War. 1942. Technical Manual, TM 9-1980, Bombs for Aircraft. War Department.

Secretary of War. 1944. Technical Manual, TM 3-300, Miscellaneous Chemical Munitions. War Department.Shaw, D. 1956. Chemical and Biological Laboratories Report, CRLR 539, Special Report, A Series of Dynamic Tests of Single E104R1 GB-filled Bomblets with an Agent/Burster Ratio of 5/1 Fired from an Inverted Mortar, AD 094267. Chemical Corps. March.

Shaw, F.B. Cpt. And F.D. Canning 2Lt, 1942. Test Report 10, Grenades, Frangible (AW), M1, in Simulated Tropical Storage., Chemical Warfare Center, 7 October.

Smith, B.F. 1940. Technical Division Memorandum Report, TDMR 227, 75-mm, Cast Iron Shell T10. Method for Sealing Leaks in Shell Bodies. May. Chemical Warfare Service.

Smith, D.E. 1948. Technical Command Report, TCR 9 Development and Testing of 10-lb. Thermal Generator Bombs E29 and E29R1 for Dispersing Mustard. October. Chemical Corps Technical Command.

Smith, D.E. 1949. Technical Command Report, TCR 18, Evaluation of 125-lb. Chemical Bomb T3E2. January. Technical Command.

Spitler, Joseph, Jr. 1976. Letter Report, Engineer Design Test (Air Transport/Airdrop) of Projectile, 8-Inch, VX2, XM736, TECOM Project No. 2-MU-003-736-019. May. Department of the Army.

Spragins, R.L. 1930. Memorandum to Chief of Infantry, Washington, D.C.: Expulsion Type, Air-Burst Bomb. War Department. 28 October.

Spurback, K. 1968. Technical Report AFATL-TR-68-87, BLU-30/B (Nonhazardous) Bomblet. Air Force Armament Laboratory.

Stewart, F., & Wagner, P. 1962. CRDL Technical Memorandum 30-66, Development of Bomb, Nonpersistent Gas, Spherical, 4.5-inch, E130R2 (U). March. Directorate of Development, U.S. Army Chemical Research & Development Laboratories, Army Chemical Center.

Stockhardt, Jay S., Captain. 1945. Technical Command Informal Report, TCIR 302, Vesicant Spray Bomb, EK-3 Filling and Clustering. May. Chemical Warfare Service.

Subcommittee on Air Defense and Missiles. 1969. AMCTC Item # 7165, Reclassification of Rocket Weapon System, M318 (Little John) from Standard-A to Obsolete. U.S. Army Materiel Command.

Sub-Committee on Bombs. 1926. OCM Item # 5812, Bomb, Chemical, 25-lb. MI – Standardization, and Designation Changed to “Bomb, Chemical, 30-lb, MI”. November. Ordnance Committee.

Sub-Committee on Bombs. 1928. OCM Item # 7209, Standardization of 30-lb, Chemical Bomb MI with WP Filling. September. Ordnance Committee.

Sub-Committee on Bombs. 1931. Item 8925, Test of Bombs - Chemical Expulsion Type at Langley Field. Ordnance Committee. 7 May.

Sub-Committee on Bombs. 1942. OCM Item # 19111, Subject: Bomb, Chemical, 100-lb, M47A1 - Modification of, to Bomb, Chemical, 100-lb, M47A2. Ordnance Committee.

Sub-Committee on Bombs. 1944. OCM Item # 23112, Bombs, Chemical, 500-lb., M78 (T3E1) and Burster, M15 - Standardization. February. Ordnance Committee.

Subcommittee on Rockets and Launchers. 1951. Ordnance Committee Item 33910, 4.5-Inch Chemical Rockets - Initiation of Development. 8 August.

Subcommittee on Weapons/Munitions Systems. 1972. AMCTC Item # 9102, Recording of Type Classification of Cartridge, 105MM: Smoke, WP, M60A2 and M60A1. U.S. Army Materiel Command. 3 February.

Tarento, F. F. 1961. Final Report EX-38 500 LB. Chemical Bomb Development, Report 5412. College Point: EDO Corporation.

Task Force Public Affairs Office. 1981. Fact Sheet: Description of MK 116, Mod 0, Chemical Bombs (Weteye). U.S. Army.

Taylor, Thomas, Col. 1941. Report of the Infantry Board, No. 1231, Incendiary and Fra[n]gible Type Chemical Smoke Grenades. Office of the Infantry Board.

Taylor, W., & Stone, H. 1965. DPGR C440, Final Report of Engineering Design Test of the USAF Bomblet, Nonpersistent Agent, USATECOM Project 5-4-0005-01. April. USATECOM.

Technical Command 1947. John A. MacLaughlin, Commanding Officer, Memorandum to R & E Division, Army Chemical Center, Subject: Modification of Set, Gas, Toxic, M1. October 24.

Technical Division. 1944. Catalogue of Standard Ordnance Items, Second Edition 1944, Volume III. March. Office Chief of Ordnance.

Technical Services Division. 1952. Field Test DPG 25a-51, Shell, GB filled, 4.2-inch mortar, T172. February. Dugway Proving Ground.

