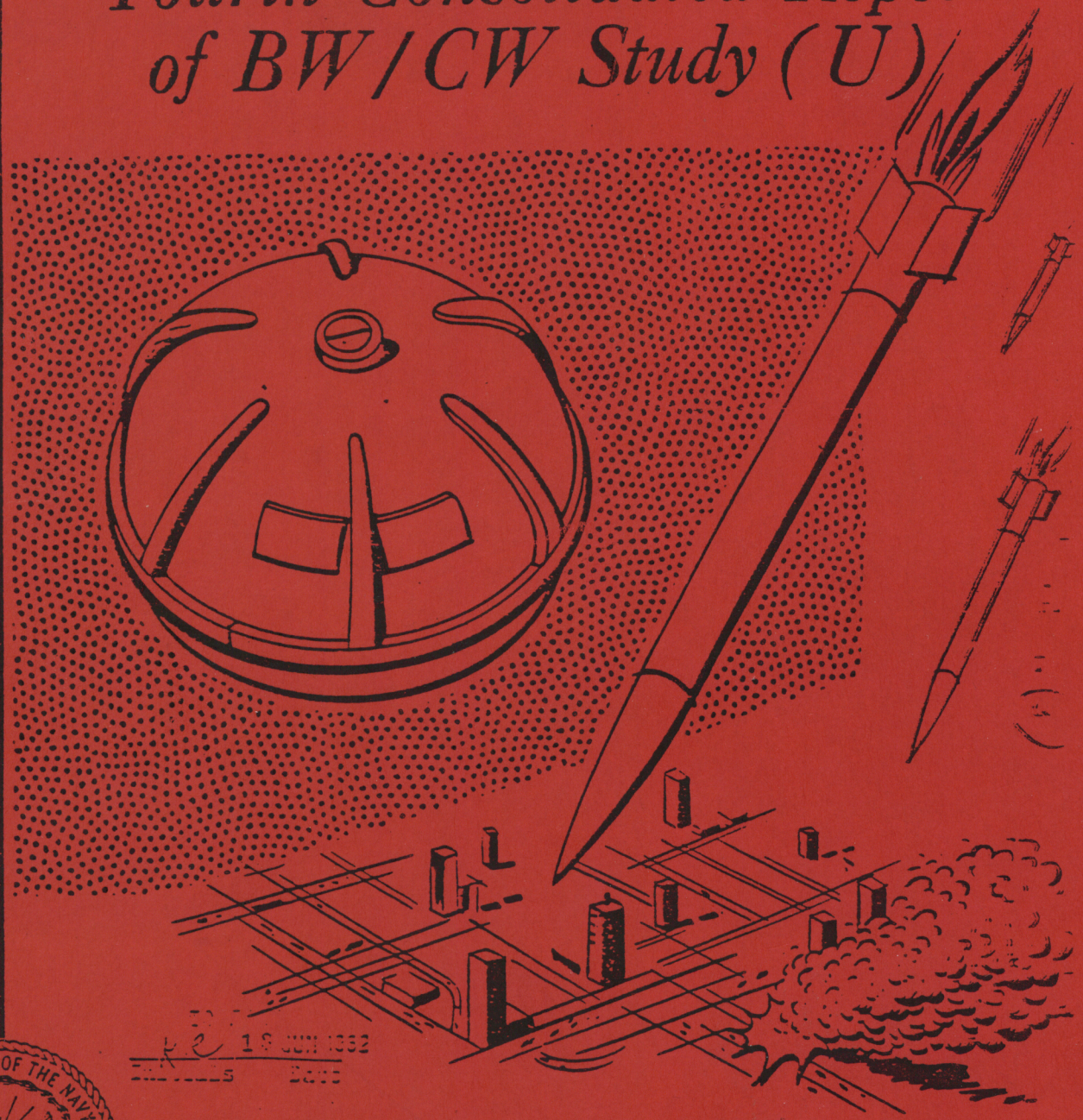
DEPARTMENT OF THE NAVY
BUREAU OF NAVAL WEAPONS

# *Fourth Consolidated Report of BW/CW Study (U)*







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# INTRODUCTION

## A. Object of Project

(1) The purpose of the study is to determine possible Navy use of existing and proposed chemical and biological warfare weapons, munitions, dissemination methods and equipment of all *services* to improve the operational effectiveness of U. S. naval forces. The study is not limited to air launched BW and CW dissemination methods, but includes all existing and projected BW and CW expendable and non-expendable devices that can be adapted to Navy use that would be compatible with existing and planned launching and delivery systems by any Navy means.

Relative effectiveness and merits of all methods and devices are to be reported together with required changes necessary for adaption to Navy use. Existing, planned or on-the-shelf items are to be included for purposes of comparison. Chemical warfare toxic agents, such as liquids and gases, as well as non-toxics, such as flame, incendiaries and *screening agents* (thermal, visual and radar) are to be included, as shall Biological warfare devices. Surface, sub-surface and air launched weapons are to be included In the study.

(2) This *revision* supersedes NAVORD Report 6954 dtd 31 March 1960 and includes many new items. Sectional drawings are shown for most items, and a section has been added to furnish general information on BW/CW agents, their properties, characteristics and area coverage. Paragraphs that formerly listed "Capabilities" and "Limitations!' have been deleted as they were mostly duplications and pertained to the agent rather than the munition. The capabilities of the agents are shown in sections 2 and 3, while any capability or limitation peculiar to the munition will be listed with the item. The data has been rechecked and brought up to date as far as was possible.

(3) It is intended that eventually this report will include all Standard BW/CW items used by the Army, Navy & Air Force, as well as those in Research and Development. Stock "On Rand" is only shown for Navy and Marine Corps items. Army stock "On Rand" is classified Secret and is available from the "Army Stock Chemical List:' Issued by the Army Chemical Center, Md. The Air Force "On Hand" stock is also Secret and is available In the Air Force Secret Supplement No. 1 which may be obtained from Deputy Chief of Staffs, Material Supply Services, The Pentagon, Washington 25, D. C.

(4) This report should be used as a guide only and should not be used as a basis for any official action such as Procurement, Supply, Operational etc. The area coverage shown with the munition is for an example only.

B. Period of Project

(1) Started FY-59 BuOrd Task No. 500-726/61036/02022 dated 23 Jan 1958. Continued BuWeps Task No. 104-9661/63053/06047 dated 7 August 1959. Continued BuWeps Task No. RMM-3773-060/301-F008-10-005 dated 3 August 1960.

(2) Schedule: Continuing

C. Acknowledgement

(1) The assistance and contributions furnished by representatives of the Army Chemical Center, Army Biological Laboratories Aberdeen Proving Ground, Picatinny Arsenal, Ordnance Ammunition Command, Headquarters USAF, Headquarters- USMC, and the Bureau of Naval Weapons is deeply appreciated.

D. Recommendation

(1) It is recommended that this document, with modifications resulting in changes to munitions and weapons, be adopted as a basis for recording all current and planned BW/CW munitions which may have a potential use for the U. S. Navy.

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## Section 1. Navy Interest in Biological and Chemical Warfare.

### A. General

(1) The Navy has a primary interest in Biological and Chemical Warfare (BW/CW) operations on the sea, in amphibious landings, in airborne, and land operations involving the employment of the Marine Corps. It may furnish BW/CW support to the Army in amphibious and coastal operations by means of Its air arm as well as its Naval Weapons. It may also receive BW/CW logistical support from the Army and the Air Force.

Primary usefulness of BW/CW to the Navy is based on their casualty effects. In the future it is visualized that useful effects of toxic BW/CW *on* personnel will fall into two categories: (a) affects which impair the physical functions of the individual, (b) effects which influence the mental functions of the individual.

(2) The broad Implications of the Navy's mission are that control of the seas is necessary to project U. S. military power to any place on the globe and to insure that supplies and reinforcements arrive. Offensive, defensive, and transport facilities are basic to attain this objective.

(3) The Navy could deliver BW/CW agents by the following methods (a) Missilewarheads launched from submarines, (b) Bombs and spray tanks from carrier based aircraft, (c) Missiles, rockets, drones, gun munitions and mines from the surface fleet, (d) &Essiles, rockets, bombs, drones, gun munitions, mines, generators, and grenades from the Navy - Marine Corps land forces.

(4) The value of BW/CW to the Navy is likely to increase unless limitations are placed on this type of warfare. BW/CW could increase the effectiveness of aircraft for neutralizing targets where it is not practicable to bring in ground forces. BW would be most effective on large area targets. CW agents delivered by Navy aircraft would be important to soften-up the enemy forces, and to shorten the duration of the conflict. BW agents might be more valuable during the early stages of the conflict and could be delivered by low flying aircraft at night.

(5) Attack with BW powder could be launched in the presence of favorable winds, preferably at night, against enemy coastal cities or troop concentrations, by means of generating spray devices Installed on surface or undersea craft. Floating nines equipped with generating devices could be sown by surface craft, undersea craft, or aircraft.

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(6) BW agents have some advantages over CW agents in that smaller and less costly amounts are required, and that epidemics may be caused. BW agents always have a delayed action of hours or days. Field detection of BW is practically impossible, as it is necessary to send suspected material to laboratories for culture and examination which may require many hours or days. Storage and transportation have presented a problem for BW, but dry powered agents are expected to improve this. A BW plant on board a large ship to manufacture and load BW munitions may be possible. For more detailed information see Secret Report CCB-3936-S-58, dated October 1958 and TM 3-216.

B. Relative Effects of BW/CW Agents. *

Basic assumption. One B-52 bomber (or equivalent) *can* carry enough CW or BW agent to create the comparable results shown below.

| | Chemical Agents | Biological Agents |
|---|---|---|
| Effective area | 100 sq. miles | 34,000 sq. miles (450 lb. of agent)' |
| Human lethality | 30% (Not necessarily lethal) | 25 to 75% (Not necessarily lethal) |
| Residual effect | 3 to 36 hours (nearly same area) | Possible epidemic or epizootic |
| Time for effect | 7-1/2 sec. to 30 min | Few to 14 days |
| Covert application | Some | Great |
| Detection-Identification | Complex but fairly effective | Difficult, Complex, Slow |
| Cost to produce | Somewhat expensive | Relatively inexpensive |
| Real property damage | Undamaged | Undamaged |
| Variation in effect | Wide, need not kill, only incapacitate | Wide, need not kill,, only incapacitate |
| Time to invade area after attack | Immediately | Immediately after incubation |

* From American Chemical Society Non Military Defense No 26 July 1960.

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## Section 2. Biological Warfare

### A. General

(1) This section on Biological Warfare (BW) provides a very brief source of information on the aspects of biology having military application and on some of the type of agents which might possibly be used against us. It is not indicative of specific agents that the enemy may have under consideration, nor does it include the whole range of agents which could conceivably have offensive value. Due to limited space only some of the anti-human agents have been listed. For more detailed information see TM3-216 which also lists anti-animal and anti-crop agents and CMLC 57-4 which is SECRET.

(2) Biological Warfare is the military use of living organisms or their toxic products to cause death, disability, or damage to man, his domestic animals, or crops.

(3) The following five general groups, because they appear to have military significance, have been classed as BW agents:

(a) Micro-organisms (bacteria, viruses, rickettsiae, fungi, and protozoa)
(b) Toxins (microbial, animal and plant)
(c) Vectors of disease - Arthropods (insects and acarids), and other animals.
(d) Pests (of animals and plants)
(e) Chemical anti-crop compounds (plant growth inhibitors, herbicides and defoliants).

(4) Micro-organisms are minute living organisms, too small to be seen by the unaided eye. When magnified 500 to 1000 times by the microscope, each organism is found to be composed of a single cell or a group of cells, each of which is capable of carrying on all the functions of life, including growth and reproduction. Reproduction may be sexual or asexual, depending on the micro-organism, but the asexual process is more common.

(5) On the basis of structure and behavior characteristic micro-organisms may be divided as follows (in order of size): fungi, protozoa, bacteria, rickettsiae and viruses. Viruses, the smallest can be seen only when photographed by the electron microscope. The unit applied in the measurement of micro-organisms is the Micron, which is equivalent to 0.001 millimeter or about

1/25,000 of an inch, For example, the Dengue Fever Virus is very small being about 17 to 25 millimicrons in size and the millimicron is one thousandth (0.001) part of a micron, or one millionth (0.000001) part of a millimeter.

B. Bacteria

(1) Bacillus Anthracis: A rod shaped, gram positive, aerobic, sporulating micro-organism the spores constituting the usual infective form: Produces disease known as Anthrax which may appear In man as cutaneous, pulmonary, and intestinal. The pulmonary form is also known as "Wcolsorters Disease". Sources of infection are cattle, sheep, horses and other animals. May be contracted by handling hair, wool, hides, flesh, etc. of infected animals. Incubation period is 1 to 7 days, usually less than 4 days. Mortality in man of untreated cutaneous cases ranges up to 25%; in pulmonary cases it is near 100%; and the rare intestinal cases usually are fatal. Not epidemic In man. Spores remain alive for many years in soil or water and will resist sunlight for several days.

(2) Shigella Dvsenteriae: A gram-negative, non-motile rod, that does not form spores. Produces disease known as Bacillary Dysentry, an infectious disease, usually accompanied by fever, and diarrhea, weakness or prostration; and ulceration of the mucous membranes of the intestine. Sources of infection is feces of infected human patients and carriers. Transmitted by eating or drinking contaminated food, water, milk, etc. Incubation period 1 to 7 days, usually less than 4 days. Mortality ranges from 2 to 20% In untreated cases. High epidemcity in unsanitary conditions. The disease is highly contagious. Organisms remain viable for considerable periods in water, ice, and mucous discharges, but are readily-killed by sunlight.

(3) Brucella Group: In this group are three closely related organisms; Bruceila melitensis, Brucella abortus, and Brucella suis. All are non-motile, non-sporulating, gram-negative, rod shaped bacilli. Disease produced is Brucellosis or Undulant Fever in man, a general infection characterized by irregular, prolonged fever, profuse sweating, chills, pain in muscles, joints, and fatigue. Illness may last for months and sometimes years. Sources of infection are found in tissues, blood, milk, dairy products, and swine. Transmitted by ingestion of infected dairy products or by contact with infected animals or animal products. Incubation period is 6 to 60 days, averaging 14 days. Mortality of untreated cases is said to average 2 to 3 percent with Br. abortus and 3 to 6% with Br. suis and Br. melitensis.

Epidemics could result from widescale consumption of dairy or meat-products. The organisms remain alive for weeks in water, soil and dairy products, and are very resistant to iow temperatures.

(4) Vibro Comma: A micro-organism, slightly bent, motile, gram-negative, non-sporulating rod. Produces disease known as Cholera, an acute infection gastro-intestional disease of man, characterized by sudden onset, with nausea, vomiting diarrhea, toxemia, and frequently collapse. Sources of infection are feces and vonitus of patients, and temporary carriers. Transmitted by fecal contamination of water or foods by soiled hands, utensils or flies. Incubation period 1 to 5 days, usually 3 days. Mortality ranges about 3 to 30% in treated cases to 50% in untreated cases. Epldemiclty is very high under unsanitary conditions especially those concerned with water supply, food and fly control. Organism is easily killed by drying. Not viable in pure water, but will survive up to 24 hours in sewage. Can withstand freezing for 3 to 4 days.

(5) Bacterium Tularense (Pasteuralla TULARENIS): A small aerobic, gram- negative cocco-bacillus, varying in size and shape, It is non-motile and non spqrulating. Disease produced is Tularemia, which is also known as Rabbit Fever and Deer Fly Faver. A fatal blood poisoning disease or wild rodents, characterized by sudden onset with chills, fever, prostration, etc. Sources of infection are rabbits, squirrel, deer flies, ticks, woodchuck, coyote, cat, skunk, deer, fox, hog, *sage* hen, and some snakes. Transmitted by infection through skin, eyes, or lungs, from handling animals, by bites from flies and ticks, or by drinking contaminated water. Incubation period is 1 to 10 days, usually about 3 days. Mortality of untreated cases is from 4 to 8%, averaging 5%. Epidemicity is low as it is not transmitted directly from man to man. Remains viable for weeks in water, soil, carcasses and hides *and* for years in frozen rabbit meat.

(6) Pasteurella PESTIS: A rod shaped, non-motile, non-sporulating, gram negative, aerobic bacterium. Disease produced is known as Plague, or Black Death, which occurs in three forms in man, i.e., Bubonic, Pneumonic, and Septicemic infections. An Infectious disease of rodents, it is transmitted to man by rodents and fleas (bubonic plague), or from man to man by contaminated droplets - sneezing and coughing (pneumonic) characterized by high fever, extreme weakness, glandular swelling, pneumonia, and hemorrhages in the skin and mucous membranes.

Incubation period 1 to 7 days for pneumonic plague and 4 to 7 days for bubonic plague. Mortality in untreated bubonic plague is from 30 to 60%, while untreated pneumonic plague kills from go to 100%. Epicemicity in pneumonic plague is high unless quarantine and other measures are taken. Organism remains viable in water for 2 to 30 days, and in moist meal and grain about 2 weeks. In freezing temperatures will remain alive from months to years.

(7) Salmonella Typhosa: A rod-shaped, motile, non-sporulating, gram-negative bacterium, which is a facultative aerobe. Disease produced is Typhoid Fever, a systemic infection characterized by continued fever, lymphoid tissue involvement, ulceration of the intestines, enlargement of the spleen, rose colored spots on akin and diarrhea. Sources of infection are feces and urine of infected individuals and carriers transmitted by organisms of feces through direct or indirect contact with carrier. Indirect spread is mainly by contaminated water, food, milk, shellfish, and flies.

Incubation period from 3 to 38 days, usually 7 to 14 days. Epidemlcity is high in the presence of carriers and lack of sanitary controls of water, food, milk supplies, and immunization. Mortality in untreated cases range from 0 to 10%. Organisms remain viable in water from 2 to 3 weeks, to 3 months in snow and ice, and 1 to 2 months in fecal material.

C. Viruses

(1) Psittacosis Virus or Rickettsia: This organism usually has been classed as a virus, but is now considered by some to be a rickettsia and as such has been named MIYAGAWANELLA Psittacci. It is a gram-negative 0.2 to 0.4 of a micron in length. Disease produced is Psittacosis or Parrot Fever, also called Ornithosis in birds. The disease in man is acute by pneumonia, with fever, cough, headache, constipation, weakness, and is sometimes accompanied by delirium. Source of infection is parrots, parakeets, love birds, canaries, pigeons and other birds.

Transmitted by contact with infected birds, their surroundings, with inhalation of infected dust or droplets. Transmission from man to man is rare, but airborne infection has occurred. Incubation period usually 6 to 15 days in humans, but may be as long as 30 days. Mortality varies from 9 to 20%. Epidemic possibility of transfer from man to man only by close contact. The virus will remain viable on surfaces for 20 to 30 days, and perhaps longer in fecal material.

(2) Encephalitis and Encephalomyelitis Viruses: A small viral organism. Diseases produced are (1) St. Louis Encephalitis is endemic and epedemic in Central and Western U.S. and prevails in summer when arthropod vectors are most numerous; (2) Eastern and Western Eucephalomyelitis, occurring in Canada, USA, Central and South America; (3) Venezulean Equine Encephalomyelitis in Central and South America; (4) Japanese B type Encephalitis in Japan, Korea, China, and some Pacific Islands; (5) Russian Far East Encephalitis in European and Siberian Russia.. Each type of disease is produced by a specific virus, but the clinical pictures are similar, varying mainly in severity and rate of progress of symptoms. Characteristics are inflamation of the meninges of the brain, headache, fever, dizziness, drowsiness or stupor, tremors or convulsions, severe prostration, occasional paralysis, and muscular incoordination. Disease is acute and of short duration.

Sources of infection are birds and horses for mosquito infection. Transmitted by mosquitos or ticks. Incubation period 2 to 15 days. Mortality is unknown, probably 5 to 60% with all types. Japanese and Eastern equine have the highest fatality rate. Irregular epidemic in dry farming areas of the Midwest. Southwest, and Eastern U.S. Endemic in hot, irrigated Western U.S. Valley areas. Stability is unknown, probably 2 to 30 days.

(3) Influenza Virus: A large virus, strains of which range between 0.07 and 0.1 micron in size. Types A and B have been identified. Disease produced is Influenza or "La Grippe" which is epidemic, occasionally pandemic, characterized by catarrhal inflamation of the respiratory tract, sudden onset, fever for 1 to 7 days, marked prostration, aches and pains in back and limbs sore throat, bronchitis, and often pneumonia as a complication.

Sources of infection are discharges from the mouth and nose of infected persons, and soiled articles. Transmitted by direct contact, droplet infection (respiratory) or by articles contaminated with nose and throat discharges of Infected individuals. Incubation period type A is 1 to 2 days, Type B is 12 to 18 hours. Mortality 0 to 1% but often followed by complicating respiratory infections with high mortality. Local epidemics are widely prevalent under favorable conditions. Pandemics occur irregularly. Stability-resistant to freezing for several weeks, can be destroyed by heat, steam, boiling and antiseptics.

(4) Variola Virus: Virus particles which pass through most filters, range from 0.15 to 0.2 micron in size. Disease produced is Smallpox, or Variola, a highly contagious disease, often fatal, characterized by severe fever, small blisters of the skin later containing pus and forming crusts which fall off



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in 10 to 40 days after the first lesions have appeared, leaving pink scars which gradually fade. Source of infections is lesions of the mucous membranes and skin of infected persons.

Transmitted by contact with patients having the disease, or with articles of persons freshly contaminated by discharges from lesions and skin of infected individuals. Incubation period 7 to 21 days, usually 12 *days.* Mortality ranges from 1% with mild type to 30% in severe cases. Epidemic rate is high depending on immunity status of population, and exposure to the disease. Virus is viable in water for several days at 39°F to 48°F, and is resistant in dry or wet form to very low tenperatures.

(5) Yellow Fever Virus: Virus particles estimated to be 0.01'7 to 0.026 of a micron and pass through most filters. Disease produced is Yellow Fever, characterized by sudden onset, chills, fever, prostration, headache, backache, muscular pain, congestion of mucous membranes, severe gastro intestinal symptoms, and jaundice from liver damage. Vomiting of blood often occurs and disease is of short duration. A forest or sylvatic type in South America and Africa is known *as* Jungle Yellow Fever, but appears to be identical with the classical type.

Source of infection is the blood of humans, and monkeys infected with Yellow Fever. Transmitted by the bite of the AEDES AEGYPTI mosquito. In forest of South America and Africa by other mosquitos. Incubation is 3 to 6 days, rarely more. Mortality is variable. Epidemics occasionally occur in Africa and South America but can be prevented by immunization and mosquito control. Is resistant to freezing and drying but destroyed by heating to 140°F.

D. Rickettsiae

(1) Rickettsia Prowazeki: Non-aotile, minute, coccoid or rod shaped, rickettsiae. Disease produced classical Typhus, epidemic in human, louse-borne, an acute infectious disease, characterized by servere headach, fever, pains and skin rash. Source of infection is from persons Infected with the disease. Transmitted by body lice.

Incubation period is from 6 to 15 days, average 12 days. Mortality is from 10 to 80% varying with epidemic and age of individuals. Epidemics occur under crowded *or* unsanitary *conditions* particularly during cold weather. Not communicable from man to man. Can be destroyed by heating to 112°F.

(2) Rickettsia Rickettsii: A rickettsial micro-organism which produces a disease known as Rocky Mountain Spotted Fever (Sao Paulo fever in South America). An acute infectious disease

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characterized by joint and muscular pains, fever, and skin rash, rapidly spreading from legs and arms over most or the body. Source of infection is ticks of various types. Transmitted by ticks or from contact with infected tick blood or feces *on* the unbroken skin.

Incubation period is from 3 to 10 days. Mortality may vary from 20 to 60% depending on the locality. Tick eradication and immunization are best control for epidemics. Not communicable from man to man. Can be killed by exposure to 112°F temperatures for 10 minutes, and also killed by drying for 10 hours.

(3) COXIELLA BURNETTI: (Rickettsia Burneti) A gram-negative, bacterium organism rickettsia which produces a disease known as Q Fever, also known as Nine Mile Fever and Queensland Fever which is characterized by acute fever of sudden onset, headache, chills, weakness and severe perspiration. Pneumonia occurs in the majority of cases accompanied by mild cough, scanty expectoration, and chest pains. Source of infection is from cows, sheep, goats, and ticks, appear to be natural resevoirs; the organism has been found in milk. Mode of transmission is not well understood but dairy products, water and ticks are probably involved. Other probables are breathing contaminated dust or by ingestion.

Incubation period is 14 to 26 days and mortality is from 0 to 4%. Non-contagious, outbreaks have occurred among slaughter house workers in Texas and Illinois. Resistant to temperatures from 72°F to minus 94°F. Probably persists on surface for 5 to 60 days.

E. Fungi

(1) Coccidioides Immitis: In man and animals, the fungus occurs as thick walled endospore-filled spherules, 20 to 80 microns in diameter; in artificial culture, it appears as a fluffy white cottony mold. Disease produced is Coccidioidomiycosis which is highly infectious. The usual primary form (known as Valley or San Joaquin fever) is an acute, disabling, self-limiting respiratory infection resembling influenza with a low grade fever of 99°F to 101°F and a slight non-productive cough. The secondary progressive form (known as coccidioidal granuloma) is a chronic, malignant, disseminated infection which involves any and all organs of the body, including skin and bones, and produces numerous abscesses. A primary localized form of infection may occur on exposed surfaces of the skin: it sometimes develops into the progressive, disseminated form of infection. Sources of infection are dust, soil, and vegetation contaminated with *spores* of this fungus.

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Transmission is made by inhalation of spores in dust, soil and dry vegetation and possibly through skin scratches or wounds. Incubation period for the primary pulmonary form is 10 to 21 days (average 12). The progressive form is not necessarily preceded by symptoms of primary infection. Fatalities are about 50% in the secondary progressive form. The disease is not contagious but small epidemics may occur in hot, dry seasons when large numbers of individuals, such as troops, are stationed in endemic areas, or engaged In maneuvers in these areas. Spores of the fungus are highly resistant to drying and will live for months or years in culture or in the soil.

(2) Nocardia Asteroides: This aerobic fungus has characteristics of both molds and has been classified In an Intermediate position. It usually forms orange colonies consisting of gram-positive weakly acid-fast, branching filaments, 1 micron or less in diameter. Produces disease known as Nocardlosis, a severe pulmonary Infection, similar in many respects to tuberculosis but tends to form numerous abscesses instead of tubercles and is characterized by chronic pneumonia.

The disease often takes other forms, such as localized subcutaneous abscesses and tumors. Pulmonary infection is characterized by general malaise, fever, productive cough, nigh sweats, loss of appetite and weight. Brain involvement presents symptoms of headache, nausea, and vomiting. Sources of infection are soil, dust, and vegetation contaminated with organisms. Transmltted by contaminated dust and possibly by droplet infection or through pus and other discharges from infected individuals. Incubation period in man is unknown; infection in guinea pigs is usually fatal in a week. Death rate is very high In untreated or advance cases of generalized infection, perhaps close to 100%. The disease is not known to spread from man to man or from animal to man but infection by droplet spray or through infection of wounds by contaminated dressings and other material is possible. As fungus exists normally in soil, it is presumed to be-quite resistant to adverse environmental conditions.

F. Toxins

(1) Botulinum Toxin: This is a protein like exotoxin formed by the botulinum bacillus. Through repeated purification procedures, it has been obtained in a crystalline form and is the most powerful poison known. The crude material or "mud" is a brownish, amorphous mass. There are at least five distinct types, A, B, C, D, and E. Types A, B, and E are known to be toxic for man; C and D are toxic for animals and probably for man.

Disease produced is Botulism which is highly fatal, acute, poisoning, and characterized by vomiting, thirst, weakness, headache, fever, dizziness, double vision, dilation of pupils, paralysis of muscles, and difficulty of speech. Respiratory paralysis is the usual cause of death.

Sources of the toxin are the bacteria Clostridum Botulinum and Cl. parobotulinum, which are rod shaped, slightly motile, sporulating, gram-positive anaerobic bacille. The principal reservoir of the bacteria is the soil. Transmission is by eating Improperly canned non-acid foods such as meats, sausage, and some others such as corn, beans, spinach and olives. Possibly the toxin could be introduced by breaks in the skin or by Inhalation. Symptoms usually do not appear until 12 to 72 hours after contaminated food has been eaten.

Mortality is approximately 65% in the U.S. but is low in Europe. The disease is not contagious. Epidemics occur only in widespread distribution and consumption of contaminated foods. Toxin is stable for a week in non-moving water which is not aerated. It persists for a long time in food not exposed to air. Toxin is destroyed when boiled 15 minutes, but the spores resist boiling for 6 hours.

For more details and also Anti-animal and Anti-crop B W agents, see TM3-216 and CMLC 57-4.

NOTE: BW agents have some advantages over CW agents in that smaller and less costly amounts are required, and that epidemics may be caused. BW agents always have a delayed action of hours or days. Field detection of BW is practically impossible, as it is necessary to send suspected material to laboratories for culture and examination which may require many hours or days. Storage and transportation have presented a problem for BW, but dry powered agents are expected to improve this. A BW plant on board a large ship to manufacture and load BW munitions may be possible. For more detailed information see Secret Report CCB-3936-S-58, dated October 1958 and TM 3-216.

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## BIOLOGICAL TERMS

Aerobe - micro-organism which can live and grow in the presence of free oxygen.

Agar-agar - gelatinous substance prepared from Ceylon moss and added to various compounds to prepare solid media for growing bacteria.

Agglutination - clumping of cells which occurs only in the presence of the specific antibody.

Anabolism - constructive or building up stage of the metabolic process concerned with growth and repair of the organism.

Antibiotic - substance produced by and obtained from living cells, usually those of lower plants, such as bacteria and molds.

Antibody - specific substance formed by the body in antagonism to a specific foreign body (antigen), such as bacteria and toxins.

Antigen - any substance which when introduced in the body stimulates the formation of an antibody.

Antiseptic - substance that will inhibit the growth and development of micro-organisms without necessarily destroying them.

Antiserum - serum containing an antibody or antibodies.

Antitoxin - substance, found in the blood serum or tissues, which is specifically antagonistic to a toxin.

Attenuation - process of reducing or weakening the virulence of a microorganism by cultivation on artificial media or by animal passage.

Bacillus (bacilli, plural) - rod-shaped bacterium.

Bacterium (bacteria, plural) - one-celled micro-organisms which have no chlorophyl and multiply by dividing in one, two, or three directions.

Bactericide - any agent that destroys bacteria.

Basic stains - stains which show a definite affinity for the nuclei of cells; nuclear stains.

Biological agents - viruses, any of certain classifications of microorganisms and toxic substances derived from living organisms used to produce death or disease in man, animals, and growing plants.

Biological warfare - tactics and techniques of conducting warfare by use of biological agents.

Botulism - poisoning by botulinum toxin.

Bubo - inflammatory swelling of a lymphatic gland, usually in the groin or armpit.

Capsule - fibrous or membranous envelope or covering.

Carrier - individual who harbors specific disease organisms without showing symptoms, thus serving as a means of conveying infection.

Catabolism - process of destruction or breakdown of tissues and cells of the body from complex to simpler compounds.

Cell - small mass of protsplasm, generally including a nucleus and surrounded by a semipermeable membrane or cell wall.
Cilia - hairlike projections or lashes found on many cells, capable of vibratory or lashing movement.
Coccus - spherical bacterium.
Colony - collection or group of micro-organisms in a culture; they are derived from the increase of a single organism or group of organisms.
Commensal - organism, not truly parasitic, which lives in, with, or on another organism, partaking usually of the same food.
Culture - growth of micro-organisms.
Culture medium - any preparation used for the culture of micro-organisms.
Cytolysis - process of dissolution or destruction of cells.
Cytoplasm - protoplasm of the cell exclusive of the nucleus.
Differential blood count - determination of the percentage of the different types of cells in the blood.
Droplet infection - infection by droplets of contaminated respiratory or oral discharges dispersed in the air by sneezing and coughing.
Endemic - native to, or prevalent in, a particular district or region.
Endotoxin - poisonous substance that is retained within a micro-organism until the cell disintegrates.
Enzootic - occurring endemically among animals; constantly present in small amounts in a given animal population.
Epidemic - an outbreak of disease which spreads rapidly and attacks many individuals in the same region at the same time.
Epiphytotic - widespread among plants, such as certain fungal diseases. Analogous to epidemics in man and epizootics among animals.
Epizootic - rapidly spreading and widely diffused among animals, Analogous to epidemics in man and epiphytotics in plants.
Extoxin - toxin formed and excreted by a micro-organism in the surrounding medium.
Filterable viruses - organisms small enough to pass through a bacterial filter made of unglazed porcelain or compressed infusorial earth that arrests bacteria. Filterable viruses are ultramicroscopic.
Fission - act of splitting. This is a form of asexual reproduction, where the cell divides into two nearly equal parts, as in bacteria.
Flagella - whiplike processes used to propel a micro-organism,; also known as cilia.
Fomite - any substance other than food which may transmit or harbor a disease, such as infected bedding, clothing, and dishes.
Formalin - approximately 40 percent solution of gaseous formaldehyde in water.

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Fumigation - exposure to fumes of a chemical which destroys micro-organisms.
Fungus - any one of a group of thallophytic plants comprising the molds, mildews, rusts, smuts, and mushrooms; they do not contain chlorophyl and reproduce mainly by asexual spores.
Germ - micro-organism; microbe.
Germicide - any agent that destroys germs or micro-organisms.
Gram's stain - differential stain for bacteria.
Hormone - specific chemical substance secreted into the body fluids by an internal secretory gland and producing a specific effect on the activities of other organs.
Host - any animal or plant which harbors *or* nourishes another organism.
Immunity - state or power of resisting the development of a disease or poison.
Incubation Period - time between which infection occurs and first symptoms appear.
Infectious disease - one which is caused by a living agent such as bacteria, protozoa, viruses, or fungi; may or may not be contagious.
Ingestion - process of taking in food for digestion.
Inoculate - to introduce a micro-organism, disease, vaccine, or immunizing serum.
Lag phase - early period following a bacterial inoculation into a culture medium in which the growth is slow.
Lesion - an injury, mechanical or pathological.
Leukocyte - white or colorless blood corpuscle; an ameboid cell found in the blood, lymph, and body tissues, and forming the chief cellular element in pus.
Lymphatic system - system or absorbent vessels which drain the lymph from various body tissues and return it to the biood stream.
Macrophage - large, mononuclear, wandering phagocyte cell which originates in the tissues.
Microbe - any individual micro-organism.
Micro-organism - minute living organism, usually microscopic in size.
Molds - parasitic and saprophytic fungi which cause moldiness.
Motile - exhibiting or capable of spontaneous movement which is neither conscious nor volitional.
Mucous membrane - membrane secreting mucous and lining the cavities of the body which *connect* with the outside air such as the respiratory., digestive, and genito-uninary tract.
Nonspecific immunity - increase of antibodies or production of immunity resulting from the injection of some nonspecific antigen.
Nuclelus (nucleoli, plural) - body within the nucleus of a cell which takes part itne metabolic process of the cell and plays a part in its multiplication.

Nucleus - round body within a cell, forming the essential and vital part.
Organism - any organized living being, animal or plant.
Pandemic - widely epidemic, affecting or attacking all or most of the population of a region.
Panzootic - occurring pandemically among animals; attacking all or most of an animal species of a region.
Parasite - plant or animal living on or within another living organism or host, at whose expense It is maintained.
Passive immunity - immunity conferred by intorduction of an immune serum.
Pasteurization - partial sterilization of a fluid to a moderate temperature (131° to 158" F.) for a definite time, with destruction of certain pathogens and undesirable micro-organism.
Pathogen - any disease-producing micro-organism or material.
Pathology - science that treats of disease.
Penicillium - genus of molds which is characterized by the development of fruiting organs resembling a broom, or- the bones of the hands and fingers; the antibiotic, penicillin, is derived from penicillium.
Phagocyte - any white blood cell that is active in ingesting and destroying waste and harmful bodies in the blood or tissues.
Plasma - fluid portion of the blood in which the corpuscles are suspended.
Polyvalent vaccine - stock vaccine made up of may strains of the same organism or different organisms.
Prognosis - forecast of the course of a disease; also the outlook for recovery as indicated by the nature and symptoms of the case.
Prophylaxis - prevention of disease, or preventive treatment,
Protoplasm - only known form of matter in which life is manifested; the essential substance of the cell.
Protozoa - lowest division of the animal kingdom, including one-celled organisms,
Retroactivity - liklihood that a biological agent will produce harmful effects against the using force.
Rickettsiae - Gram-negative, nonmotile, intracellular, one-celle parasiticmicro-organisms, probably intermediate between the bacteria and viruses.
Saprophyte - any micro-organism living upon dead or decaying organic matter.
Septic - produced by putrefaction.
Serum - clear liquid which separates, in the clotting of blood, from the clot and the corpuscles. It differs from plasma in that It does not contain fibrin.
Slant - solid media allowed to harden in test tubes set at an angle to Increase the surface for the growth of colonies.
Smear - Thin layer of material spread on a glass slide for microscopic examination.

Spirilla - small comma-shaped or spiral bacterial which are motile.

Spore - primitive reproductive bodies or resistant resting cells, produced by some plants and some micro-organisms.

Staphlococcus - any of a genus of Gram-positive bacteria (cocci) which often form grapelike clusters.

Sterilization - process of freeing completely of micro-organisms, by heat, or chemicals, or otherwise, all life being destroyed.

Strains - group of organisms within a species characterized by some particular quality (such as high virulence).

Streak - inoculation of slants or plates in such a manner as to produce a direct line movement across the surface of culture media.

Streptococcus - any of a genus of nonmotile, Gram-positive bacteria, occurring in pairs or chains and dividing in one plane only.

Symbiosis - the living together or close association of two dissimilar organisms with mutual benefit.

Thallophyta --division of the plant kingdom to which algae, bacteria, fungi, and lichens belong.

Thermophilic - not able to grow without heat. Bacteria which grow best at a temperature of about 45°C. and resist temperatures up to 65°C. or more; for example, bacteria found in fermenting manure and hot springs.

Thermostable - *no:* easily affected by moderate heat, and not destroyed by a temperature of over 55°C.

Tissue - group of specialized cells united in the performance of a particular function.

Toxemia - general poisoning or intoxication due to absorption of bacterial products (toxins) formed at a local source of infection.

Toxin - generally any poisonous substance of microbic, vegetable, or animal origin.

Toxoid - detoxified toxin which is still antigenic and produces active immunity when injected.

Vaccine - preparation of killed or attenuated infective agent used in inoculating to produce active artificial immunity.

Vector - carrier, especially the animal or host that carries the pathogen from one host to another, as the malarial mosquito.

Vegetative cell - nonporeforming bacteria or sporeforming bacteria in their nonsporing state.

Vibrio - short, curved, rod-shaped bacteria, motile by means of one, two, or three polar flagellae.

Virulence - disease-producing ability; the relative infectiousness of an organism.

virus - minute infectious agents, smaller than most bacteria, capable of passing through filters that will retain the latter, and of multiplying only within a living susceptible host cell.

## Section 3. Chemical Warfare

### A. General

(1) The purpose of this section is to acquaint the reader briefly with the properties and characteristics of Chemical Warfare (CW) agents, and also their use, capabilities, limitations, toxicity, area coverage and expenditure rates.

Due to limited space, only the CW agents used with the munitions in this report are covered. For more detailed information see TM3-200, TM3-240, TM3-215, FM3-5, FM3-8, OP2217, NWIP-1-2, CMLCD57-8, and CMLCD57-9.

(2) Major Dissemination Methods: Major dissemination systems for CW agents are considered to be spray tanks, controlled drones, missile warheads, rocket warheads, bombs, generators, mines, and shells. Bombs for current application would be either the massive, or cluster type with bomblets loaded with agents. These systems can be used by either land or carrier based aircraft.

(3) Mixtures of Chemical Agents: The medical problems presented by attack from individual chemical agents could be compounded by the use of mixtures of chemical agents. Picture the conditions in a city following simultaneous attack by GB, a psychomimetic agent, and mustard gas. The attack would take its toll of medical personnel as well as those who operate transportation, communications, water supply, electrical systems, etc. Infants, as well as the aged and infirm, would be neglected through loss of their guardians. Imagine the mass confusion and panic which would occur as partially poisoned and psychotic survivors attempted to treat the sick, remove the dead, and put the cities' utilities back Into operation.

(4) Toxic Ammunition: Toxic ammunition should be considered as a combination Toxic-HE munition, since it is difficult to distinguish the fragmentation and blast effects of a toxic munition from those of a conventional HE round. These HE effects are considered an Important bonus. Although toxic CW agents do not destroy material, they can Interfere with use of terrain, equipment or food as a result of contamination. Target sizes for toxic CW vary from individual vehicles to large area coverage Of several hundred square miles.

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B. Standard Toxic Chemical Agents

(1) The standard toxic chemicals used in the greatest variety of ground and air chemical munitions are the nerve gases GB and VX, and Mustard gas HD. GE, VX and HD are suitable for employment in liquid or vapor form, and can produce casualties by inhalation, eye effects, and by percutaneous (thru the skin) routes. Other gases such as CS-CN-DM etc., are used for riot control and similar emergencies.

(2) Principle methods for producing casualties with toxic agents are:

(a) Inhalation of agent in vapor or aerosol form.
(b) Skin absorption of agent in vapor or aerosol form.
(c) Skin absorption of agent in liquid form.
(d) Direct Injection of agent into tissues by flechette or fragment impregnated with agent.

C. Toxic Gases

(1) VX - Nerve Gas: VX is a fast acting nerve gas which is casualty producing either in Aerosol or liquid form. A liquid under all climatic conditions but with a much lower volatility than GB. Physiological effects are convulsions, paralysis, and respiratory failure. Outstanding characteristic is a very high eye and skin toxicity. Immediate area of burst is comparable to HE, and casualty effect in that area Is nearly as rapid as HE, and equally Independent of weather conditions.

VX has been made standard. About as heavy as water with the consistency of machine oil. Persistent and can contaminate areas for several days. Odorless and colorless when pure. For lethal and Incapacitating dosages see Table II. Rate of action by Inhalation 4 to 30 minutes, (mean 15 min..) by skin absorption 15 minutes to 4 hours (mean 60 min.).

VX is more difficult to vaporize and aerosolize than GB. Winds in excess of 8 MPH are unfavorable employment of chemical munitions and *may* require a prohibitive expenditure to achieve desired results. Winds below 5 MPH may fluctuate widely in speed and direction, and therefore impose difficulties in assuring safety of friendly forces, who must use protective clothing and equipment until the area has been decontaminated, or sufficient time elapses to permit dissipation.

(2) GB - Nerve Gas: GB is an odorless, colorless liquid wh pure. It is quick acting nerve agent-and casualty producin with very high eye toxicity. Produces casualties primarily inhalation effects although skin absorption is a significant factor in some cases. Immediate area of burst is comparable HE, and casualty effect in that area is nearly as rapid as H and equally independent of weather conditions. Skin toxicit low except where skin is broken. Non-persistent as a vapor; a liquid the persistency varies with the temperature. Evapo rates about the same as water depending upon the weather. R of action is very rapid, usually causing death within 2 to 3 minutes after lethal dosage is Inhaled. A drop of GB, the s of a pin head, volatized and inhaled would be lethal. The action is so fast that there is little time for protection, detection, or treatment. Lethal quantities can also be absor through the eyes and skin. Available in large quantities. Physiological effects are convulsions, paralysis, and respira tory failure. In light concentrations is a harassing gas. F Incapacitating and lethal dosage see Table II.

(3) HD - Mustard Gas: Mustard gas is an oily, irritating , blistering gas which is better for producing casualties than for its lethal effects. It is most effective in hot humid weather of about 80°F by skin absorption of vapor among masked personnel in situations where Its considerably delay in onset of incapacitation is acceptable. Considerable stocks of this agent are available. As a liquid it is effective for a longer period than as a vapor and this can cause enemy masking for extended periods of time. Has a slow rate of evaporation and is heavier than water.

HD is H which has been purified by washing and vacuum distillation, has less odor and greater blistering power than H, and is more stable In storage. Odor is like Garlic. For letha and incapacitating dosages see Table II. HD produces predominantly temporary incapacitation and a low percentage of deaths. One of its limitations is Its rate of action which is delayed usually from 4 to 6 hours. Physiological effects are inflammation of the eyes, redness of skin and blistering, inflammator reaction of nose, throat and lungs. HD is persistent and may remain one or two days under average conditions and a week or *more* under very cold conditions.

D. Incapacitating Agents

(1) General: Present research trends Indicate that future chemical warfare will be concerned with new types of incapa-

citating agents. These agents would produce temporary paralysis, blindness, or mental effects. The substances would be of sufficient potency that effective doses would be inhaled by large segsents of the population before their presence was known. Their onset of action might be immediate or delayed. They might be used during open attack or covertly. Such agents could be used in numerous ways to weaken defensive capabilities.

These agents could present unique medical problems. The recognition, collection, and care of large numbers of psychotic individuals might be a major task. The *harm,* which such individuals would inflict upon themselves and others, could multiply the medical problems. Close surveillance would be needed to recognize signs of psychosis in the medical personnel themselves.

The widespread occurrence of any of these incapacitating actions possibly could be a signal of imminent attack by an opposing force, and it might be a duty of the medical personnel to rapidly organize and supervise *some* widespread medical countermeasure which would aid in defense against an anticipated attack.

(2) DM - Diphenylaminechloroarsine (Adamsite): DM does not vaporize at ordinary temperatures and must be dispersed as an aerosol through application of heat. Has no odor. Median lethal dosage 30,000 MG-Min/M3 which *is of minor* importance for lethal casualties. Median incapacitating dosage is 22 MG-Min/M3 for 1 min exposure, or 8 MG-Min/M3 for 60 minute exposure. Skin and eye toxicity is Irritating but relatively non-toxic. Rate of action is very high requiring about 1 minute for incapacitation. Physiological action is irritating of the eyes and mucous membranes, viscous discharge from nose, sneezing, coughing, headache, pain in chest, nausea and vomiting. Used mostly in smoke candles and hand grenades. The persistency effect is low because it is disseminated as an aerosol. Rate of detoxification is rapid in small amounts and incapacitating amounts lose their effect after about 30 minutes. Used mostly for riot control purposes.

(3) CN - Chloroacetophenone: A tear gas which causes tears to flow and irritation of the skin. As with vomiting gases, CN must be vaporized or dispersed by some other means than by Its volatility. Stable in storage. Odor is fragrant similar to apple blossoms. Median lethal dosage has no exact data but - believed to be about 11,000 MG-Min/M3. Median incapacitating dosage is 80 MG-Min/M3. Rate of detoxification is rapid and effects disappear in a few hours. Skin and eye toxicity is irritating but not toxic in concentrations likely to be encountered in the field. Rate of action is practically. instantaneous.

Physiological action is powerful lachrymatory effects, irritating upper respiratory passages. In higher concentrations is irritating to the skin and causes burning and Itching sensation especially on moist parts of body. Used In smoke pots, grenades, and mortar shells. Persistency effect is low because it is disseminated as an aerosol. Effects usually disappear in a few hours. For riot control purposes.

(4) CS - Ortho-chlorobenzylidenemalononitrile: CS is a relatively nontoxic harassing agent and is stable and effective over a wide temperature range. It is effective at very low concentrations and produces incapacitation by eye effects, burning in the nose, throat, lungs and marked respiratory distress, It is more rapid acting than CN and DM. Produces no adverse effects when used repetitively or on personnel affected with mild hypertension, bronchial *asthma*, hayfever, hepatitis, or peptic ulcers..

Effects on old or yound persons are the same. When used against persons who are hyper-ventilating, Its effectiveness is greatly accentuated. Therapy has not been found effective or necessary at this time. Talking with a person who has severe chest symptoms is sufficient tc give him rapid relief. There has been little tolerance developed to this agent. Stable under ordinary conditions and has been kept in storage at ordinary temperatures for two years without evidence of any decomposition. On one test persons exposed to 4 MG-Min/M3 were incapacitated within 30 seconds. Suitable for use in grenades, smoke pots, mounted or hand held dispersers and helicopters.

Persistency effect is low because it is disseminated in aerosol form. See CWL-TM 24-28, CWLR 2365, CWL-SP-4-20.

E. Smokes
(See OP 2217, NWIP 1-2, FM j-5, FM 3-8, CMLCD 57-8)

(1) General: Smokes have many uses such as spotting, screening, signaling and when WP 'is used there is an anti-personnel and incendiary effect. The Navy can use smokes for the following: Protection of ships at anchor or In action, to cover landings and minesweeping operations, protect crippled ships and convoys, for decoy screens and rescue operations, to cover enemy command posts and to conceal ships from aircraft.

Smoke munition expenditures vary with each specific mission and meteorological condition. Under normal meteorological conditions it requires about twice as many rounds per minute to establish a smoke curtain as is required to maintain it. WP is capable of significantly attentuating and reflecting the thermal radiation produced by atomic detonations, Since the thermal

radiation is ordinarily the aost far reaching effect of an atomic explosion, use of smoke affords a means of reducing the exposure of friendly forces. It may be used to partially protect these forces from enemy-employed weapons or to Increase the safety of these forces when atomic munitions are used against the enemy in proximity to friendly forces. When smoke is used to attentuate and reflect thermal radiation, care must be exercised to ensure that the smoke will not rise to a level that Its lower surface is above the point of detonation.

(2) WP- White Phosphorus: A spontaneously Inflammable solid which burns on contact with air to for.9 solid smoke particles or phosphorus pentoxide. Phosphorus pentoxide then reacts with moisture in the atmosphere to form droplets of phosphoric acid, the dilution depending on the relative humidity. WP is used in instantaneous burst munitions. The showers of burning phosphorus particles are highly Incendiary for prolonged periods of time, which makes WP excellent for harassing enemy personnel. The heat produced In the burst of large WP munitions is so great that a large part of the smoke pillars rapidly, reducing the otherwise high screening efficiency of WP in all except fairly strong wind conditions. At night the intense light generated by WP bursts has a blinding effect on personnel. It is stable in the absence of air and is most effective at wind speeds of 10 to 20 MPH. Its low melting point sometimes causes WP to melt In stored munitions, and if munitions are not stored on end, the center of gravity 'shifts which produces instability In flight. This has been overcome to a considerable degree by plasticizing WP which is known as PWP.

Physiological Action: Solid or liquid will burn the flesh and such burns heal very slowly. WP vapors are very poisonous, producing bone decay (no vapors are found in the smoke). Used in Artillery, Mortar, or Naval shells, and in bombs, rocket warheads, and grenades. See next item PWP for details.

(3) PWP - Plasticized White Phosphorus: WP is melted and stirred into cold water; granules about 0.5 mm in diameter and produced. The slurry of granules and water is mixed with a very viscous solution of synthetic rubber (40% GRS rubber in an organic solvent). The granules become coated with a film of rubber and are thereby separated from each other. The mass is folded, stretched and refolded until the composition is homogeneous. The mass is dispersed by the exploding munition but does not break into such small particles as WP does. Burning rate is slow to such an extent that pillaring with PWP is much less marked with WP. Properties and effects are the same as WP.

(4) HC - Hexachloroethane: HC smoke mixture is a solid that reacts to form a dense, persistent, grayish white smoke cloud which is slightly less dense than WP. HC is not affected by temperature. Used for screening and spotting purposes and is most effective *In* winds of 5 to 15 mph and under conditions of high humidity. Initial heat needed to start the burning of HC smoke mixture is provided for with a starter mixture. As HC mixture burns, intense heat and smoke are produced. Having a total moisture content of 0.6% HC is very stable under normal conditions. HC smoke has no physiological action.

One of the few smokes affected by humidity, drifts too slowly and rises too high to be effective In winds below 5 mph. Disperses rapidly in winds above 15 mph. Mostly used in smoke pots, smoke candles, floats, grenades and shells. Spontaneous combustion is possible if moisture is allowed to come in contact with HC mixture.

(5) FM - Titanium Tetrachloride: A liquid compound which can be atomized by cietonation or spraying into the air. When atomized it hydrolizes and the smoke soon becomes a composition of solid and liquid particles. Carbon dioxide is used with FM to produce pressure. Tie smoke, mixture is corrosive. The, color is light yellow and In liquid form weighs 14 pounds per gallon. Reacts vigorously with the moisture in the air to form a dense, white, persistent smoke cloud. The formation of solid particles sometimes clogs spray equipment. It has been replaced to a large extent by FS. Used in generators aboard ship and also in aircraft spray tanks.. Other properties and effects are similar to FS. Most effective at wind speeds from 5 to 15 mph.

(6) FS - Sulfur Trioxide Chlorosulfonic: A liquid mixture of 55% sulfur trioxide and 45% chlorosulfonic acid weighing 16 pounds per gallon. Was used during World War II when smoke screens without fire hazard were desired. FS smoke is very ineffective at low temperatures when mechanically dispersed, Is stable in storage if dry. Should not *be* used with nylon, plastic and fibers. Odor is acrid. Physiological action; Liquid FS is highly corrosive to the skin. The smoke causes a prickling sensation on the skin because of the minute acid particles it is composed of. Exposure to heavy concentrations *or* prolonged exposure to ordinary concentrations may cause severe irritation of eyes, skin and respiratory tract. One of the few smokes affected by humidity. Mostly used in generators, spray tanks and special munitions. Most effective at wind speeds from 5 to 15 mph.

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(7) SGF - Smoke Generator Fog: Oil smokes *are* produced by mechanical generators that yield minute oil particles. A smoke generator uses a mixture of oil and water to produce the smoke. The water is not a part of the final smoke; It helps keep the oil vaporizing coil clean by reducing carbon formation during operation and by purging the coil when stopping the generator. Color is white. Final smoke cloud is stable and its life depends on meteorological conditions. Most effective at wind speeds of 5 to 12 mph. Used for producing smoke haze, blanket, curtain, etc. Oil used is low viscosity petroleum oil referred to as SGF No. 1 or SGF No. 2. SGF No. 1 has *a* higher viscosity and is used when temperature is 90°F or above. SGF No. 2 is used at temperatures of 0° to 90°F. Average field concentrations of oil smoke are-harmless.

F. Incendiaries and Thickeners

(1) TH - Thermite and Thermate: Thermite is an incendiary composed or powered iron oxide and powered aluminum, on ignitior burns at a temperature of about 4000°F and releases a white-hot molten iron which ignites material it comes in contact with. TH3 Thermate used for incendiary munitions such as bombs and grenades, is a mixture of thermlte, barium nitrate, and sulfur in an oil binder. Thermate has improved incendiary characteristics over thermite and because of the binder is more easily loaded into munitions. It is also used *as an* igniter *for magnesium type* incendiary bombs.

(2) PT-1 - Gasoline + Magnesium + IM: PT-1 is a mixture based on a paste comprisea of magnesium dust, magnesium oxide, and carbon with sufficient petroleum distillate and asphalt to form a paste. Incendiary bombs with this mixture are easily ignited by nose and tail fuzes since they contain many combustible ingredients. Incendiary effects are about the *same as* with oil incendiaries.

(3) Oil Incendiaries and Thickeners: Oil incendiaries are based on gasoline and may be either all gasoline, *or* blends of gasoline with fuel oil of any type such as No. 1 fuel oil, No. 2 fuel oil, diesel oil, lubricating oil, kerosene, and sediment free crankcase drainlngs. Mostly used in thickened form. Flame throwers use unthickened fuel in jungle warfare where maximum range is not required; Increasing the *amount* of oil increases the range and reduces the amount of fuel burned in flight to the target, Thickened fuel also gives clinging qualities. It is used in incendiary bombs and flame throwers.

(4) Ml Thickener (Napalm): This thickener is a mixed aluminum

soap in which about 50% of the organic acids are derived from coconut oil, 25% from naphthenic acids, and 25% from oleic acid. As issued it is in the form of small granular particles, light tan to brown in color. An undesirable characteristic of Ml is that it absorbs moisture rapidly from the air. Moisture causes the thickener to change so that it may be unusable. Mixed with gasoline at 18 to 29°F it swells until the mixture becomes a more or less homogeneous gel. The percentage of Ml thickener used in thickened fuel ranges from 4.2% to 12%. Standard for flamethrower fuels.

(5) M2 Thickener: An intimate mixture of 95% Ml thickener and 5% devolatilized silica aerogel or other approved anti-agglomerant. M2 thickener is an improvement over Ml for use in fire bombs because of free flowing and faster setting characteristics. Standard for fire bomb fuels.

(6) M4 Thickener: A composition of aluminum diacid soap of isooctoic acids containing 3% silica aerogel or other approved anti-agglomerants. For fire bomb and flame thrower fuels.

(7) Other Thickeners: There are several other thickeners using rubber and other ingredients that are effective but are much more difficult to use than Ml or M2. IM incendiary oil, type 1, is an example of the use of isobutyl methacrylate, polymer E. Three other IM incendiary oil mixtures are obtained by varying the Ingredients.

(8) Ignition: Most oil incendiaries are equipped with white phosphorus igniters to Insure ignition because the bursting charge may not cause ignition. Since WP ignition is prevented by water, a sodium igniter is used in incendiaries dropped over water.

G. Modifying Factors

(1) The factors which modify the behavior and effectiveness of CW agents are the methods of dissemination, meteorologic conditions, and the terrain in the target area. In tactical employment, weather influences chemical agents in vapor or smoke form more than it does those In liquid form. Chemicals may be disseminated by bursting ammunition, spray tanks, bombs, rockets, missiles, drones, mines, artillery and naval shells,

(2) Temperatures: High temperatures increase the rate at which the liquid agents evaporate, while low temperatures decrease this factor. Surface temperature of the target area affects the persistency of the liquid contamination and the vapor concentration immediately above the agent.

(3) Temperature Gradient: Vertical variations in temperature affect air stability which under unstable conditions may cause gas or smoke clouds to disperse quickly. Numerical temperature gradient values are obtained by subtracting the air temperature 1 foot above the ground from the air temperature of feet above the ground. For calculation of ammunition requirements, temperature gradient forecasts are desirable in terms of Inversion - Neutral or Lapse.

(4) Lapse (Unstable) Condition: A decrease in air temperature with an increase in height. Such conditions normally exist on a clear or partially clear day. Characterized by turbulence from thermal air currents.

(5) Neutral Condition: A condition between Lapse (Unstable) and Inversion (Stable). Such a condition exists when the air is about the same temperature between 1 and 6 feet. Usually occurs on heavily overcast days or nights about 1 or 2 hours before sunset or after sunrise.

(6) Inversion (Stable) Condition: An increase in air temperature with an increase in heights. Such a condition usually exists on a clear or partially clear night and on early mornings until about 1 hour after sunrise. Characterized by a minimum of convection currents and maximum stability.

(7) Effects of Wind: High winds increase the rate of evaporation of liquid agents, and quickly dissipate gas and smoke clouds. Large area toxic chemical attacks can best be made if the wind speed is not over 12 mph. Small area attacks can be made most effective in wind speeds of 6 mph or less. Wind can affect smoke in many different ways. See FM 3-5 for other smoke conditions.

(8) Effects of Humidity and Precipitation: High humidity, coupled with high temperature, increases the effectiveness of blister gas but does not increase the effectiveness of nerve gas. Heavy rains wash away liquid agent contamination but may not necessarily hydrolyze or destroy the agent. HC and FS smokes are affected by humidity.

(9) Effects of Cloud Cover: Clouds indirectly affect toxic chemicals since they affect the vertical temperature gradient. If the sky is covered with clouds, radiation is reduced from the sun to the earth's surface during the day, and from the earth's surface to the sky at night. The amount of this reduction depends on the extent of the cloud coverage and height and thickness of the clouds.

(10) Effect of Terrain: The contour of the surface of the ground, together with the absence or presence of trees and vegetation have important effects on toxic chemicals.

(11) Effect of Soil: The texture of the soil affects chemical shell penetration, cratering, and the extent of liquid contamination. Soft soil tends to bury point detonating ammunition before bursting, and also affects certain type bomblets and being porous soaks the agent up quickly.

(12) Surprise Effect: The ability of a weapon to deliver a surprise concentration of toxic chemicals on a target within 30 seconds is an important factor in the selection of weapons for delivery of toxic chemicals or biologicals to certain types of targets.

## H. Time of Onset and Duration of Incapacitation

(1) The time after an attack before incapacitation will occur will vary from 2 minutes to 24 hours. The exact time will depend on the type of agent, route of entry into body, amount of agent, etc. Table I gives approximation of the time delay which may be expected.

Table I - Time of Onset and Duration of Incapacitation

| Agent and Route of Entry Into Body | Time to Onset of Incapacitation (A) Range | Mean | Duration of Incapacitation | Average Percent Casualties Becoming Fatalities (B) |
|---|---|---|---|---|
| GB - Inhalation | 20-30 Min. | 15 Min. | 1-5 Days | 25 |
| HD - Eye Effects | 3-12 Hrs. | 6 Hrs. | 2-7 Days | 3 |
| ND - Skin Absorption | 3-24 Hrs. | 12 Hrs. | 2-6 Weeks | 3 |
| VX - Inhalation | 4-30 Min. | 15 Min. | 1-5 Days | 25 |
| VX - Skin Absorption | 15-240 Min. | 60 Min. | 1-5 Days | 25 |

(A) Depends on Dosage Received.

(B) Depends on Medical Treatment.

[redacted]

I. General Method for Estimating Performance of CW Munitions (Standard Criteria on which Casualty Estimates are Based)

1. Toxicity values for Incapacitating or Lethal dosage. (Table II)
2. Breathing rate of 15 liters per min. (troops in mild activities). Meteorological conditions for these estimates are:
3. Wind speed: 5mph.
4. Temperature 60°F and Temperature gradient: neutral
5. Casualty Level: 30% when practicable.
   Levels of protection used for these estimates.
6. Personnel without mask *or* other toxic protection.
7. Personnel with mask available.
8. Personnel without overhead cover (trench or fox holes).
9. Personnel with overhead cover (rain protection).
10. Terrain: Flat with scattered vegetation.
11. Personnel is assumed to function *In* target area, and randomly distributed in impact area.

Table II- Agent Toxicity

| Agent and Route of Entry Into Body | *IC-50 or ID50 Incapacitating Dosage | **LC+50 or LD50 Lethal Dosage |
|---|---|---|
| GB - Inhalation or Eye Effects | 35 MG-Min/M3 | 70 MG-Min/M3 |
| HD - Vapor Eye Effects | 200 MG-Min/M3 | 1500 MG-Min/M3 |
| HD - Vapor Skin Absorption | 2000 MG-Min/M3 | '10,000 MG-Min/M3 |
| VX - Aerosol - Inhalation | 30 MG-Min/M3 | 35 MG-Min/M3 |
| VX - Aerosol - Skin Absorption | 160 MG-Min/M3*** | 200 MG-Min/M3*** |
| VX - Liquid - Skin Absorption | 2.4 MG (Bare Skin) 24 MG with 2 Layers of Combat Clothes | 3.0 MG (Bare Skin) 30 MG with 2 Layers of Combat Clothes |

*Dosage required to incapacitate within 24 hours, 50% of personnel exposed.
**Dosage required to kill within 24 hours, 50% of personnel exposed and not subsequently treated.
***Values assumed normal combat clothing, which leaves a small fraction of total skin area uncovered.

[redacted]

J. Estimation of Expenditure Rates for Standard Conditions

Table III - Standard Agent Expenditure Rates (1)
(Pounds of Agent Per Hectare to Achieve 30% Casualties)

| Agent | Men in Open | | Men with Overhead Cover | |
|---|---|---|---|---|
| | No Masks Available | Masks Available | No Masks Available | Masks Available |
| G B | 3.0 # | 36 # (2) | 3.0 # | 36 # (2) |
| G B Spray | 6.0 # | -- | 6.0 # | -- |
| V X - Aerosol | 3.0 # | 12.0 # | 6.0 # | 24.0 # |
| V X - Liquid (4) | 4.5 # | 4.5 # | -- | |
| H D (3) | 20.0 # | 140.0 # | 20.0 # | 140.0 # |

(1) Values are based on standard meteorological and other conditions shown above in Table II and Par. I.

(2) Casualty Level 5 to 15% for this situation no higher level can be assured.

(3) Median values for various type munitions.

(4) Values apply to Airburst or Spray Munitions.

K. General Method for Estimating Munition Expenditure Rate

(1) It is usually desirable to express expenditure in terms of number of munitions per unit area rather than as weight of agent per unit area.

(2) Munition expenditure rate can be estimated by making use of the following:

$$\text{Munition expenditure rate} = \frac{\text{agent expenditure rate}}{\text{wt. of agent per munition}}$$

(3) Standard agent expenditure rates can be obtained from Table III, The weight of the agent in a munition can be estimated by using the rule of thumb in Table IV.

L. Rule of Thumb for Estimating Agent Content of a Toxic Chemical Munition.

Table IV

| Type of Munition | Agent Payload (Fraction Of Total Munition Wt.) |
|---|---|
| Artillery | .07 |
| Mortars and Small Rockets | .15 |
| Missiles and Large Rockets | .25 |
| Spray Tanks | .75 |
| Cluster Bomblets | .25 |
| Massive Bombs | .30 |
| Note: The above table should not be used when less than 10 rounds are to be fired. | |

M. Rule of thumb for estimating performance of GB, VX Aerosol, and HD against troops without masks available.

(1) The percentage of casualties in the target area is equal to the percentage of the coverage of the target with an $Ic_t50$ or greater. For example, if a sauare mile target of uniform population density is attached with GB so that 0.6 square mile of the total target area is covered with a dosage equal to or greater than $Ic_t50$ (35 MG-Min/M3) of GB, then approximately 60 percent of the total target population not equipped with masks will become casualties.

(2) Following is an example of the use of the standard agent expenditure rate in Table III and rule of thumb in Table IV. A Mortar shell weight is about 50 pounds. If this were converted to a GB round, what would be its expenditure rate to achieve 30% casualties among unprotected troops under standard meteorological conditions?

(3) The standard agent expenditure rate is in Table III for this round is 3 pounds per hectare. The agent weight In each round is estimated from Table IV to be 50X.1557.5 pounds. Accordingly, the expenditure rate of the GB round would be $\frac{3}{7.5}$ 0.4 pound per hectare to produce 30% casualties under standard meteorological conditions.

N. General Method of Estimating Area Coverage.

At times it is desirable to express performance of toxic CW munitions in term of the area covered per munition rather than as an expenditure rate. The area coverage of a munition is the reciprocal of the expenditure rate, or:

$$\text{Area coverage per munitions} = \frac{1}{\text{Expenditure Rate}}$$

For example, above It was estimated that the expenditure rate of a 50 pound GB filled mortar shell should be 0.4 rounds per hectare. Therefore, the area coverage of this round would be $\frac{1}{0.4} = 2.5$ hectares for 30% casualties under standard meteorological conditions.

O. General Method for War Gaming Toxic Chemical Munitions

The basic formula used for war gaming HE has been adapted for CW. The simplified formula is:

$$F = \frac{(N) \quad (Ca) \quad (f)}{Ta}$$

Where: F = Fraction of casualties
N = No. of munitions functioned on target
Ca= Std. Casualty Area (Hectares)
f = Correction factor (or a product of two or more correction factors)
Ta= Target Area in Hectares

To convert fraction of casualties (f) to percentage casualties multiply by 100.

P. Standard Casualty Areas

The following simplified method of calculating the standard casualty areas (CA) is :

CA = 30% Casualty Area per round x 0.3

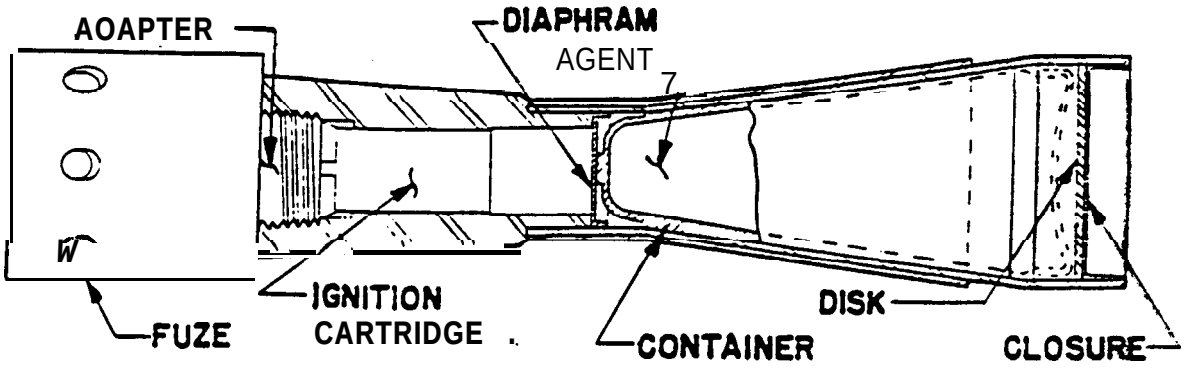
The 30% casualty area (in hectares) of a round is obtained by dividing the agent weight of the round by the standard expenditure rates for 30% casualties from Table III and par I. For example, the standard casualty area (Ca) for the GB filled 155MM Howitzer round would be:

$$Ca = \frac{6.5 \text{ lbs}}{3.0 \text{ lbs/hectare}} \times 0.3 = 0.65 \text{ hectares}$$

## Q. Meteorological Correction Factors For Expenditure Rates and Area Coverage - Table V

| Meteorological Conditions | GB** | | VX Aerosol*** | | HD | |
|---|---|---|---|---|---|---|
| | Expenditure Rate | Area Coverage Hectares | Expenditure Rate | Area Coverage Hectares | Expenditure Rate | Area Coverage Hectares |
| (1) Temperature Gradient | | | | | | |
| Inversion | 0.4 | 2.5 | 0.4 | 2.5 | 0.7 | 1.4 |
| | | 1.0 | 1.0 | 1.0 | | 1.0 |
| Lapseal | 4.0 | 0.25 | 4.0 | 0.25 | 1.0 | 0.6 |
| (2) Wind Speed (MPH) | | | | | | |
| 44 | 0.5 | 2.0 | 1.0 | 2.0 | 0.7 | 1.5 |
| 4 to 6 | 1.0 | 1.0 | 2.0 | 1.0 | 1.0 | 1.0 |
| 7 to 10 | 2.0 | 0.5 | 5.0 | 0.5 | 1.3 | 0.8 |
| 11 to 16 | 5.0 | 0.2 | | 0.2 | 1.7 | 0.6 |
| 17 to 32 | 10.0 | 0.1 | 10.0 | 0.1 | 5.0 | 0.2 |
| (3) Temperature (°F) | | | | | | |
| 0 to 40 | 1.3 | 0.8 | -- | -- | -- | -- |
| 40 to 80 | 1.0 | 1.0 | -- | -- | -- | -- |
| > 80 | 0.8 | 1.3 | -- | -- | -- | -- |
| 30 to 50 | -- | -- | -- | -- | 5.0 | 0.2 |
| 50 to 70 | -- | -- | -- | -- | 1.0 | 1.0 |
| > 70 | -- | -- | -- | -- | 0.5 | 2.0 |

* No correction factors given for VX Liquid due to lack of information.
** No meteorological correction factors are required when target personnel have masks.
*** Temperature is assumed to have no effect on expenditure rate or area coverage of VX Aerosol.




NOMENCLATURE : Bomblet, BW Agent, 1/2#, E 61R4

TYPE: Explosive - Non self Dispersing - Base Ejection

PURPOSE: For dissemination of BW agent in aerosol form by explosive means.

STATUS: Eng. Test complete. Non Std

DESCRIPTION: The bomblet body consists of four basic parts: the casing, the adapter, the rupture diaphragm, and the closure cup. The two piece casing is made from 0.0478 inch cold drawn steel. It is shaped like the frustum of a cone with an additional short cylindrical section at each end, The fuze is mechanical, air arming, point detonating impact type.

The fuze is armed during free fall after the bomblets are released from the cluster, as ram air is forced into the fuze nose causing impeller blades to rotate at high speed. These actions bring the primer in line with the firing pin and cartridge. The firing pin is driven into the primer to initiate the explosive train. The agent is carried in a flexible plastic conical container.

The E 61R4 is considered to have better dissemination than the M114 as It uses a slow burning powder, and yields higher proportions of viable agent in the clouds than were obtained with the high explosive used in the M114. Overall bomb functioning reliability was 92%.

AREA COVERAGE: See E 133R3 cluster

[redacted]



[redacted]

[redacted]

BOMBLET, BW AGENT, 1/2#, E 61R4 (CHARACTERISTICS)

CMLC DRWG: C14-5-1465

NOSE HEX: 1".5 Across flats
O.D.: 1".5 (large end).
LENGTH: 7".328
FILLER VOLUME: 35 Ml
BODY MATERIAL: Steel
FUSE: E 34R4 Air-arming PD
FUZE ARMING SPEED: 4100 RPM's
AGENT CONTAINER: E11
USED WITH: E 133R3 Cluster

TAIL Eii O.D.: 1".5
I.D.: 0".750 (small end)
WEIGHT: 1.4# Loaded
FILLER AGENT: Various BW
FUZES REQ'D: One (Nose)
PRIMER: 26
IGNITION CARTRIDGE: E36 (2.29 gr of M9 powder)
BURSTER: El5 .

E133R3 CLUSTER CAPACITY: 544 Bomblets E61R4
AGENT CONTAINER: E 11
BURSTER: See Ign Cartridge
HANDLING SAFETY: See E 133R3 Cluster

REFERENCES : Ft. Detrick Tech. Study 9 dated June 1958

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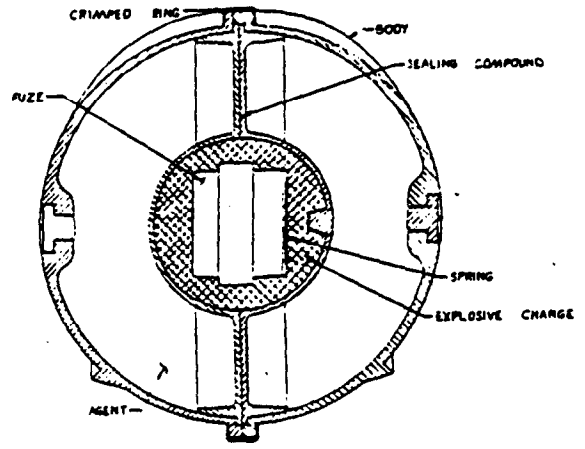


NOMENCLATURE: Bomblet, BW Spherical, 1.0# E 134

TYPE: Air to Surface - Self Dispersing - Explosive

PURPOSE: Dissemination of liquid BW aerosol agents from Sergeant Warhead.

STATUS: Dev. to be complete FY-61. T.C. Scheduled FY-62.

DESCRIPTION: The E 134 consists of four major components: the molded plastic bomblet casing in two hlaves with six external ribs 60° apart at the equatorial saturn ring and two spoilers at 45°, the explosive charge and the fuze. The agent is contained within the casing halves.

When dropped from high altitudes it disperses during fall because of rotation induced by driving ribs on the sphere surface, and *impacts* throughout the target area over a cricular pattern. Each sphere functions on impact. Patterns as a whole are aimable and do not require an accurate prediction of wind direction to place the aerosol on the target. This type sphere is capable of being released from Supersonic missile warheads. This bomb is being developed for use with the Sergeant Warhead.

DISPERSION-COVERAGE: Tests indicate that the bomb will give pattern diameters about 90 percent of the release height-Agent coverage is the same as Impact pattern and is dependent upon the agent, meteorological conditions, and release altitude. *Areas* from 15 to 60 square miles may be covered when used with the Sergeant Warhead.

BOMBLET, BW SPHERICAL, 1.0#, E 134 (CHARACTERISTICS)

CMLC DRWG: C 14-5-2624

BASIC DIA: 3".4 MAX DIA: 3".5 (Approx)

FILLED WEIGHT: 0.76# AGENT: BW Liquid .

AGENT CAPACITY: 212 Ml Approx

FUZE: T1029E2 ARMINGSPEED: 1100 to 1700 RPM's Approx

GLIDE ANGLE: 25° From Vertical (Approx)

CAN BE USED WITH: For the Sergeant Warhead, which carries about 720 bomblets. Could be used with the XMC-1 Dispenser,

HANDLING SAFETY: See XMC-1 dispenser

MECHANICAL ADEQUACY: It is anticipated that the 95% functioning customarily stated in military characteristics for explosive munitions will be achieved during the development of the explosive sphere. The explosive sphere can be designed with a very tough outer casing of high impact strength plastic. This can be advantageous, particularly in missile applications, where severe loading may occur during launch and warhead separation.

REFERENCES: Ft. Detrick Tech Study 9 dated June 1958

HISTORY: This bomblet is a scaled down model of the E 133 which was 4".5 basic diameter.

[redacted]



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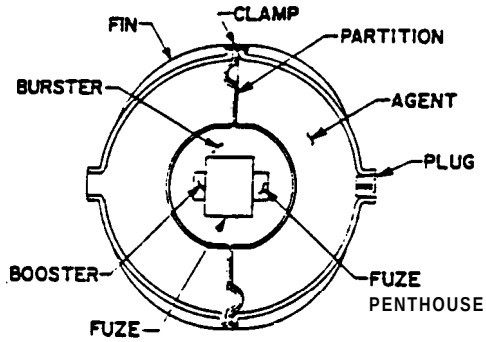


NOMENCLATURE: Bomblet, Spherical, 2.4# (GB-VX) E 130R2

TYPE: Explosive - Self Dispersing - Air to Surface

PURPOSE: Provide toxic chemical offensive capability

STATUS: Estimated completion date IQ Fy-61

DESCRIPTION: This bomblet has an aluminum outer shell with 6 aerodynamic ribs on the outer surface. A spherically shaper burster charge located concentrically with the outer surface is used for disseminating the agent. The fuze is an allways impact type which arms upon being rotated at 1800 RPM's. The bomblet is constructed of two halves to facilitate assembly of the fuze and burster charge. A steel ring clamps the two halves together. The Inner shell is of steel.

AREA COVERAGE: Dependent upon delivery system, meteorological conditions, release altitude, etc.

[redacted]

NAVORD REPORT 6954 (FIRST REVISION)

BOMBLET, SPHERICAL 2.4# (GB-VX) E 130R2 (CHARACTERISTICS)

BASIC DIA: 4.5

OVERALL WEIGHT: 2.4#

EXPLOSIVE WEIGHT: 0.15#

AGENT: GB or VX

AGENT WEIGHT: 1.30#

AGENT TO EXP. RATES: 8.5:1

GLIDE ANGLE: 23° with vertical (Approx)

TERMINAL SLANT VELOCITY: 1 7 5 VOID; sec 10%

FUZE: XM912 centrifugal arming - all ways - impact

FUZE ARMING SPEED: 1800 RPM

TERMINAL RPM: 3700

CMLC DRWG: 14-5-2768

USED WITH: Littlejohn Warhead E20, Sergeant Warhead E21, and Improved Honest John Warhead E19R2.

REMARKS: Concept studies are also being conducted on another spherical shaped bomblet which is approx 1-7/8" dia and employs an explosive for dissemination of the agent.

REFERENCES: CML-6232-20-050 dated 6 Nov 1959

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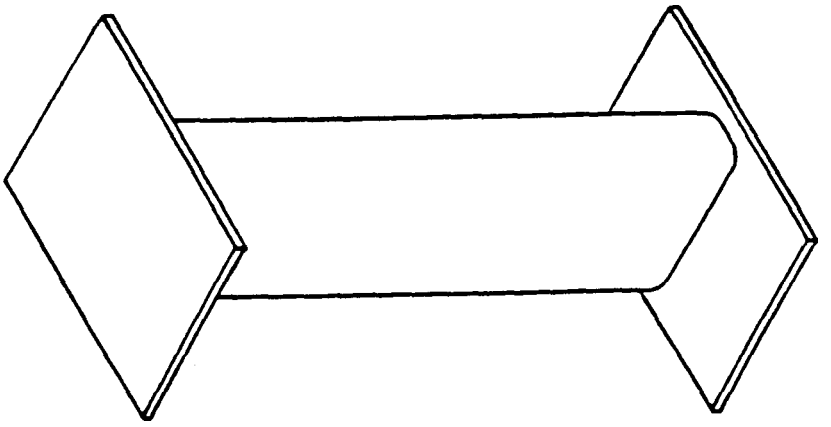


NOMENCLATURE: Bomblet, BW, Flettner Rotor

TYPE: Self dispersing Liquid Generator, or Dry Fill Disseminator

PURPOSE: Dissemination of BW agents (liquid or dry)

STATUS: The Flettner bomblet is in the research phase. Specific version for liquid agent fill could now be developed if a requirement were established.

DESCRIPTION: The Flettner bomblet configuration consists of a rectangular body with end plates. Two edges of the body are rounded to provide rotational drive forces. Rotation in flight produces lift, making the bomblet self-dispersing. Body dimensions are adjusted to fit the delivery system; lengths from 5" to 7-1/2 inches have been tested.

A 7 inch model for liquid agents can be fitted into the XMC-1 dispenser for the B47 or B52 Aircraft. The dispenser holds 176 bomblets per *carton*, 1 carton per cell or 4,224 bomblets per dispenser. Approximately 25ml of liquid agent would be generated by a fluid nozzle powered by nitrogen carried under high pressure.

A 5 inch model for dry agents has been proposed for use with missile warheads. Current research work is devoted to refining this concept. Dissemination of dry agent by gas-operated nozzles and by explosive separation of two telescoping sections of the bomblet is being studied. Folding end plates and other means to improve packaging efficiency in small diameter cylindrical warheads is also being studied. Can be used with aircraft or warheads.

[redacted]

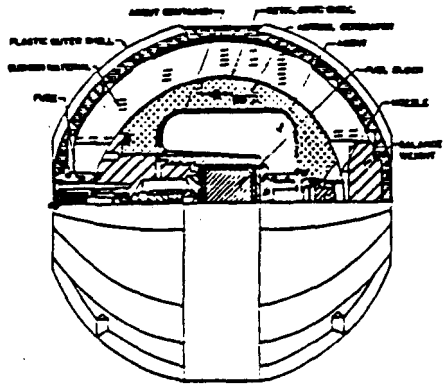
## BOMBLET, BW, FLETTNER ROTOR

IMPACT PATTERN: Recent development tests indicate that with suitable choice of end plate and body configuration, annular patterns can be produced. Outer diameter up to 2.8 times the release height can be obtained. The center of the pattern can be filled in by use of delay-opening subpackages or by use of more than one bomblet configuration In the payload.

### TYPICAL CHARACTERISTICS

| | 7" Flettner for XMC-1 | 5" Flettner for Warheads |
|---|---|---|
| APPROX. DIMENSIONS: | 6.9" x 3.225" X 1.15" | 5.1 X 2.45" x 0.88" |
| APPROX. AGENT CAPACITY: | 25 Ml | 60 cu/cm |
| APPROX. WEIGHT: | 2.1# | 1.0# |

REFERENCES: Ft. Detrick Tech Study 9 dated June 1958.



E 120R1 Shown

NOMENCLATURE: Bomblet, BW, 3.0#, Spherical, E 120R1-E 120R2

TYPE: Self Dispersing - Liquid - Generator - Air to Surface

PURPOSE: Dissemination BW Agents from aircraft

STATUS: Dev. tests complete. Eng. tests held in abeyance.

DESCRIPTION: This bonblet is composed of three major components: The ribbed plastic outer casing, cushioning material in the outer casing, and the inner generator sphere which is metal and contains the generator components, the fuze, propellant, agent container, and nozzle. The outer spherical casing is provided with nine plastic external ribs which cause the bomblet to rotate in flight, thus, imparting a lift which causes the bomblet to glide from the vertical. This lift and glide causes the bonblet *to disperse* over *a* large area after release.

The generator is designed so the heavier fuze components are opposite the nozzle in order that the bomblet *on* impact will roll and orient the nozzle in an upright position. On impact the outer plastic casing falls away and also fires the fuze which causes gases to pressurize the space surrounding the agent container, building up approx 1100 PSI in about 4 seconds to rupture a diaphragm in the agent container to release the agent. The above description is of the E 120R1. The E 120R2 is similar except for 6 rib outer casing and air arming fuze.

LIMITATIONS: Bomblets impacting on soft ground may be *trap-g& in* their self made holes to such an-extent that the sphere cannot roll free and generate the aerosol. This does not occur on firm terrain. Frangible shell limits strength and cushioning layer reduces space in sphere.

[redacted]

BOMBLET, BW, 3.0# SPHERICAL, E 120R1 - E 120R2

AREA COVERAGE: When used with XMC-1 dispenser the agent coverage is the same as impact pattern. Dependent upon agent, meteorological conditions, and release altitude, areas up to 20 square miles (circular) or up to 50 square miles (elongated by sequential release) may be covered. See XMC-1.

CHARACTERISTICS:

BASIC DIA: 4".5

FILLED WEIGHT: 3.0# Approx

AGENT CAPACITY: 90 ml

AGENT: BW Liquid

TERMINAL VELOCITY: 190 to 200 ft/sec at sea level

BODY MATERIAL: outer--plastic, inner--metal

FUZE: E 47R1 pin arming, all ways impact functioning for E 120R1, and M 212 air arming fuze for the E 120R2.

OPERATING TINE: Approx 16 seconds

USED WITH: XMC-1 dispenser

CMLC DRWG: D14-5-2426

HANDLING SAFETY: See XMC-1 dispenser

REFERENCES: Ft. Detrick Tech Study 9 dated June 1958
BWL Tech. Report 24 dtd June 1959 .

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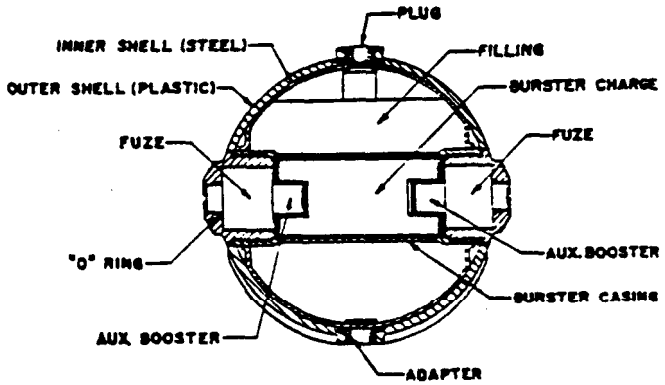


NOMENCLATURE : Bomblet, Spherical, 3.4# (GB) M134

TYPE: Explosive - self dispersing - Air to Surfahe

PURPOSE: Provide toxic chemical offensive capability

STATUS : Std USA

DESCRIPTION: This bomblet is a self dispersing, spherically shaped GB filled munition. Dispersion is accomplished by aerodynamic forces generated by nine vanes on the outside surface of the bomblet. A cylindrically shaped burster charge is located on and concentric with the spin axis of the bomblet. At each end of the burster charge is a tetryl booster *charge* and an all-ways centrifugal fuze. The outer casing of the bomblet is plastic and the inner shell is steel. The fuzes function on impact and detonate the burster. The internal pressures produced rupture the bonblet casing and disseminate the agent. A filling void is maintained to permit thermal expansion due to temperature changes.

AREA COVEEGE: Dependent upon delivery system, meteorological conditions and release altitude.

[redacted]

BOMBLET, SPHERICAL, 3.4# (GB) M 134 (CHARACTERISTICS)

BASIC DIA: 4.5 AGENT: GB F.E.: 32.4%

OVERALL WEIGHT: 3.4# AGENT-WEIGHT: 1.1#

BURSTER CHARGE: 0.18# GLIDE ANGLE: 15° to 20° from vertical

TERMINAL SLANT VELOCITY: 250 ft/sec

FUZE: M 911 Centrifugal arming - all ways - impact (2 used)

FUZE ARMING SPEED: 800 RPM's

BURSTER: M33 AUX. BOOSTER: M 135

VOID REQD: 8%

CMLC DRWG: C 14-5-2573 and C 14-5-2572

USED WITH: M 79 (E 19R1) 762 mm Warhead

DEVELOPMENT HISTORY: In development this item was designated E 130R1

NOTE : This bomb is also being tested with VX

REFERENCES: Mil I-10758

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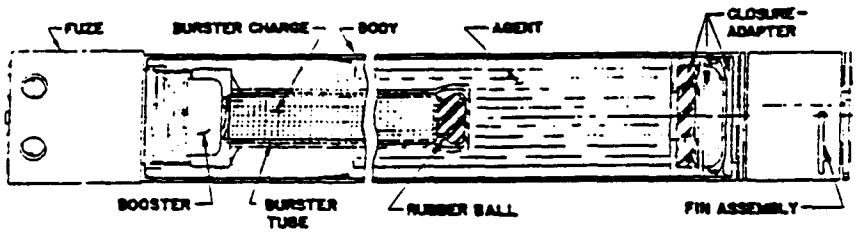


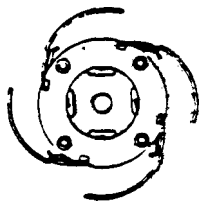

NOMENCLATURE: Bomblet, BW Agent, 4#, M 114

TYPE: Non-Self Dispersing - Clustered - Central Burst

PURPOSE: For dissemination of a liquid pathogenic agent,

STATUS: Std USAF

DESCRIPTION: The bomblet consists of two concentric sealed steel cylinders, the internal cylinder containing the explosive charges, and the peripheral cylinder containing the agent, the necessary fuzing, filling, sealing, and aeroballistic stabilizing accoutrements. The bomblet functions very quickly upon impact. The fuze, air-armed during descent, is so fast acting that the bomblet only penetrates about two Inches of its length before functioning. Each bomblet generates a discrete cloud of agent aerosol, usually round and close to the ground. Target effects are produced in areas swept by these clouds as they move downwind.

FUNCTIONING: On ejection, arming occurs when the air pressure and velocity overcome spring pressure to engage the vanes pinion gears and rack containing the primer. Rotary motion of the vanes is translated into lateral motion of the rack, bringing the previously out-of-line primer into line with the booster and the firing pin. On impact, the vane is set back still further to allow the pointed axle of the vane to strike the primer. In order, the booster initiates the burster, which ruptures the two steel cylinders and releases the agent.

AREA COVERAGE: Dependent upon height of release, height of opening, meteorological conditions etc. See M 33 bomb cluster.

[redacted]

**BOMBLET, BW AGENT, 4#, M114** (CHARACTERISTICS)

BODY DIA: 1-5/8"

DRWG: C 14-5-753

WEIGHT FILLED: 4.2# approx

LENGTH: 21-5/16"

FILLER VOLUME: 320 ml

BODY MATERIAL: Steel 0.028"

AGENT: BW Liquid

BURSTER: M29 (106 Grams-16 Pellets)

FUZE: M 174-PD-air arming

FUZES REQ'D: One - Nose

FUZE ARMING SPEED: 200 ft/sec

USED WITH: M 33 Cluster (Cluster contains 108 bomblets)

DEVELOPMENT HISTORY.: During development this bomblet was designated E 48R2.

HANDLING - SAFETY: See M 33 Cluster

REMARKS: Under tests overall functioning of the PI 114 bomblet was 89 percent.

REFERENCES: Ft. Detrick Spec. Report 236 and Ft. Detrick Tech Study 9 dated June 1958.