Technical Staff 9769 (TSU) CWS Dugway Proving Ground Mobile Unit. 1945. Dugway Proving Ground Special Report, DPGSR No. 47, Low Altitude Dropping Tests of Modified M47A2 and M70 Bombs. Chemical Warfare Service.

Technical Staff 9769 (TSU) CWS Mobile Unit. 1945. Mobile Unit Special Report, MUSR No. 2, Assessment of Traversal Hazards by Standardized Methods. Chemical Warfare Service.

Technical Staff 9769 (TSU) CWS Mobile Unit. 1946. Mobile Unit Memorandum Report, MR #5, The Tactical Usefulness of the EK3 and EK4 Bombs. Filled HD and HDV, as Compared with Ground Functioning Munitions, Namely the E5 and M47A2 Bombs. Chemical Warfare Service.

Technical Staff, Dugway Proving Ground. 1943. Dugway Proving Ground Memorandum Report, DPGMR 9, 500-LB. T2 Bombs filled with CG. Chemical Warfare Service.

Technical Staff, Dugway Proving Ground. 1944. Dugway Proving Ground Memorandum Report, DPGMR No. 18, 500-LB., 1000-LB., 2000-LB., and 4000-LB. Bombs Filled with Nonpersistent Agents. Chemical Warfare Service.

Test and Evaluation Command. 1964. Dugway Proving Ground Trial Report, DPGTR 384, Hazard Classification Test for Storage, Handling, and Disposal of M43 Bomb Cluster, BZ-Filled, 750-lb, and M44 Generator Cluster, BZ-Filled, 175-lb, USATECOM Project No. 5-3-0130-01. Dugway Proving Ground: U.S. Army.

Test Division. 1953. Chemical and Biological Laboratories Report, CRLR 198, Final Engineering Test No. 37A, Rocket, Gas, GB, 4.5-Inch, T164. June. Test Division, Chemical Corps Chemical and Radiological Laboratories.

The Chemical Corps School. 1951. Special Text 3-250-1, Bulk Chemicals and Chemical Agents. February.

Third Air Force. 1945. Report of Controlled and Other Critical Items of Equipment.

Tidwell, J.S. LT Col. 1958. Memorandum From: Traffic Consultant OCCm10. To: Chief of Transport. Attention: Freight Movements Division. Subject: Request for Airlift. Date. 26 March 1958.

Trott, B.D. 1982. Engineering and Technical Support of Agent BZ Disposal, ARO Scientific Services Program TCN-81-220, Test Report for Agent BZ, Detonation Tests. Battelle Columbus Laboratories.

U.S. Army Armament Command. 1977. 1977, Materiel Status Record Submission 01776009, Projectile, 155mm, Lethal Binary, GB2, XM687.

U.S. Army Chemical Research and Development Laboratory 1962. Quarterly Historical Report, 1 July to 30 September 1962. December.

U.S. Army Combined Arms Support Command. 2011. Interpreting Ammunition Markings and Color Codes: Subcourse MM2597 Edition 6. 3-4. August. Fort Lee, Virginia: U.S. Army.

U.S. Army Corps of Engineers. 2015. Engineer Manual, EM 200-1-15, Technical Guidance for Military Munitions Response Actions. October. Retrieved from USACE Publications: http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_200-1-15.pdf?ver=2015-12-01-161235-923

U.S. Army Materiel Command. 1970. AMCTC Item 8234, Reclassification of War Gas Identification Set, Instructional: Nondetonation, MI from Standard-B BuOrd Type to Obsolete Type.

U.S. Army Missile Command. 1988. Pershing, Intermediate-Range and Shorter-Range Missile, Escort Officer's Equipment Information Guide. June. Science Applications International Corporation.

U.S. Army Program Manager for Chemical Demilitarization. 1995. Chemical Agent Identification Sets (CAIS) Information Package. November. Department of Defense.

U.S. Army Toxic and Hazardous Materials Agency. 1980. Public Affairs Plan, Laboratory-Scale Incineration/Detonation Tests Involving Incapacitating BZ Agent & Munitions. Department of the Army.

U.S. Army, Marine Corps, Navy, and Air Force. 2005. Field Manual, FM 3-11.9/MCRP 3-37.1B/NTRP 3-11.32/AFTTP(I) 3-2.55, Potential Military Chemical/Biological Agents and Compounds. U.S. Army.

U.S. Army. 1944. Specification 97-54-254, Set, Gas, Toxic, M1. 2 September.

U.S. Army. 1945. U.S. Army Specification No. 97-54-396, Set, Gas Identification, Instructional, M2. Chemical Warfare Service.

U.S. Army. 1954. Ammunition Complete Round Charts. Prepared by ORDBB-TG2.

U.S. Army. 1970. Technical Manual, TM 3-1365-2000-10, Operators Manual, Training Set, Chemical Agent Identification: M72. August.

U.S. Naval Ordnance Laboratory. 1958. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. Naval Ordnance Systems Command.