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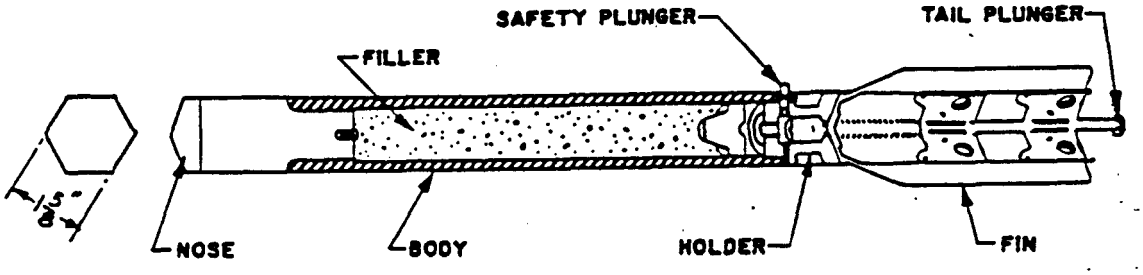



NOMENCLATURE: Bomb, Incendiary, (TH-3) 4#, M 126

TYPE: Bomblet - Air to Surface - Fin Stabilized

PURPOSE: Provide incendiary offensive capability

STATUS: Std USAF

DESCRIPTION: This bomb is an air to surface munition, hexagonal in cross section with a hollow magnesium body which contains the main incendiary charge. The nose end is closed with solid iron so that It falls nose downward and penetrates a target without crumpling. Three vent holes in the body permit combustion products from the filling vent without bursting the body. The major components of the bomb are body, filler,, safety plunger, fin assembly, tall plunger, iron nose, holder and firing assemblies.

The tall fin assembly has retractible fins in a hollow steel fin body. The fins extend through longitudinal slots in the fin body and can be retracted by pressing a spring-loaded tail plunger at the rear of the bomb. The M 126 Bomb is used in the M 36 cluster. Upon release from the cluster, the tail fins are extended by springs and the safety plunger is forced outward arming the bomb. The bomb explodes upon impact as inertia causes the firing pin to strike the primer. The primer Ignites the first fire mix, which ignites the filling, which ignites the magnesium body and releases the filling.

AREA COVERAGE: See M 36 Bomb Cluster.

NAVORD REPORT 6954 (FIRST REVISION) [redacted]

BOMB, INCENDIARY, (TH-3) 4# M 126 (CHARACTERISTICS)

FIRED WT: 3.6# FILLER-WT: TH 3-10 oz F.E.: 18.4%

BURNING TINE: 5 to 8 min

MATERIAL : Magnesium body, Iron Nose, Steel Tail

FINS: M 15 (Retractable fins actuated by a spring loaded safety plunger.

FUZE: None - Functions as inertia fuze on impact.

SAFETY PLUNGER: Depressed by contact with ajacent bomb in cluster adapter.

USED WITH: M 36 Cluster, M 30 cluster adapter

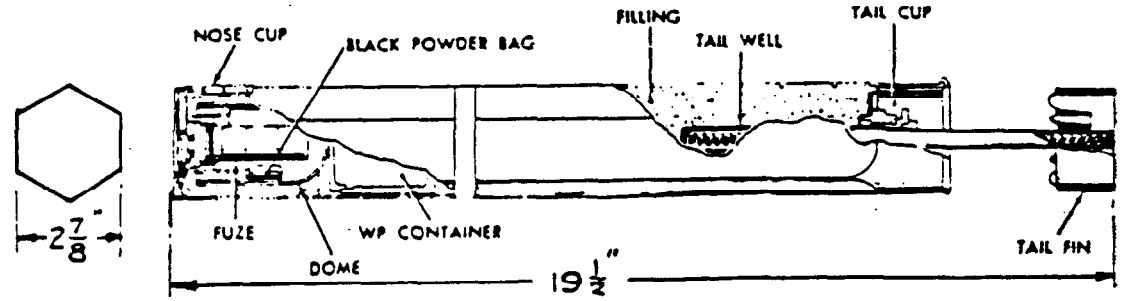
HANDLING SAFETY: See TM 3-400

NOTE : The M 126 bomb is' identical with the M 50A3 except that it uses the M 15 fin in place of a hollow sheet steel tail section.

DEVELOPMENT HISTORY: In development this bomb was designated E89.

REFERENCES: TM 3-400

[redacted]




NOMENCLATURE: Bomb, Incendiary, (PT-1) 10#, M 74A1

TYPE: Bomblet, Air to Surface - Fin Stabilized

PURPOSE: To provide chemical offensive capability

STATUS: Std USAF

DESCRIPTION: This is an air to surface munition, used with the M 35 cluster. It is hexagonal in cross section, except the tail, and measures 2-7/8 inches *across* the faces of the hexagon. An extendable tail fin stabilizes the bomb in flight. The complete bomb consists of a sheet metal body, a dome, a WP igniting charge, filling, fuze and tail assembly. The nose end is closed by a steel cup which provides a seat for the fuze. The tail end is also closed by a metal cup.

The dome is located behind the *nose* cup and separates the fuze from the filling and forms a container for two small bags of magnesium and Black Powder Mix. A WP igniter charge is contained in a plastic container behind the dome and ahead of the filling. The booster end of the fuze is insude the dome and adjacent to the black powder mix. When released from the cluster, the spring loaded bar flies off, freeing the fuze release pin, allowing the fuze to arm. The tail fin extends to stabilize the bomb in flight. Upon impact, the fuze ignites the black powder in the dome which blows gases toward the bomb tail. This breaks the cup with WP and ejects the filling and the WP. The WP ignites upon contact with air and sets fire to the incendiary filling which burns for 5 to 10 minutes.

AREA COVERAGE: The burst radius of one bomb is approximate- 3 to 5 yards. See M 35 Bomb Cluster.

[redacted]

BOMB, INCENDIARY, (PT-1) 10# M 74A1 (CHARACTERISTICS)

FILLED WT: 8.5# FILLER-WT: 2.75# (PT-1) F.E.: 32.3%

IGNITION CHARGE: 6 oz WP FUZE: M 197

FUZE LOCATION: Nose BODY MATERIAL: Steel

FUZE TYPE: Impact - Direct Arming - Arming Pin - 1.5 to 3.0 seconds delayed action.

FINS REQ'D: Integral, Telescoping, Radial type tail fin attached to tall sleeve.

SAFETY: Release bar held in depressed position when bomb is clustered.

BURNING TIME: 5 to 10 minutes

USED WITH: M 35 Cluster - 57 required

SAFETY HANDLING: See TM 3-400

REMARKS: M 74A1 is Identical to M 74 except M 74A1 has an M 197 fuze instead of the M 142A1, and is used with the M 35 cluster rather than the M 31 cluster.

REFERENCE: TM 3-400

[redacted]



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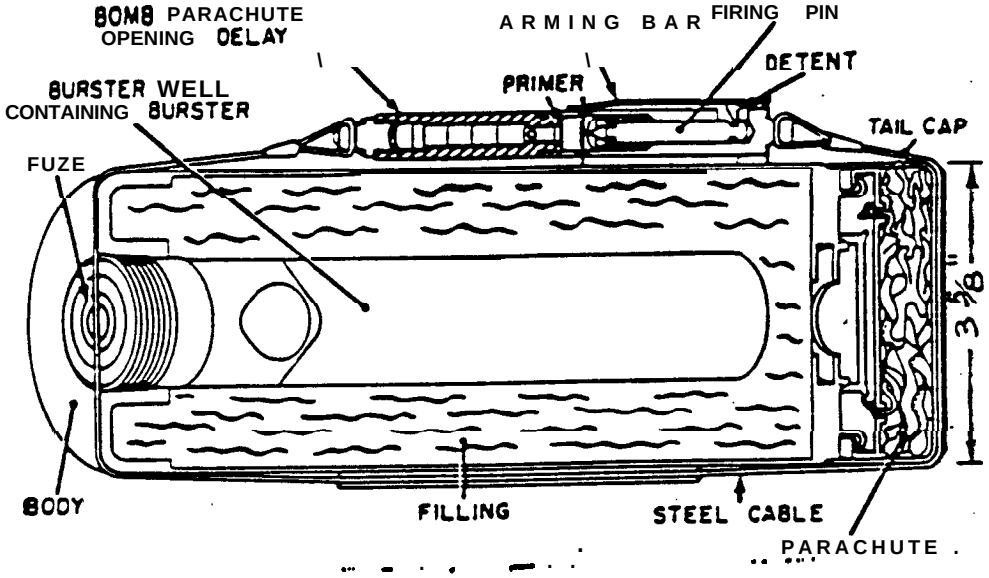


NOMENCLATURE : Bomb, Gas (GB) 10#, M 125A1

TYPE: Bomblet - Air to surface

PURPOSE: Provide toxic chemical offensive capability

STATUS : Std USAF

DESCRIPTION: This is a bomblet type, air to surface munition, used with the M 34A1 *cluster*. The bomb consists of a body, filling, parachute, a parachute opening delay, a burster and fuze. The body is a sheet metal cylinder with a burster well and fuze at the front end and a parachute at the rear. The parachute opens to 14 inches diameter and is operated by a delay tube fastened to the outside of the body. The delay tube is 1/2" diameter x 6-1/4 long and contains a firing mechanism, delay charge, and explosive charge. When released from the cluster, the arming bar springs away from the parachute delay and the firing pin fires the primer. The primer ignites the delay charge which buns for 3 to 7 seconds, then sets off the charge in the parachute delay. The explosion breaks the steel cable, freeing the tail cap and removes restraint *from* the fuze arming ring. The parachute opens and slows the descent of the bomb, This deceleration causes the arming ring to fall from the fuze, arming the fuze. Upon impact the fuze ignites the burster . which explodes the body releasing the filling.

A&A COVERAGE: See M 34A1 Cluster.

BOMB, GAS (GB) 10# M 125A1 (CHARACTERISTICS)

ACTUAL WEIGHT: 8.5# LENGTH: 12" F.E.: 30.6%

WEIGHT FILLER: 2.6# GB BODY DIA: 3-5/8"

BODY MAT'L: Sheet Steel FINS REQ'D: None

FUZE REQ'D: M 196 (Installed in bomb during manufacture)

FUZE LOCATION: Nose

FUZE TYPE: Detonator - Safe impact nose fuze of the direc-arming inertia arming t-ye.

REV. REQ'D TO ARM: None PARACHUTE-OPENING DELAY: M1A1

BURSTER REQ'D: M 31

ARMING DEVICE: Arming ring type restrained by parachute arming aelay

IGNITING CHARGE REQ'D: None

HANDLING SAFETY: See TM 3-400. Never attempt to disarm an armed fuze in this bomb, or to defuse the bomb; a bomb with an armed fuze must be disposed of by bomb disposal personnel.

USED WITH: M 34A1 Cluster

DEVELOPMENT HISTORY: In development was designated E 54R6

REFERENCES: TM 3-400, TM 3-250, TM 9-1980

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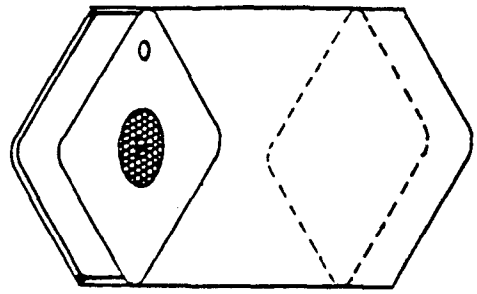

NOMENCLATURE: Bomb, Cube, Toxic, 100# (VX-GB) E 132

TYPE: Self Dispersing - Cube

PURPOSE: Dissemination of Chemical Agents from Aircraft

STATUS: Study complete. Awaiting USAF requirement. Non Std.

DESCRIPTION: A compact munition designed with maximum performance and payload weight per total systems weight, having greatest Area Coverage consistent with the potential of the agent employed. This infers widely dispersed multiple source points, the use of chemical agents of increased toxicity, and an efficient agent dissemination through improved fuzing - burster system.

Can be dropped from Aircraft using Boeing or Hays dispensers which carry 72 bombs. A B47 can carry one dispenser with an agent payload or 5000 lb's or a B52 can carry two dispensers. Self dispersion is accomplished by driving vanes on the cube body to provide spin during flight. The combined translational and rotational motions Induce a lift force which causes the munition to glide from the vertical. The fuze system may be set for Air or Ground burst.

LIMITATIONS: As the optimum burst height may fall at any altituaes less than 100 ft. avove the target, various fuze systems were applicable to various burst-height ranges below that figure. As GB may be used as well as VX it may require different burst-heights and a new fuze or a compromise fuze may be used.

AREA COVEEGE: Based on CWL work it has been estimated that an agent contamination density of 100 $mg/m^2$ will be effective against personnel when VX is used. A mathematical model for aerosol deposition was employed to determine the optimum area coverage at'the "100" level. These calculations indicated optimum area coverage for a single cube to be 113,000 $m^2$ when functioned 400 ft above the target. Meteorological conditions of 60°F air temperature, 8 MPH wind and a neutral temperature gradient were assumed. The weapons systems capabilities of the B 52 loaded with 2 dispensers will cover 4.2 sq miles effectively.

[redacted]

BOMB, TOXIC, 100# (VX-GB) E 132 (CHARACTERISTICS)

LENGTH: . 14" WIDTH: 14" HEIGHT: 13"

LOADED WEIGHT: 125# (Include fuze and burster)

AGENT-'WT: 70# vx or GB F.E.: 56%

AGENT BURSTER RATIO: 7:1 FINS: 1-1/2" Width diagonally opposed

FUZE SYSTEM:' Electric fuze burster which may be air or ground burst. Proximity type fuze. See TR707 Diamond Ord. Lab 28 Oct. 1958

ANTENNA TYPE: Diopole Popout GLIDE ANGLE: 12° from vertical

ROTATIONAL VELOCITY; 900 RPM Approx

HANDLING SAFETY: See TM 3-250, TM 3-400

DEVELOPMENT HISTORY: CMLC project 4-04-15-032-08

REFERENCE : CWL Tech Memo 30-52, TR707 Diamond Ord. Lab TM 3-200, TM 3-400

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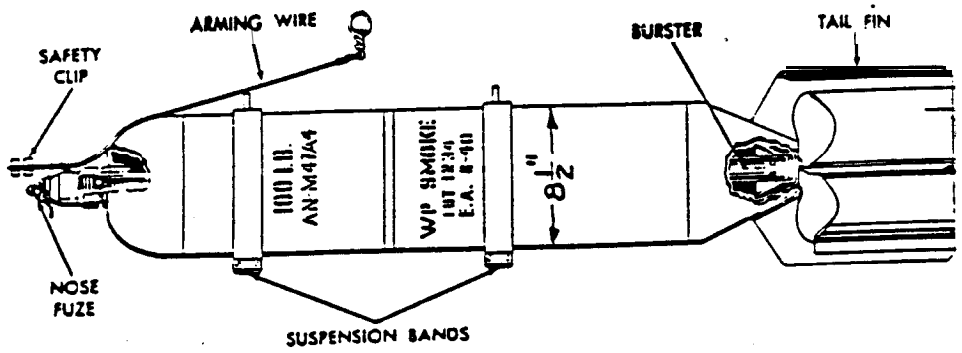


NOMENCLATURE: Bomb, Smoke, PWP of WP, 100# AN-M 47A4

TYPE: Massive - Fixed Pin Stabilized

PURPOSE: Produce casualties, provide spotting and screening smoke.

STATUS Std USA and USN 18490.in Navy stock as of 31 Dec 1960

DESCRIPTION: This bomb is fin stabilized and designed for WP or PWP. The body is cylindrical with a rounded nose and truncated conical tail section with a fixed fin. The major components are the bomb body, fins, filling chemical, burster, fuze, and arming wire. The bomb is essentially the same as the M 47A3 except for filling, burster and suspension lugs which are of heavier construction on the M 47A4. The body is sheet steel with a metal bursting tube extending the full length of the bomb. A threaded hole in the nose of the bomb receives the fuze. Two suspension bands with lugs at the top are clamped around the body with screws. A four vane tall fin is welded to the tail section. The filling chemical is WP or PWP used for spotting, screening, and anti-personnel effects. Bomb will penetrate about four inches of reinforced concrete.

AREA COVERAGE: On impact the filling of one bomb is scattered over an area of about 20 to 30 yards in diameter.

BOMB, SMOKE, PWP or WP 100# AN-M 47A4 (CHARACTERISTICS)

LOADED WEIGHT: 105# PWP, 131# WP F.E.: PWP - 70.5%

FILLER-WT: 74# PWP, 100# WP F.E.: WP - 76.35%

LENGTH 52.9/16".

BODY MAT'L: Steel DRWG: 82-0-80

FUZE REQ'D: AN-M 159 Preferred, AN-M 126A1 is alternate.

FUZE TYPE: AN-M 159 direct-arming, arming-vane type, detonator-safe impact nose fuze. Instantaneous action. AN-M 126A1 direct arming, arming-vane type, impact (all ways) nose fuze. instantaneous action.

REV. REQ'D TO ARM: 400 to 500 for AN-M 159, 325 for AN-M 126A1

FINS REQ'D: 4 vane, welded to tail section during manufacture.

BURSTER REQ'D: AN-M 20 in PWP bomb, M 18 inWP bomb. See remarks.

ARMING WIRE: C5 type A IGNITING CHARGE: None

HANDLING AND SAFETY: TM 3-400 SUSPENSION: 2 Lug 14"

REMARKS: LFB#14 states that M4 burster should be used for WP when bombing from high altitude; the M18 for WP when used in low altitude bombing.

REFERENCES: TM 3-400, TM 3-250, TM 9-1980 and Landing Force Bull. #14. OP 2216

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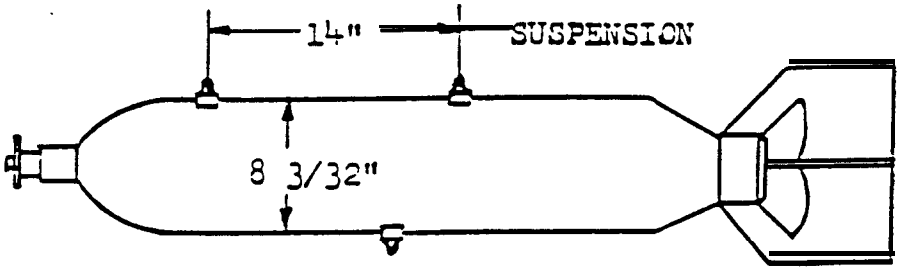



NOMENCLATURE: Bomb, Gas, 115#, (HD), M 70A1

TYPE: Massive - Central Burst - Fin Stabilized

PURPOSE: Provide toxic chemical offensive capability

STATUS: Std USA and USN. Stocks are classified "Secret"

DESCRIPTION: This is a central burst, fin stabilized bomb cylindrical in shape with an ogival nose and truncated conical tail section. The complete bomb consists of a steel body, filling agent, tail fin assembly, burster, nose fuze and arming wire. A tubular burster extends the length of the bomb from a threaded hole in the nose to the tail. A fuze well adapter is screwed into the opening of the burster. Two suspension lugs are 14" apart. Filling of the bomb is 60# of HD.

Can be used with propeller driven aircraft such as AD4, AD5, AD7, JD1, and P2V when equipped with 14" suspension racks such as MK51 and aero 14A. Used primarily for anti-personnel effects. When the bomb is released the fuze arms after a certain number of revolutions. Upon impact the fuze functions to ignite the burster charge which explodes the bomb releasing the agent.

LIMITATIONS: Lack of low drag configurations discourages use with Jet aircraft. M 103A1 fin assembly is restricted to 300 knots.

AREA COVERAGE: See ACC report "Test of 125#T1 Chemical Bomb and Ordnance Report on Project #3580." Coverage estimates are given in TACWIF parts 1 and 2 (9th and final report) dated 4/29/46.

[redacted]



[redacted]

BOMB, G A S . 115#, (HD), M70A1 (CHARACTERISTICS)

ACTUAL WEIGHT: 128# WEIGHT-FILLER: HD - 60# F.B.: 46.87%

BODY MAT'L: Steel DRWGS: 82-0-83, D 14-5-1187

FINS REQ'D: M 102, M 102A1 or AN-M 103A1

FUZZ REQ'D: AN-M 158 Preferred; M 110A1 Authorized Alternate.

FUZZ LOCATION: Nose SUSPENSION: 2 Lug - 14 inch

FUZE TYPE: Vane arming, impact functioning, instantaneous

REV. REQ'D TO ARM: 325 for AX-X 110A1, 375 to 500 for AN-M 158

BURSTER REQ'D: id 10 OVERALL LENGTH: 51-1/2"

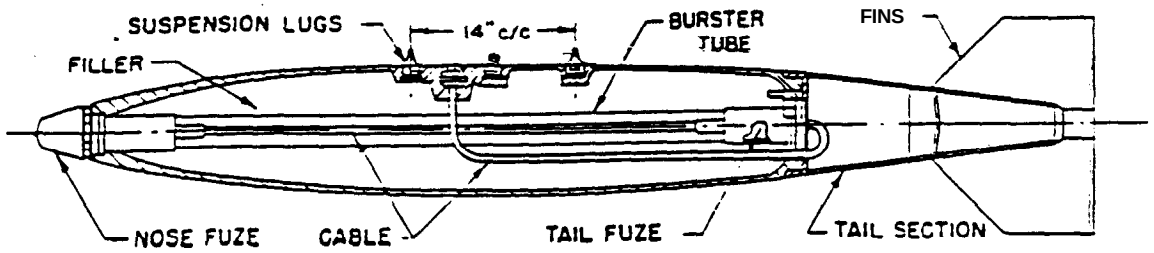
ADAPTER BOOSTER REQ'D: M 10 - 230 grams Tetrgl

ARMING WIRE: One M2 Type D IGNITING CHARGE REQ'D: None

HANDLING AND SAFETY: See TM 3-400, TM 3-250

NOTE: t gage fins prohibited on Jet aircraft but are considered satisfactory for Navy use when used with AN-X 103A1 fin assembly and fin lock nut Ml. (see letter of 1/6/55 from Re3c to Pld via Re3, ReXa) (Summary of low usage bombs). The M 70A1 is identical with the M 70 except that HD is used instead of H and the M 70A1 has an interior phenolic varnish coating.

REFERENCES: TX 3-250, TM 3-400, TM 9-1980, TACWIF Part 1 and 2 dated 4/29/46, 0? 2216




NOMENCLATURE: Bomb, Toxic, 500# (VX-GB) EX38

TYPE: Massive - Dow Drag - Fin Stabilized

PURPOSE: Provide Toxic Chemical Offensive Capability by Aircraft

STATUS: Held up pending Navy Decision.

DESCRIPTION: Suitable for carriage and release from current and future high speed, carrier based Navy Aircraft. This bomb is a low drag design of ballistic stability and aimability with accomodations for standard fuzing of impact, VT and electrical fuzes. Meets design requirements for airborne stores, and is compatible with existing handling and transport equipment, as well as military safety and storage.. The system can be set tc air burst at 20 to 60 ft. altitude or 100 to 160 ft. altitudes. Functions under release conditions of 200 knots to mach 1.3, and 1500 to 60,000 ft. altitude, at spin rates to 1800 RPM's. Can be used with Aero 7A and Aero 20A bomb racks and the Aero 3A fuze charging system.

LIMITATIONS: GB being a volatile agent is best disseminates by ground or low air bursts. VX being non-volatile is best disseminated at relatively high air bursts. Since burst height influences agent dispersion pattern, VX predictions are that a burst height in excess of 100 ft. will be required for optimum dispersion of an agent payload of approximately 310 lbs. A lengthy and costly R & D program would have to be established to parallel bomb development. This does not appear justified, in the light of the advantages mentioned.

AREA COVERAGE: (GB) On one test with GB a lethal dosage of 70 Mg-Min/m3 extended over an area of 5050 sq meters in 30 seconds and 132,000 sq meters in about 20 minutes. An incapacitating dosage of 35 Mg-Min/m3 covered 5600 sq meters in 30 seconds and 288,000 sq meters in 20 minutes. With VX the casualty producing area is estimated to be that area covered with a ground contamination of 0.1, g/m3. From mathematical models, itwas determined that a 050 ft. burst height would net 295,000 m as an optimum area having a ground contamination of 0.1 g/m2 or greater. This does not represent the actual capability as the fuzing system will limit the burst height to 160 ft. For this hypothetical case, the EX-38 bomb could cover an'area of 43,000 sq meters at 0.1 g/m2 le

[redacted]

AREA COVERAGE (Cont.): (VX) The VX agent capability of a single EX-38 bomb has been estimated at 137,000 $m^2$. This is based on a ground contamination density of at least 100 Mg-Min/$m^2$ and the design burst height of the VT fuze i.e. 165 ft. The GB agent capability was 132,000 $m^2$ for lethal effects and 286,000 $m^2$ for incapacitating effects. For these estimates, total dosage was assumed with effective dosage levels being respectively 70 and 35 Mg-Min/$m^3$.

BOMB, TOXIC, 500# (VX-GB) EX-38 (CHARACTERISTICS)

MAX DIA: 14"0 LENGTH: 120"0 F.E.: 61% approx.

AGENT: VX (GB Alternate) AGENT WT: 310# estimated

FIRED WT: 514# approx. EMPTY WT: 164#

AGENT DISSEMINATION: Explosive Burster - Ground or air burst

ELECTRICAL FUZE SYSTEM: M913 (T768) NOSE FUZE: VT - M20

TAIL FUZE: M 990 Electric SUSPENSION: 2 lug (14")

MECHANICAL FUZE SYSTEM: M 904 nose and M 905 tail

FINS: Attached to tail section

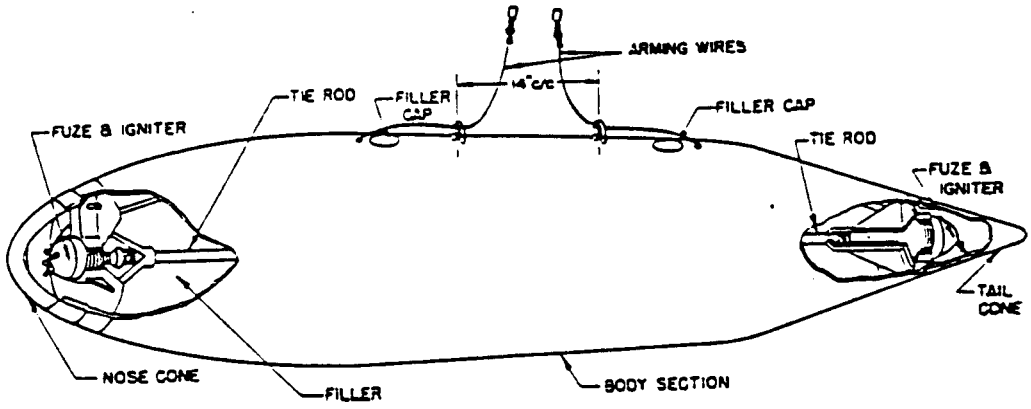
BODY MATERIAL: 0"103 thickness. aluminum ~~DRWG~~: CWLR-314-5-3370

USED WITH: FJ4B, A3D, A4D, and A2F are being considered as carriers of this bomb.

HANDLING SAFETY: See TM 3-250

REMARKS: May replace MK94 if satisfactory.

REFERENCES: CWL Tech Memo 30-45, TM 3-250, TM 3-400, OP 1280.




NOMENCLATURE : Bomb, Fire (NP) 500# MK 77 Mod 1

TYPE: Massive - Nonstabilized

PURPOSE : Use against dug-in troops, supply installations wooden structures and convoys at low level horizontal flight

STATUS : Std USN. 4344 in Navy stock as of 31 Des 1960

DESCRIPTION: This is a non-stabilized, cigar shaped steel or aluminum bomb used for incendiary purposes. It consists of three main sections and two end cones. A center tie rod holds the nose, center, and aft sections together. Aluminum ring adapters secure the nose and tail cones to the main sections. The filling is 75 gallons of gasoline gel, two **igniters** and fuze combinations ignite the fuel on impact. Tubes carry the arming wires from outside the bomb to the inside. Bomb is released at low levels for max effect. Release at high altitudes causes bomb to dig crater which **traps** gel, preventing it from spreading. All bombs not expended must be jettisoned prior to landing afloat or ashore. Max speed limited to 475 K Ias or A43 a-- and max of 2.5 G's.

AREA COVERAGE: Four unstabilized bombs dropped from F9F-5 at 100' altitude, 300/340 KIAS covered an average of 589 sq yds. Three bombs stabilized with MK 19 Mod 0 conversion kit, dropped from same aircraft, same altitude and 330/350 KIAS covered an average of 734 sq yds. "Coverage" means area in which 75-100% of gel is burned. ACC letter report RS 1176 dated 12 Nov 1952 states 2 bombs modified to 75 gal capacity covered an average of 2926 sq yds when released singly, and 4 bombs dropped in pairs averaged 3313 sq yds. See NAOTS Report #19

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BOMB, 500# FIRE, MK 77 MOD 1 (CHARACTERISTICS)

BUORD DWG. NO.: 1380243 ACTUAL WEIGHT: 520# full, 63# empty

WEIGHT OF FILLER: 450# (75 gal. gas gel) F.E.: 87% approx.

FINS REQ'D: none . BODY MATERIAL: aluminum - steel

FUZE REQ'D: M 173 with igniter M 23 (nose & tail), M 157 with igniter M 15 or M 16 (nose or tail)

OVERALL LENGTH: 108"6 MAX DIA: 18"73

FUZE TYPE: M 157 with igniter M 16 (tail only) two fuzes required. Vane arming. Impact functioning (all ways) instantaneous action, nose or tail. 20 rev. to arm.

ARMING WIRES:, Double (two required) ~~SUSPENSION~~: 2 lug - 14"

HANDLING SAFETY: Handling and storage of napalm thickener see OP 2183. For safety procedures, in handling Igniters and fuzes, see OP 988.

REMARKS: 500# low drag bomb intended as replacement for this bomb was canceled.

DEVELOPMENT HISTORY: USMC had 2 requirement for a bomb usable on the 500# rack. MK 77 Mod 0 was modified to 75 gal. capacity by shbrtening the center nose & tail sections.

REFERENCES: OP 1280, OP 2183, OP 988, OP 2216,
Navord Inst 08150.6 dated 13 Apr 1954
Maots Report #19 dated April 1953
Aircraft Armaments Bulletin 161 Feb 1954
PTP-AV-31002 Report 1 final Sept 1959

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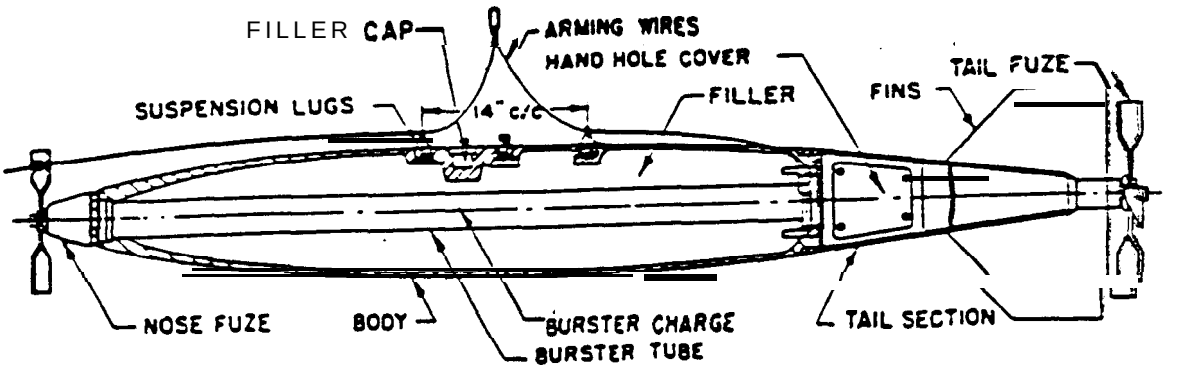


NOMENCLATURE: Eomb, Toxi(NP), 500#, (GB) MK 94 MOD 0

TYPE: Massive - Low Drag - Central Burst - Fin Stabilized

PURPOSE: Provide Toxic Chemical Offensive Capability

STATUS: Std. USN. Stock is classified "Secret"

DESCRIPTION: This bomb is essentially a MK 82 GP fin stabilized, low drag bomb which has been modified for GE filling. Its primary use is for anti-personnel effects. The body is steel with a pointed nose. Can be fused for impact or air burst. The fuzes are located in the nose and tail. A conical type fin is attached to the tail by screws. A burster tube extends the length of the body cavity. Adapter boosters are used with the mechanical fuzes. Two suspension lugs are spaced 14" apart, with a hoisting lug located on the center of gravity. A hand-hole cover is provided in the tail section to reach the tail fuze and arming wires in the fin.

The major components of the bomb are body section, fin assembly, arming wire, nose fuze, long stem tail fuze, burster tube with charge, suspension and hoisting lugs.

LIMITATIONS: NAVORDINST 8024.25 restricts use of externally carried stores with arming wires to 475 knots IAS.

AREA COVERAGE: Precise coverage depends on the specific mission and metecrological conditions. Dynamic functioning of 8 bombs at DPG to determine dissemination efficiency indicated that lethal dosages (100 Mg-Min/M$^3$) for 15 and 30 second intervals averaged 3814 and 6836 sq yds respectively. The diameter of the gas cloud formed 10 to 30 seconds after the burst is about 40 to 70 meters in open terrain and 25 to 45 in wooded terrain. See DPGR-207 for more data.

[redacted]

BOMB, TOXIC, (NP), (GB), 500#, MK 94 MOD 0 (CHARACTERISTICS)

LENGTH: 88.79 with fuze MAX DIA:

AVERAGE FILLED WEIGHT: 441# BUORD DWG. NO.: 1380220

WEIGHT-AGGJT: 108# GB BODY MAT'L: Steel F.E.: 24.5%

FINS REQ'D: Integral with tail cone (DWG. No. 1380549)

FUZES REQ'D: AN-M 103A1 Nose; M 195 Tail for impact, or M 166E1 nose and M 195 tail for air burst.

BURSTER: (Drwg 1380977) 16.1# wt Burster and Explosive

AGENT/EXPLOSIVE RATIO: 8:1 ADAPTER BOOSTER: M 115A1

ARMING WIRE TYPE: Two M6A2 SUSPENSION: 2 lug - 14"

HANDLING SAFETY: See TM 3-250, TM 3-400 and OP 1280

DEVELOPMENT HISTORY: Developed by CMLC July 1953 and released to production January 1958. Was designated EX23 by Navy and E110 by ACC during development

REFERENCES: NAVORD INST 8024.25, DPGR-207, TM 3-250, NAOTS Report No. 2-58-OP, 1280, OP 2216, TM 3-400, BUAER CONF. MSG. 102134Z (April 1958) to COMNAVAIRLANT and COMNAVAIRPAC.

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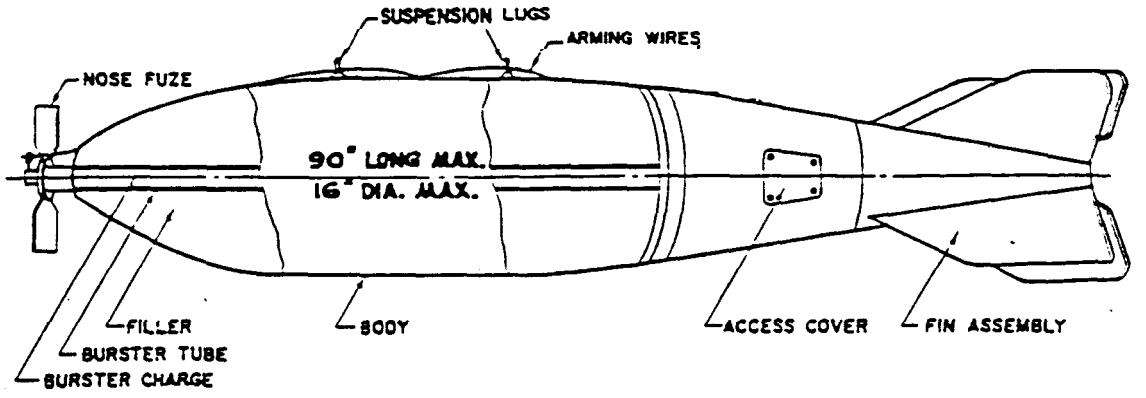


NOMENCLATURE: Bomb, Toxic (NP) 750# (GB) MC-1

TYPE: Massive - Low Drag - Fin Stabilized

PURPOSE: To provide toxic chemical offensive capability

STATUS: Std. USAF

DESCRIPTION: The MC-1 bcnb is essentially a M117-GP demolition bomb modified for a liquid chemical filler and burster, The complete bomb consists of the body, fin assembly, one arming wire, three suspension lugs, a nose fuze, adapter boosters, burster, filling agent, and a tail fuze whichincludes a tail fuze drive with a flex coupling which connects the drive to the tail fuze. The bomb body is round in cross section with an ogival nose and truncated conical tail.

A burster tube is welded to the body at the nose end and into a hole in the base plate at the rear. The burster tube is internally threaded at each end and is fitted with fuze wells. The burster is a tubular fiberboard container filled with composition B and closed by metal end caps. It is installed in the burster tube when the boinb is assembled. For use with one or two lug suspension on current USAF bomber and fighter-bomber type aircraft. Designed for internal or external carriage on aircraft with release speeds to 600 knots IAS, and altitudes to 60,000 feet or low altitude bomblng systems.

AREA COVERAGE: Dosages equal to or greater than 5 Mg-Min/m$^3$ were detected for 20 to 30 hours on each trial. Dosages equal to or greater than 100 Mg-Min/m$^3$ were recorded outside of one bunker for eleven hours, and dosages equal to or greater than 25 Mg-Min/m$^3$ were recorded inside the bunker for eleven hours. Dosages of equal to or greater than 5 Mg-Min/m$^3$ can be expected at least one mile downwind when bomb Is functional under strong inverse conditions.

It is predicted that significant dosages will be found 30 to 40 miles downwind when 27 MC-1 bombs (B52 load) are functional under strong inverse conditions with temperatures

[redacted]

AREA COVERAGE (Cont.) : greater than 50°F. Troops occupying fortifications in the immediate vicinity of bursting MC-1 bombs will be subjected not only to the hazard of the initial vapor cloud, but also to the residual vapor following which may remain in the vicinity for three days.

BOMB, TOXIC, GB, 750# MC-1 (CHARACTERISTICS)

WEIGHT 710# MAX. DL4: 16" LENGTH : 90"

WEIGHT FILLER: 220# (24 gal) GB F.E.: 30.9%

FIN ASSEMBLY : M 131 ('I' 152E2). Suspension lugs shipped With fin.

SUSPENSION: Single or double lug 14" CHEM. CORPS DRWG: 14-5-2735

ADAPTER BOOSTER REQ'D: T 45E1 nose; T 64E4 tail

BURSTER: 14 1/2# Comp. B. AGENT/BURSTER RATIO: 15:1

FUZES REQ'D: T 709E3 (M 904) nose; T 771E4 (M 905) tail, with T 25E6 tail fuze drive assembly and T 40 flexible coupling.

ARMING WIRE : T 10 (type E, 2 branch).

HANDLING SAFETY : TM 3-400-2 and TM 3-250. Rough handling and storage test at dugway proving grounds indicate that this bomb is satisfactory for normal military handling, shipping and storage.

REMARKS : This bomb replaces the M 78 *and* M 79 Gas Bombs only. For external carriage, use of arming wires restricts bomb to speed of 450 knots IAS. See EUAER Message 1021342 April 1958.

DEVELOPMENT HISTORY: Developed for USAF under R & D contract With A. O. Smith co. MC-1 bomb is a modification of the M 117 Ordnance bomb.

REFERENCES: DPGR #219 June 1958, TB 3-400-2, *TM* 9-1980, TM 3-250, and AFR 80-14

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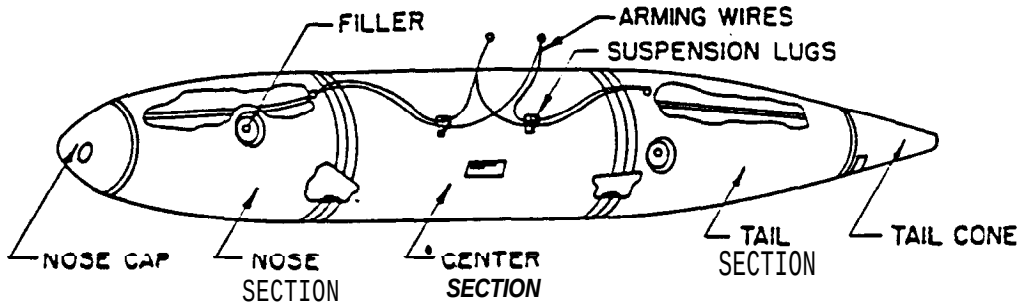



NOMENCLATURE: Bomb, Fire, 750#(NP), M 116A2

TYPE: Massive - Explosive Ejection - Low Drag

PURPOSE: Use against dug-in troops, supply installations, wooden structures and land convoys.

STATUS: Ltd Std USAF

DESCRIPTION: This bomb is especially designed for use on F 100 type aircraft from which it is forcefully ejected by two explosion activated pistons. It is identical with the M 116A1 bomb except that the two annular aluminum bulkheads in the center section have been strengthened by two "C" shaped reinforcements of 5/16" aluminum bolted to each bulkhead beneath the suspension lugs. The reinforcements provide rigidity to with-stand the explosive ejection. The tail section body is truncated conical in shape.

The major components of the bomb are aluminum nose, center and tail sections, with a nose cap and a tail cone os steel. The center section is cylindrical in shape and is braced by two bulkheads which are connected by an aluminum beam. There are two suspension lugs spaced 14" apart. Two internal arming wires are used, one holds the nose cap and tail cone in place. One fuze with igniter is used in both the nose and the tail. The bomb is filled with 100# of thickened fuel and used for incendiary and anti-personnel effects.

AREA COVERAGE: It is estimated that one bomb released from an altitude of 100 ft at a speed of 300 to 350 knots IAS would cover an ellipse area of 20 by 100 yards, and the average duration of the fireball would be approx. six seconds,, For more detailed information see A?G-TAB 47 Test of M 116A1 Fire bomb.

BOMB, FIRS, (NP), 750# M 116A2 (CHARACTERISTICS)

ACTUAL WEIGHT: 685# full: 70# empty F.E.: 89.8%

WEIGHT FILLER: 100 gallons (615#) of NP

FINS REQ'D: none SUSPENSION: 2 lug 14"

FUZZ REQ'D: One M 173 or AN-M 173A1 bomb igniter fuze in each igniter.

IGNITERS REQ'D: One M 23 or AN-M 23A1 WP igniter in each igniter cup (One nose, One tail).

FUZE TYPE: Direct-arming, arming-vane type, nose or tail, impact (all-ways), instantaneous functioning. M 173 and AN-M 173A1 are identical except that the latter has large diameter threads on the fuze head and is used with the AN-M 23A1 igniter.

REV. REQ'D. TO ARM: 20 ARMING WIRES: Two-M 17 Type E

CENTER SECTION: Dia 18-5/8" X 48-5/8" long

NOSE SECTION: Dia 18-1/2" X 32-1/2" long

TAIL SECTION: Dia 18-9/16" X 39-1/4" long

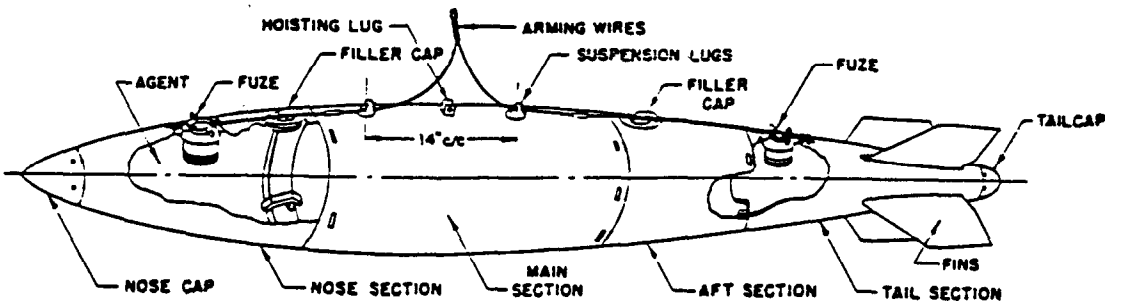
OVERALL LENGTH: 137"

REMARKS: Safe release speed without ejection 450-500 knots

USED WITH: F 100D, F 100F, F 84 and F 86

HANDLING AND SAFETY: See TM 3-400-9

REFERENCES: TM 3-400, TM 3-366, APG-TAB-47, TB 3-400-9




NOMENCLATURE: Bomb, Fire, 1000#, (NP) Mk 79 Mod 1

TYPE: Massive - Low Drag - Fin Stabilized - Collapsible

PURPOSE: Use against dug-in troops, supply installations, wooden structures and land convoys.

STATUS: Std USN. 1444 on hand 30 Dec 1960

DESCRIPTION: This is a low drag, fin stabilized, collapsible bomb which was originally designed for mechanical fuzes, but provisions have been made for electrical fuzes also. It consists of four basic sections; nose, main, aft, and tail which telescope together. The first three sections are steel, and the tail section being a void space is aluminum. Fuel-resistant gaskets seal the joints between all sections, Detachable aluminum fins are installed on the tail for stability in flight. Nose and tail caps are also provided.

Two screw-in suspension lugs are provided in the main section 14" apart. A hoisting-lug is-located midway between the suspension lugs.

AREA COVERAGE: When dropped from 3500 to 4300 ft. altitude at 270 to 290 knots IAS with 50 to 60 degree angle dive the following patterns were found:

LENGTH: Min. 60 yds, Max. 100 yds, Average 74 yds.
WIDTH: Min; 20 yds, Max. 47 yds, Average 35 yds.
AREA: Min. 875 sq yds, Max. 2750 sq yds, Average 1834 sq yds. Greater area coverage was obtained when dropped from higher altitudes.

[redacted]

BOMB, FIRE, 1000#, (NP) MK 79 MOD 1 (CHARACTERISTICS)

WEIGHT EMPTY: 212# WEIGHT FULL: 912# F.E.: 76.7%

WEIGHT-FILLER: 700# (112 gal.) Gas - NP Mix - 5% void

LENGTH: " MAX : 19"6 at Fins

FINS REQ'D: Detachable aluminum fins installed on tail section.

FUZES REQ'D: Mechanical, M 173 fuzes with M 23 igniters in two places, or electrical, XB66C with M 20 nose element for air burst.

FUZE TYPE: M 173 is vane-arming, impact functioning (all-ways) instantaneous action. nose or tail fuze, 20 revolutions required to arm. XB66C is electric fuze actuated by impact or M 20 (VT) nose fuze.

ARMING WIRES : Mk 2 type D double DRWG NO: 1884353 and LD 517551

GROUND BURNING TIME: 11 sec. average

SUSPENSION: 14" 2 lug BODY MATERIAL: Aluminum and Steel

HANDLING AND SAFETY : Once the telescoping sections of the bomb are assembled they cannot be disassembled. When bomb is filled, it must be used or jettisoned as landing afloat or ashore is prohibited. Restricted by NAVORDINST 8024.25 when carried externally and equipped with VT fuze unless auxiliary safety device and arming delay are used and then restricted to 400 knots IAS. Arming wires restricted to 450 knots IAS.

REMARKS: This bomb will replace all 750# Navy Fire bombs.

REFERENCES: OP 1280, OP 2183, OP 2216, Aircraft Armaments Bull. 161, NAVORDINST 8024.25, BUAER Message 102134-Z April 1958.

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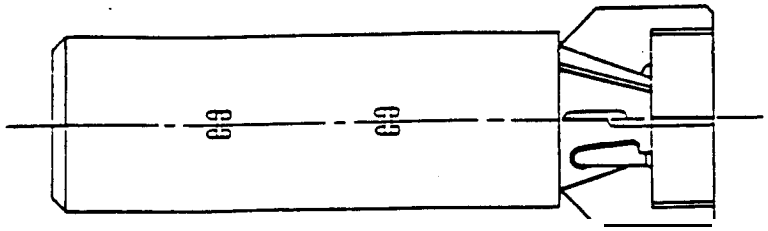


NOMENCLATURE: Cluster, BW, Bomblet , 500# M 33

TYPE: BW - Bomblet Carrying - Air to Surface

PURPOSE: Tc provide biological offensive capability

STATUS: Ltd Std USAF

DESCRIPTION: The 500 lb cluster adapter M 26 is designed to contain 108 BW bomblets M 114, forming the M 33 cluster, The fin is prepared by securing a 38 inch length of primacord to one fuze adapter, circling the primacord around a light sheet metal disc in the center of the fin cone and securing the other end to the opposite fuze adapter.

Upon functioning of either tail fuze, the primacord is detonated, driving firing pins into the three cartridges whose blast flatter.s the small split nut retaining spider allowing its prongs to open and release the cluster from the casing. As the pressure increases against the end of the cluster, it is ejected froa the casing. Once out of the casing, the four buckles unfold to allow the air to separate the bomblets.

LIMITATIONS: Current bcnber aircraft are not equipped to deliver the M 33 cluster. The M 33 cluster has no means for maintaining temperature control within the cluster. The agent fill will freeze upon storage at freezing temperatures and will deteriorate in storage at room temperature or higher.

[redacted]

CLUSTER, BW BOMBLET, 500# M 33

AREA COVERAGE:

Agent Coverage: Area coverage is dependent upon the agent, local meteorological conditions, and release altitude.

Impfact Pattern: Clusters have been released at altitudes from 5,000 ft to 35,000 ft. The ground impact pattern produced by M 114 bonblets from the M 33 clusters is a long, narrow ellipse when released and opened at high altitude. Patterns for low altitude opening are much shorter. Pattern dimensions depend on the height of cluster opening and the cosine of the cluster angle at the instant of opening. With cluster released at 35,000 ft and opening at 30,000 ft a ground pattern about 4,500 ft long and 450 ft in width was obtainea.

CHARACTERISTICS:

DIA: 15" LENGTH: 60-3/8"

WEIGHT 710# (Includes bonblets and fuses)

SUSPENSION: 2 lug BOMBLET CAPACITY: 108 of M 114 bomblets

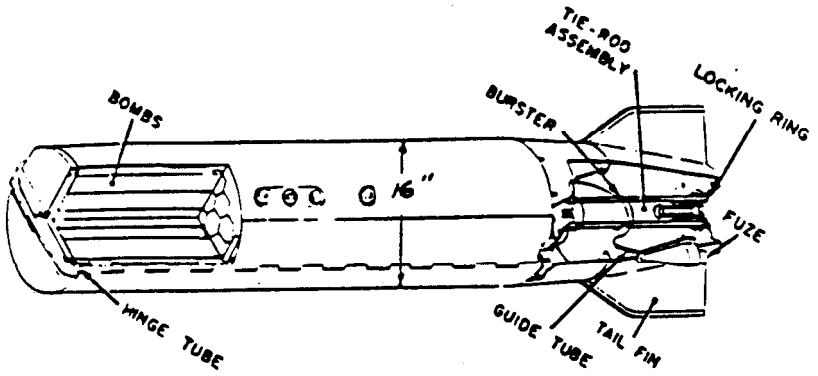
FILLING VOLUME: 3.46 X $10^4$ milliliters FIN: M7

CLUSTER OPENING: 38" Primacord FUZES: Two M 153 in tail

DEVELOPMENT HISTORY: During develcpment this cluster was designated # 9oR3.

HANDLING SAFETY: One M 33 cluster was dropped intact from an aircraft, penetrated the ground without functioning of the fuzes or bonbiets, thus demonstrating the safe jettisoning and handling characteristics.

REFERENCES: Ft. Detrick Tech Study #9 dated June 1958, TN 3-400, Ft. Detrick Spec Report 236 dtd Jan 1956




NOMENCLATURE: Cluster, Incendiary Bomb (PT-1) 750# M jj

TYPE : Fin Stabilized - Bomblet - Air to Surface

PURPOSE: Provide incendiary offensive capability

STATUS: Std USAF

DESCRIPTION: This is an air to surface, fin stabilized cluster used for incendiary and anti-personnel effects. Major components are an M 30 cluster adapter filled with 57 - M 74A1 bombs (bomblets) and fitted with a burster, two fuzes, tie rod, arming wire and fin assy. The bosblets are loaded into the cluster adapter in 3 bundles of 19 bombs each, in such a manner that the release bar of each bomb is depressed by an adjacent bomb.

The burster is 19 feet of detonating cord which is threaded through the hinge tube, explodes the hinges and release the bombs on functioning. When released from the aircraft, the arming wire is pulled, the fuze arming vanes rotate and the fuzes arm. The fuzes function after a preset time which detonates the burster which releases the bomb. Upon impact the individual bomb fuzes function to release the filling. Designed for USAF bomber aircraft. Does not have lowdrag configuration. Can be modified with E 23R1 nose fairing for external stowage.

AREA COVERAGE: Cluster separation at 5,000 feet above the target disperses M 74A1 bombs over a 40,000 sq. yd. area. Separation at 10,000 ft disperses saae bonb over a 90,000 sq. yd. area.

NAVORD RETORT 6954 (FIRST REVISION) [redacted]

CLUSTER, INCENDIARY BOMB (PT-1) 750#, M 35 (CHARACTERISTICS)

ACTUAL WEIGHT: 690# DRWG. NO: D 14-23-3324

WEIGHT-FILLER: 57-M 74A1 Incendiary bonblets 8.5# ea.

BODY MAT'L: Steel (M 30 Cluster adapter with M 14 tail fin).

FUZE REQ'D: Combination mechanical tine and impact tail fuze. Delayed arming, arming vane and pin, adjustable from 7 to 92 seconds, 260 rev. and 4.5 seconds required to arm. (M 152 or AN-M 152A1).

FINS REQ'D: M 14 tail fin LENGTH: 90" DIA: 16'"

BURSTER REQ'D: 19 feet of detonating cord threaded through hinge tubes

IGNITION CHARGE REQ'D: none

ARMING WIRE REQ'D: *One* M 23 type B.

HANDLING AND SAFETY: See TM 3-400

NOTE: E 23R1 could be made available for external stowage

REFERENCES: TM 3-400, TM 9-1980, CMLR 348 May 1954

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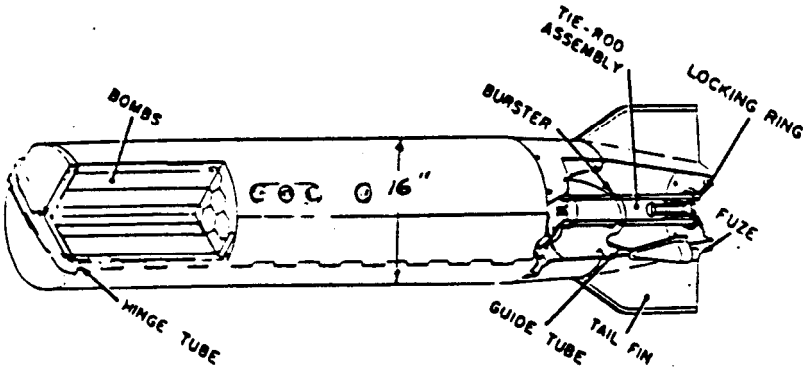


NOMENCLATURE: Cluster, Incendiary Bomb, (TH-3) 750# M 36

TYPE: Fin Stabilized - Bomblet - Air to Surface

PURPOSE: Provide incendiary offensive capability

STATUS. Std USAF

DESCRIPTION: This a fin stabilized. air to surface cluster used for incendiary and anti-personnel effects. Major components are an M 3 0 cluster adapter filled with 182 - M 126 incendiary bombs (bomblets), 2nd fitted with a burster, fin assy, two fuzes, arming wire and a tie rod. The bombs are loaded in the adapter in 3 bundles of 60-61-61 bombs each, and are arranged in such a manner that the safety plunger of each bomb is depressed by the adjacent bomb.

In functioning the cluster is released from the aircraft and the arming wire is pulled, which causes the arming vanes to rotate in the air stream and arm the fuzes. After a preset time, the fuzes function to ignite the burster which breaks the hinges of the cluster, thereby releasing the bombs. Upon impact the fuzes in the individual bombs ignite to release their filling. Designed for use with USAF Bomber aircraft. Does not have low drag configuration. Can be modified with E 23R1 nose fairing for external stowage,

AREA COVERAGE: Separation at 5000 ft above target disperses the M126 bombs over a 20,000 to 30,000 sq. yd. area,

[redacted]

CLUSTER, INCENDIARY BOMB, (TH-3) 750# M 36. (CHARACTERISTICS)

DRWG. NO: E 14-23-3320 ACTUAL WEIGHT: 900#

WEIGHT-FILLER: 'Consists of 182 M 126 incendiary bombs. 3.6# ea.

BODY MAT'L: Steel (M 30 cluster adapter with M 14 tall fin)

FUZE REQ'D: Two M 152 or AN-M 152A1 MT fuzes

FUZE LOCATION: In tail fin LENGTH: 90" DIA: 16"

FUZE TYPE: M 152 is vane and pin arming, time and impact, adjustable 5 to 92 seconds, instantaneous or impact. M 152A1 same as M 152 except improved clockwork mechanism.

REV. REQ'D TO ARM: 260 rev. and 4.5 seconds.

BURSTER REQ'D: 19 ft detonating cord threaded through hinge pin.

ARMING WIRES: M 23 type B (1 required)

IGNITION CHARGE REQ'D: none

HANDLING AND SAFETY: See TM 3-400

NOTES: E 23R1 fairing could be made available for external stowage

REFERENCES: TM 3-400, CMLR 378 dated Jan 1954

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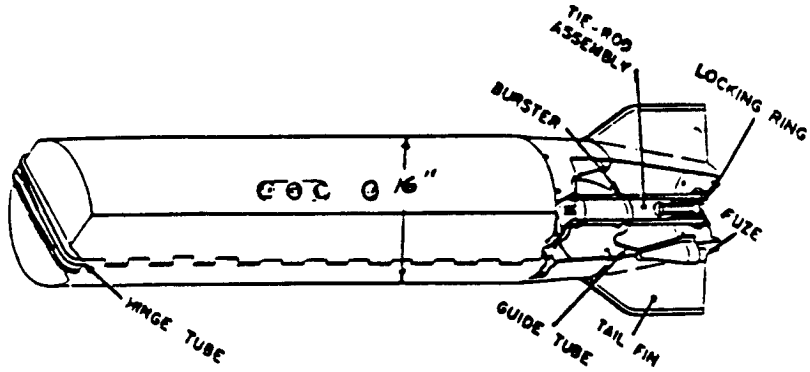


NOMENCLATURE: Cluster, EW Bomblet, 750#, E 133R3

TYPE: Bomblet Loaded - Air to Surface - Fin Stabilized

PURPOSE: To provide biological offensive capability

STATUS: Eng. tests complete. Pending T.C. Non. Std

DESCRIPTION: The E 133R3 consists of one M 30 cluster adapter, its components, and 544 bomblets E 61R4. The munitions function in two stages, as the E 133R3 cluster is released from the aircraft, it falls for a predetermined period until it is separated by an explosive primacord.

The bomblets fall to the target surface and function on impact. The R3 version of the cluster incorporates electric connectors for the electric blanket, and projected electric cluster fuze, with a well for the electric fuze in the cluster tail.

The principal delivery aircraft for this cluster is the B36 and B47. Various models of the E36 can carry 48 clusters while the long bay B47 can carry 21 clusters.

LIMITATIONS: Does not have low drag configuration. Delivery limited to approx 500 knots.

IMPACT PATTERN: Clusters have been dropped at 30,000 and 40,000 ft at 450 knots and set to open at 10,000; 20,000; and 30,000 ft above the terrain. A release at 40,000 ft with true air speed averaging 460 knots, the pattern area averaged 1,149,000 square feet for 15 drops. A release at 30,000 ft with the same air speed, the pattern averaged 1,109,000 square feet. The width of these patterns was slightly over or under 600 feet. Agent effects may extend beyond impact pattern depending upon agent used and local meteorological conditions.

CLUSTER, BW BOMBLET, 750#, E 133R3 (CHARACTERISTICS)

BODY DIA: 16" LENGTH: 90"

LOADED WEIGHT: 985# with bomblets and fuzes

SHIPPING WEIGHT: 1050# CLUSTER ADAPTER: M 30 with M 14 fin

MUNITIONS LOAD: 544 of E 61R4 bomblets a 1.4# each.

FILL VOLUME: 1.9 X $10^4$ Ml.

CLUSTER OPENING: 60 Grain Primacord

FUZES REQ'D: Two M 152 air arming-time delay or electric

FUZE LOCATION: Screwed in M 14 tail

REMARKS: This cluster has the same external configuration as the M 35 and M 36 bomb clusters

HANDLING SAFETY: See TM 3-400. Rough handling and vibration tests failed to explode or arm any of the fuzes., One cluster dropped from 30,000 feet *on to* hard alkaline target surface, with positive indicated that no components burned or exploded; possible contamination confined to a circle 50 ft. in diameter.

REFERENCES: Ft. Detrick Spec. Report 251 dtd Sept 1955
Ft. Detrick Tech Study #9 dated June 1958

NOMENCLATURE: Dispenser, Bomb, 900#, XMC-1

TYPE: Bomblet Loaded - Air to Surface

PURPOSE: Provide BW/CW large area coverage

STATUS: No USAF requirement at present. Non Std

DESCRIPTION: This dispenser is composes of 24 cells, each 15.5 inches square. A single suspension lug at the top of the dispenser above the center of gravity engages the U-2 shackl on the aircraft.

To release the cells, a rotary solenoid is activated allowing a spring to close, disengaging the latches and allowing the cell door and cartons to fall free. Final models will have electric heaters to maintain a constant temperature control.

AREA COVERAGE: (CW) It is estimated that a B-47 with 72 cube bombs (E 152) filled with VX could contaminate an area of 385 hectares with a density of 150 $Mg\text{-}Min/m^2$ when dropped from 20,000 ft. Under the same conditions when filled with GB an area of 384 hectares would be contaminated with a density of 50 $Mg\text{-}Min/m^3$. A B-52 carrying two dispensers should double this coverage. Using a 100 $Mg\text{-}Min/m^2$ density to evaluate the capability of a single dispenser, it is estimated that optimum coverage at this density level, occurs about 30,000 ft. The target level covered with 100 Mg-Min/ or greater, therefore would equal 2.1 sq. miles.

In estimating the GB capability of the single dispenser it is estimated that a 15,000 ft. dispersion height with a net coverage of about 2.1 sq. miles if the criterion for incapacitating effects (35 $Mg\text{-}Min/m^2$) is to be optimized. For max. lethal effects, the criterion of 70 $Mg\text{-}Min/m^2$ would net an optimum coverage equal to 1.1 sq. miles when the bombs are dropped from 10,000 ft.

(BW) Area covered by self dispersing BW bomblets is a function of the bomblet used, height of release, and sequen of release of the individual dispenser cells. The E 120R2 and E 134 bomblet impact patterns are circular, with a diameter of approximately 9/10 the release height. The Flettne bomblets can be designed to give patterns up to 2.8 times the release height in diameter. Release of individual cell in sequence will produce a series of overlapping circular impact patterns. Approximate areas of impact pattern3 for a single release point at 35,000 ft. are as follows:

E 134 or E 120R2 ---------- 28 square miles
Flettner Rotor----------100 square miles

[redacted]

[redacted]

DISPENSER, BOMBLET, 900#, XIX-1 (CHARACTERISTICS)

WIDTH: 57.7" NUMBER OF CELLS: 24

HEIGHT: 46.50" TOTAL SYSTEM WT: 7000 to 10,000#

LENGTH: 129.4"

MUNITION USED: E 120R1, E 120R2, E 132, E 134 and Flettner Bomblets

DISPENSER WEIGHT EMPTY: 910# AGENTS USED: Various BW/CW

FUZZ SYSTEM: One dispersion per cell to initiate package separation after a timed release. The fuze sub system consists of a control group, dispersion unit, and bomb fuze, all connected to the air craft power supply.

CARTON CLOSURE: Fiberglass or steel with timer and opening mechanism.

MUNITION CAPACITY:

| | Per Carton | Per Cell | Per XMC-1 |
|---|---|---|---|
| E 120R1, E 120R2 | 27 | 81 | 1944 |
| E 134 | 64 | 192 | 4600 |
| Flettner (7" lng) | 176 | 176 | 4224 |
| E 132 Cube | 1 | 3 | 72 |

LIMITATIONS: Hot approved for use at low altitudes

HISTORY: CMLC-R & D project 4-04-15-032-08 jointly conducted by Army Chemical Corps and USAF.

USED WITH: B-47 one dispenser, B-j2 two dispensers

REMARKS: Material for construction of dispenser has not been determined.

REFERENCES: Ft. Detrick Tech Study #9 dated June 1958, CWL Tech Memo 30-52, TM 3-400, Ft. Detrick Spec Tech Report BWL.24 dtd June 1959.

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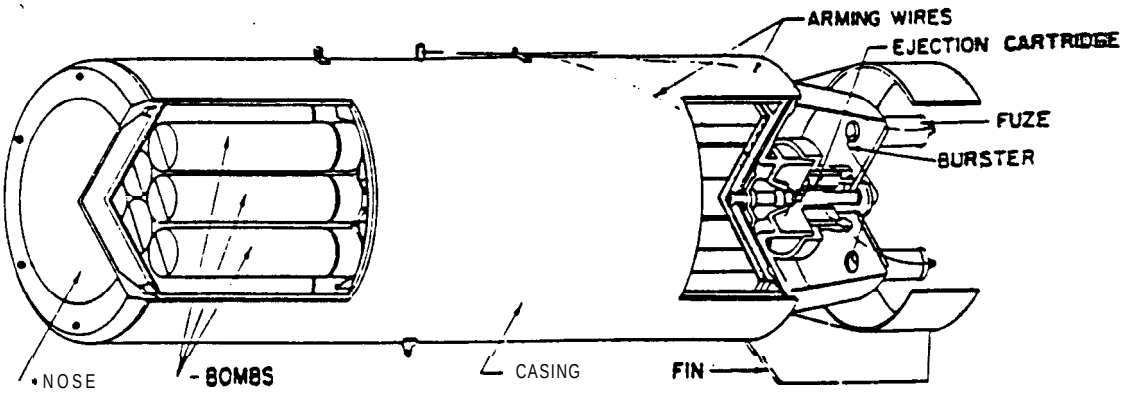


NOMENCLATURE: Cluster, Gas Bomb, (GB) 1000# M 34A1

TYPE: Fin Stabilized - Air to Surface - Bomblet Loaded

PURPOSE: Provide Toxic chemical offensive capability

STATUS: Std USAF.

DESCRIPTION: This is a fin stabilized, air to surface cluster loaded with 76 - M 125A1 bombs (bomblets) and used for anti-personnel effects. The major components are a M 29 adapter, bombs, arming wire, *striker*, 2 fuzes, burster, fin assy, and 4 cluster ejection cartridges. The bombs are loaded into the adapter in 4 bundles of 19 each and are arranged in such a manner that the arming bar of each bomb is depressed by the adjacent bomb. The tail fin and burster are parts of the M 29 adapter ass-y.

*When* released from the aircraft the arming wire is withdrawn, the fuze arming vanes rotate in the airstream and the fuzes arm. After a preset time the fuzes function and detonate the burster, which in turn sets off the ignition cartridges which release the bombs. upon impact the individual bomb fuzes function to release the chemical agent. Designed for use with USAF bomber aircraft.

AREA COVERAGE: Precise coverage is a function of temperature and meteorological conditions. Cluster separation at 5000 f disperses M 125A1 bomblets approximately 24,000 square yards The mean area effectiveness for two tests are as follows: (For one bomb cluster only)

(a) Terrain - open, Temperature - 40 to 85°F, Wind - 5 to 10 MPH, Temperature Gradient - Inversion thru Lapse. MAE in Sq. Meters: In 15sec = 3900, in 30 sec = 15,600

(b) Terrain - wooded, Teaperature - 40 to 80 °F, Wind - 0 to 15 MPH, Temperature Gradient - Inversion thru Lapse, MAE in Sq. Meters: For 15 sec = 4,000 for 30 sec = 16,000.

CLUSTER, GAS BOMB, (GB) 1000# M 34A1 (CHARACTERISTICS)

WEIGHT: 1130# OVERALL LENGTH: 685'5 DIA: 19-1/8"

WEIGHT-FILLER: 76 M 125A1 bomblets at 8-1/2# each (2.6# of GB in each).

BODY MAT'L: Steel ARMING WIRES: One M 22 Type B

CLUSTER ADAPTER: M 29 IGMITION CARTRIDGE: *None*

CLUSTER EJECTION CARTRIDGES: 4-M3

FUZE TYPE: M 152 or M 15A1 are mechanical time and impact tail fuzes with arming vane and pin. No nose fuze req'd.

REV. REQ'D TO ARM: 260 revolutions and 4.5 seconds, adjustable 5 to 9.2 seconds, instantaneous or impact.

FINS REQ'D: M 13 tail fin (Component of cluster adapter). M 129 fin required for external stowage.

BURSTER REQ'D: Component of M 29 cluster adapter (In tail fin).

HANDLING-SAFETY: See TM 3-400

DEVELOPMENT HISTORY: In development was designated E 101R3

REFERENCES: TM 9-1980, TM 3-400



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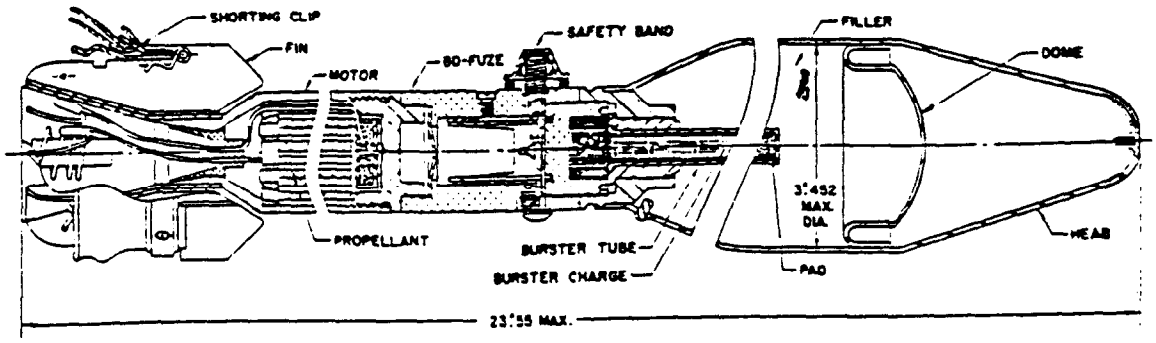


NOMENCLATURE: Rocket, Ground, 3.5, Smoke (WP) M 30

TYPE: Fixed Pin - Surface to Surface - Central Burst

PURPOSE: Produce casualties; provide spotting, screening; and incendiary effects.

STATUS: Ltd Std USA; Std USAF - USMC. 688,060 in USMC stock as of Dec 1960

DESCRIPTION: This is a fixed fin surface to surface rocket loaded with WP and used for spotting, screening, limited incendiary, and anti-personnel effects. The major components are motor assembly, head assembly, BD fuze, burster, motor propellant and WP filler. Its external contour is similar to the HEAT rocket.

At the rear the heed has a union that is internally threaded to receive the fuze. The burster casing is 2 press fit into the forward end of the union and the steel body is fitted over It. The ogive, and the steel dome which closes the front end of the filler cavity are a part of the body assembly. The fixed fins are a part of the motor assembly. Used with 3.5 launchers M 20, M 25 or M 30.

AREA COVERAGE: Assuming an 8 MPH wind, 60% FF, neutral temperature gradient and temperature avove 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the are2 until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example if the required curtain is established in 1 min. with 30 rounds, then approx 15 rds/min. should maintain the Curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radius for anti-personnel effect is about 10 to 15 yds for a single M 30 rocket. See FM 3-5 for other conditions.

[redacted]

ROCKET, GROUND, 3".5, SMOKE (WP) M 30 (CHARACTERISTICS)

FIRED WEIGHT: 8.90# Approx

MOTOR O.D. : 2.01"

FILLER -WEIGHT: WP - 2.3#

FUZE: M 404A1 or M 404A2-BD

PROPELLING CHARGE: M7 (0.36#) 12 sticks

BURSTER: M 19

BURNOUT VELOCITY: 860 ft/sec

LAUNCHER: M 20 - M 31 or M 25

MOTOR WT: 3.30#

MIN IGN. CURRENT: 0.55 am?

ORD DRWG: 82-6-26 (P 30854)

LENGTH: 23.55" (with fuze)

HEAD O.D.: 3.5"

F.E.: 26%

MAX RANGE: 860 yds

IGNITER CHARGE: A5

IGNITER: M 20

BURNING TIME: 0.045 sec

HEAD LENGTH: 10".58

SQUIB: M.1A1 Electric

HEAD WT: 4.45#

DEVELOPMENT HISTORY: In development this rocket was designated T 127E3

REFERENCES: ACRC 1959, OP 2211, TM 9-1950

[redacted]



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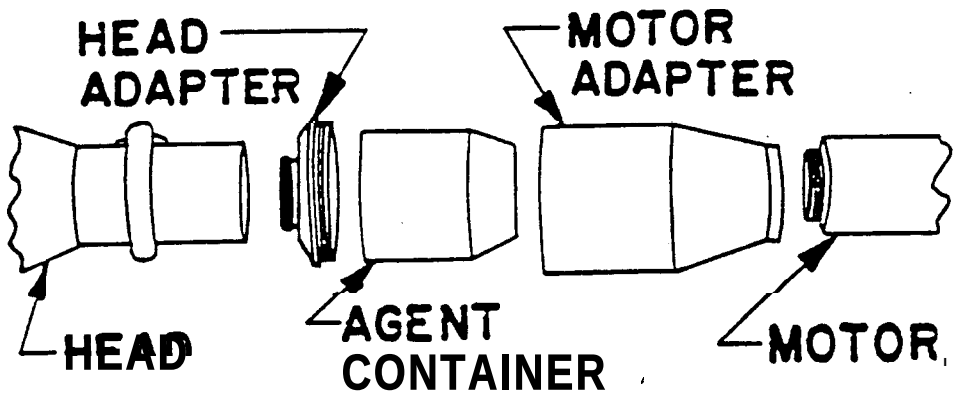


NOMENCLATURE: Agent Kit, Toxic (GB) 3.5 Rocket, E8

TYPE: Cylindrical Unit - Two Component - HEAT

PURPOSE: For injecting a lethal dosage of toxic agent into a tank for neutralizing effect.

STATUS: Study complete. Non-Std.

DESCRIPTION: The E8 toxic agent kit as designed to be adopted by the individual soldier to the standard 3.5 Heat Rocket M28A2. The kit consists of a container and two component adapters. The steel agent container holds about 175cc of GB or other comparable liquid agents.

The two component liquid adapter is made of aluminum and is designed to hold the agent container and to adapt it in place between the motor and the rocket head. No special tools are required in the field and it is fired from the standard 3.5 rocket launcher. Basically stable up to about 300 yds.

DOSAGE: Dosage against a tank is 200 mg min/$m^3$ Which is four times the lethal dosage.

AGENT KIT, TOXIC (GB) 3"5 ROCKET, E8 (CHARACTERISTICS)

WEIGHT OF KIT: 1.25#

LENGTH: 5-1/2" approx

MAX RANGE.: 500 yds

MAX DIA: 3115

MAX VELOCITY: 320 ft/sec

AGENT VOLUME: 167 cc

USED WITH: M28A2 Rocket

LAUNCHER: M 20, M 25 or M 30

For more information see CWLR2328 dated 8 Dec 1959 which is Secret

REFERENCE: CWLR2328 dated 8 Dec 1959 which is Secret



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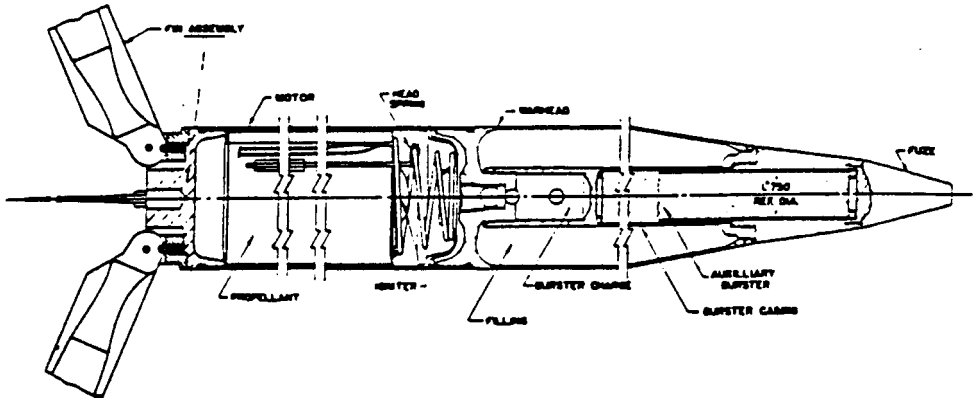

NOMENCLATURE: Rocket, Gas, NP, 115MM (GB) M 55

TYPE: Fin Stabilized - Surface to Surface - Central Burst

PURPOSE: Provide toxic chemical offensive capability for large tartet areas at long range.

STATUS: Std USA and USMC. No USMC Stocks as of 31 Dec 1960.

DESCRIPTION: This is a folding fin stabilized, surface to surface rocket designed for the delivery of GB liquid agent against large area targets. The major components are 8 warhead filled with GB, a PD fuze, Burster, Auxiliary Burster, Headspring, Igniter, Motor with fins and propellant. The system can be air lifted by helicopter or can be fired from a truck or by ground emplacement. The launcher is capable of delivering 45 rockets in 15 seconds and is loaded and operated by a crew of six men. A battalion can fire 1620 rounds in the first 30 seconds.

Refinements in design of the rocket and launcher during the past year have resulted in denser impact patterns and better accuracy than previously reported. Approximately 30% improvement is realized in deflection probable error at max. range; correspondingly compressed patterns are achieved by the system at shorter ranges. About 300 rockets were fired with satisfactory results since the modifications were made.

AREA COVERAGE: Assuming a neutral temperature gradient, 5 MPH wind, and 60°F temperature the number of rounds required to obtain 50% coverage of a Hectare with a dosage of 50 Mg-Min/ within 30 seconds is 6.7.

DEVELOPMENT HISTORY: In development this rocket was designated T-238.

NAVORD REPORT 6954 (FIRST REVISION) [redacted]

ROCKET, GAS, NP, 115MM (GB) M 55 (CHARACTERISTICS)

FIRED WT: 59# FILLER-VT: GB - 10.0#? F.E.: 17% Approx

BURNOUT WT: 39.7# MAX RANGE: 10,500 Met VOID: 10%

FUZE: PD - M 417 (T 2058) BURNING TIME: 2.6 Sec a 70°F

BURNING DISTANCE: 3000 ft a 70°F BURNOUT VEL: (Max) 1980 ft/sec

IMPACT VEL a MAX RANGE: 840 ft/sec LAUNCH VEL: 80 Ft/Sec

STABILIZATION: Folding fin (M 150) LAUNCHER: M 91

ROCKETS PER LAUNCHER: 45 LAUNCHERS/BATTALION: 36

ROUNDS/BATTALION/30 SEC: 1620

WARHEAD USED: M 56 (GB) HEAD LENGTH: 33"4 with fuze

MOTOR LENGTH: 44"75 with Fins Folded

ROCKET LENGTH: 78" approx WARHEAD WT: 20.60#

P.E. range at Max) 60 yds, In deflection at Max - 20 mils

MOTOR WT: 37.5# MOTOR USED: M 67 CALIBER: 4"44

BURSTER: M 34 (Comp B) AUX. BURSTER: M 36 (Comp B)

TOTAL IMPULSE: 3200 lb/sec (avg) MOTOR IGNITER: M 62 (25 grams)

MOTOR THRUST: 123% average PROPELLANT CHARGE: M 28 (19.3#)

SQUIB M 2-2 used MIN. IGN. CURRENT: 0.5 amps

DRWG: E 90-l-10 RELOAD TIME: 20 min approx

SAFETY-HANDLING: See TM 9-350 CONTAINER: M 441

REFERENCES: TM 3-250, TM g-1950, TM 3-200, FM 3-5, FM 3-8, CMLCD 57-9 Report

NOTE: An adaptionkit for mounting the M 91 launcher on various vehicles has been recommended

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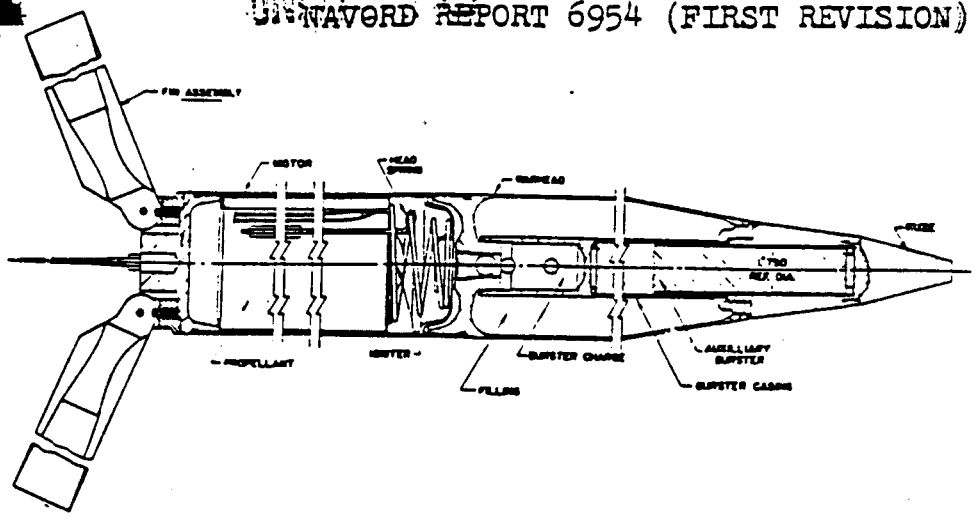

NOMENCLATURE: Rocket, Gas (P), 115MM (VX) M 55

TYPE: Fin Stabilized - Surface to Surface - Central Burst

PURPOSE: Provide toxic chemical offensive capability for large target area.

STATUS: Std USA and USMC
No USMC stock as of 31 Dec 1960.

DESCRIPTION: This is a folding, fin stabilized, surface to surface rocket designed for the delivery of VX liquid agent against large area targets. The major components are a warhead filled with VX, a PD fuze, Burster, Auxiliary Burster, Headspring, Igniter, Motor with fins and propellant. The rocket can be air lifted by helicopter or can be fired from a truck or by ground emplacement. The launcher is capable of delivering 45 rockets in 15 seconds and is loaded and operated by a crew of six men. A battalion can fire 1620 rounds in the first 30 seconds.

Refinements in design of the rocket and launcher during the past year have resulted in denser impact patterns and better accuracy than previously reported. Approximately 30% improvement is realized in deflection probable error at max. range; correspondingly compressed patterns are achieved by the system at shorter ranges. About 300 rockets were fired with satisfactory results since the modifications were made.

AREA COVERAGE: Assuming a neutral temperature gradient, 5 MPH wind, and 60°F temperature it requires 5 rounds to obtain 50% coverage of one Hectare with a dosage of 50 Mg-Min/$m^3$ within 30 seconds.

DEVELOPMENT HISTORY: In development this rocket was designated T-238.

[redacted]

ROCKET, GAS (P) 115MM(VX) M55 (CHARACTERISTICS) GB as more dense than VX. GJK

FIRED WT: 58.2# FILLER-WT: VX - 10.7#, F.E.: 18.9%

BURNOUT WT: 38.7# MAX RANGE: 10,500 meters VOID: 9%

FUZE: PD - 417. Tests are also being made with VT fuze T 2061

BURNING TIME 2.6 sec a 70°F. BURNING DISTANCE: 3000 ft a 70°F

BURNOUT VEL (MAX): 1980 ft/sec IMPACT VEL MAX RANGE: 840 ft/sec

LAUNCH VEL: 80 ft/sec STABILIZATION: M 150 folding fin

LAUNCHER: M 91 LAUNCHERS/BATTALION: 36

ROCKETS/LAUNCHER: 45 RDS/BATTALION/30 SEC: 1620

ROCKET LENGTH: 78" approx WARHEAD LENGTH: 33".4 with fuze

WARHEAD USED: M 56 MOTOR LENGTH: 44".75 with fins folded

WARHEAD WT: 20.60# MOTOR WT: 37.5#

MOTOR USED: M 67 CALIBER: 4".44

P.E.: (max range) 60 yds IN DEFLECTION (MAX RANGE): 20 mils

BURSTER: M 34 (Comp B) AUXBURSTER: M36 (Comp B)

MOTOR IMPULSE: 3200# average MOTOR IGNITION: M 62 (25 grams)

MOTOR THRUST: 1230# average PROPELLANT CHARGE: M28 (19.3#)

SQUIB: M 2 (2 used) MIN IGN CURRENT: 0.5 amps

DRWG: E 90-l-10 RELOAD TINE: 20 min approx

SAFETY HANDLING: See TM 9-350 CONTAINER: M 441

REFERENCES: TM 3-250, TM 9-350, TM g-1950, TM 3-200, FM 3-5, FM 3-8, CMLCD Report 59-9

NOTE: An adaption kit for amounting the M 91 launcher on various -vehicles has been recommended. Also being 'studied with Air Burst fuze.

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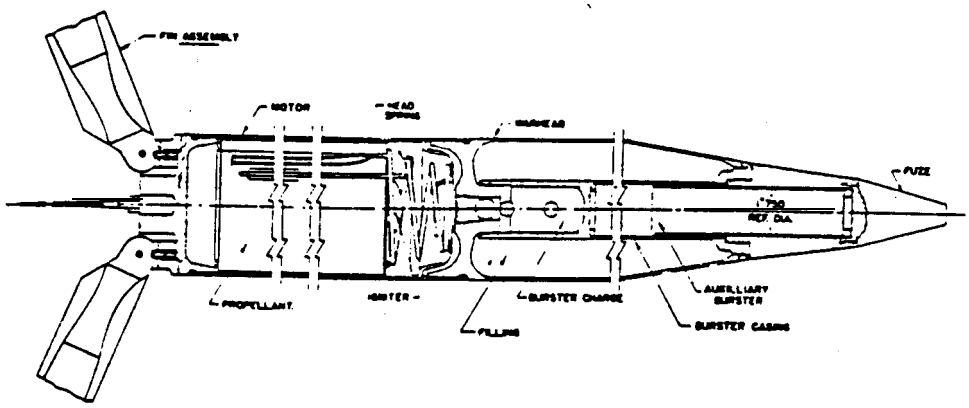


NOMENCLATURE: Rocket, Area Toxic, 115MM (WP) T-238

TYPE: Fin Stabilized - Surface to Surface - Central Burst

PURPOSE: Spotting, Screening, Incendiary and Anti-personnel

STATUS: Feasibility Study - Non Std

DESCRIPTION: This is a folding fin, surface to surface rocket designed for the delivery of WP. The major components are a warhead filled with WP, a PD fuze, Burster, Auxiliary Burster, Beadspring, Igniter, Motor with fins and propellant. The rocket can be air lifted by helicopter or can be fired from a truck or ground emplacement. The launcher is capable of delivering 45 rockets in the first 15 seconds and is loaded and operated by a crew of six men. A battalion can fire 1620 rounds in the first 30 seconds.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired. For example if the required curtain is established in 1 min. with 10 rounds, then approx. 5 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. See FM 3-5 for other conditions.

[redacted]

NAVORD REPORT 6954 (FIRST REVISION)

[redacted]

ROCKET, AREA TOXIC, 115MM (WP) T-238 (CHARACTERISTICS)

FIRED WT: 65# WT-FILLER: 17.5# WP . F.E.: 26.9%

BURNOUT WT: " 45.7# STABILIZATION: Folding Fin M 150

MAX RANGE: 10,000 Meters VOID: 5%

FUZE: PD - M 417 BURNING TIME: 2.6 sec a 70°F

BURNING DISTANCE: 3000 ft a 70°F LAUNCH VEL: 80 ft/sec

PROPELLANT CHARGE: M 28 - 19.3# LAUNCHER REQ'D: M 91

LAUNCHERS/BATTALION: 36 ROCKETS/LAUNCHER: 45

HEAD LENGTH: 33"4 with fuze MOTOR LENGTH: 445'75

OVERALL LENGTH: 78" approx READ WT: 21.6# (M 56)

MOTOR WT: 37.5#(M 67) BURNOUT VEL: 1980 ft/sec

IMPACT VEL AT MAX RANGE: 840 ft/sec SQUIB: M2 (2 used)

ROUNDS/BATTALION/30 sec: 1620 BURSTER: M 34

AUX BURSTER: M 36 Comp B BURSTER FILL: 3# Comp B

MOTOR USED : M 67 IGNITER CHARGE: 25 gm BP

MIX! IGN. CURRENT: 0.5 amps RELOAD TIME: approx 20 min

MOTOR O.D.: 4"44 CALIBER: 41'44

MOTOR THRUST: 1230# average MOTOR IMPULSE: 3200 lb/sec

P.E. MAX RANGE: 60 yds P.E. MAX RANGE DEFLECTION: 20 mils

REFERENCES: TM 3-250, TM 9-1950, FM 3-5, FM 3-8

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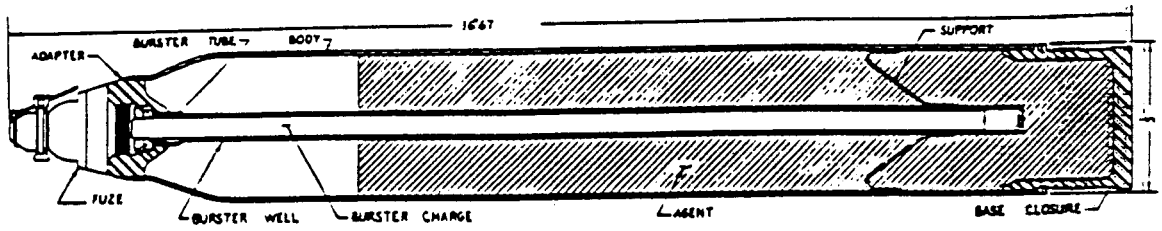



NOMENCLATURE: Warhead, Rocket, Smoke, 5", (PWP) Mk 4 Mod 1

TYPE: Fin Stabilized - HVAR - Central Burst - Air to Surface

PURPOSE: Spotting, screening, and anti-personnel effects

STATUS: Std USN. 44,793 in Navy stock as of Dec 31,1960

DESCRIPTION: This warhead, when used with Motor Mark 10 Mod 6, comprises the Mark 36 Mod 1 Smoke Rocket 5" (PWP) HVAR. Forward fired from aircraft to surface for spotting, screening, anti-personnel, and limited incendiary effects, The motor is fin stabilized and attains a distance of 1000 yard in about 2.5 seconds. The warhead contains the PWP filler, nose fuze, fuze adapter, burster tube, burster well, burster charge, support, and base closure. The burster tube extend almost the full length of the warhead. The base is closed by a threaded member.

The motor consists of a body, fin assembly, propellant, igniter assembly and arming wire. The range of the warhead is approximately 11,000 yards.