U.S. Naval Ordnance Laboratory. 1968. NAVORD Ordnance Pamphlet, OP 2217, Miscellaneous Chemical Munitions, Description and Operation, First Revision, Change 1. August. Naval Ordnance Systems Command.

U.S. Navy Bomb Disposal School. 1944. United States Bombs and Fuzes, Pyrotechnics, Land Mines, Firing Devices. June.

U.S. Navy Bomb Disposal School. 1945. Rockets and Fuzes. 15 May.

Unknown. 1938. Airplane Chemical Spray Tank Designations (For A17 and A17-A Airplanes). DENIX file name: NARA College Park_RG175_EUD-2A_Bx103.

Unknown. 1946. Photograph from TDMR 1220, 10-lb. Smoke Bomb M67. Edgewood Arsenal.

Unknown. N.d. Report on Toxic Gas Containers, Edgewood Arsenal. AD0495499.

Vavra, B.L., & Oaks, S.A. 1976. Engineer Design Test, Phase IV (In-flight mixing) of Projectile, 8-Inch, VX-2, XM736. October.

Wagner, P. 1958. CWL Technical Memorandum 30-35, Development of Bomb, Nonpersistent gas, Spherical, 4.5-inch, E130R1, AD356703. August.

Wagner, P., & Scherer, R., & LaMonica, V. 1956. Munitions Development Division, Technical Memorandum, TM 12, Development of Rocket, Non-Persistent Gas (GB), 5-Inch, E43 and Rocket, Persistent Gas (HD), 5-Inch, E45. Chemical Warfare Laboratories.

Walton, Ralph & Kratzer, John. 1959. Chemical Warfare Laboratory, CWL Technical Memorandum 30-47, Preliminary Chemical Warhead Study for the Bullpup Missile (U). Army Chemical Warfare Laboratories.

War Department 1918. Office of Chief of Ordnance, Trench Warfare Section, Memorandum to Colonel Walker, Subject: Munitions to be Filled and Approximate Fill Weight. March 9.

War Department 1927. Technical Regulations, TR 1355-155A, Mobile Artillery Ammunition, Ammunition For 155-MM Howitzers, M 1917 (French) and M1918 (American). November 23.

War Department. 1927. Technical Regulation, TR 1355-240A, Mobile Artillery Ammunition, Ammunition for 240mm Howitzer, M1918 (Schneider). November.

War Department. 1928. 4-Inch Chemical Mortar Shell Painting and Marking Diagram and Bill of Material. May. Chemical Warfare Service.

War Department. 1935. Index Card 400.171/75, HS (Replacement of Sample of DA in Gas Identification Sets with HS). April.

War Department. 1942. Basic Field Manual, FM 23-30, Grenades. June 15.

War Department. 1942. Field Manual, FM 3-5, Chemical Warfare Service Field Manual: Tactics of Chemical Warfare. July. War Department.

War Department. 1942. Technical Manual, TM 3-315, Portable Chemical Cylinder MIA2. February. War Department.

War Department. 1942. Technical Manual, TM 3-320, 4.2-Inch Chemical Mortar, MIA1. Information Division.

War Department. 1942. Technical Manual, TM 3-325, Livens Projector MI. MI. Dugway Proving Ground.

War Department. 1943. AR 850-60, Miscellaneous, Compressed Gas Cylinders; Safe Handling, Storing, Shipping, Using. April. U.S. Government Printing Office.

War Department. 1943. Technical Manual, TM 3-250, Storage and Shipment of Dangerous Chemicals, Change 1. U.S. Government Printing Office.

War Department. 1943. Technical Manual, TM 3-255, Chemical Handling and Loading Equipment. 30 October.

War Department. 1944. Basic Field Manual, FM 23-30, Hand and Rifle Grenades, Rocket, AT, HE, 2.36-inch. February 14.

War Department. 1944. Technical Bulletin, TB 3-255A-1, Airplane Smoke Tank M10. November. War Department.

War Department. 1944. Technical Manual, TM 3-255, Chemical Handling and Loading Equipment. Change 2.

War Department. 1944. Technical Manual, TM 9-1901, Artillery Ammunition, 29 June 1944. June. War Department.

War Department. 1944. Technical Manual, TM 9-1904, Ammunition Inspection Guide. March. U.S. Government Printing Office.

War Department. 1944. Technical Manual, TM 9-1980, Bombs for Aircraft. Washington: U.S. Government Printing Office.

War Department. 1945. Technical Bulletin, TB 3-255B-1, Airplane Smoke Tanks AN-M33A1 and M33. May. War Department.

War Department. 1945. Technical Bulletin, TB CW 22, Nonpersistent Gas Bombs: Handling, Shipping, and Storage.

War Department. 1945. Technical Bulletin, TB CW 27, Complete Round Charts of Chemical Munitions. April.

War Department. 1945. Technical Manual, TM 3-215, Military Chemistry and Chemical Agents, Change No. 2. War Department.

War Department. 1945. Technical Manual, TM 3-320, Mortar, Chemical, 4.2-Inch. United States Government Printing Office.

War Department. 1945. Technical Manual, TM 9-1900, Ammunition, General. June. U.S. Government Printing Office.