AREA COVERAGE: The warhead has a persistence of approximately 1 minute. Visibility to aircraft is 15,000 ft, and visibility to ground observer is 5,000 ft. Burst radius for anti personnel effect is approximately 50 yards for one Mk 4 war

WARHEAD, ROCKET, SMOKE, 5", (PWP) MK 4 MOD 1

HEAD CHARACTERISTICS: (MK 4 MOD 1) DRWG: 656341

FIRED WEIGHT: 50.84# DIA: 5.0" LENGTH: 36.67

FILLER-WEIGHT: PWP - 19.65# F.E.: 38%

NOSE FUZE: Mk 149

BURSTER CHARGE: Tetryl approx. 135 grams

MOTOR CHARACTERISTICS: (Mk 10 Mod 6) DRWG: 656724

MOTOR TYPE: Mk 10 Mod 6 IGNITER: Mk 114 (0.25# HE)

PROPELLANT GRAIN: Mk 18 Mod 0 (24.83#) THRUST: 4700# Average

ARMING WIRE: Mk 1 or M 6A2 BURNING TIME: 1.15 Sec

FIRED WEIGHT: 89.87# FIN DIA: 15.26 LENGTH: 51.31

ROCKET CHARACTERISTICS: (Mk 36 Mod 0)
(Mk 4 Mod 1 Head and Mk 10 Mod 6 Motor)

BURNOUT WEIGHT: 114.9# BURNOUT VELOCITY: 1325 ft/sec

RANGE: 10,900 yds a -45" OVERALL LENGTH: 845'98

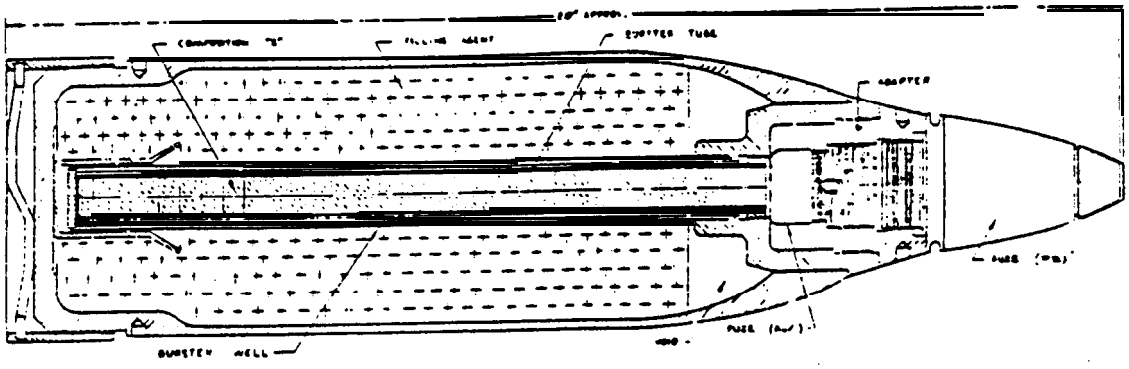
FIRED WEIGHT: 140.71#

USED WITS: Launchers Mk 5 thru Mk 9, and AERO 14A Rack

SAFETY-HANDLING: See TM 3-250

REMARKS: The Mk 4 Mod 1 head, and Mk 10 Mod 6 motor make up the Mk 36 Mod 0 Rocket

REFERENCES: OP 1415, OP 1239, NAVORDINST 8650.6, OP 2210, OP 1829, MIL I - 17924, OP 1304, OP 1855



NOMENCLATURE: Warhead, Rocket, 5", Smoke (WP) Mk 39 Mod 0

TYPE: Spin Stabilized - Surface to Surface - Central Burst

PURPOSE: Produce casualties; provide spotting and screening Smoke

STATUS: Non Std. USN. No stock as of 31 Dec 1960.

DESCRIPTION: This is a spin stabilized surface to surface rocket warhead which was developed to fulfill a Navy requirement for a smoke filled 5" warhead for use in off shore bombardment. To afford interchangability with existing 5" Naval rockets the Mk 39 was designed from an unmodified Mk 14 warhead for the standard Navy Mk 4 rocket motor. Although a smaller diameter burster tube is used in this rocket, the heads as well as the press fit closures are the same as those used on the Gas projectile. Upon Impact the PD fuze functions to set off the auxiliary fuze; which In turn ignites the burster charge to explode the munition and release the chemical

AREA COVERAGE: WP clouds produced had good density and particle size appeared satisfactory. Clouds held together 5 to 10 min in winds of 5 to 15 MPH. The burst radius for anti-personnel effect is about 50 yards for a single warhead

  [redacted]

WARHEAD, ROCKET, 5", SMOKE, (WP) MK 39 MOD 0 (CHARACTERISTICS)

ROCKET FIRED WEIGHT: 51# FILLER-WEIGHT: WP-10.96# F.E.: 21.5

RANGE: 4600 yds BURNOUT WT.: 45# DIA: 5"0

HEAD WEIGHT: 29.3# (M-14) HEAD LENGTH: 20" With Fuze

LAUNCHER: Mk 50, Mk 51, Mk 102, Mk 105, Mk 52, Mk 101

ROCKET LENGTH: 32"2 FUZE: PD Mk 30 Mod 4

AUX. DET: Mk 44 Mod 2 MOTOR: Mk 4 Mod 4

BURNOUT VEL: 807 ft/sec BURSTER CHARGE: 0.43#Comp "B"

CLOSURE: Press Fit BURNINGTIME: 77 sec a 120°F

BURSTER CASING: M 5

PROPELLANT WEIGHT: 6# approx. BUWEPS DRWG: 1380985

STABILIZATION: Spin

LAUNCHER - RATEOFFIRE: Mk 50 - 2 rds/sec single or 4 rds/sec in pairs; Mk 51 - 12 rds/5 sec; Mk 52 - 7rds/4 sec; Mk 101 - 2 rds/0.3 sec; Mk 102 - 30 RPM; Mk 105 - 48 RPM.

HANDLING-SAFETY: Test conducted on vibration, rough road haul, moving drop, low drop and safe drop were successful and indicated that this warhead is safe for normal military handling, shipment and storage, See TM 3-250.

DEVELOPMENT HISTORY: In development this item was designated E 44.CCTC Item 3022 dated 19 April 1955.

REFERENCES: OP 1260, OP 1415 (Conf.), OP 1424, OP 1304, TM 3-250 DPGP #209 April 195.8, MIL-W-14586, OP 2210. (NOTE: OP 1424 is Conf.)

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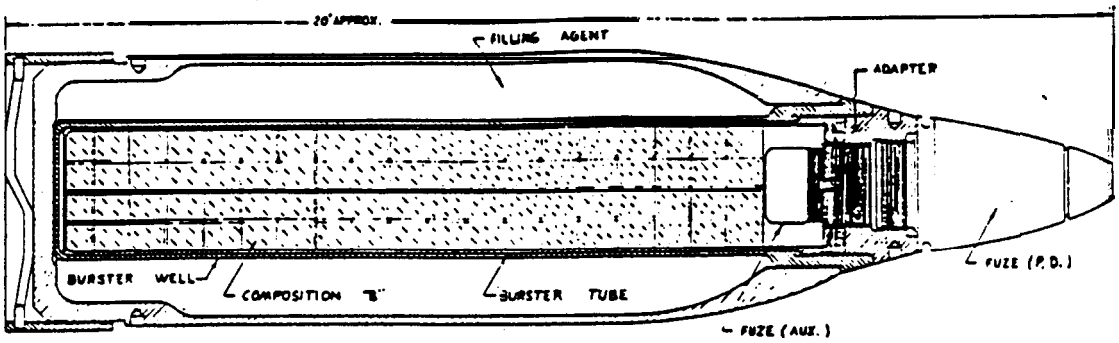


NOMENCLATURE : Warhead, Rocket, 5", Gas (GB) Elk 40 Mod 0

TYPE: Spin. Stabilized - Surface to Surface - Central Burst

PURPOSE: Provide toxic chemical offensive capability

STATUS: NoUSN:d No stock as of 31 Dec 1960

DESCRIPTION: This is a spin stabilized, surface to surface rocket warhead which was developed to fulfill a Navy requirement for a chemical filled 5" warhead for use in off shore bombardment. To afford interchangeability with existing 5" Naval rockets the Mk 40 was patterned after the standard Mk 14 Mod 0 warhead. The principal modifications of this head are adaptions for a larger burster, providing for a nominal agent to burster ratio of 2/1 for better dissemination of agent in aerosol form, and for better sealing of the burster well within the warhead to minimize leakage.

Metal parts of the warhead are designed for use with standard Navy rocket motor and fuzes. Upon impact the PD functions to set off the auxiliary fuze, which in turn ignites the burster charge to explode the munition and release the agent.

AREA COVERAGE: Assuming a wind speed of 6 MPH, Temperature 54°F, Temperature gradient +0.1, and RH of 55% the coverage of 1 Hectare In 30 seconds with a lethal dosage of 100 Mg-Min/m3 is 4.26 rounds for 50% coverage and 6.6 rounds for 80% coverage.. See DPGR #206 for detailed coverage.

DEVELOPMENT HISTORY: During development this item was designated E 43.

[redacted]

WARHEAD, ROCKET, 5", GAS (GB) MK 40 MOD 0 (CHARACTERISTICS)

ROCKET FIRED WEIGHT: 50.5# (With fuze) F--WEIGHT: GB 4.8#

ROCKET LENGTH: 32"2 BURNOUT WEIGHT: 44.5#

PROPELLANT WEIGHT: 6# F.E.: 9.51% BUWEPS DRWG: 1380991

HEAD WEIGHT: 28.8# (With fuze) HEAD LENGTH: 20" with fuze

DIA: 5"0 FUZE: PD Mk 30 Mod 4, and Aux. AD Mk 44 Mod 2

MAX RANGE: 4600 yds AGENT/BURSTER RATIO: 1.7/1

MOTOR: Mk 4 Mod 4 BURNING TIME: 77 sec a 120°F

BURSTER CHARGE: 2.80# Comp. B BURNOUT VEL: 807 ft/sec

LAUNCHER - RATE OF FIRE: Mk 50 - 2 rds/sec single or 4 rds/sec in pairs; Mk 51 - 12 rds/5 sec; Mk 52 - 7 rds/4 sec; Mk 101 - 2 rds/o .3 sec; Mk 102 - 30 RPM; Mk 105 - 48 RPM.

CLOSURE: Press fit STABILIZATION: Spin

HANDLING-SAFETY: This warhead successfully passed the rough handling, surveillance, solar radiation, temperature conditioning and vibration tests which indicates that it is safe for normal military shipment, handling and storage. See TM 3-250.

REFERENCES: Operational Research' Grou pStudy #17. OP 2210, TM 3-250, OP 1260, OP 1415, OP 1421, OP 1304, TM 9-1950 DPGR # 206 Dec 1958 (Conf.) MIL-W-45087, CCTC Item 2462.

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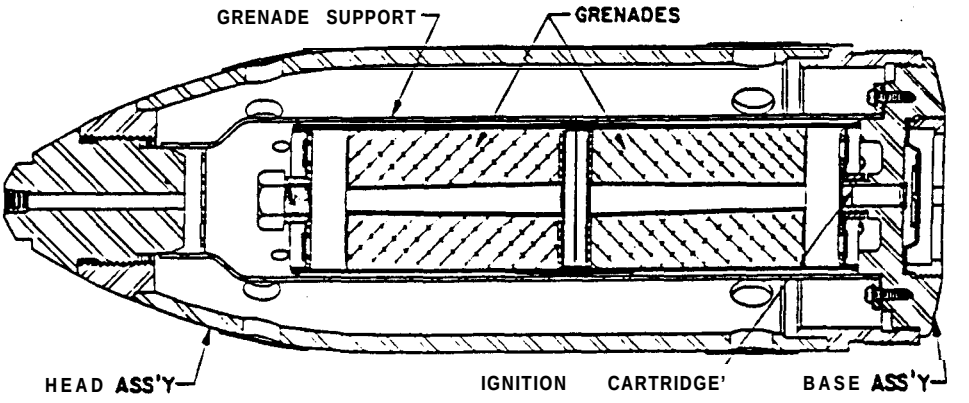


NOMENCLATURE: Warhead, Rocket, 5"0 Smoke Target Mk 21 Mod 0-1

TYPE: Central Firing - Surface - Spin Stabilized - Pyro

PURPOSE: Simulate aerial targets for *gunnery* practice

STATUS: Non-Std USN. No stock on hand as of 31 Dec 1960

DESCRIPTION: Warheads Mod 0 and Mod 1 are composed of a perforated head with adhesive tape covered holes arranged circumferentially fore and aft, a loading components assembly, and a nose plug. The *loading* components are two M I colored smoke grenades connected back to back with adhesive tape. The holes which normally appear in the front en of the grenade are tape covered. The forward grenade has a plug closing the fuze well. The base is attached to the af grenade by a threaded stud in the fuze well. The base has a diaphragm with a central firing boss and a .32 caliber long cartridge with a primer and "first fire mixture".

This first fire mixture is composed of 3 parts black powder and 5 parts of a mixture of aluminum and potassium perchlorate. This is blended with 7% solid solution of shellac and ethanol. The ethanol is evaporated, leaving about 1% of shellac in the final first-fire mixture. A cylindrical, perforated grenade support encloses the granades and is attached to the base by a flange and screws. The cylindrical support has a neck that receives the nose plug. The *nose* plug supports the grenade support. An air-inlet port is drilled thru the center of the nose plug. When the rocket is fired, motor gases snap the diaphragm forward, The central firing boss impinges against the primer in the cartridge case. The primer fires the first-fire mixture, causing' the grenade to ignite. The smoke generates pressur and bursts the adhesive tape covering the holes. The smoke passes thru the holes in the support, bursts the tape cover ing *the* head holes and flows into the atmosphere.

WARHEAD 5"0, SMOKE TARGET MK 21 MODS 0-l (WARHEAD CHARACTERISTICS)

OVERALL LENGTH: 16"06 DIA: 4"97

FIRED WT: 22# EMPTY WT: 12.93#

DRWG: 655868 FUZE: *None* MAX RANGE: 4620 yds

FILLER-WT: Two M 18 Grenades 1.5# ea. TOTAL PAYLOAD WT: 7.02#

BALLISTIC TABLE: OP 1498 STABILIZATION: Spin

Mod 0 and Mod 1 have different steel at base *of* head. Mod 0 is a modified version of 5" Mk 10 Mod 9 warhead.

MOTOR CHARACTERISTICS: 'TYPE: MK 4 MODS 0-l-2-4

FIRED WT: 21.69# EMPTY WT: 15.42#

THRUST: 114% BURNING TIME: 1.06 sec

MAX LENGTH: 15"65 O.D.: 4"97

PROPELLANT GRAIN: *Mk 22* Mods 0-l-2-3 (5.78#)

IGNITER: Mk 118 Mods 0-l-2 (0.129

DRWGS: 1 - 467049; Mod 4 - 655922

COLORS USED: Red, green, violet or yellow

ROCKET CHARACTERISTICS: (MK 27)

FIRED WT: 43.69# BURNOUT WT: 37.70#

LENGTH: RANGE: 4620 yds CONTAINER: Mk 23 Mod 0

MAX VEL: 778 ft/sec BURNING TIME: 1.06 sec

DRWGS: Gen arrangement 660860, LD 174517

LAUNCHERS: Mk 50; Mk 51; Mk 102; Mk 105;

NOTE: *The* Mk *21* warhead and the Mk 4 motor make up the Mk 27 Mod 0 rocket.

REFERENCES: OP 2210; OP 1415; OP 1260; OP 1498; OP 1246; OP 1424; OP 2110; OP 1304; OP 1855

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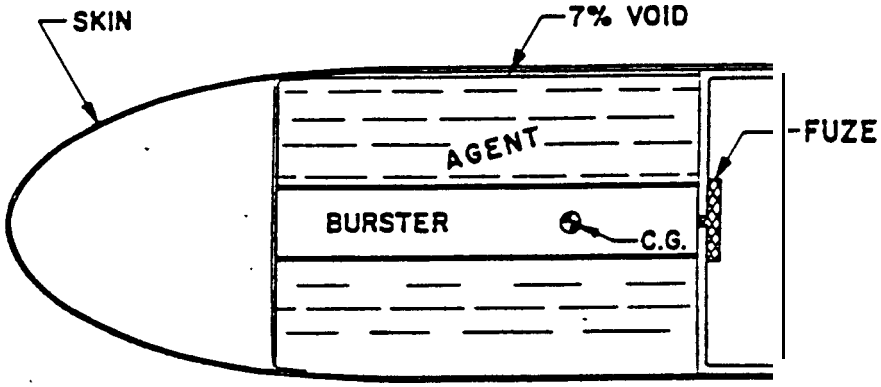


NOMENCLATURE: Warhead, Missile, Chemical, (GB) SS-11

TYPE: Massive - Central Burst - Wire Guided - Surface to Surfac

PURPOSE: Anti personnel and anti tank with CW agents for use against small targets.

STATUS: Feasibility study complete. Prototypes being fabricated

DESCRIPTION: A light surface to surface missile propelled by tw separate rocket motors, (1) a booster for Initial accelerati and (2) a sustainer for powered flight. Guidance commands are transmitted through two wires which unwind from the missile during flight. The missile is controlled and brought into alignment with the target during flight by means of a manual control stick located near the launch point, It 3.3 possible for one gunner to control a battery of six missiles and the missiles can be fired directly from their shipping containers. A small crew can set up the entire battery and ground station in about 15 minutes.

A cable allows the gunner to select an observation point removed from the launch site, With the remote-control equip ment the gunner acquires the missile, and guides it to the target. The best accuracy is attained at maximum range, Th liquid agent is contained in the volume of the cylindrical ogivenose between the skin and the burster tube. Upon initiation of the fuze and consequent detonation of the burster at missile-target impact, the agent is disseminated as a cloud of vapor, aerosol, and liquid splash. It is possible that VX could be substituted for GB fill with a minimum change in hardware design.

AREA COVERAGE: Dissemination efficiencies of 50% and 62% reflec effective agent strengths for 30 second and total dosage. Meteorological assumptions are neutral temperature gradient, 5 MPH wind, and ambient air temperature of 60°F. It is assumed that 10 missiles could be salvoed on a target for a 30 second suprise condition, and that up to 22 missiles could be launched within 5 to 10 minutes for a total dosage condition.

WARHEAD, MISSILE, CHEMICAL (GB) SS-11 (CHARACTERISTICS)

WARHEAD WT: 13#
AGENT-WT: GB 7.0# F.E.: 53.8%
WARHEAD LENGTH: 16".28
WARHEAD DIA: 6".49
WARHEAD SKIN THICKNESS: .064
BALLASTWT: 1.9#
MISSILE LENGTH: 42".5
MAX. VEL: 624 ft/sec
NO. OF FINS: 4
FIN SPAN: 20"
MISSILE LAUNCH WT: 62#
VOID: 10%
MIN. RANGE: 550 yds
MAX RANGE: 3830 yds
RATE OF FIRE: 10/30 sec

REFERENCE: CWL Tech Memo 30 - 53 dated February 1960 which is Secret.

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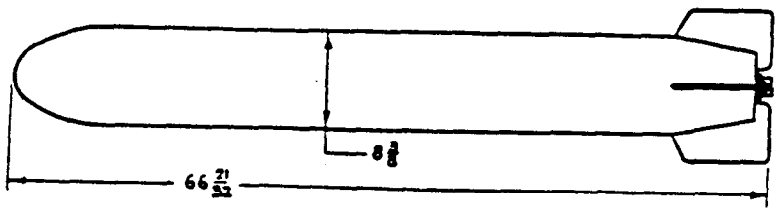


NOMENCLATURE: Rocket, Fire, 8",(NP) E 42R2

TYPE: Field Loaded - Free Rocket - Fin. Stabilized

PURPOSE:: Provide incendiary offensive capability

STATUS: Development complete. Tests discontinued. Research being conducted in field of propulsion. This item may be reinstated at a later date. Requirement cancelled.

LIMITATIONS: To be determined.

AREA COVERAGE: A single round will spread napalm over a 25 yard diameter. Accuracy dispersion indicates a target area of 600 yds long X 500 wide at 2000 yds range.

ROCKET, FIRE, 8" (NP) E 42R2 (CHARACTERISTICS)

FILLER-CAPACITY: 5.7 Gal or 32.5# Napalm (2.25% M4)

WEIGHT LOADED: Approx 64# WEIGHT EMPTY: Approx 28#

LENGTH: 67" Approx DIA: 8-3/8" F.F.: 53.20%

ROCKET MOTOR: Standard 2.75" FFAR Mk 2 Mod 1

MAX VELOCITY: 540 ft/sec a 30" Elevation - 2000 yds

VELOCITY OFF LAUNCHER: 80 ft/sec approx.

FINS: Replaced by chemical corps

FUZE: P.D. Nose mounted E 15 always type

IGNITOR: M 23A1 BURNOUT TIME: 1.6 sec

MAX RANGE: 3000 yds BURNOUT DISTANCE: Approx 350 ft

LAUNCHER: Single rail - expendable
8 shot truck mounted has been used
15 shot truck mounted has been used
Multiple type launcher to be developed by Amy Ord.

REMARKS: Field filled and assembled. Designed as a compact package,

REFERENCES : OP 1239; OP 1415; OP 2210; OP 1304; OP 1855

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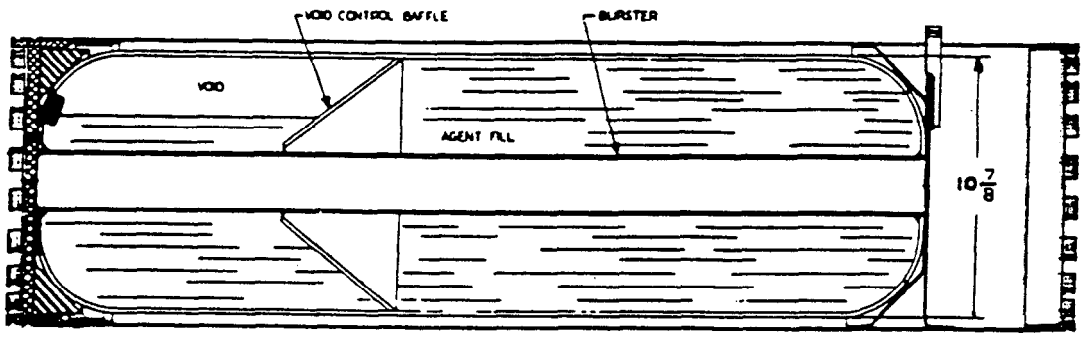


NOMENCLATURE: Warhead, Bullpup Missile, (GB) (250#)

TYPE: Massive - Supersonic - Air to Surface

PURPOSE: For use with attack type aircraft in support of ground troops and for use against small tactical targets.

STATUS: Feasibility study complete. Project not established. Prototypes fabricated.

DESCRIPTION: This is a massive type warhead, air to surface to be carried by a variety of Naval Aircraft. The CPE of the Bullpup warhead is 30 ft., and this high accuracy coupled with small or "point" type of targets to be attacked by this warhead, indicates a single unit or massive type warhead as the weapon of choice, since high concentrations or "over kill" of small areas are desired. The warhead consists of a cylindrical agent container with a central burster for explosive dissemination.

The warhead will be interchangeable with other warheads which are used with the Bullpup Missile. A relatively thick casing of mild steel is used which will withstand severe handling loads. Ballast is necessary to obtain the correct weight. The missile is radio controlled to the target and can be used against small crafts, tanks, vehicles and small buildings.

AREA COVERAGE: with 105# of GB it is estimated that the area covered by lethal dosage or higher to a resting man (Lct 50=100 Mg-Min/m3) in 30sec, based on Inhalation effects only, is 2900 sq. meters average, and 1450 sq. meters r&r&-mum. Coverage is based on a target of neutral temperature gradient, 4MPH wind, and air temperature of 60°F. Average area produces a circle of 100 ft. radius, and the min. area produces a 70 ft. radius. Since both the average and the min. effects RADII are greater than the CPE, the aiming point will always be covered by a lethal dosage. Area coverage on a total dosage basis, under the same meteorological conditions will produce 100 Mg-Min/m3 for 30,000 sq. meters

[redacted]

AREA COVERAGE (Cont.): or an ellipse of 64 x 600 meters, 35 Mg-Min/m3 for 94,000 sq. meters, or 100 x 1200 meter ellipse, 20 Mg-Min/m3 for 175,000 sq. meters or 150 x 1500 meter ellipse. See CWL Tech Memo 30-47 for more details.

WARHEAD, BULLPUP MISSILE, GAS (GB) 250# (CHARACTERISTICS)

DIA: 10-7/8" LENGTH: 38".42

GROSS WEIGHT: 250# loaded F.E.: 42%

AGENT WEIGHT: 100# of GB

FUZE: Impact BURSTER WEIGHT: 3 to 10# approx.

BALLAST WEIGHT: 49.5# BURSTER TYPE: Central

WARHEAD OPENING: Impact MAX VELOCITY: Mach 2.2 (Mach. 1.4 avg)

C.P.E.: 30 ft from 8,000 to 15,000 ft altitude.

DIVE ANGLE: 0° to 70"

BODY MATERIAL: 0".188 Steel

MISSILE CHARACTERISTICS:

TOTAL MISSILE WT: 570# BURNOUT WT: 467#

FUEL WT: MISSILE LENGTH: 126".0

WING SPAN: 37".9

HANDLING-SAFETY: *Due* to the thick wall casing this warhead is considered safe for normal handling.

REMARKS: VX is also being studied for use in this warhead.

REFERENCES: CWL Tech Memo 30-47 which is confidential. ACC Project #4-16-020-01

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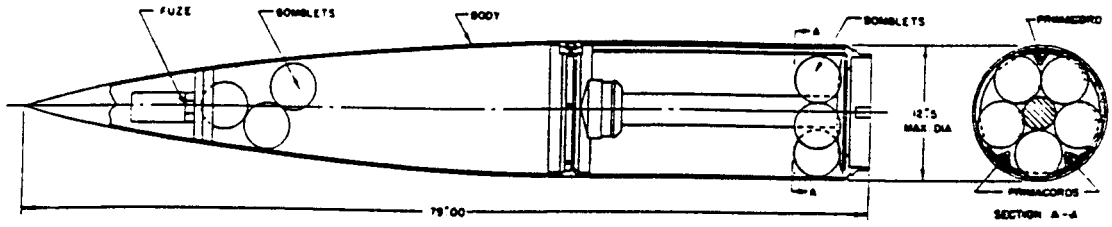


NOMENCLATURE: Warhead, 318MM Rocket, (GB-VX), E 20

TYPE: Bomblet Loaded - Surface to Surface

PURPOSE: Provide toxic chemical offensive capability

STATUS: TC expected Fy-62

DESCRIPTION: This is a surface to surface warhead used to carry the E 130R2 spherical bomb. The warhead for the Little John Missile is based on a modification of the Quadrant design and is helicopter transportable on its launching gear. It is fabricated of *0.81"* aluminum alloy and is sealed at three stations with gaskets to protect against any leakage that might occur. Three extruded longeron members are initiated through a detonator block.

This block has a small central tetryl pellet into which a primacord is led and accepts the two out-put flask tubes extending from the fuze. Upon functioning the skin severs into three sections. The Aerodynamic forces displace the three sections aft and ram air pressure ejects the munitions. The ejection of the bombs is aided by two thrust cones. The bombs in the lower part of the warhead are deflected outward by the upper thrust cone.

AREA COVERAGE: Assuming neutral temperature gradient, 5 MPH wind speed, 60°F temperature, average breathing rate 15 liters/min; to achieve a 30% casualty rate, a predicted area coverage of 27.8 Hectares* (.272 sq. mi.) is possible for unmasked personnel. If inversion conditions exist, the stated area coverage is increased by a factor of 2.5; under lapse conditions, the stated area coverage will be 25% as great; winds under 5 MPH will double the stated area coverage and from 7 to 10 MPH, the stated area coverage will be halved. Temperatures above 80°F will increase the stated area coverage by 30% and temperatures from 0° to 40°F will *decrease* the stated area coverage by 20%.

* Based on test data of individual bomblet static tests

[redacted]

NAVORD REPORT 6954 (FIRST REVISION) [redacted]

WARHEAD, 318MM ROCKET, (GB-VX) E 20 (CHARACTERISTICS)

WARHEAD FILLED WEIGHT: 262#

WARHEAD DIA: 12"5 (317.5MM)

BOMBLET: 130R2

BOMBLET QUANTITY: 52 a 2.4# ea.

ROCKET MOTOR: XM26E1

BOMBLET FUZE: XM912 Centrifugal arming, All-ways impact

WARHEAD OPENING: Priinacord

LAUNCHER: XM34

C.P.E.: 100 yards

ROCKET GROSS WT.: 879#

MAX. RANGE: 25,000 yds.

MIN RANGE: 3,500 yards

WARHEAD LENGTH: 79"

WARHEAD FUZE: T-2075-MT

BOMBLET ARMING SPEED: 1800 RPM

MAX. VELOCITY: 2825 ft/sec

TIME TO MAX. VEL.: 10.2 sec

ROCKET LENGTH: 150"

ROCKET DESIGNATION: XM-51(Consists of E-20 warhead and XM26E1 motor)

RATE OF FIRE: 3 to 6 rockets/min/hr/launcher. 4 launchers per battery, 3 batteries per battalion, 1 battalion per division

HANDLING-SAFETY: ACC-Tl-196-12 May 1960, TM 9-1903

NOTE: This warhead is also being studied for VX. The warhead is usually referred to as the "Littlejohn"

REFERENCES: CMLC *Board* Report titled "Casualty Effectiveness of Toxic CW Munitions" dated 6/27/58 (Conf.). Tech Memo 30-32 (Conf.) dated Sept 1957. Tl-196-12, TM 9-1903

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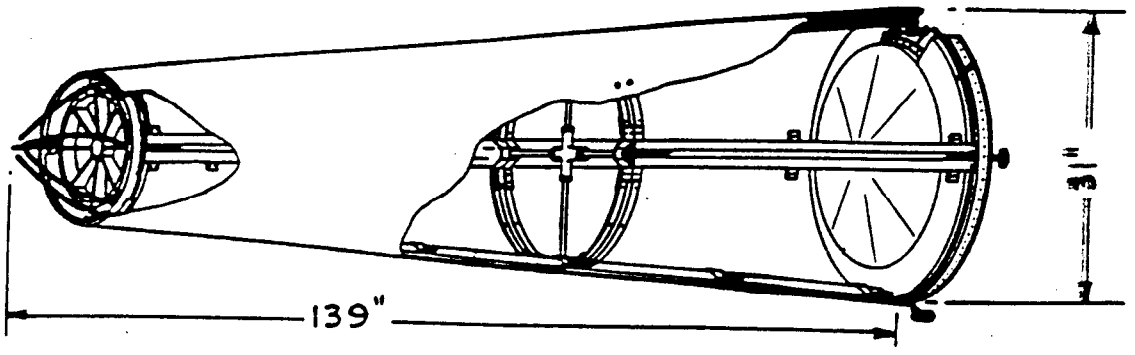


NOMENCLATURE: Warhead, Sergeant Missile, (GB-VX) E-21

TYPE: Supersonic - Bomblet Loaded - Surface to Surface

PURPOSE: Provide toxic offensive capability.

STATUS: TC expected 2 Quarter Fy-63

DESCRIPTION: This is a surface to surface munition powered by a solia propellant rocket motor which burns to completion on each flight. The warhead is cone shaped with an aluminum skin, and is smaller at the nose end than it is at the motor. It is loaded with 329 bombs E 130R2 for GB, or 720 b&s E 134 for VX. The fuze is in the nose section which is 50" long and the bombs are in the rear section which is 89" long. Since the warhead compartment is volume limited the fore and aft dividers have been eliminated. Four longitudinal non load carrying primacord back up bars are held tightly against the inside skin surface by clips, and recess into the forward and aft bulkheads. Primacord is also located circumferentially in these bulkheads. Upon functioning the warhead skin is split by the primacord and is peeled off releasing the munitions.

AREA COVERAGE: Assuming neutral temperature gradient, 5 MPH wind speed, 60°F temperature, average breathing rate of 15 liters/min; to achieve a 30% casualty rate, a predicted area coverage of .67 sq. mi.* is possible for unmasked personnel. If inversion conditions exist, the stated area coverage is increased by a factor of 2.5. Under lapse conditions, the stated area coverage will be 25% as great. Winds under 5 MPH will double the stated area coverage and from 7 to 10 MPH, the stated area coverage will be halved. Temperature above 80°F will increase the stated area coverage by 30% and temperatures from 0° to 40°F will decrease the stated area coverage by 20%.

* Based on test data of individual bomblet static tests,

[redacted]

WARHEAD, SERGEANT MISSILE, (GB-VX), E-21 (CHARACTERISTICS)

WARHEAD WEIGHT: 1611#

RANGE: 75 Nautical miles

WARHEAD DIA': 31"

WARHEAD LENGTH: 139"

MUNITION: E 130R2, E 134

MUNITION QUANTITY: 329 of E 130R2 or 120 of E 134

WARHEAD FUZE: Barometric

WARHEAD OPENING: Primacord

ROCKET MOTOR: XM-53

LAUNCHER.

MAX VEL: Mach 4.5

HANDLING - SAFETY: See CWL Tech Memo 30-19

NOTE : This warhead is also being considered for VX.

REFERENCES : CWL Tech Memo 30-19 Confidential

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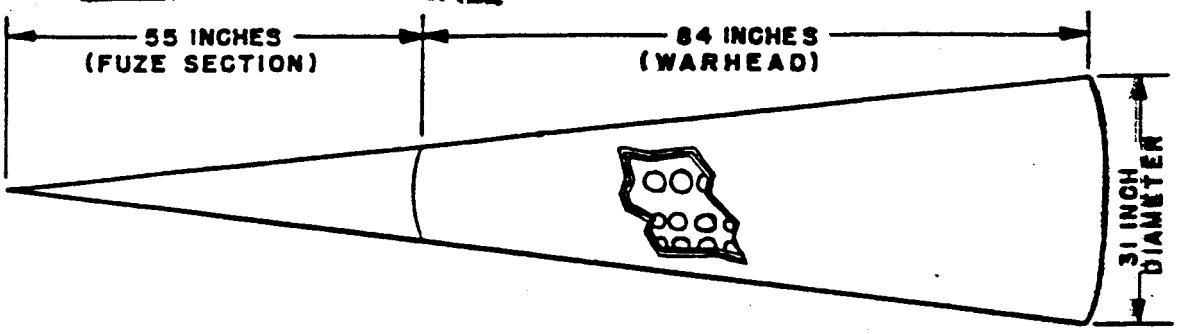


NOMENCLATURE: Warhead, Sergeant Missile, Liquid (BW) .

TYPE: Surface to Surface - Ballistic Missile - Supersonic

PURPOSE: Dissemination of BW Liquid Agents

STATUS: R&D. T.C. schedule 4 Quarter FY 1962

DESCRIPTION: The outside skin is identical to the other Sergeant Warheads. The fuze is in the nose section which is 50 inches long and the payload section is 84 inches long. The bomblets are carried in a fiberglas container. There is one half inch space between the fiberglas container and the outer aluminum skin. There is also a layer of "E" felt insulation on the outside of the fiberglas container. An insulated shipping container will include an electric heat pump to control the agent storage temperature.

OPERATION: The warhead fuzes function at a preset position along the normal Sergeant flight path. At the time of functioning the warhead skin and enclosed fiberglas container are split simultaneously by linear charges which results in peeling of the skin and liner.

AREA COVERAGE: Pattern area depends on opening height. Expected use opens from 25,000 to 50,000 feet which would give a bomblet impact pattern area of 15 to 60 sq. miles, Assuming a night operation, unprotected personnel, neutral meteorological conditions, open terrain, 5 MPH wind, and RH of 85% it is estimated that this warhead filled with E 134 bomblets could cover 60 sq. ml. at a 30% level.

[redacted]

WARHEAD, SERGEANT MISSILE/LIQUID, (BW) (CHARACTERISTICS)

FIRED WT: Approx 1640# FILLER CAPACITY: 152,000 ml approx,

CAPACITY: 720 - E 134 Bomblets AGENT: Various BW Liquid

WARHEADLENGTH: a4"0 DIAMETER: Large end: 31"0
Small end: 14"5

FUZE SECTION: 55"

FUZE: Barometric FUZE LOCATION: Nose

WARHEAD OPENING: Linear shaped charge

MAX RANGE: 75 N miles MIN RANGE: 25 N miles

MOTOR: XM-53 MAX VEL: Mach 4.5

LAUNCHER:

DEVELOPMENT HISTORY: CCTC Item 3402 dated March 27, 1958 to meet CONARC requirement.

REFERENCES: CCTC 3580 dtd 9 June 1959

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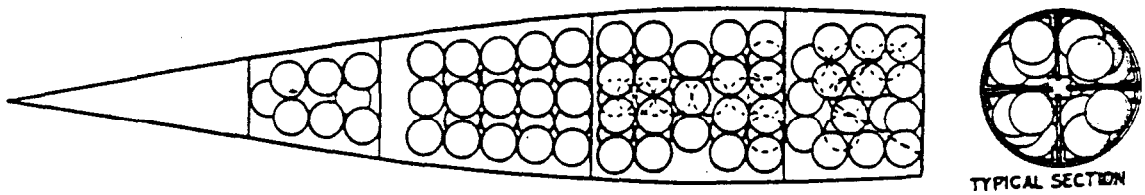


NOMENCLATURE: Warhead, 762MM Rocket, Gas (GB) M 79

TYPE: Explosive Opening - Bomblet Loaded - Fin Stabilized

PURPOSE: Provide toxic chemical offensive capability

STATUS: Std USA and USMC

DESCRIPTION: This concept is known as the "quadrant" warhead design and consists of partitioning the missile nose cone casing into four longitudinal quadrants within which are packed bomblets. The warhead casing is made of aluminum alloy sheet and is reinforced with internal structural members. At a preset time along the flight path the fuze functions which in turn detonates the primacord, separating the outer skin along the quadrant partitions thereby releasing the bomblets into the airstream. Upon impact the fuzes within the individual bomblets function to release the agent. A conical wedge is provided at the rear end of the warhead to assist in effecting clean ejection of the bomblets.

AREA COVERAGE: Assuming neutral temperature gradient, 5 MPH wind speed, 60°F temperature, average breathing rate of 15 liters/min for troops; to achieve a 30% casualty rate, a predicted area coverage of .73 sq. mi.* is possible for unmasked personnel. If inversion conditions exist, the stated area coverage is increased by a factor of 2.5; under lapse conditions, the stated area coverage will be 25% as great. Winds under 5 MPH will double the stated area coverage and from 7 to 10 MPH, the stated area coverage will be halved. Temperatures above 80°F will Increase the stated area coverage by 30% and temperatures from 0° to 40°F will decrease the stated area coverage by 20%.

* Based on Test Data of Individual Static Tests.

[redacted]

 UNCLASSIFIED [redacted]

WARHEAD, 76MM ROCKET, (GB ) GAS, M 79 (CHARACTERISTICS

WARHEAD WEIGHT: 1468# WARHEAD LENGTH: 115"

WARHEAD DIA: 30" (762MM) RANGE: 8500 to 25,900 meters

USED MUNITION: E 130R1 MUNITION QUANTITY: 356

ROCKET MOTOR: M6A1 MUNITION WT.: 3.4# ea.

WARHEAD FUZE: T 2075-MT

MUNITION FUZE: XM911 - Centrifugal arming, al!.-ways impact

WARHEAD OPENING: Primacord

LAUNCHER: M386, M289, or XM33 DRWG: D90-11-3

HANDLING SAFETY: See CWL Tech Memo 30-41

DEVELOPMENT HISTORY: In development this item was E19R1

NOTE: Rocket M31A1C consists of the M-79 warhead and the M6A1 motor

REFERENCES: CWL Tech Memos 30-19 and 30-41 (Conf.). Artillery Board Report ATBA-RM 252/6(FA5158) C HQTS U.S.A. Artillery Board 20 July 59, TB 3-300-9

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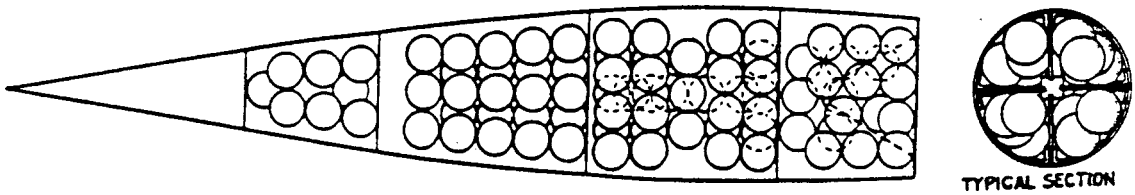



NOMENCLATURE: Warhead, 762MM Rocket, (GB-VX) E 19R2

TYPE: Explosive Opening - Bomblet Loaded - Surface to Surface

PURPOSE: Provide toxic chemical offensive capability

STATUS: TC expected 3 Quarter Fy-62. Non Std USA

DESCRIPTION: This concept is known as the "quadrant" warhead design and consists of partitioning the missile nose cone casing into four longitudinal quadrants within which are packed bomblets. The warhead casing is made of aluminum alloy sheet reinforced with internal structural members, At a preset time along the flight path the fuze functions which in turn detonates the primacord, separating the outer skin along the quadrant partitions thereby releasing the bomblets into the airstream. Upon Impact the fuzes within the individual bomblets function to release the agent. A conical wedge is provided at the rear end of the warhead to assist in effecting clean ejection of the bomblets.

AREA COVERAGE: Assuming neutral temperature gradient, 5 MPH wind speed, 60°F temperature, average breathing rate 15 liters/min for troops; to achieve a 30% casualty rate, a predicted area coverage of .73 sq. mi.* is possible for unmasked personnel. If inversion conditions exist, the stated area coverage is increased by a factor of 2.5; under lapse conditions, the stated area coverage will be 25% as great. Winds under 5 MPH will double the stated area coverage and from 7 to 10 MPH, the stated area coverage will be halved. Temperatures above 80°F will increase the stat& area coverage by 30% and temperatures from 0° to 40°F will decrease the stated area coverage by 20%.

* Based on test data of individual bomblet static tests-

[redacted]

WARHEAD, 762MM ROCKET, (GB-VX) GAS E 19R2 (CHARACTERISTICS)

WARHEAD FILLED WEIGHT: 1238# WARHEAD LENGTH: 115"

WARHEAD DIA: 30" (762MM) MAX RANGE: 39,000 Meters

UNIT MUNITION: E 130R2 MUNITION QUANTITY: 364 a 2.4# e.a

MUNITION WEIGHT: 873# AGENT WT: 462#

MUNITION FUZE: XM 912 - Centrifugal Arming, All-ways, Impact

FUZE ARMING SPEED: 1800 RPM LAUNCHER: M386, M289, XM33

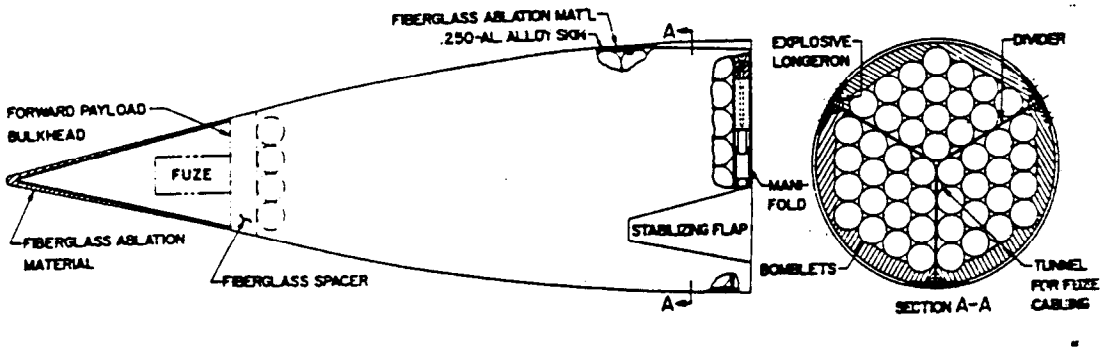
WARHEAD OPENING: Primacord WARHEAD FUZE: AT-T2075

The XM-50 Rocket consists of 1 ea E 19R2 Warhead and XM-31 motor

HANDLING-SAFETY: See CWL Tech Memo 30-41 ROCKET MOTOR: XM-31

NOTE: This warhead is also being considered for BW

REFERENCES: ACC-T1-195. CLMC Board Report titled "Casualty Effectiveness of Toxic CW Munitions," dated 6/27/58. Chemical War. Lab. Tech. Memo 30-19 (Conf.)




NOMENCLATURE: Warhead, Pershing Missile (GB-VX)

TYPE: Surface to Surface - Solid Propellant

PURPOSE: Dissemination of Chemical Warfare Agents

STATUS: Feasibility Study complete. F.E.T. scheduled to be complete by December 1962.

DESCRIPTION: The CW warhead for the Pershing is based on the utilization of self-dispersing munitions, or bomblets, clustered within the missile nose section. The clustering of the bomblets requires a special warhead system design which will release the bomblets into the airstream at a predetermined altitude upon receipt of a fuzing signal. The ground impact pattern may be increased in size by increasing the altitude of bomblet release, or vice versa. The maximum pattern size for a given release altitude will be limited by the glide angle of the bomblet. The E130R2 bomblet, which would be used in the warhead, glides at an angle of about 20° with the vertical. This glide angle is sufficient to achieve maximum utilization of the agent potential. This study indicated that the Pershing missile will be an effective delivery for a GB warhead if proposed modifications to the nose section are technically feasible, and can be incorporated into the weapons system concept. At a predetermined altitude the payload compartment is opened by explosive means, allowing the bomblets to release into the airstream. The payload compartment is divided longitudinally into three equal sections. The proposed method of skin separation utilized three explosive longerons within which are housed a linear shaped charge.

AREA COVERAGE: It is estimated that with a CPE of 400 meters, under neutral meteorological conditions, 30% casualties will be produced in target areas 1.1 sq. miles with a GB payload. If an attack can be timed to take advantage of moderate inversion conditions casualties can be obtained in target areas of 4 sq. miles. A CPE of 600 meters does not greatly reduce casualty effects in targets over 1 sq. mile in area.