War Department. 1946. Field Manual, FM 3-5, Characteristics and Employment of Ground Chemical Munitions. May. War Department.

War Department. 1946. Field Manual, FM 3-6, Employment and Characteristics of Air Chemical Munitions. October. War Department.

Weaver, F.R. 1934. Edgewood Arsenal Technical Report, EATR 147, Portable Chemical Cylinder MIA1 (E3), A Final Report. June. War Department.

Weaver, F.R. 1938. Technical Division Memorandum Report, TDMR 127, Report of Comparative Tests of Airplane Chemical Spray Tank E6R9 and Air Corps A-17 Chemical Tank with Airplane YIA-18. Chemical Warfare Service.

Weaver, F.R. 1938. Technical Division Memorandum Report, TDMR 127, Report of Comparative Tests of Airplane Chemical Spray Tank E6R9 and Air Corps A-17 Chemical Tank with Airplane YIA-18. April. Chemical Warfare Service.

White, S.A. Lt. Colonel. 1939. Edgewood Arsenal Technical Report, EATR 299, Hydrocyanic Acid. Field Tests (Static and Artillery Fire) of HCN in 155-mm Shell. Chemical Warfare Service.

Willke, L. G. 1946. Technical Division Memorandum Report, TDMR 1244, Development of Explosive Incendiary Bombs E5X and E5XR2. Chemical Warfare Service.

Woodberry, David L. 1934. Edgewood Arsenal Technical Report, EATR 140, Project B 1.2-lb, 4-in. Chemical Mortar Empty Complete Round E1. May 17. Chemical Warfare Service.

Woodberry, David L. 1936. Technical Division Memorandum Report, TDMR 67, Report of the Static Firings of Twenty (20) 105-mm Chemical Shell T4, May 21, 1936. Edgewood Arsenal.

Woodberry, David L. 1937. Technical Division Memorandum Report, TDMR 107. Report of the Test of 105 mm Chemical Shell, T4, HS-Filled, Fired for Impact Burst, May 24, 1937. Edgewood Arsenal.

Woodberry, David L. 1938. Technical Division Memorandum Report, TDMR 149, Report of Static Fragmentation Test of 81-mm Chemical Shell, T9, FS and WP Filled. December 12. CBRNIAC-CB-023440.

Woodberry, David L. 1939. Technical Division Memorandum Report, TDRM 176, Chemical Filling for Artillery Shell, Static Tests of 155-mm (How.) Chemical Shell MK. II, Filled with Simulated HS and WP, and Equipped with Special Bursters Developed by the Ordnance Department, July 12, 1939. Chemical Warfare Service Technical Command.

Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 241, Chemical Filling for Artillery Shell Static Test of 155-mm. (How.) Chemical Shell MKIIA1, Filled with WP, FS, and HS. August. Chemical Warfare Service.

Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 215, Chemical Fillings for Artillery Shell Static Tests of 155-mm. (How.) Chemical Shell T6E1, Filled with WP and Simulated HS, February 7, 1940. February. Chemical Warfare Service Technical Command.

Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 216, Chemical Fillings for Artillery Shell, Static Tests of 105-mm (How,) Chemical Shell T4E1, Filled with WP and Simulated HS. February 8, 1940. Chemical Warfare Service Technical Command.

Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 220, Test of 81 mm. Mortar and the 4.2-in. Chemical Mortar Using Phosgene Filled Ammunition. May 12. Chemical Warfare Service.

Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 226, Chemical Fillings for Artillery Shell, Static Tests of the 75-mm, Chemical Shells T10 and MK. II, Filled with FS, WP, and Simulated HS. May 21. Chemical Warfare Service.

Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 238, Chemical Filling for Artillery Shell Static Test of 105-mm (How.) Chemical Shell T4E1, Filled with WP, FS, HS and Simulated HS, June 20, 21, 25, 27 and 28, 1940. Chemical Warfare Service Technical Command.

Woodberry, David L. 1940. Technical Division Memorandum Report, TDMR 254, Chemical Fillings for Artillery Shell, Firing of 75-mm Chemical Shell T10 (Cast Iron), Filled with HS. November. Chemical Warfare Service.

Woodberry, David L. and Carson, J.S. 1940. Technical Division Memorandum Report, TDMR 258, Chemical Filling for Artillery Shell, Static Test of the 75-mm Chemical Shell T10 (Cast Iron) Filled with HS. December. Chemical Warfare Service.

Yeager, Kurt E. 1963. Test of M-43 Cluster Bomb, Aerospace Internal Data Report No. 63-28. May. Department of the Air Force.