[redacted]

WARHEAD, PERSHING MISSILE, (GB)

CHARACTERISTICS:

NOSE SECTION WEIGHT: 1900# (Modified from Std Head)

MUNITION USED: E130R2 Bomblet (approx 537 a 2.4# ea - 1290#)

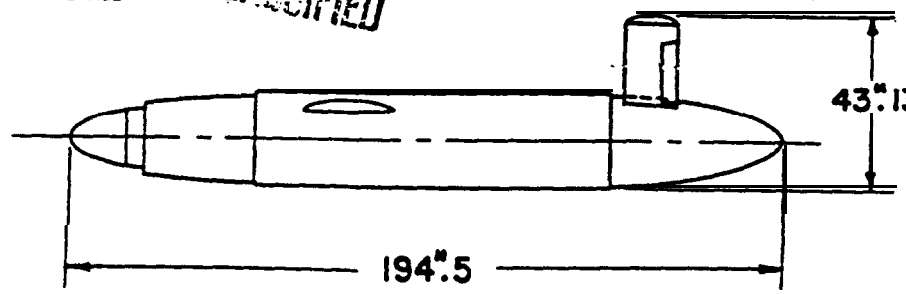
FUZE: Barometric

RANGE: 100 to 300 Nautical miles

Other characteristics are Secret. See CWL Tech. Memo 30-49 &ted Jan 1960 which is Secret.

REFERENCE: CWL Tech Memo 30-49 dated Jan 1960 Secret.

[redacted]




NOMENCLATURE: Drone Xeapons System, Multipurpose, AN-USD-2

TYPE: Remote controlled - (Low endurance) - Recoverable

PURPOSE: Dissemination of BW/CW agents.

STATUS: Feasibility study complete on BW/CW. Now under development. T.C. expected FY-62.

CAPABILITIES: Developed for use as a toxic gas dissemination system, BW agent dissemination system, as well as for combat surveillance usage. For new battlefield stratagems, the target location for BW is not accurately required, Timing for enemy incapacitation can be selected, and roads and facilities are not destroyed in compromising the enemy. The advantages of the modular concept with removable tank are as follows:

Modules are prepared in the zone of interior and can be installed in the field. Transfer of agents in the field is not required and the shipping container can be handled as a unit massive bomb.

AREA COVERAGE: For BW agents, payload can be disseminated at 2 preset rates, 11.6 and 23.2 gallons per minute, giving dissemination lines 5 and 10 nautical miles in length. The extent of downwind effects depends on the meteorological conditions on the agent used. For CW agents' an effective downwind dispersion from 775 to 1900 ft was determined, Considering a wind velocity of 5.7 knots, a drone dispersing velocity of 200 knots, and a VX agent flow rate of 2.29 gal/sec, an effective lethal area coverage of 255,000 to 625,000 sq meters can be realized using the recoverable drone. Under a similar condition with a non-recoverable drone the effective coverage would be 425,000 to 1,043,000 sq meters with a lethal dosage of VX. Due to lack of test data only lethal dosage was considered. It is realized that the area covered by an incapacitating dosage would be greater. New CW incapacitating agents are being developed which will probably be suitable for dissemination with this system.

[redacted]

DRONE WEAPONS SYSTEM, MULTIPURPOSE; AN-USD-2 (CHARACTERISTICS)

OVERALL LENGTH: 194".5

WING SPAN: 160".0

EMPTY WEIGHT: 790#

PAYLOAD: 210# approx.

MAX SPEED: 300 knots

MIN SPEED: 110 knots

SERVICE CEILING: 20,000 ft.

DISPENSING ALTITUDE: 100 to 250 ft.

DISPENSING VELOCITY: 200 to 300 knots

MAX ALTITUDE: 20,000 ft

TARGET ACCURACY: ±1% range

NOZZLE LOCATION: tail

BODY DIA: 23".0

OPERATIONAL WEIGHT: 1500#

AGENT USED: Liquid BW/CW

POWER PLANT: 232HP

CRUISING SPEED: 236 knots

OPERATING TIME: 45 Min (Min)

METHOD OF LAUNCH: zero

DRONE CAPACITY: 25 gal

MIN. ALTITUDE: 250 ft

RADIUS OF ACTION: 100 N. miles

READYTIME: 240 *min.*

GUIDANCE: Line of sight command and pre-programming.

REMARKS: Parachute recovery will be used. See USD-4 and USD-5 for other drone systems in this report.

REFERENCES: CWL Tech Memo 30-46. DA Report 9001. (Conf.)
Contract DA-18-064-404-CML432-AEROJET General



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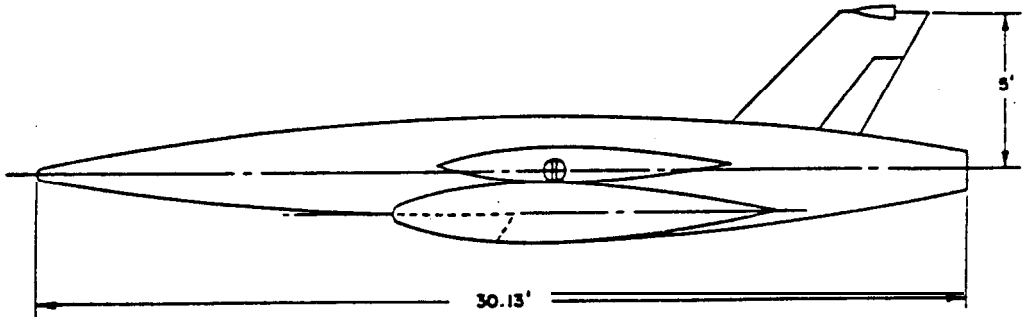


NOMENCLATURE: Drone Weapons System, Multipurpose AN-USD-4

TYPE: Remote controlled - Medium endurance - Recoverable

PURPOSE: Dissemination of BW/CW agents

STATUS: Feasibility study complete. Requirement cancelled.

DESCRIPTION: The system is designed to launch a drone for either low or high penetration of enemy territory to disseminate BW/CW agents and return the drone to its launch point for recovery by parachute. Guidance is by pre-programmed inertial system using a Minneapolis-Honeywell inertial platform. There is also employed a short range "Line-of-Sight" command guidance system. The drone can be launched from a zero launcher mounted on a flatbed trailer. Jato boosters are used for launching and are mounted beneath the drone. Two different size boosters are used. The drone can carry external tanks mounted under the wings.

AREA COVERAGE: Two basic premises are used to determine the ability to cover the target area. The first assumes that the rate of dissemination covers a 1000 ft. width with 100 mg per sq. meter, and the second assumes that more than one parallel pass over the target area can be made. At a @average of 100 mg per sq. meter over a 1000 ft. width the rate of dissemination would be 125# per nautical mile of travel over the ground., For example: 8 nautical miles would be traversed to dispense 1000# of agent.

On'the basis of the analysis, calculations indicate that to cover a 100 ft. wide line target such as a road at a distance from launch of 75 nautical miles one pass with Line-of-Sight guidance will cover the target with 95% probability. With inertial guidance alone, two parallel passes will be required to insure 95% probability of covering the target. At a distance from launch of 150 nautical miles one pass with Line-of-Sight guidance will still cover the target but with inertial guidance alone it will take 5 successive parallel passes to assure 95% probability.

[redacted]

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## DRONE WEAPONS SYSTEM, MULTIPURPOSE AN-USD-4 (CHARACTERISTICS)

OVERALL LENGTH: 31.1 ft.

WING SPAN: 11.45 ft.

FUSELAGE O.D.: 30"

TANK O.D.: 18"

EMPTY WEIGHT: 2992#

AGENTS: Liquid BW/CW

NOZZLE LOCATION: Tail

CEILING: Above 35,000 ft.

TARGET ACCURACY: 1% of range

READY TIME: 240 min.

METHOD OF LAUNCH: zero

ENGINE: J-60 Turbojet

GUIDANCE: Preprogrammed Inertial or Line-of-Sight

DISPERSING ALTITUDE: 250 ft. to 35,000 ft.

MAXSPEED: Mach. 0.9 sea level, mach. 1.4 at altitudes

MIN SPEED: Below 200 knots

MAX ENDURANCE AT MACH. 0.9: 55 min. at sea level.

SEA LEVEL PERFORMANCE WITH TWO100 GAL. TANKS

| | UNITS | BW | | | CW | | |
|---|---|---|---|---|---|---|---|
| Initial Gross Wt. | lb | 5478 | 5727 | 5911 | | | 5911 |
| Payload Fuel | lb | 1235 | 654 | 1668 | 5478 | 5727 | 1668 |
| % Vol. of Tanks used for payload | % | 0 | 50 | 100 | 1235 | 650 | 100 |
| Spray Time | min | 0 | 5.0 | 10.1 | 0 | 2.02 | 4.04 |
| Distance of Spray | N.Mi | | | | 0 | 6.7 | 13.4 |
| Vel. During Spray | Knots | 0 | 37.7 | 75.4 | 0 | 200 | 200 |
| Spray Rate | lb/min | 0 | 462 | 462 | 0 | 412 | 414 |
| Cruise Speed | Knots | 434 | 434 | 423 | 434 | 436 | 435 |
| Max. Radius/Action | N.Mi | 302 | 217 | 125 | 302 | 214 | 117 |
| Max. Range | N.Mi | 561 | 399 | 232 | 361 | 390 | 219 |
| Cruise Altitude | ft | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |

REFERENCES : Cornell Aeronautical Laboratories Report CM 1212412 aatea 15 Dec 1959 (Conf.). DA Project 3D58-01-001-04 Republic Aircraft

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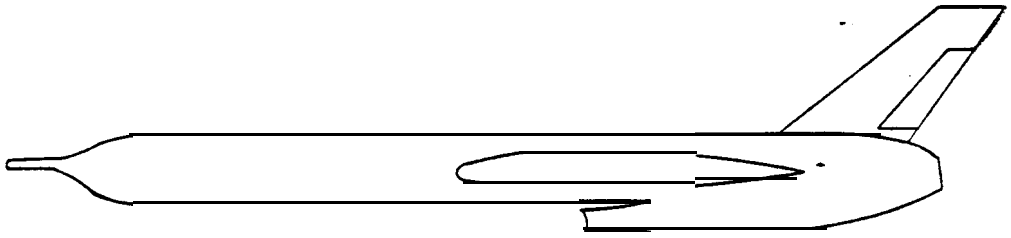

NOMENCLATURE: Drone Weapons System, Multipurpose. AN-USD-5

TYPE: Remote controlled - Recoverable - Long endurance

PURPOSE: Dissemination of BW/CW agents

STATUS: Feasibility study completed. Held in-abeyance. May be developed later.

CAPABILITIES: Capable of human incapacitation, the degree is dependent upon the agent used. For new battlefield stratagems, broad battlefield coverage, and weapon effectiveness, the target location for BW is not accurately required. Timing for enemy incapacitation can be selected, and roads and facilities are not destroyed in compromising the enemy. Can change heading, altitude, speed, and commands to subsystems in a preprogrammed manner. (See remarks)

REMARKS: This is one of several systems investigated. See USD-2 and USD-4 for other systems in this report.

AREA COVERAGE: To be determined.

[redacted]

DRONE WEAPONS SYSTEM, MULTIPURPOSE AN-USD-5 (CHARACTERISTICS)

LENGTH: 36'7"

WING SPAN: 24'8"

WING AREA: 200 sq. ft.

ENGINE: P&W-J60-P-2

ENGINE THRUST: 2900#

PAYLOAD: 1260#

CRUISE SPEED: Mach. 0.75+

OPERATION RADIUS: 278 to 669 N. Mi.

AGENT CAPACITY: 200 gal liquid

MAX. WEIGHT AT LAUNCH: 101800# includes Booster

FUEL LOAD: 3007#

AGENT PRESSURE: 30 PSI

NAVIGATIONAL ACCURACY: 1% of range travel

METHOD OF LAUNCH: Zero (from trailer or other fixture)

GUIDANCE: Preprogrammed inertial

MAX. ALTITUDE: 35,000 ft.

NOZZLE LOCATION: Tail

RANGE: 350 N. Miles

READY TIME: 255 min

SAFETY-HANDLING: To be determined.

REFERENCES: Fairchild Report M-280G BW/CW Weapons System dtd Dec 1960 which is Secret.

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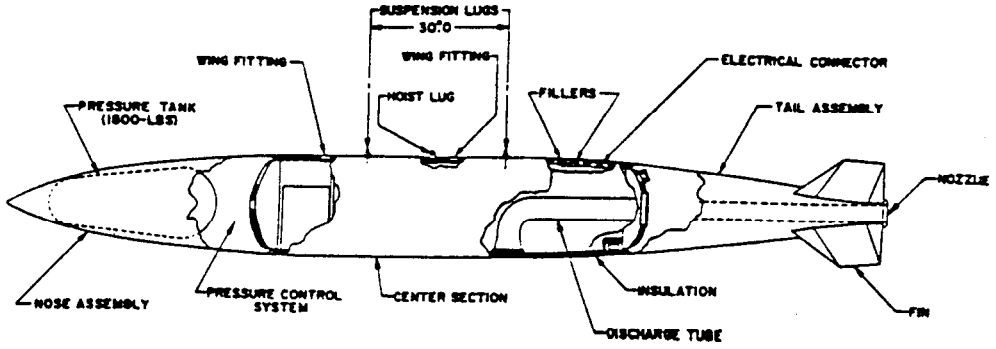


NOMENCLATURE: Tank, Aircraft, Liquid Spray, Aero 14B

TYPE: Air to Surface - Single Fluid

PURPOSE: To provide BW/CW offensive capability

STATUS: Std. USN. No stock *on* hand as of 30 Dec 1960.

DESCRIPTION: The Aero 14B Spray Tank is *a* pressure controlled, combination storage and airborne dispersion medium for various liquid agents. The major components are nose section, center section, tail section, pressure control system, and the tail pipe assembly. An 1800 PSI tank is located in the nose and a regulator reduces this pressure to 100 PSI for operation. The discharge nozzle is located at the rear of the tail section. Four removable fins are bolted on the tail section. The center section contains the agent reservoir. A pneumatically operated valve releases the agent through the discharge tube and nozzle and is controlled by the pilot. Suspension is 2 lug 30". These tanks are being tested with BW agents.

The Edo Corp. has a contract to develop a more efficient dissemination system and tests are planned for early 1961.

AREA COVERAGE: With the use of greatly reduced flow rates and increased release height-wind speeds ratios, area coverages have been roughly estimated to be from 50 to 150 sq. tiles. from the use of one spray tank full of agent. Maximum area coverage at the 100 Mg-M2 level on trial CW 442-B3 was 546,252 sq. meters. Area coverages in excess of 500,000 sq meters from a single tank, are predicted for a large range of release height-wind speeds ratios. See DPGR 247 far more detailed coverage.

[redacted]

TANK, AIRCRAFT SPRAY, AERO 14B (CHARACTERISTICS)

GROSS WEIGHT: Varies from approx. 1400 to 2000 lbs depending upon the agent.

EMPTY WEIGHT: Approx. 650 to 657 lbs VOID: 10%

AGENT WEIGHT: Approx. 725#

BUAER DRWGS: 20515 and 54A50E1

PRESSURE TANK: 1800 PSI; OPERATING PRESSURE: 100 PSI

BODY MATERIAL: Aluminum SUSEPNSION: 2 lug - 30"

OVERALL LENGTH: 190.0 MAX DIA: 221'0

AGENT CAPACITY: 84 gal

FINS: Min. of 2 fins req'd for gravity drop (4 Provided). Adjustable in' 45" increments. No Pins req'd for ejector type racks.

HANDLING-SAFETY: NAVAER 11-45-600 (Unclassified) and NAVAER 11-45-601 (Secret)

DEVELOPMENT HISTORY: Developed under operational requirements CWO3401 and CWO3402 by the Edo Corp.

REFERENCES: NAVAER 11-45-600, NAVAER 11-45-601 Secret), DPGR247, DPG#CW-442

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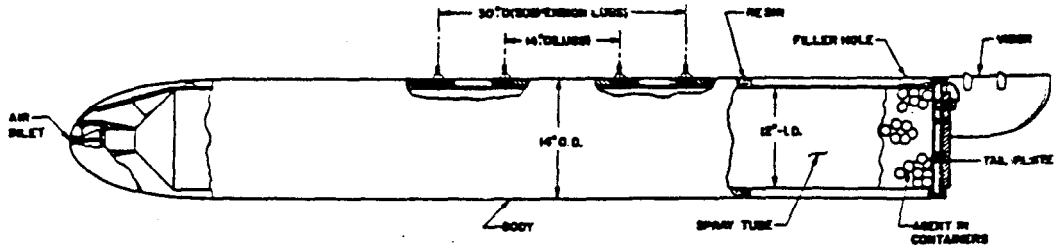


NOMENCLATURE: Tank, Chemical Aircraft, MK 12 MOD 0

TYPE: *Massive* - Air to Surface - Spray

PURPOSE:' Providing smoke screens. May be capable of disseminating toxic agents

STATUS: USN - USMC. Recommended for T.C.

DESCRIPTION: This item is designed to generate smoke screens from aircraft. It consists of a 12" cylindrical tube 92" *long* faired with a 14" cylindrical tube. A 2-5/8" glass plate is used as a closure in the *nose* inlet to permit ram air to be used as the discharge pressure. The tank Is filled with 500 spheres 2.7 dla after the spheres are In place, the tank is filled under vacuum with FS agent, This method completely fills the spheres and the void around them.

The tail plate is hinged at the bottom and is secured by a mechanism actuated by an explosive bolt designed by N.W.L., Dahlgren. The MK-1 Filling Unit is used to fill the spray tank. Drawings, specifications, and manuals are being prepared by the contractor Aircraft Armaments,

AREA COVERAGE: From an air emission altitude of 75 to 250 ft at speeds up to 450 MPH, satisfactory smoke curtains approx 250 ft high x 1200 ft long have been formed. Firing the tanks "In Train" extends the length to about 2000 ft. At impact the spheres developed sufficient force to eject the caps and a cloud (approx 6 ft dla x 8 ft high) of very small droplets was formed. The impact points of the spheres were so dense that the clouds merged into a solid wall which was carried downwind.

[redacted]

NAVORD REPORT 6954 (FIRST REVISION) UNCLASSIFIED [redacted]

TANK, CHEMICAL AIRCRAFT MK 12 MOD 0 (CHARACTERISTICS)

LENGTH: 115" 0 DIA.: 14" I DIA.: 12" (Spray tube)

WEIGHT: 290# empty, 1100# full AGENT: S

AGENT CAPACITY: Approx. 40 gal. DRWG: Being prepared

FILLER: 500 spheres 2"7 Dia. 250 are drilled with 1/8" hole and 250 with a 1/2" hole.

SUSPENSION: 14 and 30 inch

FUNCTIONING: On command of the aircraft pilot the nose closure is ruptured by a detonator and the tail closure mechanism is actuated by the explosive bolt. This results in the ejection of the contents of the tank. The bulk agent around the spheres form a dense cloud of smoke at aircraft altitude. The 1/4" hole spheres discharge their contents during decent to form a vertical curtain and the 1/8" hole spheres rupture on Impact to form a dense cloud of smoke at ground level.

DEVELOPMENT HISTORY: Was E-33 In development

REMARKS: It is possible that this system can be adopted for the use with toxics, as the cloud generated would contaminate personnel and material and also enter the respiratory system. The agent around the spheres could be thickened to assure the decent of the cloud to the ground. Also being investigaged for CS.

NOTE: These tanks have been carried on USAF-F80, F86, A4D, and -satisfactorily on the FJ-4B at 414 knots.

REFERENCES: TM 3-400, TM 3-2.55

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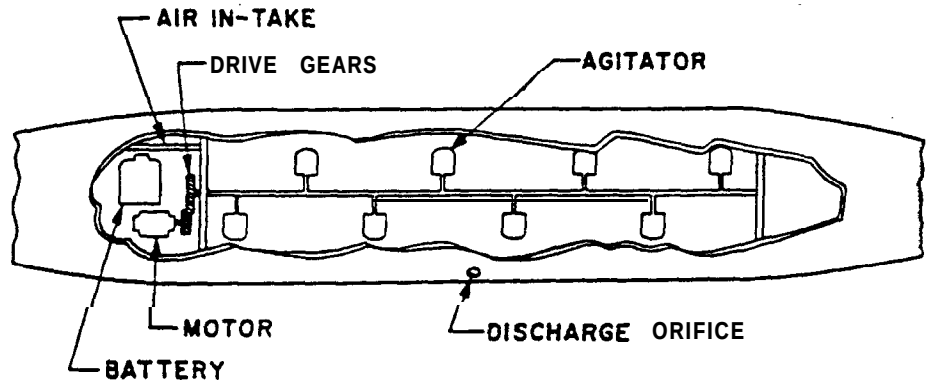


NOMENCLATURE: Tank, Aircraft Spray, Aero X-2A

TYPE: Wing Tank - Massive--Air to Surface

PURPOSE: Dissemination of dry BW agent from aircraft for anti-personnel and anti-crop effects.

STATUS: Non Std - USN. There is a possibility that this tank may be modified and used with other agents.

DESCRIPTION: A wing tank that can be used with fighter or fighter bomber aircraft. Operates on an experimentally observed phenomenon that a fine, dry, particulate material, when agitated within a pressurized container, assumes fluid like properties. In this state the particulate material will flow thru an orifice, obeying the fluid flow laws, in that flow rate is proportional to the square root of the pressure head.

Ram air is used to pressurize the container, providing a self regulating condition in that, as the speed is increased, the pressure head increases--thus increasing the flow of material thru the orifice. Flow rate can be adjusted by changing the orifice size to provide rates from 2.2 pounds to 10 pounds per nautical mile for material having a density of 0.2 gram per cubic centimeter, or as high as 21 pounds per nautical mile at a density of 0.5 gram per cubic centimeter. Large areas could be covered by low flying aircraft.

LIMITATIONS: Dependent upon agent used and meteorological conditions. Must be released at low levels.

[redacted]

NAVORD REPORT 6954 (FIRST REVISION) UNCLASSIFIED [redacted]

TANK, AIRCRAFT SPRAY, AERO X-2A (CHARACTERISTICS)

OVERALL LENGTH: 198"1/4

EMPTY WEIGHT: 475#

MAX. AGENT WEIGHT: 300#

AGENT: Dry BW

O. DIA: 22"

MAX. LOADED WEIGHT: 775#

F. E.: 38.7%

CAPACITY: 15,280 cu. In.

HANDLING SAFETY: TM 3-400

REFERENCES: Ft. Detrick Tech Study 9 dtd June 1958, TM3-400, Gen. Mills "Handbook, Operations, and Service Instructions." 57-FDS-1619

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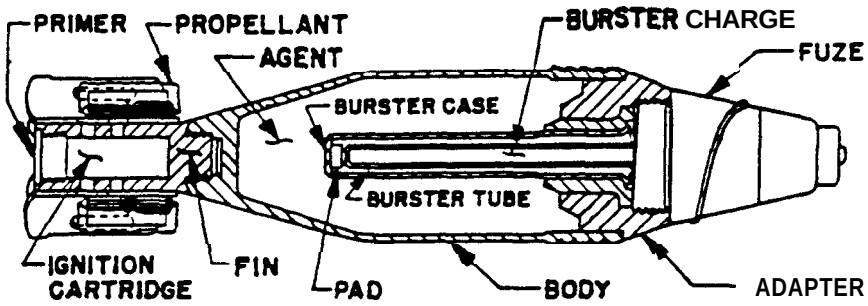


**NOMENCLATURE:** Cartridge, Mortar, 60MM (WP) M302

TYPE: Semi-fixed - Central Burst - Fin Stabilized

PURPOSE: Anti-personnel, Spotting, Screening and Incendiary

STATUS: Ltd Std USA.

DESCRIPTION: This is a semi-fixed, fin stabilized, central bursting type round used with WP for spotting, screening, anti-personnel, and limited incendiary effects. The round is composed of six major components - the body, PD fuze, fin-assembly, propelling charge of four increments, ignition cartridge and primer. The body is a thin-wall steel casing with cylindrical side walls, and conical base which is threaded to receive the shaft of the fin assembly.

The front end is closed with an adapter which holds the fuze and the burster casing. The burster extends about three fourths the length of the round cavity, which upon functioning bursts the casing to release the chemical contents. The WP Ignites and burns spontaneously on contact with air. Used with 60MM mortars M2 and M19.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min to adjust- fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 6 gun battery of 60 MM mortars, each firing at the rate of 18 rd/min could place 108 rd/min into the area to establish a smoke curtain. If the required curtain is established in 1 min with 108 rounds, then approx. 54 rds/min should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radius for anti-personnel effects is approx. 15 to 20 yards for one cartridge. See FM3-5 for other conditions.

[redacted]

CARTRIDGE, MORTAR, 60 MM (WP) M302 (CHARACTERISTICS)

FIRED WEIGHT: 4.0# FILLER-WEIGHT: WP - 0.76#

F.E.: 19% ASSY DRWC: 75-i-218

MAX RANGE: 1610 Yds(with 4 increments) MAX DIA: 2".36

FUZE: PD-M82A1B1 See Note 1 FIN: M2

BURSTER CHARGE: M19-0.023# HE BURSTER CASING: M8

PROPELLING CHARGE: M3A1 - 0.02# LENGTH OF RD: 11".07 with fuze

IGN. CARTRIDGE: M5A1 PRIMER: M32

USED WITH: 60MM Mortar M2 and M19 MUZZLE VEL: 439 ft/sec

HANDLING-SAFETY: See TM3-250

NOTE 1: Some rounds with PD M82A1B1, M82, M52B1E5, M82A1, and M52BE1, E2, E3 and E4

REFERENCES: OCM 26708, TM3-250, TM9-1901, ORD 11 SNL R-4 ARCR - II June 59, .FM 3-5, FM 3-8, TM3-200 and TM9-1900

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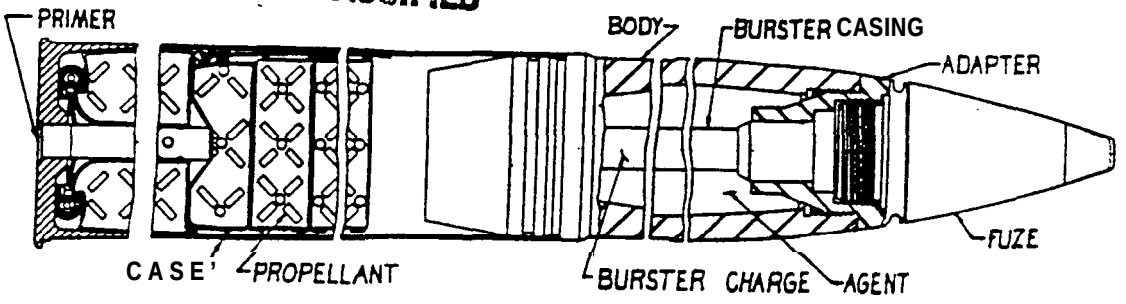


NOMENCLATURE: Cartridge, Howitzer, 75MM (WP) M64

TYPE: Semi-fixed - Smoke - Central Burst

PURPOSE: Anti-personnel, Spotting, Screening and Incendiary

STATUS: Ltd Std USA, Std USMC. 27873 in USMC stock Dec 1960

DESCRIPTION: This round is a semi-fixed, central burst, smoke producing cartridge which is used for spotting, screen-, incendiary and anti-personnel effects. Cartridge case, primer, and propelling charge are the same as those used with HE rounds. The projectile is similar to, and has the same ballistics as the M48 HE round. The nose is cut and threaded to hold an adapter which screws into the body. The adapter serves three purposes: to provide a tight seal for the chemical contents, to hold the fuze, and to provide a seat for the forward end of the burster.

The burster casing is a thin-walled steel tubular casing extending nearly the length of the filler cavity and contains a burster initiator charge to ignite the burster charge which ruptures the shell and disperses the chemical contents. Used with M1A1 and M3 Howitzers 75MM.

AREA COVERAGE: Assuming an 8MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 4 gun battery of 75MM Howitzers, each firing at the rate of 12 rd/min. could place 48 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 48 rounds, then approx. 24 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. Burst radius for anti-personnel effect is approx 20 to 30 yds for one cartridge. See FM3-[illegible] for other conditions.

[redacted]

CARTRIDGE, HOWITZER, 75MM,(WP) (CHARACTERISTICS)

PROJECTILE WEIGHT: 14.70# FILLER-WEIGHT: WP - 1.34#

COMPLETE RD WT: 18.89# MAX RANGE: 9620 yds

F.E.: 9.21%

CARTRIDGE DRWG: 75-1-114 FUZE: PD - M48A3 (See Note 1)

BURSTER CHARGE: M8 (0.11#) BURSTER CASING: M6

PROPELLING CHARGE: M1 (1.06#) CARTRIDGECASE: M5A1

PRIMER: M1B1A2, (See Note 2) MAX. DIA: 75MM

USED WITH: M1A1 and M3 Howitzers

CARTRIDGE LENGTH: 23.49 PROJECTILE LENGTH: 151'04 (With Fuze)

**HANDLING - SAFETY:** See TM3-250

REMARKS: Cartridge can also be loaded with CNS, H, L, and FS

NOTE 1: Some rounds on hand may have fuze PD-57

NOTE 2: Primer percussion M1, M1A1, or M1B1A1 may be used. Alternate is primer percussion M1A2

REFERENCES: OCM 16 167, ORD 3 SNL R-1, TM 9-1901, OCM 33067 ACRC 1959 FM 3-5, FM 3-8, TM3-250, TM3-200, TM9-1900

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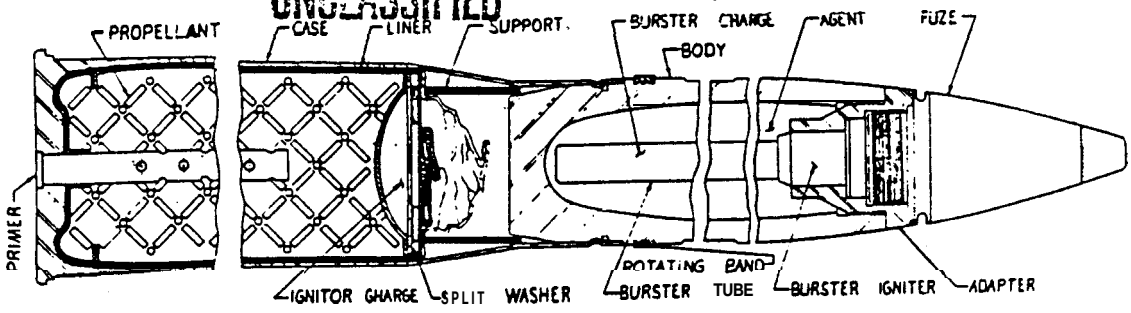


NOMENCLATURE: Cartridge, Rifle, 75MM, Smoke (WP) M311A1

TYPE: Fixed - Smoke - Central Burst

PURPOSE: Anti-personnel, Spotting, Screening and Incendiary

STATUS: Ltd Std USA, Std USMC. 4753 in USMC stock as of Dec 1960

DESCRIPTION: A fixed, central burst smoke munition which is used for spotting, screening, anti-personnel, and a very limited incendiary effects. Is similar to the M64 WP round except the base is turned to a slightly smaller diameter and a narrower pre-engraved rotating band. The nose of the round body is threaded to hold an adapter to provide a tight seal for the chemical filler, to provide a seat for the forward end of the burster casing, and to seat the fuze.

The burster is made up of the burster charge and burster initiator held in the burster casing, which is a thin wall cylindrical casing tube extending nearly the length of the filler cavity. With the PD fuze set "Superquick", a surface burst is obtained on Impact; or when set on "Delay" a burst is obtained after penetration or ricochet results. Used with M20 rifles.

AREA COVERAGE: Assuming an 8MPH wind, 60% RR, neutral temperature gradient and temperature above 60°F It normally requires about 3 min. to adjust fire on the target, and a smoke curtain Is established by volley firing smoke rounds Into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 6 gun company of 75MM Rifles, each firing at the rate of 6 rd/min. could place 36 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 36 rounds, then approx. 18 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radius for anti-personnel effect is approx. 20 to 30 yds for one cartridge. See FM3-5 for other conditions.

[redacted]

CARTRIDGE, RIFLE, 75MM SMOKE, (WP) M311A1 (CHARACTERISTICS)

PROJECTILE WEIGHT: 15.10#

COMPLETE RD WT: 22.78#

RANGE: 7020 yds

FUZE: PD M48A3 See Note 1

PROPELLING CHARGE: M10 (3.42#)

CARTRIDGE CASE: M31A1

INITIATOR BURSTER: M1

MUZZLE VEL: 2400 ft,'sec

CARTRIDGELENGTH: 28".92

FILLER WEIGHT: WP 1.35#

F.E.: 8.9%

DRWG NO: 75-l-225

BURSTER: M8 (0.07# or 0.11#)

BURSTER CASING: M6

PRIMER: M47

USED WITH: M20 Rifle

MAX DIA: 75MM

PROJECTILE LENGTH: 15 ".04 (with fuze)

HANDLING - SAFETY: See TM3-250

REMARKS: Shell is similar to 75MM M64 (WP)

NOTE 1: Some rounds assembled with fuze PD -M57. M48A3 has .05 sec delay

REFERENCES: TM9-1901, ARCR-1959, FM 3-5, TM3-250, TM3-200, TM TM9-1900, FM 3-8

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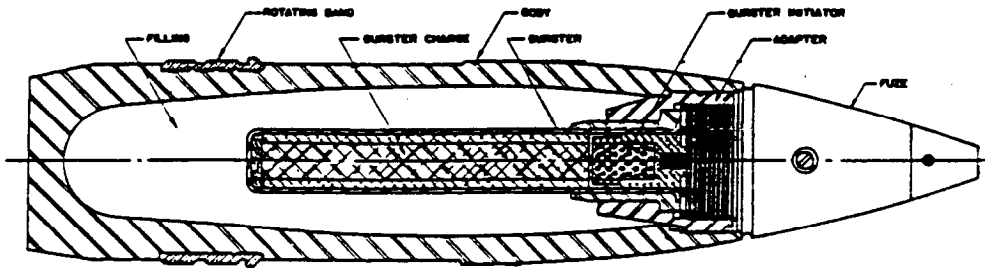


PROJECTILE ILLUSTRATED

NOMENCLATURE: Cartridge, Gun, 76MM, Smoke, (WP) M361

TYPE: Fixed - Central Burst

PURPOSE: Anti-personnel, Spotting, Screening, and Incendiary.

STATUS: Std. USA and USMC. None In USMC Stock as of Dec 1960.

DESCRIPTION: This is a fixed, central burst smoke munition used for spotting, screening, anti-personnel, and very limited incendiary effects. The body of the round is similar to that of the HE round externally except that the walls are thinner just forward of the rotating band. An adapter serves as a seat for the fuze, holds the forward end of the burster tube and provides a tight seal for the chemical filler. The burster tube extends approximately two thirds the length of the cavity.

The round if fitted with a PD fuze for superquick action on impact, giving surface burst and effective dissemination of the chemical filler, An outstanding. characteristic of this round is the "case-over band" construction which permits the case to be assembled over the rotating band and be ridgidly crimped to it. A burster initiator is located in the forward end of the burster tube. For use with 76MM guns M32 or M48.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desire

For example a 10 gun company of 76MM guns, each firing at the rate of 6 rd/min. could place 60 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 60 rounds, then approx. 30 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radius for anti-personnel effects is approx. 20 to 30 yds for one cartridge. See FM3-5 for other conditions.

[redacted]

CARTRIDGE, GUN, 76MM, SMOKE (WP) M361 (CHARACTERISTICS)

COMPLETE RD WT: 25.8#

PROJECTILE WT: 15.71#

BURSTER CASING: Ml.2

BURSTER INITIATOR: M2

PRIMER: M68 or M58

MUZZLE VEL: 2400 ft/sec

CARTRIDGE LENGTH: 34".05

MAX DIA: 2".99

FILLER WT: 1.38# WP

F. E.: 8.8%

BURSTER CHARGE: M23 (0.16#)

CARTRIDGE CASE: M88

FUZE: PD-48A3

MAX RANGE: 16070 yds

PROPELLANT: M6 (3.64#)

PROJECTILE LENGTH: 14".46 with fuze

ASSY DRWG: 75-I-367

P. E. IN MILS: 0.125 and 0.150 at 1000 and 2000 yds

USED WITH: 76MM Gun M32 or M48

HANDLING SAFETY: See TM3-250

DEVELOPMENT HISTORY: In development was designated T-140.

REFERENCES: TM9-1900, TM9-1901, FM3-5, FM3-8, TM3-200, TM3-250, ACRC I959, DPS/OTA-33 of Aberdeen Proving Grounds, Md. TM9-1300-203.

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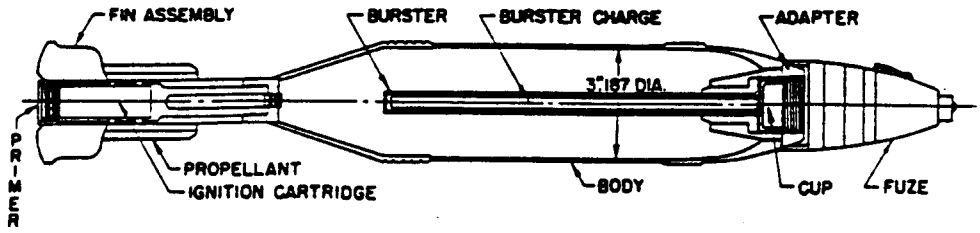


NOMENCLATURE: Cartridge, Mortar, 81MM (WP-FS) M57A1

TYPE: Semi-Fixed - Central Burst - Fin Stabilized

PURPOSE: Anti-personnel, Spotting, Screening, and Incendiary

STATUS: Ltd STD USA. Std. USMC. 144,281 in USMC stock as of Dec 1960

DESCRIPTION: This is a semi-fixed, fin stabilized, central burst round used with WP or FS smoke for spotting, screening, and anti-personnel effects. The round consists of a body; PD fuze, fin assembly, propelling charge, ignition cartridge, primer, adapter and burster. The adapter is located at the forward end of the round cavity and supports the burster tube as well as holding the fuze. The adapter also acts as a tight seal which is necessary for the chemical filling.

The burster is a thin-walled tube which extends about three-fourths the length of the cavity. The burster casing is a press fit into the adapter. The burster functions to release the chemical contents. Used with 81MM mortars M1 and M29.

AREA COVERAGE: (WP) assuming an 8MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 8 gun battery of 81MM mortars, each firing at the rate of 15 rd/min. could place 120 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 120 rounds, then approx. 60 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radius for anti-personnel effects is approx. 20 to 30 yds. for one cartridge. See FM3-5 for other conditions.

[redacted]

## CARTRIDGE, MORTAR, 81MM, (WP-FS) M57A1 (CHARACTERISTICS)

COMPLETE RD. WEIGHT: 11.88# FS
11.38# WP

FILLER--WEIGHT : WP (4.06#) SEE NOTE 2
FS (4.59#)

RANGE: 2330 Yds/4 increments.

DRWGS: 75-1-93, 75-1-94

FUZE: PD-M525A1 SEE NOTE 1

BURSTER CHARGE: M1 (0.08# HE)

USED WITH: 81MM Mortar M1 and M29

FIN: M4A1

F.E.: 40.4% - FS

F.E.: 35.7% - WP

LENGTH: 22.91 with fuze M525A1
24.39 with fuze M77

PRIMER: M34

BURSTER CASING: M2

MAXDIA: 81MM

IGN. CARTRIDGE: M6

MUZZLE VEL: 535 ft/sec.

PROPELLING CHARGE: M2A1 (820 Grains) 4 Increments

HANDLING--SAFETY: See TM3-250

NOTE 1: Alternate fuze PD-525. Also may use TSQ M77 fuze.

NOTE 2: This shell can also be used with FS smoke filler using TSQ fuze M77.

REFERENCES: OCM 15674, TM3-250, FM3-5, TM9-1901, TM9-1900
ORD 11 SNL R-4, FM3-8, TM3-200, ACRC 1959

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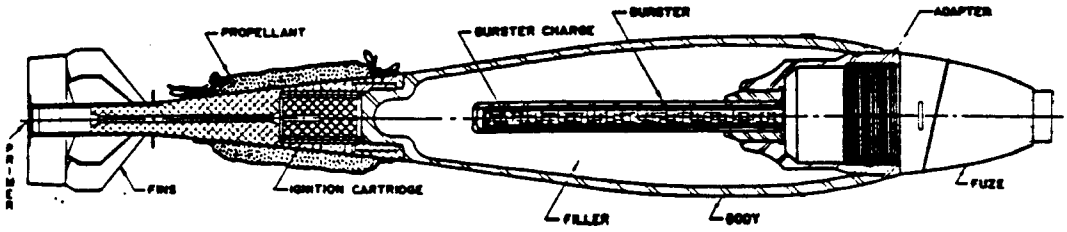


NOMENCLATURE: Cartridge, Mortar, 81MM, Smoke (WP) M370

TYPE: Semi-fixed - Central Burst - Fin Stabilized

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Std. USA and USMC (No USMC Stock as of 31 Dec 1960)

DESCRIPTION: This is a semi-fixed, central burst, fin stabilized round used with WP for spotting, screening, or anti-personnel effects. The round consists of a body, fuze, burster, ignition cartridge, propellant, fin assembly, primer, adapter and WP filling. The front end of the burster tube is a press fit into the adapter which also holds the fuze and provides a tight seal for the chemical agent.

The base of the round is externally threaded to receive the fin assembly. The burster casing is thin-walled and extends about three-fourths the length of the cavity. When the burster functions the chemical contents are released. Used with 81MM Mortars Ml or M29.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 8 gun battery of 81MM mortars, each firing at the rate of 15 rd/min. could place 120 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 120 rounds, then approx. 60 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radius for anti-personnel effects is approx, 10 to 30 yds. for one cartridge. See FM3-5 for other conditions.

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CARTRIDGE, MORTAR, 81MM, SMOKE (WP) M370 (CHARACTERISTICS)

COMPLETE RD WEIGHT: 9.34#

**LENGTH:** 20".76 with fuze

**FILLER--WEIGHT:** WP 1.60#

DRWG: 75-1-299

PRIMER: M71 (0.04#)

F. E.: 17.2%

FUZE: PD M524 (Alternate PD M526 or VT 517)

**BURSTER CHARGE:** M47-0.07#

FIN: M141

PROPELLANT: M5 (1400 grains) 8 Increments

**IGN.** CARTRIDGE: M66

MAX. DIA: 3".18

RANGE: 4,000 Yards approx. at 45° elevation

**USED WITH:** 81MM Mortar M1 or M29

**BURSTER CASING:** M2

HANDLING--SAFETY: See TM3-250

REFERENCES: OCM 15674, ORD 11 SNL R-4, TM9-1901, ACRC-II June 1959, FM3-5, TM3-250, FM3-8, TM3-200, TM9-1900

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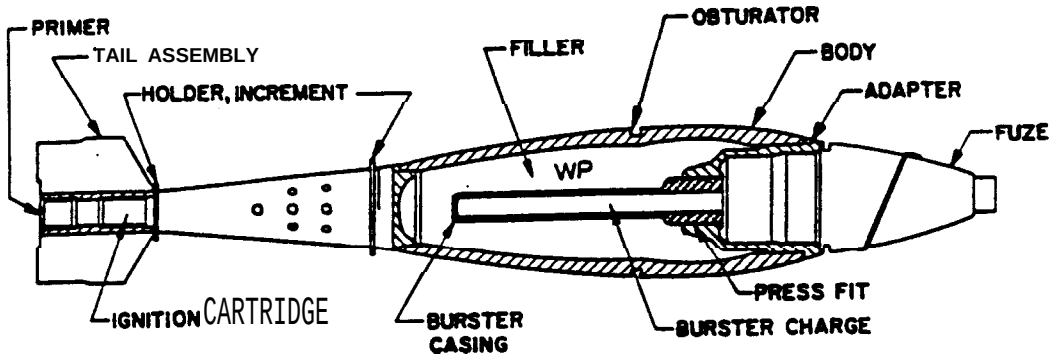


NOMENCLATURE : Cartridge, Mortar, 81MM (UP) XM-375E1

TYPE: Semi Fixed - Central Burst - Fin Stabilized

PURPOSE: Anti personnel - Spotting - Screening - Incendiary

STATUS: Development Tests. TC Scheduled 4Q FY62

DESCRIPTION: This is a semi fixed, central burst, fin stabilized round filled with WP for spotting, screening, anti-personnel and limited Incendiary effects. The major components are body, fuze, adapter-burster, burster charge, ignition cartridge, propellant, and fin assembly. The front end of the burster-adapter casing is a press fit into the shell body. The PD fuze screws Into the adapter.

The base of the round is threaded to receive the fin assembly. The adapter-burster casing is one piece aluminum and extends about three fourths the length of the shell cavity. This is essentially an M376-HE modified to Incorporate an aluminum burster and a plastic obdurating band.

AREA COVERAGE: To be determined

[redacted]

CARTRIDGE, MORTAR, 81 MM (WP) XM375E1 (CHARACTERISTICS)

FIRED WT: 8.80# FILLERWT: 1.65# F.E.: 17.1%

LENGTH: 20"76 (with fuze)

MAX DIA: 3"18

FUZE: PD-526A1

FIN: M141

IGN. CARTRIDGE: M66

PROPELLANT: M9 (8 Increments)

PRECUSSION PRIMER: M71 (0.04#)

MAX. VEL: 820 Ft/Sec

BURSTERCHARGE: T46E

PRIMER: M71E1

BURSTER CASING: M2

MAX RANGE: 5000 yds approx.

FRANKFORD DRWG: FD21784

LOAD DRWG: FF9055 and FD21870

PICATINNY DRWG: XP112957

USED WITH: 81MM Mortar M1 or M29

HANDLING SAFETY: See TM3-250

REFERENCES: TM9-1900, TM9-1901, FM3-5, FM3-8, TM3-200, TM3-250

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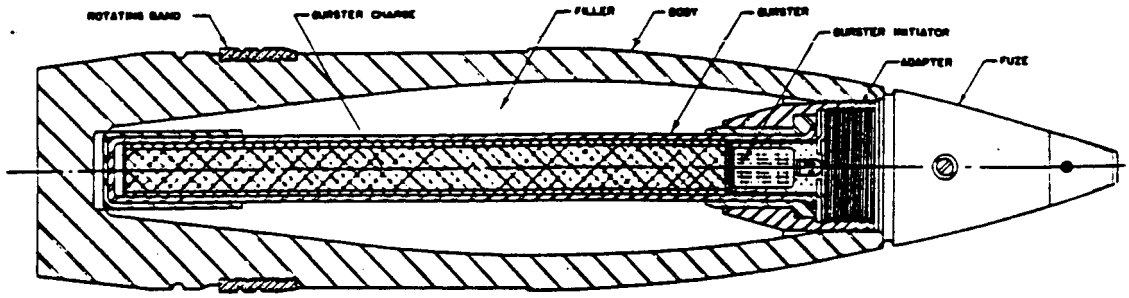


PROJECTILE ILLUSTRATED

NOMENCLATURE: Cartridge, Gun, 90MM, Smoke (WP-T) M313E1

TYPE: Fixed - Central Burst

PURPOSE: Anti-personnel, Spotting, Screening, and Incendiary.