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U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	AC	AS	AW	BA	BM	BZ	CA	CG	CK	CG/CL	CL	CN	CN-DM	CNB	CNC	CNS	CS	DA	DM	DP	ED	EG	FM	FS
Bombs																								
Bomb, 30-pound, E2 Series, E4																							E	
Bomb, 30-pound, M1																E							X	
Bomb, 30-pound, M46, M46A2																								
Bomb, 5-gallon/50-pound, LC-50																								
Bomb, 100-pound, Cube, E132																								
Bomb, 100-pound, M47 Series AN-M47 Series	E	X														E								
Bomb, 100-pound, MK 42																								
Bomb, 115-pound, E46, E46R1																								
Bomb, 115-pound, M70, M70A1	E							E	E															
Bomb, 125-pound, M113 (T3E2)																								
Bomb, 125-pound, T2																								
Bomb, 500-pound, EX38																								
Bomb, 500-pound, BLU-52, BLU-52/B, BLU-52A/B																	X							
Bomb, 500-pound, BLU-80/B, Bigeye																								
Bomb, 500-pound, EX38																								
Bomb, 500-pound, M78, AN-M78	E							X	X															
Bomb, 500-pound, MK 94 Mod 0 (EX23, E110)																								
Bomb, 500-pound, MK 116 Mod 0, Weteye																								
Bomb, 500-pound, T2	X							X	X															
Bomb, 750-pound, MC-1																								
Bomb, 1,000-pound, M79, AN-M79 (T3E1)	X							X	X															
Bomb, 1,000-pound, T1	X							X	X															
Bomb, 1,000-pound, T2	X							X	X											X				
Bomb, 1,000-pound, General Purpose, (y) E2C																								
Bomb, 2,000-pound, T2	E							E	E															
Bomblets																								
Bomblet, 2.5-inches, E139																								
Bomblet, 4.25-inch, Cube, E123																								
Bomblet, 4.5-inch, Spherical, M139 (E130R2)																								
Bomblet, 5.2-inch, Spherical, E118, E118R2																								
Bomblet, 3-pound, E91, E91R1																								
Bomblet, 3.4-pound, Spherical, M134 (E130R1)																								
Bomblet, 6-pound, E104, E104R1																								
Bomblet, 6-pound, E105																								

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	GA	GB	H	HC	HD	HL	HN	HT	HV	IM	KJ	L	MD	MR	NC	NP	PD	PG	PS	PS/CL	PT	PWP	TH3	VX	VX2	WP	SIM
Bombs																											
Bomb, 30-pound, E2 Series, E4			E	E																						E	E
Bomb, 30-pound, M1			X																							X	
Bomb, 30-pound, M46, M46A2			X																							X	
Bomb, 5-gallon/50-pound, LC-50			X																								
Bomb, 100-pound, Cube, E132		E																						E			
Bomb, 100-pound, M47 Series AN-M47 Series			X		X	E	E			E		E				X					X	X				X	
Bomb, 100-pound, MK 42			X																								
Bomb, 115-pound, E46, E46R1	E	E																									
Bomb, 115-pound, M70, M70A1			X		X		E			X		X				X										X	
Bomb, 125-pound, M113 (T3E2)		X	X		X																						
Bomb, 125-pound, T2			X																								
Bomb, 500-pound, EX38		X																						X			
Bomb, 500-pound, BLU-52, BLU-52/B, BLU-52A/B																											
Bomb, 500-pound, BLU-80/B, Bigeye																								X			
Bomb, 500-pound, EX38		X																						X			
Bomb, 500-pound, M78, AN-M78																											
Bomb, 500-pound, MK 94 Mod 0 (EX23, E110)		X																									
Bomb, 500-pound, MK 116 Mod 0, Weteye		X																						X			
Bomb, 500-pound, T2																											
Bomb, 750-pound, MC-1		X																									
Bomb, 1,000-pound, M79, AN-M79 (T3E1)																											
Bomb, 1,000-pound, T1																											
Bomb, 1,000-pound, T2			X									X															
Bomb, 1,000-pound, General Purpose, (y) E2C					E																						
Bomb, 2,000-pound, T2																											
Bomblets																											
Bomblet, 2.5-inches, E139		E																									
Bomblet, 4.25-inch, Cube, E123		E																									
Bomblet, 4.5-inch, Spherical, M139 (E130R2)		X																						X			
Bomblet, 5.2-inch, Spherical, E118, E118R2		E																									
Bomblet, 3-pound, E91, E91R1		E																									
Bomblet, 3.4-pound, Spherical, M134 (E130R1)		X																						E			
Bomblet, 6-pound, E104, E104R1		E																									
Bomblet, 6-pound, E105		E																									

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	AC	AS	AW	BA	BM	BZ	CA	CG	CK	CG/CL	CL	CN	CN-DM	CNB	CNC	CNS	CS	DA	DM	DP	ED	EG	FM	FS
Bomblet, 6-pound, M69 (E1), AN-M69, AN-M69A1, M69X																								
Bomblet, 7.5-pound, BLU-30/B23						X											X							
Bomblet, 10-pound, E29 (G8), E29R1																								
Bomblet, 10-pound, E49 Series																								
Bomblet, 10-pound, Ejection Airburst, EK Series																								
Bomblet, 10-pound, M67	E																							
Bomblet, 10-pound, M74 (E5), M74A1																								
Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8)																								
Bomblet, 10-pound, M138 (E135)						X																		
Bomblet, BLU-19/B23																								
Bomblet, BLU-39/B23, BLU 50/B						X											X							
CAIS																								
CAIS, Chemical Agent Identification, Simulants, M72A1, M72A2, SCAITS																								
CAIS, Gas Identification Set, Instructional, K955, M1												X						*	X					
CAIS, Gas Identification Set, Instructional, M2												X						X						
CAIS, Replacement Set, Gas Identification, Instructional, Navy X Sets								X				X							X					
CAIS, Toxic Gas Set, K941, M1																								
CAIS, Toxic Gas Set, K942, M2 (E11)																								
CAIS, Training Set, Chemical Agent Identification, K945, M72, CAITS								X																
CAIS, War Gas Identification Set, Instructional, K951/K952, M1								X																
CAIS, War Gas Identification Set, Instructional and Detonation, K953/K954, AN-M1A1								X	X															
Candles																								
Candle, Comings																			X					
Grenade																								
Grenade, Frangible, M1	X		X						X							X								X
Grenade, Hand, M6													X											
Grenade, Hand, M58 (XM58)																	X							
Grenade, Hand, MK1					X																			
Grenade, Hand, MK II																								

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	GA	GB	H	HC	HD	HL	HN	HT	HV	IM	KJ	L	MD	MR	NC	NP	PD	PG	PS	PS/CL	PT	PWP	TH3	VX	VX2	WP	SIM
Bomblet, 6-pound, M69 (E1), AN-M69, AN-M69A1, M69X			X							X		E		X		X											
Bomblet, 7.5-pound, BLU-30/B23																											
Bomblet, 10-pound, E29 (G8), E29R1			E		E																						
Bomblet, 10-pound, E49 Series	E		E																								
Bomblet, 10-pound, Ejection Airburst, EK Series			E		E				E																		
Bomblet, 10-pound, M67			X																							X	
Bomblet, 10-pound, M74 (E5), M74A1			E					E				E				X					X					X	
Bomblet, 10-pound, M125 (E54R6), M125A1 (E54R8)		X																									
Bomblet, 10-pound, M138 (E135)																											
Bomblet, BLU-19/B23		X																									
Bomblet, BLU-39/B23, BLU 50/B																											
CAIS																											
CAIS, Chemical Agent Identification, Simulants, M72A1, M72A2, SCAITS																											X
CAIS, Gas Identification Set, Instructional, K955, M1			X									X							X								X
CAIS, Gas Identification Set, Instructional, M2			X		X							X							X								X
CAIS, Replacement Set, Gas Identification, Instructional, Navy X Sets			X				X					X							X								
CAIS, Toxic Gas Set, K941, M1			X		X																						
CAIS, Toxic Gas Set, K942, M2 (E11)			X		X																						
CAIS, Training Set, Chemical Agent Identification, K945, M72, CAITS		X			X							X															X
CAIS, War Gas Identification Set, Instructional, K951/K952, M1			X									X							X								
CAIS, War Gas Identification Set, Instructional and Detonation, K953/K954, AN-M1A1					X		X					X															X
Candles																											
Candle, Comings			X		X																						
Grenade																											
Grenade, Frangible, M1										X		X				X										X	
Grenade, Hand, M6																											
Grenade, Hand, M58 (XM58)																											
Grenade, Hand, MK1																											
Grenade, Hand, MK II											X																

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	AC	AS	AW	BA	BM	BZ	CA	CG	CK	CG/CL	CL	CN	CN-DM	CNB	CNC	CNS	CS	DA	DM	DP	ED	EG	FM	FS
Mine																								
Mine, Land, E2																								
Mine, 1-gallon, Land, M1		X																						
Mine, 2-gallon, M23																								
Miscellaneous																								
Container, Bulk, One-ton, Type A	X							X	X		X													
Container, Bulk, One-ton, Type D	X							X	X		X													
Container, Bulk, One-ton, Type E	X							X	X		X													
Cylinder, Portable, MI, MIA1, MIA2								X		X				X		X							X	X
Cylinder, 150-pound								X																
Cylinder, 300-pound								X																
Drone Weapon System, Multipurpose, AN-USD-2																								
Drum, 55-gallon												X		X	X	X		X	X		X		X	X
Tank, 23-gallon, Airplane, E6R9														E		E							E	E
Tank, 30-gallon, Airplane, M10 (E12)		X												X	X	X							X	X
Tank, 30-gallon, Airplane, M21, Pressure		X												X		X								X
Tank, 50-gallon, Airplane, M20, Pressure		X												X		X								X
Tank, 70-gallon, Airplane, M33 and AN-M33A1		X												X		X							X	X
Tank, 84-gallon, Aircraft, Aero 14B																								X
Tank, Aircraft, TMU-28/B																								
Tank, Airplane, E28R1, E28R2																								
Mortar																								
Mortar, 81-mm, M57								E																X
Mortar, 4-inch, Stokes, E1, E1R1								E				E				E							E	E
Mortar, 4-inch, Stokes, M1				X			X	X				X		X		X	X						X	X
Mortar, 4.2-inch, M1A1, M2, M2A1								X	X			X		X		X							X	X
Mortar, 4.2-inch, T172, T172 Modified																								
Mortar, 8-inch, Livens Projector, MI, MII, MIIA1, MIIA2, MIIA3								X			X												X	X
Projectile																								
Projectile, 75-mm, MK II				X			X	X				X				X							X	X
Projectile, 75-mm, M64																X								X
Projectile, 75-mm, T10																								E
Projectile, 105-mm, Howitzer, M60 (T4E1), M60A1, M60A2																X								X
Projectile, 105-mm, Howitzer, M360 (T173)																								