STATUS: Std. USA and USMC. 95,920 in USMC stock as of Dec 1960.

DESCRIPTION: A fixed, central burst munition used for anti-personnel, spotting, screening, and limited incendiary effects. This round resembles the HE shell in external appearance, has a boat-tail, and the ogival nose is threaded for an adapter. The adapter provides a tight seal for the chemical filler, and is threaded internally to receive a PD fuze.

It also provides a seat for the forward end of the burster casing -which is a thin-wall steel tube extending the full length of the body cavity. The burster initiator charge is in the forward end of the burster, directly behind the fuze, and ignites the burster charge that ruptures the casing and disperses the chemical. Used with 90MM tank guns M36, M41, and M54.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 17 gun company of 90MM guns, each firing at the rate of 4 rd/min. could place 68 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 68 rounds, then approx. 34 rds/min. should maintain the curtain. For a blinding and casual-effect WP is fired directly on the target at the Same rate required to establish the curtain. The burst radius for anti-personnel effects is approx. 15 to 30 yds for one cartridge. See FM3-5 for other conditions.

[redacted]

## ,RTRIDGE, GUN, 90MM,(WP-T) M313E1 (CHARACTERISTICS)

PROJECTILE WEIGHT.: 23.64#

FILLER-WEIGHT: WP-1.97#

COMPLETE RD. WT: 41.93#

DRWG. NO.: 501 and 75-l-224

F. E.: 8.35%

MUZZLE VEL: 2400 ft/sec.

MAX RANGE: 19560 Yards

BURSTER CHARGE: M24 (HE-0.31#)

FUZE: M48A3-PD

INITIATOR BURSTER: M2

BURSTER CASING: Ml3

PRIMER: M49 and M28B2 Perc

PROPELLANT: M6, Ml5 (5.39#) See Note 1

CARTRIDGE CASE: M19B1 See Note 2

PROJECTILE LENGTH: 16.34 (With Fuze)

CARTRIDGE LENGTH: 37.46

MAX. DIA: 90MM

USED WITH: M36, M41, and M54 - 90MM Tank Gun

SAFETY-HANDLING: See TM3-250

REMARKS: Similar to M71 HE with MT-M43A5 fuze

NOTE 1: M6 is smokeless and M15 is smokeless and flashless.

NOTE 2: Alternate CTG case M19.

REFERENCES: OCM32055, TM3-250, TM9-1901, ORD3SNL P-5, FM 3-5, ACR 1959, TM3-200, TM9-1900, FM3-8.

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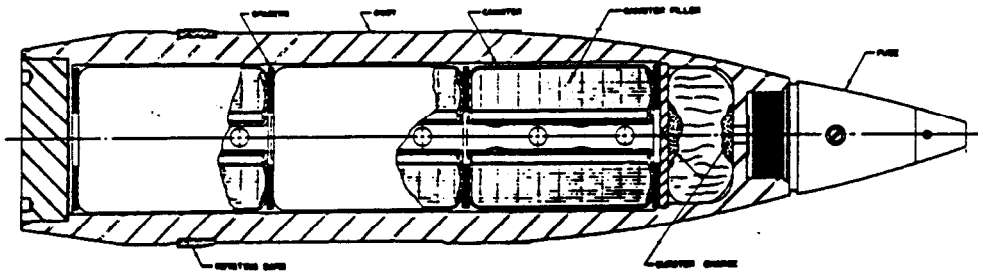

PROJECTILE ILLUSTRATED

NOMENCLATURE: Cartridge, Howitzer, 105MM, Smoke M84 and M84B1

TYPE: Base Ejection - Semi-Fixed - Canister Loaded

PURPOSE: Signalling, Screening, and Spotting, Smoke

STATUS: Std. USA and USMC. 79,673 in USMC stock as of Dec 1960

DESCRIPTION: A semi-fixed, base ejection, smoke round used for spotting and screening. Designed to overcome certain difficulties in the bursting type smoke round. Designed for use with mechanical time super quick fuze. It is a base ejection round consisting of a section of drawn steel tubing which contains three canisters of either HC or colored smoke mixtures. A small black powder charge at the front end of the cavity is used to expel1 the canisters out the base end of the shell.

The shell casing resembles the HE round in outward appearance, being boat-tailed and having a nose formed to a long ogive. Internal construction differs from the HE round in that the cavity is cylindrical in shape and extends the full length of the shell. Both ends are threaded to hold the rear base plate and the noze fuze. Transmission of the explosive action is provided for by a flash tube that extends through the doughnut shaped canisters. The round is fired with standard semi-fixed propelling charge for M2, M4, and M49 Howitzers 105MM.

AREA COVERAGE: (HC) assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke In the round, meteorological conditions and the density of the curtain desired.

For example a 6 gun battery of 105MM Howitzers. each firing at the rate of 4 rd/min. could place 24 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 24 rounds, then approx. 12 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. See FM3-5 for other conditions.

[redacted]

CARTRIDGE, HOWITZER, 105MM, SMOKE M84 AND M84B1 (CHARACTERISTICS)

FILLERS AND WEIGHTS:

| SMOKE | COMPLETE RD WT. | FILLER WT. | PROJECTILE WT. | F. E. | CANISTER TYPE |
|---|---|---|---|---|---|
| Violet or Green | 39.58 | 5.12# | 30.48# | 12.9% | M2 |
| Red | 39.78 | 5.32# | 30.68# | 13.4% | M2 |
| Yellow | 39.38 | 4.92# | 30.29# | 12.5% | M2 |
| H. C. | 42.7# | 7.5 # | 32.86# | 17.5% | M1 |

MAX RANGE: 12205 Yds.

LOAD DRWG: 75-14-341

FUZE: M501A1 Mech.Time Super Quick (See Nqte 1)

BURSTER CHARGE: BP (0.19)

ASSY DRWG: 75-1-189

CARTRIDGE CASE: M14

PROPELLING CHARGE: M1 (2.85 or 3.04#)

USED WITH: M2A1, M2A2, M4, M4A1, and M49 Howitzers.

CANISTERS PER LOAD: Three

PRIMER: M28B2 (M28A2 alt.)

CANISTER DRWGS: (M1) C15-11-22 (M2) C14-11-60

CANISTER DIMENSIONS: 2".96 Dia x 3".56 length

BURNINGTIME: 1 to 4 minutes

CARTRIDGE LENGTH: 30".49

MUZZLE VEL: 1550 ft/sec.

MAX DIA: 105MM

PROJECTILE LENGTH: 18".84 (with fuze)

NOTE 1: Some rounds on hand have M54TSQ, MTSQ, M501, and M501A fuzes.

HANDLING-SAFETY: See TM3-250

REFERENCES: FM3-5, FM3-8, TM3-200, TM3-1900, TM3-1901, TM3-250, ACRC-1959

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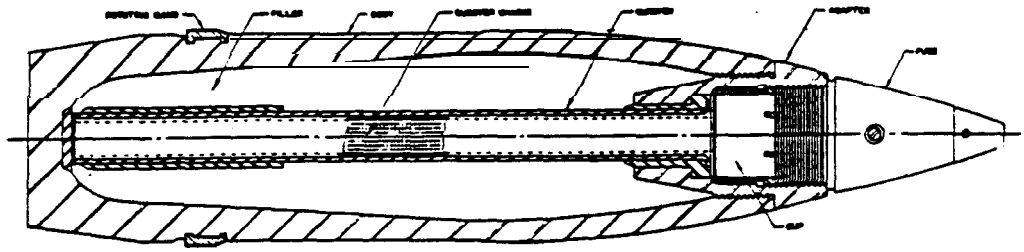

PROJECTILE ILLUSTRATED

NOMENCLATURE: Cartridge, Howitzer, 105MM, Smoke, (WP), M60

TYPE: Semi-Fixed - Central Burst

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Std. USA and USMC. 180,173 in USMC stock as of Dec 1960

DESCRIPTION: A semi-fixed, central burst smoke round used for spotting, screening, anti-personnel, and limited incendiary effects. The M60 which resembles the HE round in external appearance is boat-tailed and the nose is ogival and threaded for an adapter. The adapter provides a tight seal for the smoke or chemical contents, holds the fuze, and provides a seat for the forward end of the burster tube. The casing is thin walled steel tubing extending from the adapter to the rear of the round cavity. A burster charge ruptures the casing to disperse the contents. Used with PD fuze to provide super-quick or delay action. The round is used with M2, M4, and M49 Howitzers 105MM.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desi:

For example a 6 gun battery of 105MM Howitzers, each firing at the rate of 4 rd/min. could place 24rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 24 rounds, then approx. 12 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radiu: for anti-personnel effect is approx. 20 to 40 yds for one cartridge. See FM3-5 for other conditions.

[redacted]

## CARTRIDGE, HOWITZER, 105MM, SMOKE (WP) M60 (CHARACTERISTICS)

COMPLETE RD. WT.: 43.81#

PROJECTILE WEIGHT: 33.58# WP

E. . : 11.40%

MAX RANGE: 12205 Yds - Full charge #7

FUZE: M51A5PD (See Note 1)

BURSTER CASING: M5

CARTRIDGE CASE: M14

USED WITH: M1A1 and M3 Howitzers 105MM

PROJECTILE LENGTH: 19".47 (With fuze)

CARTRIDGE LENGTH: 31".10 (With fuze)

FILLER-WEIGHT: WP - 3.83#

DRWG NO: 75-l-110

MUZZLE VEL: 1550 ft/sec

BURSTER CHARGE: M5 (0.51# HE)

PROPELLING CHARGE: M1 (2.75#)

PRIMER: M28A2 (Alternate M28B2)

MAX DIA: 105MM

HANDLING-SAFETY: See TM3-250

NOTE 1: M51A5 assembled with booster. Some rounds assembled with fuse PD-M57 booster M22, or fuze PD M51A4. M51A5 is a .05 second delay fuze.

REFERENCES: CCM 23423 and OCM 31463, ORD 3 SNLR1, TM9-1901, FM3-5, TM3-250, TM3-200, TM3-1900, FM3-8, ACRC-1959

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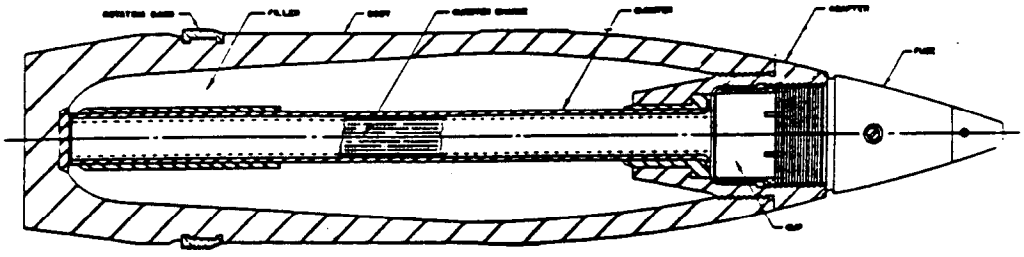

PROJECTILE ILLUSTRATED

NOMENCLATURE: Cartridge, Howitzer, 105MM (H-HD) M60

TYPE: Semi-Fixed - Gas - Central Burst

PURPOSE: Provide toxic chemical offensive capability

STATUS: Std. USA and USMC. 80,457 in USMC stock as of Dec 1960

DESCRIPTION: A semi-fixed, central burst, H or HD gas round used for anti-personnel effects. The M60 which resembles the HE round in external appearance is boat-tailed and the noze is ogival and threaded for an adapter. The adapter provides a tight seal for the smoke or chemical contents, holds the fuze, and provides a seat for the forward end of the burster tube; The casing is thin walled steel tubing extending from the adapter to the rear of the round cavity, A burster charge ruptures the casing to disperse the contents. Used with PD fuze to provide super-quick or delay action. The round is used with M2, M4, and M49 Howitzers 105MM.

AREA COVERAGE: Average meteorological conditions used to estimate unit HD capabilities are: neutral temperature gradient temperature about 70°F, wind speed about 8 MPH and dry weather. Under these conditions a battery of six 105MM Howitzers can contaminate about 2.2 hectares (100 meter squares] with liquid HD in about 15 minutes. The battery can cover in 15 minutes about 2 hectares with a concentration of HD Vapor that will incapacitate masked personnel after about 1 hours' exposure. See TM3-200 for other specific conditions.

[redacted]

CARTRIDGE, HOWITZER, 105MM, (H-HD) M60 (CHARACTERISTICS)

COMPLETE RD. WT.: 43.27#

PROJECTILE WEIGHT: 34.60# of H, FILLER WEIGHT: 2.86# F.E.: 8.28%

PROJECTILE WEIGHT: 33.46# of HD, FILLER WEIGHT: 2.69# F.E.: 8.35%

FUZE: PD-M51A5 (See Note 1) MAX RANGE: 12,205 Yds

DRWG: 75-l-109 BURSTER CASING: M5

BURSTER CHARGE: M5 - 0.51# HE MAX DIA: 105MM

PROPELLING CHARGE: Ml - 2.75# PROJECTILE LENGTH: 19.47 with fuze

CARTRIDGE CASE: M14, M14B1 CARTRIDGE LENGTH: 31.10

PRIMER: M28A2 (Alternate M28B2) MUZZLE VEL: 1550 ft/sec.

USED WITH: M2A1, M2A2, M4, M4A1, and M49 Howitzers

HANDLING-SAFETY: S e e TM3-250

NOTE 1: Stocks on hand with fuze PD-M51A4, and M57 Ltd Std will be issued until exhausted. M51A5 assembled with booster. M21A4, M57 with booster. M22 and M51A5 is .05 sec delay fuze.

REFERENCES: ACRC-1959, TM9-1900, TM9-1901, TM3-200, TM3-250, FM3-5, FM3-8

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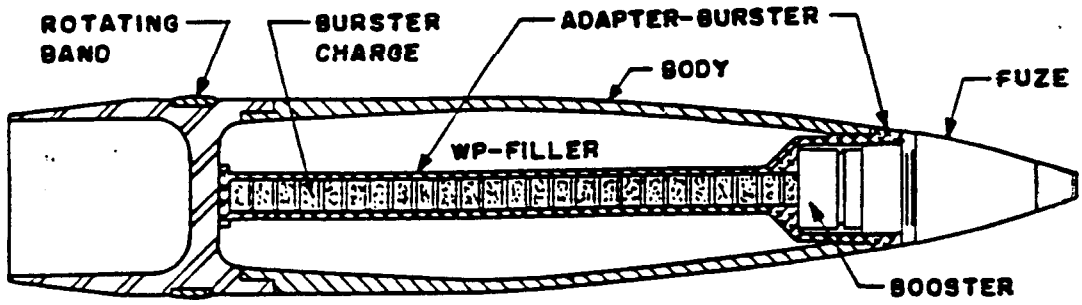


PROJECTILE ILLUSTRATED

NOMENCLATURE: Cartridge, Howitzer, 105MM(WP) XM-427

TYPE: Semi-fixed, Central Burst, Hollow Base, Boat-tailed

PURPOSE: Spotting, Screening, Incendiary, Anti-personnel

STATUS: Research and Development

DESCRIPTION: This is a semi-fixed, central burst, hollow base, boat-tailed munition filled with WP for screening, spotting, anti-personnel, and limited incendiary effects. The major components are a body, rotating band, PD fuze, one piece adapter-burster casing and a fuze booster. The hollow base forging is silver brazed to a pearlitic malleable iron body and fitted with a sintered iron rotating band. The hollow base is intended to increase the effective chamber capacity, thus, muzzle energy and maximum range have been increased without a substantial increase in pressure.

Use of the pearlitic iron in the fragmenting wall will provide more anti-personnel effectiveness than the standard HE projectile. One propelling charge provides the minimum to intermediate range, while another charge provides for the maximum range. The standard M14 case is used with a new primer.

AREA COVERAGE: To be determined.

CARTRIDGE, HOWITZER, 105MM (WP) XM-427 (CHARACTERISTICS)

COMPLETE RD WT: 40#

PROJECTILE FIRED WT: 28.8#

FILLER-WEIGHT:' WP-6.0# Avg.

F. E.: 20.9%

PROPELLING CHARGE WT: ND

PROJECTILE LENGTH: 22".04

MUZZLE VELOCITY: ND

COMPLETE CARTRIDGE LENGTH: 34".17

FUZE: PD-M51A5

BURSTER CHARGE: Comp. B-72 grams

PROPELLING CHARGE: m-56 Min. to Intermediate Range, XM-57 for Max. Range.

MIN. RANGE: 900 meters.

PRIMER: ND

MAX. RANGE: 13,700 meters

DRWG: XP112882

CARTRIDGE CASE: Ml4

RATE OF FIRE: 8 per min.

USED WITH: M2A2E2, T252 or T195 Howitzers 105MM

HANDLING SAFETY: TM3-250

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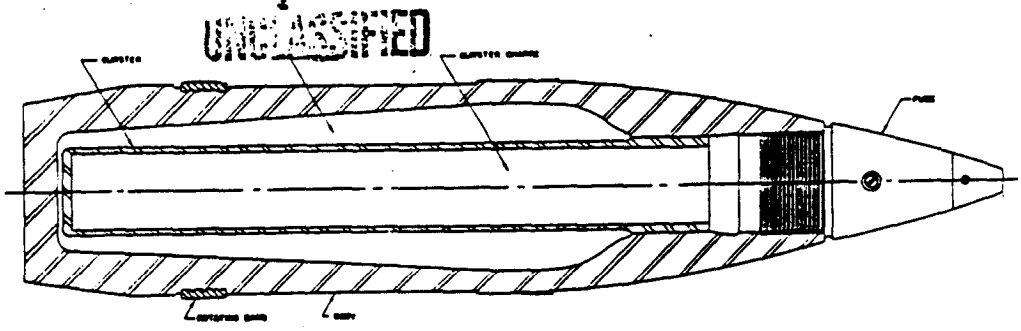


PROJECTILE ILLUSTRATED

NOMENCLATURE: Cartridge, Howitzer, 105MM,(GB), M360

TYPE: Semi-fixed, Gas, Central Burst

PURPOSE: Provide toxic chemical offensive capability

STATUS: Std. USA and USMC. 37,460 in USMC stock as of Dec 1960

DESCRIPTION: A semi-fixed, central burst GB gas round used for anti-personnel effects. The M360 which resembles the HE round in external appearance is boat-tailed and the nose is ogival and threaded for an adapter. The adapter provides a tight seal for the smoke or chemical contents, holds the fuze, and provides a seat for the forward end of the burster tube. The burster casing is thin walled steel tubing extending from tne adapter to the rear of the round cavity. A burster charge ruptures tne casing to disperse the contents, Used with PD fuze to provide super-quick or delay action. The round is used with M2, M4, and M49 Howitzers 105MM.

AREA COVERAGE: Average meteorological conditions used to estimate unit GB capabilities are: neutral temperature gradient, temperature above 60°F, and wind about 8 MPH. Under these conditions a battery of six 105MM Howitzers can cover about 2 hectares (100 meter squares) with an incapacitating dosage, o: about 1 hectare with a lethal dosage of GB in 30 seconds. See TM3-200 for other specific conditions.

[redacted]

CARTRIDGE, HOWITZER, 105MM(GB) M360 (CHARACTERISTICS)

COMPLETE RD. WT: 44.57#

PROJECTILE WEIGHT: 35.59#

MAX RANGE: 12330 Yds

FUZE: PD-M508 (See Note 1)

PROPELLING CHARGE: M1-2.75#

CARTRIDGE CASE: M14

CARTRIDGE LENGTH: 31"18

MUZZLE VEL: 1550 ft/sec

FILLER WEIGHT: GB-1.63#

F. E.: 3.66%

DRWG: 75-1-363

BURSTER CHARGE: M10 (1.9# Tetrytol)

BURSTER CASING: M16

PRIMER: M28A2 (Alternate M28B2)

PROJECTILE LENGTH: 19"47 with fuze

MAX. DIA: 4"132

USED WITH: M2A1, M2A2, M4, M4A1, and M49 Howitzer

HANDLING-SAFETY: See TM3-250

NOTE 1: Stocks on hand with fuze PD-M51A4, M51A5, and M57 Ltd Std will be issued until exhausted. M51A5 assembled with booster M21A4, M57 with booster M22. M51A5 is .05 sec delay fuze.

REFERENCES: ACRC-1959, TM9-1900, TM9-1901, TM3-200, TM3-250, TM9-1910, FM3-5, FM3-8, Landing Force Bull. #5.

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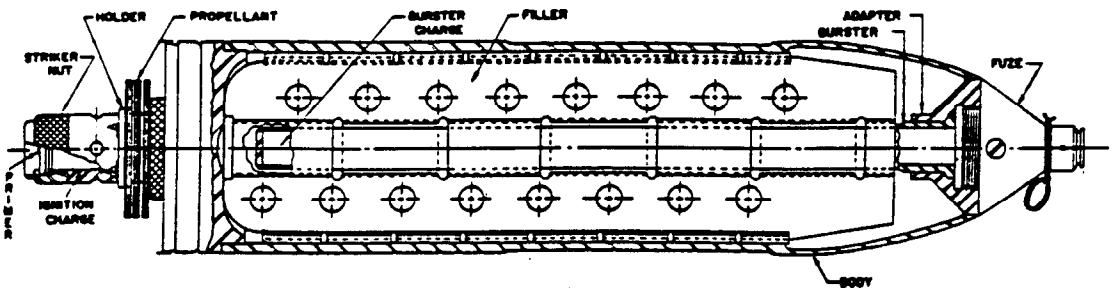


NOMENCLATURE: Cartridge, Mortar, 4.2", Gas and Smoke M2A1

TYPE: Semi fixed - Central Burst - Spin Stabilized

PURPOSE: To provide chemical offensive capability

STATUS: Std USA and USMC. - 235,637 (WP) in UsMC stock as of Dec 1960

DESCRIPTION: This is a semi-fixed, central burst, spin stabilized munition which is used with both gas and smoke fillings. Several different kinds of gas and smoke are used with this round which are used for spotting, screening; and anti-personnel effects. The major components are a body, fuze, burster, propellant, ignition *cartridge,* primer, adapter, and filling. The burster tube extends the length of the body cavity.

Stabilization is accomplished by a "rotating disk" on the base of the shell which engages the rifling of the mortar. The base of the shell is externally threaded to receive the propellant holder, the propelling charge, and the Ignition cartridge. See characteristics on next page for gases and smokes used. Used with 4.2 Mortars M30.

AREA COVERAGE: (WP only) A heavy mortar company of twelve 4.2 mortars can effectively screen an average front of 2,200 meters, and under very favorable conditions it cam screen effectively 3 times its average front, and under unfavorable conditions It may be able to screen only one eigth its average front. Space does not permit cover-all gases and smokes here; refer to FM 3-5 for other smoke conditions and see TM3-200 for gas condltions and coverage.

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UNCLASSIFIED

CARTRIDGE, MORTAR 4.2, GAS SMOKE, M2A1 (CHARACTERISTICS)

| AGENT | COMPLETE WEIGHT | RD # | FILLER WEIGHT # | F.E. APPROX % |
|---|---|---|---|---|
| WP-FS-FM | 25.10 | | 7.50 | 29.9 |
| HD | 23.50 | | 6.00 | 25.6 |
| PWP-CG | 23.80 | | 6.25 | 26.2 |
| H | 23.70 | | 6.20 | 26.1 |
| HT | 23.30 | | 5.75 | 24.6 |
| CK | 22.60 | | 5.00 | 22.1 |
| CNS | 23.17 | | 7.00 | 30.2 |
| CNB | 21.62 | | 5.45 | 25.2 |

MAX RANGE: 4300 yds

ASSY DRWG: 75-1-284

OVERALL CARTRIDGE LENGTH: 21.01 with fuze

MAX DIA: 4.19

FUZE: PD-M8

BURSTERCHARGE: M14

PROPELLING CHARGE: M6 - 0.43#

IGN. CARTRIDGE: M2

PRIMER: See ignition cartridge

MUZZLE VEL: 820 ft/sec

USED WITH: M30 Mortar 4.2

HANDLING - SAFETY: See TM3-250

REMARKS: Similar to M329 in appearance

REFERENCES: TM9-1900, TM9-1901, TM3-200, TM3-250, FM 3-5, FM 3-8, ACRC 1959, Mil-C-13065, TMg-2008, TM9-2009

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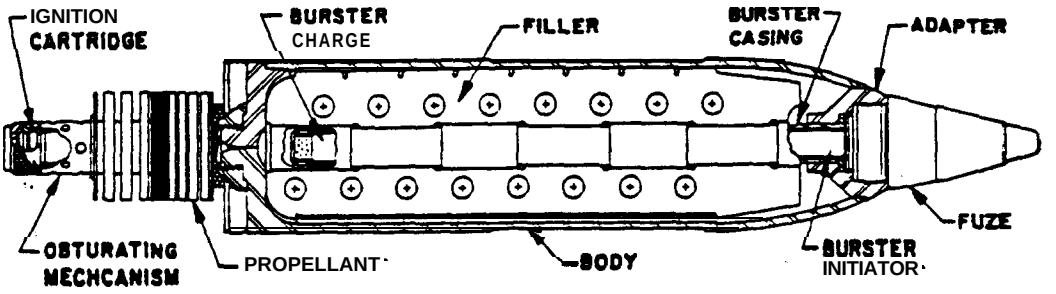


NOMENCLATURE: Cartridge, Mortar, 4.2, Smoke (WP) M328

TYPE: Semi-fixed - Central Burst - Spin Stabilized

PURPOSE: Anti-personnel, Spotting, Screening and Incendiary

STATUS: Std USA and USMC (No USMC stock as of 31 Dec 1960)

DESCRIPTION: This is a semi-fixed, central burst, spin stabilized munition which is used with WP filling for spotting, screening, and anti-personnel effects. The major components are body, fuze, burster, propellant, ignition cartridge, adapter, and filling. The burster tube extends the length of the body cavity.

Stabilization is accomplished by a "rotating disk" on the base of the shell which engages the rifling of the mortar. The base of the shell is externally threaded to receive the propellant holder, the propelling charge, and the ignition cartridge. See characteristics on next page for gases and smokes used., Used with 4.2 mortars M30.

AREA COVERED: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until *the* desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the Curtain desired.

For example a 6 gun battery of 4.2 Mortar, each firing at the rate of 12 rd/min. could place *72* rd/min. into the area to establish *a* smoke curtain. If the required curtain is established in 1 min. with *72* rounds, then approx. 36 rounds/minute should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. The burst radius for anti-personnel effect is approx. 20 to 50 yds for one cartridge. See FM3-5 for other conditions.

[redacted]

CARTRIDGE, MORTAR, 4.2 SMOKE (WP) M328 (CHARACTERISTICS)

WEIGHT: 25.1#

F.E.: 32.44%

MAX. DIA: 4.19

FUZE: M521-(T247) PD

CASING: Part of M8 Fuze

FILLER-WT: WP - 8.14#

MAX. LENGTH: 25.77 with fuze

MUZZLE VEL: 820 ft/sec

BURSTER INITIATOR: M13

BURSTER CHARGE: M35

PROPELLING CHARGE: M36 (0.69#)

IGN. CARTRIDGE: M2 MAX RANGE: 4300 yds with 41 increments

PRIMER: See Ignition Cartridge

ASSY DRWG: F8797829

LOAD DRWG: F8797838

USED WITH: M30 - 4.2 Mortar

HANDLING SAFETY: See TM3-250

REFERENCES: OCM 32041 CAT. CW-11-1, TM9-1901, TM3-250, TM3-320, ORD 11 SNL R-4, FM 3-5, FM 3-8, TM9-1900, TM3-200, ACRC-1959

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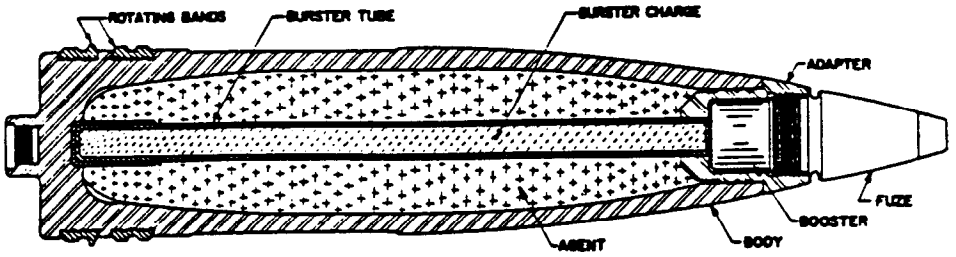


NOMENCLATURE: Projectile, 120MM Gun, Smoke (WP) T16E4

TYPE: Separated - Smoke - Central Burst

PURPOSE: Anti-personnel - Incendiary - Spotting - Screening

STATUS: Recommended for T.C. (USMC - 7571 on hand Dec 1960)

DESCRIPTION: This is a separated load, central burst, WP smoke round used for spotting, screening, Incendiary and anti-personnel effects. The projectile and the propelling charge are separate units and are packed and shipped separately although they are loaded into the gun as a unit. The round is similar in size, shape, weight, and ballistics to the HE round. The difference being a central burster tube and charge, a burster initiator, an adapter which holds the front end of the burster tube and also a PD fuze. The burster extends the full length of the projectile cavity.

Two rotating bands are located near the rear of the projectile. The initiator burster is located directly behind the fuze, in the forward end of the burster, and ignites the burster charge which ruptures the casing to disperse the chemical contents. Used with 120MM tank guns M1A3 and M58.

AREA COVERAGE: Assuming an 8MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. dedepending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 17 gun company of 120MM Guns, each firing at the rate of 3.5 rd/min. could place 60 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 60 rounds, then approx. 30 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the sane rate required to establish the Curtain. The burst radius for anti personnel effects is approx 50 yds for one projectile. See FM3-5 for other conditions.

[redacted]

'PROJECTILE, 120MM GUN, SMOKE (WP) T-16E4 (CHARACTERISTICS)

PROJECTILE DRWG: P85104

LOADING DRWG: P85103

FIRED RD WT: 50.41#

FILLER-WT: WP - 7.51#

F.E.: 14.8%

PRIMER: M67-PE

PROPELLANT: M15 - 12.30#

PROJECTILE LENGTH: 24".83 (with fuze) DIA: 4".69

FUZE: PD - M51A5

BURSTER CHARGE: 0.55#

BURSTER INITIATOR M2 - 0.06# CARTRIDGE CASE: M109

MUZZLE VELOCITY: 3100 ft/sec MAX RANGE: 28,275 yds

BODY MATERIAL: Steel - Forging

USED WITH: 1A3 and M58 Guns 120MM

HANDLING SAFETY: See TM3-250

REMARKS: Similar in size, shape and ballistics as the HE - 120MM Shell. Also can be used with fuze T212 when it is available.

REFERENCES: TM9-1900, TM9-1901, TM3-200, TM3-250, FM 3-5, FM 3-8, Ammo complete round chart 1959

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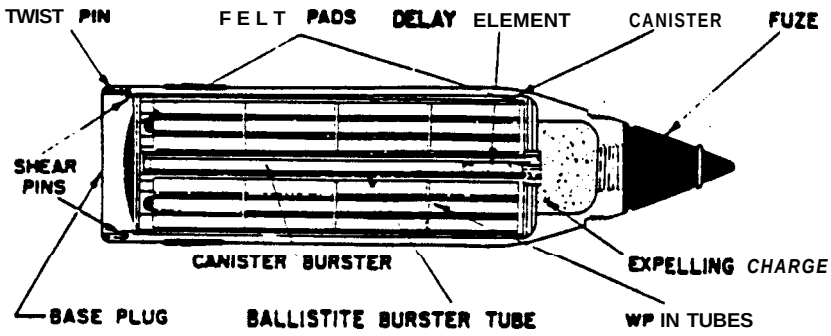


NOMENCLATURE: Projectile, Gun, 5"/38 (WP) Mk 30

TYPE: Semi-fixed - Base Ejection Canister

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Std USN. 3288 In Navy stock as of Dec 1960 (16904 of Mk 30 and Mk 44 on hand overseas Dec 1960)

DESCRIPTION: This is a semi-fixed base ejection projectile filled with WP which can be used for spotting, screening, a&i-personnel, and limited incendiary effects. A light steel canister is packed with WP and small tubes which increase the burst radius of the WP. The nose is fitted with either a PD or MT fuze.

The expelling charge of black powder is located directly back of the nose fuze and in functioning expells the canister from the rear of the projectile by forcing off the base plat. A delay element located just behind the fuze, is initiated b the expelling charge, and detonated shortly after the canister clears the projectile which ignites the burster charge in the canister to explode the canister and release the filling. The canister burster tube extends the full length of the canister and is a press fit in the canister body. Two 1/2 inch holes are in the base for filling and are sealed by pipe plugs.

AREA COVERAGE: Using a mechanical time fuze, a smoke screen can be laid so that bursts occur 25 to 50 ft. above water, and 35 to 40 yards apart. Bursts which occur higher may allow vision beneath the cloud, and those that strike the water are useless. Under normal conditions the smoke screen will be effective for seven minutes or'more, but will, of course, drift with the wind.

Using a point detonating fuze with this shell a smoke screen may also be laid on land. Lateral spacing of burst should be the same as for a screen over Water, and an allowance should be made for the drift during the effective time Of the screen. An area of about 50 yds diameter is covered by one shell. For more information see OP2217.

[redacted]

PROJECTILE, GUN, 5"/38 (WP) MK 30 (CHARACTERISTICS)

FIRED WEIGHT: 54.4# FILLER-WEIGHT: WP - 7.1#

F.E.: 13.0% ASSY DRWG: 1305683

RANGE: 17280 yds. PROJECTILE DRWG: D15-11-3

MAX VELOCITY: 2600 ft/sec MUZZLE VEL: 2600 ft/sec (Max)

PROJECTILE LENGTH: 19".97 PROJECTILE DIA: 5"

FUZE: Mk 29 Mod 3 PD, and Mk50-MTP MK MER: 8

EXPELLING CHARGE: 4 oz black powder CANISTER LENGTH: 12"

CANISTERS PER LOAD: One M5 CANISTER BURSTER: 14 grains (M30)

CARTRIDGECASE: Mk 5

CANISTER DRWG: C15-11-17 or C15-11-97 (M5)

PROPELLANT: Full charge 15.2# Reduced charge 3.6#

CANISTER FILL: 7.1# WP - 12.1# Packing CANISTER DIA: 3".9

USED WITH: Mk 12 Gun

RATE OF FIRE: 16-20 rds/min per barrel

REMARKS: Interchangeable with Mk 44 Projectile

DEVELOPMENT HISTORY: In development this item was designated EIR1

HANDLING SAFETY: See TM3-250

REFERENCES: TM3-250, FM 3-5, TM9-1901, OP2215, TM3-200, TM9-1900 FM3-8, Spec Mil C-14583, NWIP-1-2.

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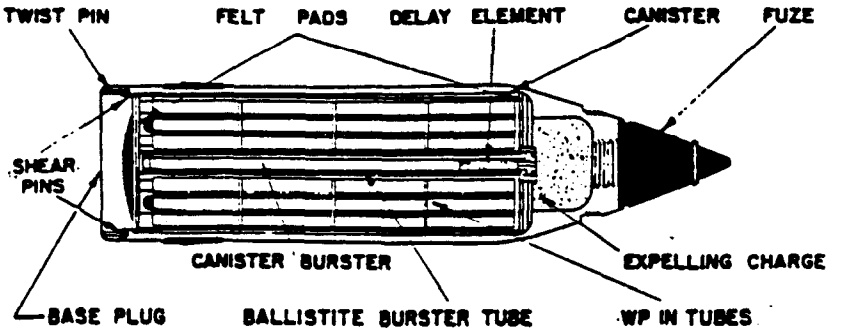


NOMENCLATURE: Projectile, Gun, 5"/38, Smoke (WP) Mk 44 Mod 1

TYPE: Semi-fixed, Base ejection, Canister

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Std. USN. 38934 in Navy stock as of Dec 1960. (16,904 of Mk 30 and Mk 44 on hand overseas as of Dec 1960)

DESCRIPTION: This is a semi-fixed, base ejection projectile filled with WP which can be used for spotting, screening, anti-personnel, and limited incendiary effects. A light steel canister is packed with WP and small metal tubes which increase the burst radius of the WP. The nose is fitted with either a PD or MK fuze.

The expelling charge of black powder is located directly back of the nose fuze and in functioning expells the canister from the rear of the projectile by forcing off the base plate. A delay element located just behind the fuze is initiated by the expelling charge, and detonated shortly after the canister clears the projectile, which ignites the canister burster charge to explode the canister and release the filling. The canister burster tube extends the full length of the canister and is a press fit in the canister body. Two 1/2 inch holes are in the base for filling and are sealed by pipe plugs.

AREA COVERAGE: Using a mechanical time fuze, a smoke screen can be laid so that bursts occur 25 to 50 ft. above the water, and 35 to 40 yards apart. Bursts which occur higher may allow vision beneath the cloud, and those that strike the water are useless. Under normal conditions the smoke screen will be effective for seven minutes or more, but will, of course, drift with the wind.

Using a point detonating fuze with this shell a smoke screen may also be laid on land. Lateral spacing of burst should be the same as for a screen over water, and an allowance should be made for the drift during the effective time of the *screen.* An area of about 50 yds in diameter is covered by one shell. For more information, see OP 2217.

[redacted]

PROJECTILE, GUN, 5"/38, SMOKE, (WP) MK 44 (CHARACTERISTICS)

FIRED WEIGHT: 54.4#

FILLER WEIGHT: WP - 7.-#

E. . : 13.0%

MAX RANGE: 17,280 Yds

FUZE: Nose PD MK 29 Mod 3, and MK 50-MT

CANISTERS PER RD: One - M5

CANISTER BURSTER: 14 Grains (M30)

EXPELLING CHARGE: 4 OZ. Black Powder

PRIMER: MK 48-CE

CANISTER DRWGS: C15-11-17 and C15-11-97 (M5)

CANISTER DIA: 3."9

PROPELLANT: Full Chg 15.2#, reduced Chg 3.6#

CANISTER LENGTH: 12"

MAX VELOCITY: 2600 ft/sec

CANISTER FILL: 7.1# WP
12.1# Packin

PROJECTILE LENGTH: 19"97

CARTRIDGE CASE: MK 5

ASSY. DRWG: 1305683

RATE OF 'IRE: 16-20
ras/min per barrel

USED WITH: MK 12 Gun

PROJ. DIA: 5"

HANDLING-SAFETY: TM3-250

PROJ. DRWG: D15-11-3

REMARKS: Interchangeable with MK 30 Projectile 5"/38 (WP)

REFERENCES: TM3-250, TM9-1901, OP 2215, MIL-C-14583, NWIP-1-2, TM9-1900



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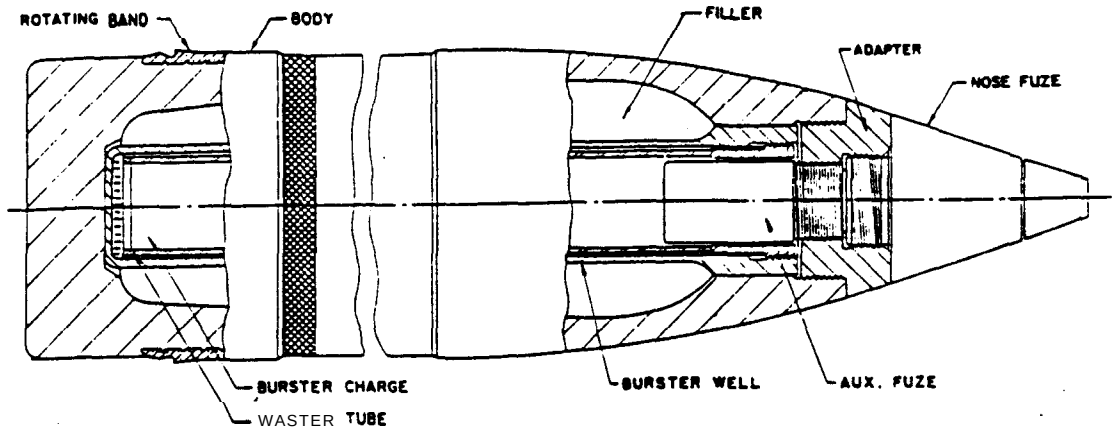


NOMENCLATURE: Projectile, Gun, 5"/38, Gas (GB) MK 53 Mod 0

TYPE: Central Bursting, Semi-fixed

PURPOSE: To provide toxic chemical capabilities.

STATUS: Planned Std USN

DESCRIPTION: This is a semi-fixed, central burst gas projectile loaded with GB filled agent to be used for anti-personnel effects. A central burster tube extends the full length of the projectile cavity and is a press fit into the fuze adapter. A PD fuze with auxiliary booster is located on the forward end, of the projectile, which on functioning initiates the burster charge to explode the projectile and release the filling agent. An adapter located in the forward end of the projectile holds the fuze and the forward end of the burster tube.

The design is based on the MK 49 HC projectile and has similar exterior ballistic qualtities. A one piece forging eliminates joints, and minimizes leakage possibilities. Base fuzing is eliminated.

AREA COVERAGE: For a 5"/38 projectile loaded with GB agent it is estimated that it requires 3.51bs of agent to cover hectares for a standard 100% casualty level which is the equivalent area of complete effect against troops without protection, and under standard meteorological conditions with temperature of 60°F, wind 5 MPH, and temperature gradi neutral. For a 30% casualty level under the same condition the area coverage would be 0.98 hectares.

[redacted]

PROJECTILE, GUN 5"/38, GAS (GB) MK 53 (CHARACTERISTICS)

COMPLETE ROUND WT: 55.2#

RANGE: 18,000 Yards

FILLER WEIGHT: GB - 3.25#

BURSTER RATIO: 2.4:1

PROPELLANT CHARGE: MK 5 MOD 0

CLOSURE: Press Fit

FUZE REQ'D: PD MK 29 MOD 3, and AUX. AD-MK 54 MOD 1

CARTRIDGE CASE: MK 5

LOAD DRWG: 1381146

USED WITH: MK 12 Gun

RATE OF FIRE: 16 to 20 rds/min per sec

LENGTH: 20.75 with fuze

MUZZLEVEL: 2500 ft/sec approx.

F. E.: 5.90%

MAX. DIA: 5.0

BURSTER: 1.5# Explosive "D"

PRIMER: MK 48-CE

ARRIVAL VEL: 900 ft/sec

DRWG. LIST: 289029

HANDLING-SAFETY: See TM3-250. Rough haul, vibration, and Jolt, drop test, and altitude tests indicate this projectile is safe for normal military handling, shipping, and storage.

DEVELOPMENT HISTORY: Was EX-34 in development. CCTC item 2462.

REFERENCES: TM3-250, TM9-1900, TM9-1901, DPGR-208 (CONF), CWL Tech Memo 30-17, OP 2215, MU-~-25078.

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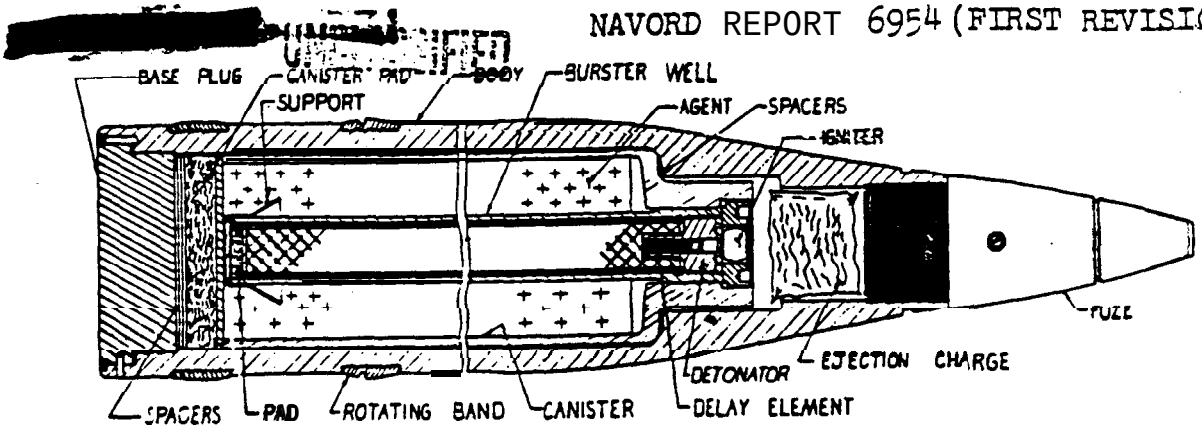


NOMENCLATURE: Projectile, Gun, Smoke (WP) 5"/54, MK 48 MOD 0

TYPE: Semi-fixed, Base Ejection, Canister

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Planned Std USN

DESCRIPTION: This is a semi-fixed base ejection smoke projectile, loaded with WP for spotting, screening, anti-personnel, and limited incendiary effects. A light steel canister filled with WP. The nose is fitted with a PD fuze.

The expelling charge is located directly back of the nose fuze and in functioning expells the canister from the rear of the projectile for forcing off the base plate. A delay detonator located in the forward end of the canister, is initiated by the expelling charge, and is detonated shortly after the canister clears the projectile, which in turn ignites the canister burster charge to explode the canister and release the filling.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and 8 smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 4 gun battery of 5"/54 guns. each firing at the rate of 5 rd/min. could place 20 rd/min. into the area to establish *a* smoke curtain. If the required curtain is established in 1 min. with 20 rounds, then approx. 10 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. Burst radius for anti-personnel effect is approx. 25 yds. See FM3-5 for other-conditions.