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	GA	GB	H	HC	HD	HL	HN	HT	HV	IM	KJ	L	MD	MR	NC	NP	PD	PG	PS	PS/CL	PT	PWP	TH3	VX	VX2	WP	SIM
Mine																											
Mine, Land, E2			E																								
Mine, 1-gallon, Land, M1			X		X							X		X													
Mine, 2-gallon, M23					E																			X			
Miscellaneous																											
Container, Bulk, One-ton, Type A																			X								
Container, Bulk, One-ton, Type D	X	X	X		X		X	X				X												X			
Container, Bulk, One-ton, Type E		X	X		X		X	X				X							X					X			
Cylinder, Portable, MI, MIA1, MIA2																				X							
Cylinder, 150-pound			X																								
Cylinder, 300-pound																											
Drone Weapon System, Multipurpose, AN-USD-2																								X			
Drum, 55-gallon		X	X		X		X					X	X	X			X		X							X	
Tank, 23-gallon, Airplane, E6R9			E			E						E		E					E								
Tank, 30-gallon, Airplane, M10 (E12)	X		X		X	X			X			X		X													
Tank, 30-gallon, Airplane, M21, Pressure			X			X			X			X		X													
Tank, 50-gallon, Airplane, M20, Pressure			X			X			X			X		X													
Tank, 70-gallon, Airplane, M33 and AN-M33A1			X		X	X						X		X													
Tank, 84-gallon, Aircraft, Aero 14B		X			X																			X			
Tank, Aircraft, TMU-28/B																								X			
Tank, Airplane, E28R1, E28R2	E	E																									
Mortar																											
Mortar, 81-mm, M57			X																							X	
Mortar, 4-inch, Stokes, E1, E1R1			E																							E	
Mortar, 4-inch, Stokes, M1			X								X	X			X			X	X				X			X	
Mortar, 4.2-inch, M1A1, M2, M2A1			X		X			X				X										X				X	
Mortar, 4.2-inch, T172, T172 Modified		E																									
Mortar, 8-inch, Livens Projector, MI, MII, MIIA1, MIIA2, MIIA3			X												X			X	X				X				
Projectile																											
Projectile, 75-mm, MK II			X												X											X	
Projectile, 75-mm, M64			X		X							X														X	
Projectile, 75-mm, T10			E											E												E	
Projectile, 105-mm, Howitzer, M60 (T4E1), M60A1, M60A2			X		X		E					X														X	
Projectile, 105-mm, Howitzer, M360 (T173)		X																									

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	AC	AS	AW	BA	BM	BZ	CA	CG	CK	CG/CL	CL	CN	CN-DM	CNB	CNC	CNS	CS	DA	DM	DP	ED	EG	FM	FS
Projectile, 105-mm, T4, T4E1																								E
Projectile, 4.7-inch, Common Steel, MK II, MK V				X			X	X															X	
Projectile, 5-inch, Common Steel, MK VI				X				X															X	
Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 (EX 34)																								
Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0 (EX 36)																								
Projectile, 6-inch, Common Steel, MK III				X				X															X	
Projectile, 155-mm, Artillery, E15, E15R1, E15R2, E15R3																								
Projectile, 155-mm, M104																								X
Projectile, 155-mm, M105, M105B1																								X
Projectile, 155-mm, Gun or Howitzer, M110, (M110E1), M110A1 (M110E2), M110A2 (M110E3)																X								X
Projectile, 155-mm, Howitzer, M121, M121A1 (T77)																								
Projectile, 155-mm, Gun, M122 (T179)																								
Projectile, 155-mm, M687																								
Projectile, 155-mm, MK II, MK IIA1, MK IIA1 Mod 1				X			X	X								X							X	X
Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1				X			X	X															X	X
Projectile, 155-mm, T6, T6E1	E							E																E
Projectile, 155-mm, Howitzer, T387																								
Projectile, 175-mm, Gun, T223																								
Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III				X			X	X															X	
Projectile, 8-inch, Howitzer, M426 (T174 series)																								
Projectile, 8-inch, T19 Series																								
Projectile, 8-inch, XM736																								
Projectile, 9.2-inch				X			X	X															X	
Projectile, 240-mm, Field Artillery, Howitzer, M1918				*			*	*															*	
Warhead, Missile, and Rocket																								
Missile, 250-pound, Warhead, Bullpup																								
Missile, Warhead, Pershing																								
Rocket, 2.36-inch, M10 Series (T26E2), M26									X															
Rocket, 2.36-inch, T70																								
Rocket, 2.36-inch, T71								E																

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	GA	GB	H	HC	HD	HL	HN	HT	HV	IM	KJ	L	MD	MR	NC	NP	PD	PG	PS	PS/CL	PT	PWP	TH3	VX	VX2	WP	SIM
Projectile, 105-mm, T4, T4E1			E																							E	E
Projectile, 4.7-inch, Common Steel, MK II, MK V			X												X				X							X	
Projectile, 5-inch, Common Steel, MK VI			X												X												
Projectile, 5-inch/.38 Caliber, Gun, MK 53 Mod 0 (EX 34)		X			E																						
Projectile, 5-Inch/.54 Caliber, Gun, MK 54 Mod 0 (EX 36)		X			E																						
Projectile, 6-inch, Common Steel, MK III			X												X												
Projectile, 155-mm, Artillery, E15, E15R1, E15R2, E15R3		E																									
Projectile, 155-mm, M104			X		X		*					*														X	
Projectile, 155-mm, M105, M105B1			X		X							X														X	
Projectile, 155-mm, Gun or Howitzer, M110, (M110E1), M110A1 (M110E2), M110A2 (M110E3)			X		X																					X	
Projectile, 155-mm, Howitzer, M121, M121A1 (T77)		X																						X			
Projectile, 155-mm, Gun, M122 (T179)		X																									
Projectile, 155-mm, M687		X																									
Projectile, 155-mm, MK II, MK IIA1, MK IIA1 Mod 1			X									X			X				X							X	
Projectile, 155-mm, Howitzer and Gun, MK VII, MK VIIA1			X												X				X							X	
Projectile, 155-mm, T6, T6E1																										E	E
Projectile, 155-mm, Howitzer, T387																								E			
Projectile, 175-mm, Gun, T223		X																						E			
Projectile, 8-inch, Common Steel, Howitzer and Gun, MK III			X												X				X							X	
Projectile, 8-inch, Howitzer, M426 (T174 series)		X																						X			
Projectile, 8-inch, T19 Series					E																			E		E	
Projectile, 8-inch, XM736																									X		
Projectile, 9.2-inch			X												X				X							X	
Projectile, 240-mm, Field Artillery, Howitzer, M1918			*												*				*							*	
Warhead, Missile, and Rocket																											
Missile, 250-pound, Warhead, Bullpup		X																									
Missile, Warhead, Pershing		X																						X			
Rocket, 2.36-inch, M10 Series (T26E2), M26																										X	
Rocket, 2.36-inch, T70			E																								
Rocket, 2.36-inch, T71																											

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	AC	AS	AW	BA	BM	BZ	CA	CG	CK	CG/CL	CL	CN	CN-DM	CNB	CNC	CNS	CS	DA	DM	DP	ED	EG	FM	FS
Rocket, 2.36-inch, T72	E																							
Rocket, 2.36-inch, T73									E															
Rocket, 3.5-inch, Kit, E8																								
Rocket, 4.5-inch, T164, T165, T166																								
Rocket, 115-mm, M55 (T238), Bolt																								
Rocket, 115-mm, Dummy Training, M60 (E49)																						X		
Rocket, 115-mm, Practice, M61 (E50)																						X		
Rocket, 5-inch, E43, E45																								
Rocket, 5-inch, Warhead, MK 40 Mod 0																								
Warhead, Missile, 6.5-inch, SS-11																								
Rocket, 7.2-inch, M25, M27, T24								X	X															
Rocket, 7.2-inch, T50, T51, T53	E																							E
Warhead, Rocket, 318-mm, M206 (E20), Little John																								
Warhead, 762-mm, Rocket, M79 (E19R1), Honest John																								
Warhead, 762-mm, Rocket, M190 (E19R2), Honest John																								
Missile, 787-mm, Warhead, M212 (E21), Sergeant																								

E = fill was experimental/developmental/test for that munition
* = See text for details
SIM = simulant

U.S. Chemical Weapons and Related Materials, Fill Matrix

Munition	GA	GB	H	HC	HD	HL	HN	HT	HV	IM	KJ	L	MD	MR	NC	NP	PD	PG	PS	PS/CL	PT	PWP	TH3	VX	VX2	WP	SIM
Rocket, 2.36-inch, T72																											
Rocket, 2.36-inch, T73																											
Rocket, 3.5-inch, Kit, E8		X																									
Rocket, 4.5-inch, T164, T165, T166		E			E																						E
Rocket, 115-mm, M55 (T238), Bolt		X																						X		X	
Rocket, 115-mm, Dummy Training, M60 (E49)																											
Rocket, 115-mm, Practice, M61 (E50)																											
Rocket, 5-inch, E43, E45		E			E																						
Rocket, 5-inch, Warhead, MK 40 Mod 0		X			X																						
Warhead, Missile, 6.5-inch, SS-11		X																						X			
Rocket, 7.2-inch, M25, M27, T24																											
Rocket, 7.2-inch, T50, T51, T53																										E	
Warhead, Rocket, 318-mm, M206 (E20), Little John		X																						E			
Warhead, 762-mm, Rocket, M79 (E19R1), Honest John		X																						E			
Warhead, 762-mm, Rocket, M190 (E19R2), Honest John		X																									
Missile, 787-mm, Warhead, M212 (E21), Sergeant		X																						E			

E = fill was experimental/developmental/test for that mu
* = See text for details
SIM = simulant