PROJECTILE, GUN, 5"/54, SMOKE, (WP), MK 48 (CHARACTERISTICS)

FIRED WEIGHT: 70#

EMPTY WEIGHT: 46.4#

MAX RANGE: 21,000 Yards

FILLER WEIGHT: WP - 6.60# (Approx.)

FUZE: MK 30 MOD 3,(PD)

BURSTER RATIO: Lbs. Fill/Lbs. HE=16/1

BURSTER CHARGE: Comp A3 (0.588#) Approx.

CLOSURE: Press Fit

DETONATOR: MK 42

RATE OF FIRE: 40 rds/min per barrel

CANISTER LOAD DRWG: 1381151 (MK 14)

CANISTERS PER RD: One (MK 14)

LENGTH: 26" (With fuze)

MAX. DIA: 5"0

MUZZLE VELOCITY: 2650 ft/sec

F. E.: 9.28%

CARTRIDGE CASE: MK 7

PROPELLANT: 18.5# BP

PRIMER: MK 45- CE

EJECTION CHARGE: 3.0 Oz. Black Powder

PROJECTILE DRWG: 1381150

'JSED WITH: MK 16, MK 18 Guns

HANDLING-SAFETY: See TM3-250

DEVELOPMENT HISTORY: Basic shell for this projectile is proj. illum. MK 48 MOD 1 (DR. NO. 1381171).

REFERENCES: TM9-1901, FM3-5, TM3-250, OP 2215, NWIP-1-2.

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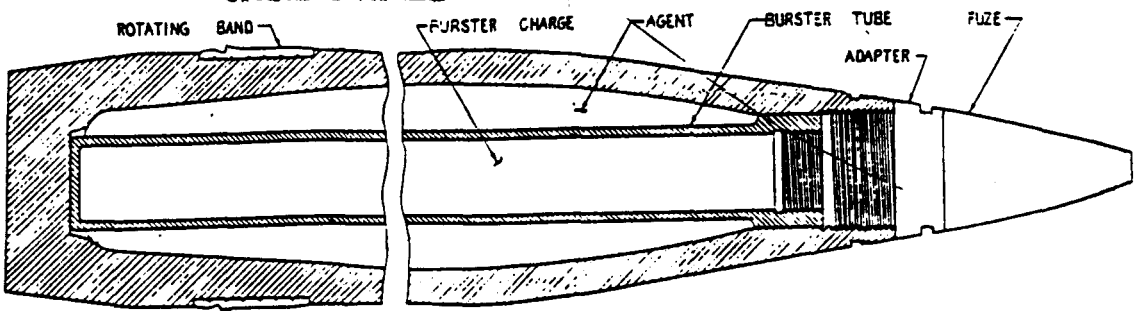


NOMENCLATURE: Projectile, Gun, 5"/54, Gas, (GB) MK 54 MOD 0

TYPE: Semi-fixed, Central Burst

PURPOSE: Provide ships with toxic chemical offensive capability

STATUS: Planned Std USN. Released for Navy procurement

DESCRIPTION: This is a semi-fixed, central burst projectile loaded with GB agent to be used for anti-personnel effects. The projectile is unique in that the stress figures for the metal components are markedly than for other projectiles so far designed with central burst system. These figures are due to the high accelerations obtained to reach the required muzzle velocity. Flight characteristics are similar to the MK 41 HC projectile which was used for prototype design.

One piece forged construction and accurately machined press fit closures eliminates joints, minimizes leakage possibilities and provides maximum safety. A burster tube extends the entire length of the projectile cavity and is a press fit into the fuzz adapter. A PD fuze with auxiliary booster is located on the forward end, which on functioning initiates the burster charge to explode the projectile and release the filling agent. An adapter is also located on the forward end of the projectile to hold the fuze and the burster tube.

AREA COVERAGE: For a 5"/54 projectile loaded with GB agent it is estimated that it requires 4.3 lbs of agent to cover 0.43 hectares for a standard 100% casualty level which is the equivalent area of complete effect against troops without protection, and under standard meteorological conditions with temperature of 60°F, wind 5MPH, and temperature gradient neutral. For a 30% casualty level under the dame conditions the area coverage would be 1.2 hectares.

[redacted]

# PROJECTILE, GUN, 5"/54, ~~GAS,~~ (GB) MK 54 (CHARACTERISTICS)

FIRED WEIGHT: 6.2# Approx. Agent

WEIGHT FILLER: 4.75# GB

BURSTER CHARGE: 1.72# Explosive "D" (Central Burst)

MUZZLE VELOCITY: Approx. 2700 ft/sec

FUZE REQ'D: PD MK 30 MOD 3

CLOSURE: Press Fit

CARTRIDGE CASE: MK 7

RATE OF FIRE: 40 rds/min per barrel

HANDLING-SAFETY: See TM3-250

PROPELLANT: 18.5# Powder

BURSTER RATIO: 2.1

F. E.: 7.7%

RANGE: 21,000 Yds max. approx.

AUX. FUZE: MK 43-AD

LENGTH: 26

MAX. DIA: 5"0

LOAD DRWG: 1381167

DRAWING LIST: 289031

PRIMER: MK 45-m

USED WITH: MK 16 and MK 18 Guns

DEVELOPMENT HISTORY: In development was designated EX-36.

REFERENCES: TM3-250, TM9-1901, FM3-5, CCTC3022, OP 2215, DPGR #245 VOL. I-II, MIL-P-45183.



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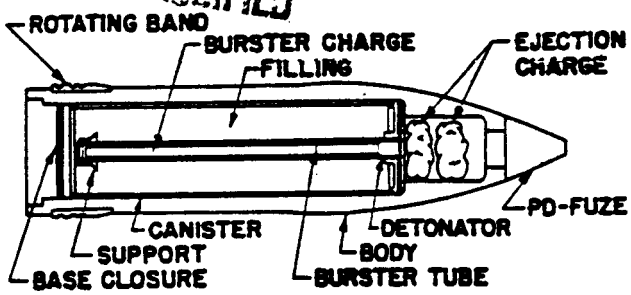



NOMENCLATURE: Projectile, Gun, Smoke (WP), 6"/47, MK 38 MOD 0

TYPE: Semi-fixed - Base Ejection Canister

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Planned Std USN

DESCRIPTION: This is a semi-fixed, base ejection projectile, loaaea with WP for spotting, screening, anti-personnel, and limited incendiary effects. A light steel canister filled with WP is enclosed in the projectile. The nose is fitted with a PD fuze.

The expelling charge is located directly back of the nose fuze and in functioning expells the canister from the rear of the projectile by forcing off the base plate. A delay detonator located in the forward end of the canister is initiated by the expelling charge, and is detonated shortly after the canister clears the projectile, which in turn ignites the canister burster charge to explode the canister and release the filling.

AREA COVERAGE: Using a mechanical time fuze, a smoke screen can be laid so that bursts occur 25 to 50 ft. above the water, and 35 to 40 yards apart. Bursts which occur higher may allow vision beneath the cloud, and those that strike the water are useless. Under normal conditions the smoke screen will be effective for seven minutes or more, but will, of course, drift with the wind. Burst radius for anti-personnel effect is approx. 25 yards.

Using a point detonating fuze with this shell a smoke screen may also be laid on land. Lateral spacing of burst should be the same as for a screen over water, and an allowance should be made for the drift during the effective time of the screen. An area of about 50 yds of diameter is covered by one shell.

[redacted]

PROJECTILE, GUN, 6"/47,(WP) MK 38 (CHARACTERISTICS)

FIRED WEIGHT: 100# Approx.

WEIGHT FILLER: 10.4# WP

BURSTER CHARGE: Comp A3. Weight 0.86#

FUZE: PD-MK 30 MOD 3

CLOSURE: Press Fit

EJECTION CHARGE:, 0.56# Black Powder

FIRED FROM: 6"/47 Cal. Gun MK 16

MAX RANGE: 21,000 Yds

MUZZLE VELOCITY: 2800 ft/sec

LENGTH: 30"with fuze

F. E.: 10.4% approx.

MAX. DIA: 6"0

PRIMER: MK 39 full, MK 40 Reduced Range

DETONATOR: MK 42

CARTRIDGE CASE: MK 6

PROPELLANT: 33# Powder

LOAD DRWG: 1380988 (MK 13)

ASSY. DRWG: 1381152

REMARKS: Standard navy projectile MK 38 is used as the basic shell for fabrication of this projectile.

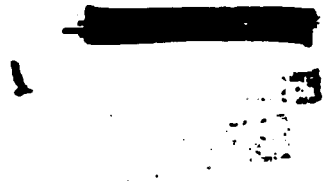
RATE OF FIRE: 7 to 12 rds/min per barrel depending on elevation.

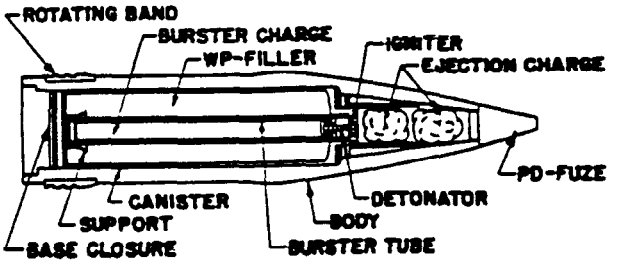
HANDLING-SAFETY: TM3-250

DEVELOPMENT HISTORY: BUORD requirement 1952. CCTC item 2452.

REFERENCES: TM3-250, TM9-1901, FM3-5, OP 2215, Spec. MIL-C-14585, NWIP-1-2, CWL-TM30-18.








NOMENCLATURE: Projectile, Gun, Smoke (WP), 6"/47, MK 41 MOD 0

TYPE: Semi-fixed - Base Ejection Canister

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Planned Std USN

DESCRIPTION: This is a semi-fixed, base ejection projectile, loaded with WP for spotting, screening, anti-personnel, and limited incendiary effects. A light steel canister filled with WP is enclosed in the projectile. The nose is fitted with a PD fuze.

The expelling charge is located directly back of the nose fuze and in functioning expells the canister from the rear of the projectile by forcing off the base plate. A delay detonator located in the forward end of the canister, is initiated by the expelling charge, and is detonated shortly after the canister clears the projectile, which in turn ignites the canister burster charge to explode the canister and release the filling.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 4 gun battery of 6"/47 guns, each firing at the rate of 4 rd/min. could place 16 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 16 rounds, then approx. 8 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. Burst radius for anti-personnel effect is approx. 25 yds. See FM3-5 for other conditions.

[redacted]

NAVORD REPORT 6954 (FIRST REVISION)

PROJECTILE, GUN, 6"/47, SMOKE, (WP) MK 41 (CHARACTERISTICS)

FIRED WEIGHT: 100#

WEIGHT-FILLER: 10.4# WP

BURSTER CHARGE: Comp A3 - 0.95#

FUZE: PD-MK 30

EJECTION CHARGE: 0.56# Black Powder

MUZZLE VELOCITY: 2800 ft/sec

MAX RANGE: 21,000 Yds

USED WITH: MK 16 Gun

RATE OF FIRE: 7 to 12 rds/min per barrel depending on elevation.

LENGTH: 30" with fuze

F. E.: 10.4% approx.

DRWG NO: 1253363

MAX DIA: 6"0

DETONATOR: M 42

CLOSURE: Press Fit

PRIMER: MK 39 full chg. MK 40 reduced chg.

CARTRIDGE CASE: MK 6

PROPELLANT: 33# Powder

LOAD DRWG: 1380988 (MK 13)

HANDLING-SAFETY: See TM3-250. Safety tests at DPG indicate this projectile is safe for normal handling and shipping.

DEVELOPMENT HISTORY: BUORD 1952 requirement. CCTC item No. 2452 and 3022.

REMARKS: Standard Navy Projectile MK 41 is used as the basic shell for fabrication of this chemical projectile.

REFERENCES: TM9-1901, TM3-250, TM3-5, OP 2215, NWIP-1-2, CWL-TM30-18, Spec. MIL-C-14585.

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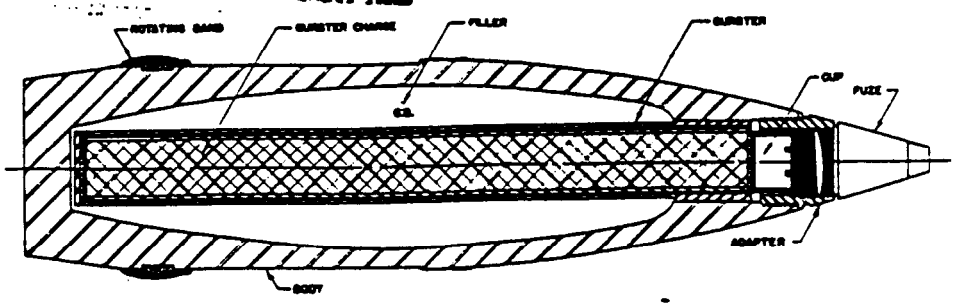


NOMENCLATURE:. Projectile, Howitzer, 155MM, Gas (GB) M121

TYPE: Separate Loading - Gas - Central Burst

PURPOSE: Provide toxic chemical offensive capability

STATUS: Std USA and USMC. 9.600 in USMC stock as of Dec 1960

DESCRIPTION: A separate loaded, central burst, GB agent filled round, which can be used for anti-personnel effects. It is similar to the HE round except for the filling and the burster. The burster casing is one piece, extending the full length of the projectile cavity and is a press-fit into the body. The burster charge contained in a thin tube, is held in the burster casing by the fuze well cup.

The adapter on the forward end is screwed into the body and is threaded to receive the PD fuze. The body is thin-walled steel with a nose formed to a long ogive. The single rotating band is located about 3.5 in front of the base. Used with M1, M1A1, and M45 Howitzers.

AREA COVERAGE: The average meteorological conditions used to estimate unit GB capabilities are: neutral temperature gradient, temperature above 60°F, and wind speed at 8 MPH. A battery of six 155MM Howitzers can cover about 6 hectares (100 meter squares with an incapacitating dosage, or about 3.5 hectares with a lethal dosage of GB in 30 seconds,

To produce 50% casualties within 2 mins. (through surprise or imperfect gas discipline or with unprotected troops in open or wooded terrain with wind speed of less than 8 MPH neutral temperature gradient and temperature of 60°F. or above, an ammunition expenditure of five (evenly distributed rounds per 100 x 100 yard square is required. Doubling ammunition expenditure gives 80% casualties. Higher expenditure not feasible when compared witn results obtained. For ammunition requirements for other atmospheric conditions see TM3-200.

PROJECTILE, HOWITZER, 155MM, GAS (GB), M121 (CHARACTERISTICS)

FIRED WEIGHT: 101.23# ASSY DRWG: 75-14-656

FILLER-WEIGHT: GB - 6.5# E . . 6.43%

RANGE: 10780 Yds'with M3 Charge, 16355 Yds with M4A1 Charge

MUZZLE VELOCITY: 1850 ft/sec LOAD DRWG: 73-l-264

P. E. AT MAX RANGE: 41 Yds FUZE: PD-M508

PROPELLING CHARGE: M3 (5.5#), or M4A1 (13.19#)

OVERALL LENGTH: 27".54 with fuze (less fuze 23".80)

MAX DIA: 6".098 BURSTER: M37 (2.72# HE)'

PRIMER: AGENT/BURSTER RATIO: 2.1 Nominal

USED WITH: Ml, M1A1, and M45 Howitzer 155MM

HANDLING-SAFETY: See TM3-250

REFERENCES: ACRC-1959, TM9-1900, TM9-1901, FM3-5, TM3-250, TM3-200, FM3-8, Landing Force Bulletin #5

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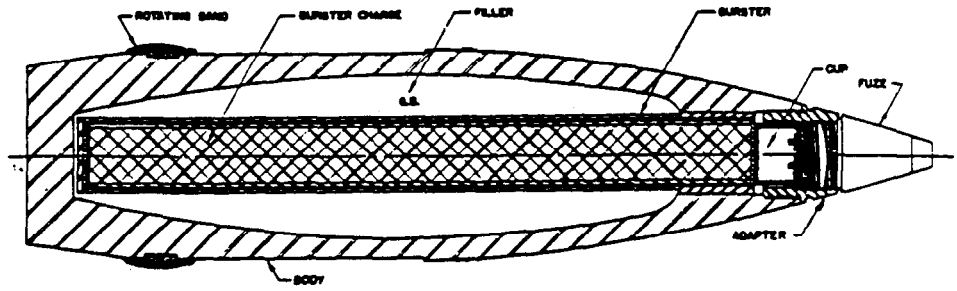


NOMENCLATURE: Projectile, Howitzer, 155MM, Gas, (VX) M121

TYPE: Separate Loaded - gas - Central Burst

PURPOSE: Provide toxic chemical offensive capability

STATUS: Non Std USA and USMC. (No USMC stock)

DESCRIPTION: A separate loaded, central burst, VX agent filled round, which *can* be used for anti-personnel effects: It is similar to the HE round except for the filling and the burster. The burster casing is one piece, extending the full length of the projectile cavity and is a pressflt into the body. The burster charge contained in a thin tube, is held in the burster casing by the fuze well cup.

The adapter on the forward end is screwed into the body and is threaded to receive the PD fuze. The body is thin-walled steel with a nose formed to a long ogive. The single rotating band is located about 3.5 in front of the base. . Used with Ml, M1A1, and M45 Howitzers.

AREA COVERAGE: For a single 155MM projectile loaded with VX agent it is estimated that it requires 6.3 lbs of agent to cover 0.4 hectares for a standard 100% casualty level which is the equivalent area of complete effect against troops without protection, and under standard meteorological *conditions* with temperature of 60°F, wind 5 MPH, and temperature gradient neutral. For a 30% casualty level under the same conditions the area coverage would be 1.12 hectares.

PROJECTILE, HOWITZER, 155MM (VX) M121 (CHARACTERISTICS)

FIRED WEIGHT: 101.23# (Approx)

FILLER-WEIGHT: VX 6.5# (Approx)

F. E.: 6.43%

P. E. AT MAX RANGE: 41 Yds

RANGE: With M3 charge 10780 Yds; With M4A1, 16355 Yards

FUZE: PD-M508

BURSTER: M37 with M15 casing (Comp B. - 2.72#)

BURSTER/AGENT RATIO: 2:1 Nominal

PROPELLING CHARGE: M3 (5.50#) or M4A1 (13.19#)

PRIMER: MK2A4

OVERALL LENGTH: 27".54 with fuze

USED WITH: M1, M1A1, and M45 Howitzer 155MM

HANDLING-SAFETY: See TM3-250

DEVELOPMENT HISTORY: This shell is the same as M121 (GB) except for the agent.

ASSY DRWG: 75-14-656

LOAD DRWG: 73-1-264

DIA: 6".098

MUZZLE VELOCITY: 1850 ft/sec

REFERENCES: TM9-1901, FM3-5, TM3-250, TM3-200, TM9-1900, ACRC-1959, FM3-8

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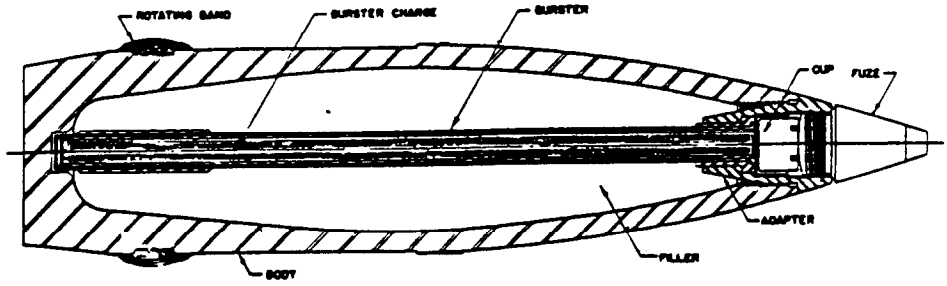


NOMENCLATURE: Projectile, Gun or Howitzer, 155MM (WP) M 110

TYPE: Separate Loading - Smoke - Central Burst

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Std USA and USMC. 129,535 in USMC stock as of 31 Dec 1960

DESCRIPTION: A separate loaded, central burst (WP) smoke round used for spotting, screening, anti-personnel, and limited incendiary effects. It is similar to the standard HE round except for the filling, burster tube, and burster charge. The burster charge, contained in a thin metal tube, is held in place in the burster casing by a fuze well cup. The forward end of the burster casing is assembled to the adapter in the nose of the round and extends the full length of the projectile. The adapter is threaded to receive the PD fuze. The body is of thin-walled steel with a noze formed to a long ogive. A single rotating band is located about 3.5" in front of the base.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.-

For example a 6 gun battery of 155MM Howitzers, each firing at the rate of 2 rd/min. could place 12 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 12 rounds, then approx. 6 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. See FM3-5 for other conditions.

## PROJECTILE, GUN OR HOWITZER, 155MM, SMOKE (WP) M 110

(CHARACTERISTICS)

FIRED WEIGHT: 97.50#

FILLER-WEIGHT: WP-15.6#

DIA: 6".098

F. E.: 16%

OVERALL LENGTH: 27".54 with fuze

LOAD DRWG: 73-l-264

MAX RANGE: 16355 Yds

FUZE: M51A5 (See Note 1)

ASSY DRWG: 75-14-317

BURSTER CASING: Ml

BURSTER CHARGE: M6 (0.83# HE)

PROPELLING CHARGE: M3 (5.5#), M4A1 (13.19#). M3 charges use Zones 1 - 5, M4A1 used Zones 3-7.

CARTRIDGE: None

PRIMER: MK2A4

USED WITH: Ml, M1A1 and M45 Howitzer 155MM or M2, M2A1 and M46 Gun 155MM.

HANDLING-SAFETY: See TM3-250

NOTE : Other fuze combinations TSQ-M55; MT-M67; or PD M51A4

REFERENCES: OCM 23555, ORD 11SNLR2, TM9-1901, FM3-5, TM3-250, ACRC 1959, TM3-200, TM9-1900, FM3-8.



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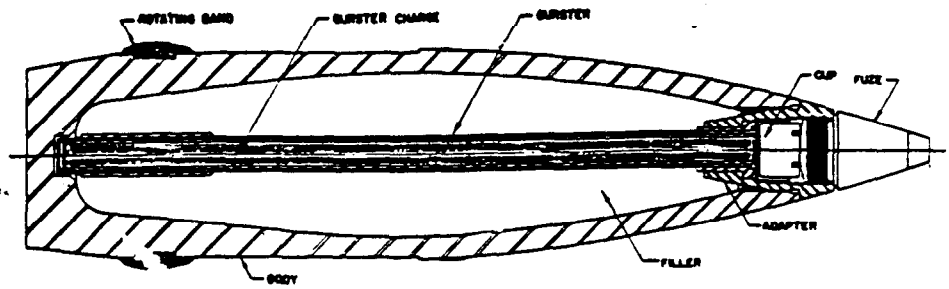


NOMENCLATURE: Projectile, Gun or Howitzer, 155MM (H-HD) M 110

TYPE: Separate Loading - Gas - Central Burst

PURPOSE: Provide toxic chemical offensive capability.

STATUS: Std USA and USMC. 44,228 in USMC stock as of 31 Dec 1960.

DESCRIPTION: A separate loaded, central burst or gas round used for anti-personnel effects. It is similar to the standard HE round except for the filling, burster tube and burster charge. The burster charge, contained in a thin metal tube, is held in place in the burster casing by a fuze well cup. The forward end of the burster casing is assembled to the adapter in the nose of the round and extends the full length of the projectile. The adapter is threaded to receive a PD fuze. The body is of thin-walled steel with a nose formed to a long ogive. A single rotating band is located about 3.5" in front of the base. Used with M1, M1A1, and M45 Howitzers 155MM.

AREA COVERAGE: The average meteorological conditions used to estimate unit HD capabilities are: neutral temperature gradient, temperature about 70°F, wind speed about 8 MPH, and dry weather. Under these conditions a battery of six 155MM Howitzers can contaminate about 5.5 hectares with liquid HD in 15 minutes. The battery can cover in 15 minutes about 4.5 hectares with a concentration of HD Vapor that will incapacitate masked personnel after about 1 hours exposure. See TM3-200 for other specific conditions.

[redacted]

PROJECTILE, HOWITZER, 155MM (H-:HD) M 110 (CHARACTERISTICS)

FIRED WT: HD - 92.5# FILLER WT: 9.7# HD F.E.: 10.50%

FIRED WT: H - 93.10# FILLER WT: 10.30# H F.E.: 11.10%

MAX RANGE: 16355 Yds ASSY DRWG: 75-14-317

BURSTER CASING: Ml LOAD DRWG: 73-1-179

BURSTER CHARGE: M6 - 0.83# HE CARTRIDGE: None

PROPELLING CHARGE: M3-5.5#, M4A1 - 13.19#

PRIMER: MK2A4 FUZE: M51A5 (See Note 1)

OVERALL LENGTH: 27".54 with fuze

MAX. DIA: 6".098 MUZZLE VEL: 1.850 ft/sec

USED WITH: Ml, M1A1, and M45 Howitzer 155MM

HANDLING-SAFETY:' See TM3-250

*NOTE 1*: Other fuze combinations TSQ-M55; MT-M67; or PD-M51A4

REFERENCES: TM9-1901, TM3-250, TM3-200, FM3-5, FM3-8, TM9-1900, ACRC 1959, Technical Aspects of CW in the field (Parts 1 & 2) 9th & Final Report dated 29 April 1946



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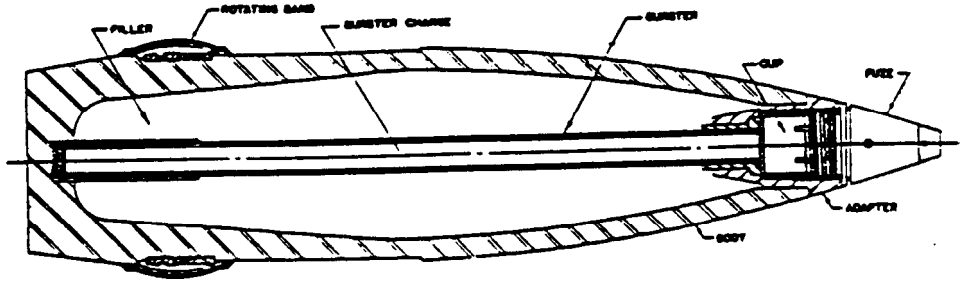


NOMENCLATURE: Projectile, Gun, 155MM, Smoke (WP) M 104

TYPE: Separate Loading - Central Burst

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Std USA and USMC. 47,672 in USMC stock as of 31 Dec 1960

DESCRIPTION: This is a separate loaded, central burst WP smoke round similar to the HE round, and is used for anti-personnel, smoke screening, and spotting effects, There is a 2" wide rotating band located near the base of the projectile. An aluminum burster tube extends the full length of the projectile cavity and is supported at the forward end by the adapter, which also holds a PD fuze. The base is boa:-tailed. Upon impact the PD fuze ignites the burster charge which explodes the projectile and releases the filling. This projectile is used with 155MM Guns M2 or M46.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 4 gun battery of 155MM guns, each firing at the rate of 2 rd/min. could place 8 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 8 rounds, then approx. 4 rds/min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. Burst radius for anti-personnel effects is approx. 18 to 60 yards. See FM3-5 for other conditions.

[redacted]

PROJECTILE, GUN, 155MM, SMOKE (WP) M 104 (CHARACTERISTICS)

**FIRED WT**: 98.71# WP
100# FS

E. . : 15.9% - WP
16.9% - FS

RANGE: 25715 Yds

**FUZE**: PD-M51A5 (See Note 1)

**BURSTER CASING**: Ml

OVERALL LENGTH; 27"66 with fuze

MUZZLE VELOCITY: 2800 ft/sec

FILLER-WEIGHT: WP - 15.60#
FS - 16.90#

DRWG: 75-14-296

MAX. DIA: 6"098

**BURSTER CHARGE**: M6 (0.83# HE)

PROPELLING CHARGE: Mlg (31.60#)

PRIMER: MK2A4

USED WITH: M2, M2A1, and M46 (T80) 155MM Gun

HANDLING-SAFETY: See TM3-250

NOTE 1: Other fuze combinations TSQ-M55; MT-M67; or PD M51A4

REFERENCES: OCM 16848 OBD 11SNL P-1, TM9-1901, TM3-250, TM3-200, FM3-5, Landing Force Bulletin #5, FM3-8, TM9-1900, ACRC 1959

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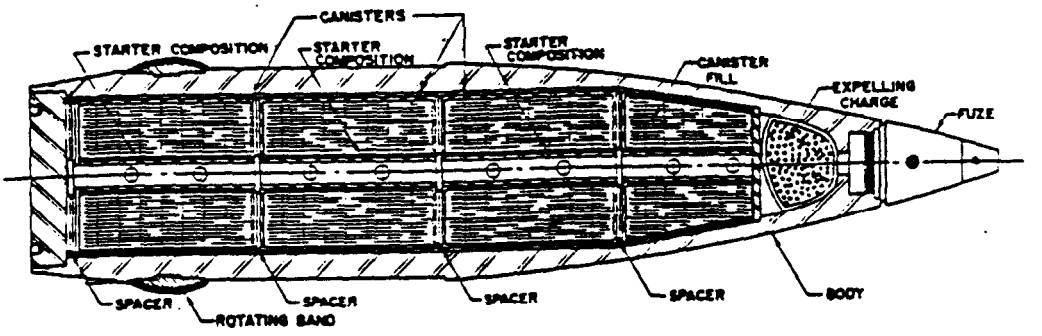



NOMENCLATURE: Projectile, 155MM, Gun or Howitzer, Smoke, M 116B1

TYPE: Separate Loading - Base Ejection Canister

PURPOSE: To provide spotting, screening, and signaling with HC or colored smokes

**STATUS :** Std. USA

DESCRIPTION: This projectile is a separated loaded, base ejection, smoke canister type in which the nose, body, and base are made as separate parts. An expelling charge of black powder is located in the front end of the shell cavity. The remainder of the cavity holds four canisters of smoke, one behind the other. The front canister is conical to conform with the taper of the nose cavity. A hole passes through the baffle plate and the longitudinal axis of each canister, forming a flash tube.

The base of the projectile is closed with a base plug which is blown out when the canisters are ejected. The colored smoke cloud emitted from each canister burns from 30 seconds to 4 minutes and is about two to three times greater than that of the 105MM BE smoke round. Canisters filled with HC or color smokes are used. Used with 155MM Guns M27, M46, *and* 155MM Howitzers Ml, and M45.

AREA COVERAGE.: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target and a *smoke* curtain is established by volley firing smoke rounds intointo the area until the desired density is achieved. This may take 1 or 2 min. depending on the amount of smoke in the round, meteorological conditions and the density of the curtain &sired. .

For example a 4 gun battery of 155MM Guns, each firing at the rate of 2 rd/min. could place 8 rd/min. into the area to establish a smoke curtain. If the required curtain is established in 1 min. with 8 rounds, then approx. 4 rds/min should maintain the curtain. Burst radius for anti-personnel effect is approx. 30 to 60 yds. See FM3-5 for other conditions.

[redacted]

PROJECTILE, 155MM GUN OR HOWITZER, SMOKE, M 116B1 (CHARACTERISTICS)

PROJECTILE DWG: 75-14-381 OVERALL LENGTH: 27"17 with fuze

| FILLER-WEIGHT: | FIRED WEIGHT: | E. . : |
|---|---|---|
| H. C. Smoke - 25.84# | 95.35# | 27.1% |
| Color Smoke - 17.19# | 86.44# | 19.9% |

PROJECTILE LENGTH: 26"41 MAX. DIA: 6"098

| | |
|---|---|
| M1 Canister (HC) | CMLC Dwg C15-11-33 Straight |
| M2 Canister (HC) | CMLC Dwg C15-11-41 Tapered |
| M3 Canister (Color) | CMLC Dwg C15-11-67 Straight |
| M4 Canister (Color) | CMLC Dwg C15-11-70 Tapered |

Colored Smokes are Red, Green, and Yellow

CANISTER DIMENSIONS:

| Dia | Length |
|---|---|
| M1, M3 - 4"5 | 4"72 (Straight) |
| M2, M4 - 3"25 and 4"15 | 3"75 (Tapered Nose) |

EJECTION CHARGE: 0.28# Black Powder

BURNING TIME: 30 sec'to 4 min(HC), 60 to 80 sec, colored

FUZE: M501A1 - MTSQ PRIMER: MK2A4 Percussion

MAX RANGE: Howitzer 16700 yds with full charge
Gun 25715 yds with full charge

MAX. MUZZLE VEL: Howitzer 1850 ft/sec with full charge
Gun 2800 ft/sec with full charge

BODY MATERIAL: Forged Steel

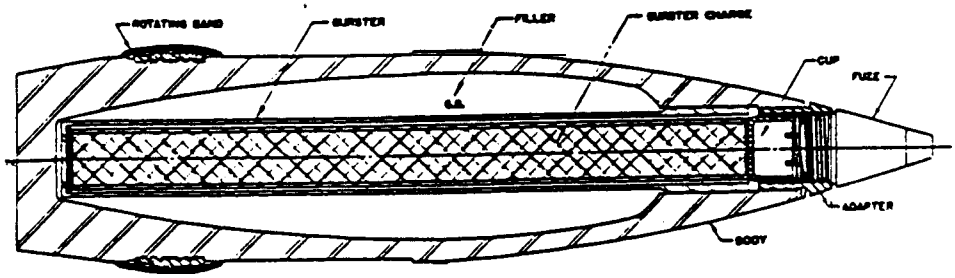
PROPELLING CHARGE: Howitzer M3 (5.50#) reduced charge
Howitzer M4A1 (13.19#) full charge
Gun M19 (31.60#) full charge

CANISTERS PER LOAD: 3 of M1 or M3, and 1 of M2 or M4

USED WITH: M1, M1A1, or M45 Howitzer 155MM; M2, M2A1, or M46 Gun 155MM

SAFETY-HANDLING: See TM3-250

REFERENCES: TM9-1900, TM9-1901, TM9-1910, ACRC-1959, FM3-5, FM3-6, TM3-200, TM3-250 [redacted]




NOMENCLATURE: Projectile, Gun, 155MM (GB) M 122

TYPE: Separate Loading - Gas - Central Burst

PURPOSE: Provide toxic chemical offensive capability.

STATUS: Std. USA and USMC. 28,494 in USMC stock as of 31 Dec 1960

DESCRIPTION: This is a separate loaded, central burst GB gas round similar to the HE round, and is used for anti-personnel effects. There is a 2" wide rotating band located near the base of the projectile. An aluminum burster tube extends the full length of the projectile cavity and is supported at the forward end by an adapter, which also holds a PD fuze. The base is boat-tailed. Upon impact the PD fuze ignites the burster charge which explodes the projectile and releases the filling. This projectile is used with 155MM Guns M2 or M46.

AREA COVERAGE: The average meteorological conditions used to estimate unit gas capabilities are: neutral temperature gradient, temperature above 60°F, and wind speed about 8 MPH. Under these conditions a battery of four 155MM guns can contaminate about 2.5 hectares (100 meter squares) with an incapacitating dosage, or about 1.6 hectares with a lethal dosage of GB in 30 seconds. For other specific conditions, see TM3-200.

[redacted]



[redacted]

PROJECTILE, GUN, 155MM (GB) M 122 (CHARACTERISTICS)

FIRED WEIGHT: 97.78#

F. E.: 6.65%

DR. NO.: 75-14-704

BURSTER CHARGE: M37 (4.7# HE)

PROPELLING CHARGE: M 19 (31.60#)

MAX. DIA: 6".098

MUZZLE VEL: 2800 ft/sec

FILLER-WEIGHT: 6.5# GB

RANGE: 25715 Yds (Supercharge)

FUZE: PD-M508

BURSTER CASING: M16

OVERALL LENGTH: 27".54 with fuze

PRIMER: MK2A4

USED WITH: M2, M2A1, and M46 (T80) 155MM Gun

HANDLING-SAFETY: See TM3-250

REFERENCES: TM9-1901, TM9-1900, TM3-200, ACRC-1959, TM3-250, FM3-5, FM3-8, Operational Research Group Study #17



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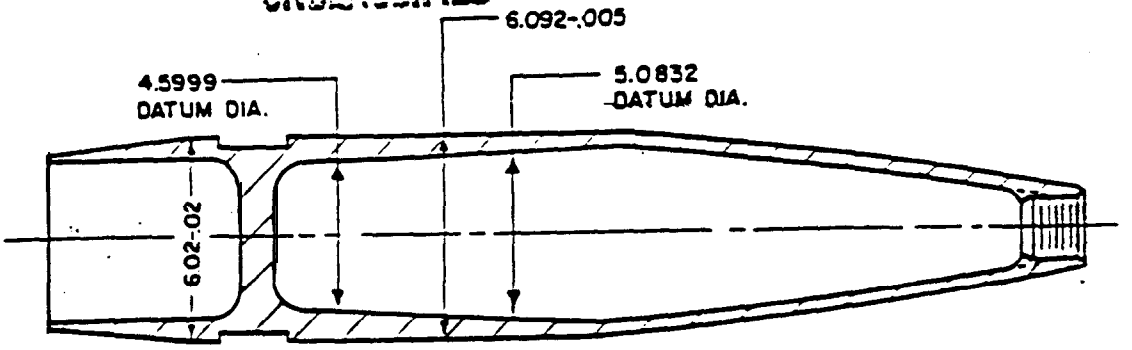



NOMENCLATURE: Projectile, Howitzer, 155MM (VX) T-387

TYPE: Separate Loading - Thin Wall - Central Burst

PURPOSE: Long range toxic chemical offensive capability

STATUS: Held in abeyance.

DESCRIPTION: This is a thin walled, extended range, projectile that holds approximately 50% more agent than the M 121. It is a separate loaded, central burst round filled with VX for anti-personnel effects. Similar to the HE round except for the filling and burster. The burster charge, contained in a thin metal tube, is held in place in the burster casing by a fuze well cup.

The forward end of the burster casing is assembled to the adapter in the nose of the round and extends the full length or' the cavity. The adapter is threaded to receive the PD fuze. The body is thin walled steel with a nose formed to a long ogive. A single rotating band is located near the base of the projectile. Used with Ml, M1A1, and M45 Howitzers 155MM.

AREA COVERAGE: For a single 155MM projectile loaded wit;". VX agent itis estimated that it requires 6.3 lbs of agent to cover 0.4 hectares for a standard (10 0%) casualty level area which is the equivalent area of complete effect against troops without protection, and under standard meteorological conditions with temperature of 60°F. wind j MPH, and temperature gradient neutral. For a 30% casualty level under the same conditions the area coverage would be 1.12 hectare:

PROJECTILE, HOWITZER, 155MM, (VX) T-387 (CHARACTERISTICS)

WEIGHT : As fired 95# (Approx.) FILLER-WEIGHT: VX - 9.5#

BURSTER CHARGE: 1.25# HE PRIMER: T106 (See-Note 1)

PROPELLANT CHARGE: T34 (15#) F. E.: 10%

MUZZLE VELOCITY: Min. 700 ft/sec, Maximum 2100 ft/sec

TERMINAL VELOCITY: Min. 625 ft/sec, Maximum 1160 ft/sec

RANGE: Min. 2898 Yds., Maximum 20013 Yds

LENGTH OF PROJECTILE: 30"04 with fuze MAX.DIA: 6"09

FUZE REQ'D: VT M513 or M514 type

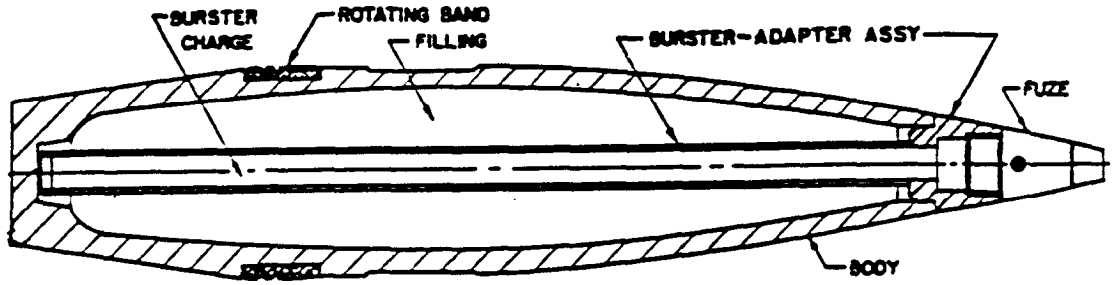
SHELL BODY: Ord. Corps. Dr. No. FD 21551, Body, (Modified)

NOTE 1: To be replaced by XM82.

DEVELOPMENT HISTORY: HE shell T387 was used as basic shell for development of thin wall VX shell. This project divsaw is Phase II In the development of 155MM extended range Howitzer shell.

REFERENCES: TM9-1901, FM3-5, TM3-250, TM3-200, TM9-1900, FM3-8

[redacted]




NOMENCLATURE: Projectile, Gun, 175MM, Smoke (WP) T 204

TYPE: Separate Loaded - Central Burst - Long Range

PURPOSE: Anti-personnel, Incendiary, Spotting, Screening

STATUS: Non-Std USA. Held in abeyance pending decision.

DESCRIPTION: This is a separate loaded, central burst projectile used for spotting, screening, anti-personnel and limited incendiary effects. It is essentially a T-203 shell modified to accommodate WP. The adapter is a press fit into the casing and the adapter and burster are a single assembly. The burster extends the full length of the cavity. A PD fuze screws into the forward end of the adapter - burster assembly.

AREA COVERAGE: Assuming an 8 MPH wind, 60% RH, neutral temperature gradient and temperature above 60°F it normally requires about 3 min. to adjust fire on the target, and a smoke curtain is established by volley firing smoke rounds into the area until the desired density is achieved. This may take 1 or 2 min. depending *on* the amount of smoke in the round, meteorological conditions and the density of the curtain desired.

For example a 4 gun battery of 175MM Guns, each firing at the rate of 1 rd/2 min. could place 4 rd/2 min into the area to establish a smoke curtain. If the required curtain is estabiished in 2 min. with 4 rounds, then approx. 2 rds/2 min. should maintain the curtain. For a blinding and casualty effect WP is fired directly on the target at the same rate required to establish the curtain. Burst radius for anti-personnel effects should be approx. 30 to 60 yds. See FM3-5 for other conditions.

OJECTILE, GUN, 175MM, SMOKE (WP) T 204 (CHARACTERISTICS)

WEIGHT: 142#

WEIGHT-FILLER: 2% WP

BURSTER CHARGE: 1.37# H.E.

RANGE: Anticipated 35,000 Yds

MUZZLE VELOCITY: 2975 FPS

FUZE REQ'D: M51A5 PD

USED WITH: T256 Gun

HANDLING-SAFETY: See TM3-250

OVERALL LENGTH: 341'12 (with fuze)

BURSTER RATIO: 24# Filler/1# HE

MAX. DIA: 175MM

F. E.: 20.42% Approx.

CLOSURE: Press Fit

DEVELOPMENT HISTORY: Army Ordnance Corps has contract with Firestone for development of this shell. Fifteen prototype shells with one piece aluminum burster have been manufactured and are awaiting firint test. Firestone awaiting decision relative to development of oversize charge prior to reopen- of development work. Chemical Corps will participate in development and testing of the end Item. The temperature surveillance test was satisfactory.

REFERENCES: TM3-250, TM9-1901, FM3-5, FM3-8, TM3-200, APG No. DPS/TW 111/4 DTD March 59, TM9-1900



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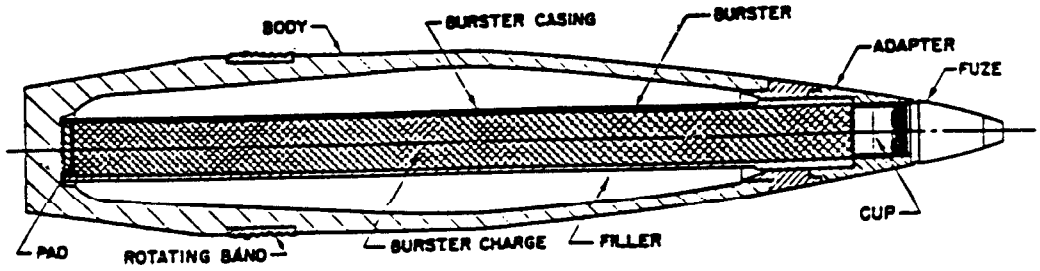


NOMENCLATURE : Projectile, 175MM, Gun, (GE) T 223

TYPE: Separate Loaded - Gas - Central Burst

PURPOSE: To provide toxic chemical offensive capability

STATUS: Engineering Tests. Non-Std

DESCRIPTION: This is a separate loaded, central burst munition which is used for anti-personnel effects. A single rotating band is located near the base of the projectile. The base is boat-tailed. An adapter at the forward end of the projectile holds the PD fuze and supports the burster tube which extends the full length of the cavity. Used with 175MM Guns, T 145 or T 256.

AREA COVERAGE: Average meteorological conditions used to estimate unit GB capabilities are: neutral temperature gradient temperature above 60°F, and wind speed about 8 MPH. Under these conditions four 175MM Howitzers can cover about 2.3 hectares (100 meter squares) with an incapacitating dosage, or about 1 hectare with a lethal dosage of GB in 30 seconds. For specific conditions, see TM3-200.

[redacted]

PROJECTILE, 175MM GUN, (GB) T-223 (CHARACTERISTICS)

FIRED WEIGHT: 147#

LENGTH: 34.12 (with fuze)

BURSTER RATIO: ND

ASSY DRWG: ND

MUZZLE VEL: 2975 ft/sec

CLOSURE: Press Fit

WEIGHT-FILLER: ND # GB

%. E.:

MAX. DIA: 175MM

BURSTER CHARGE: ND

MAX RANGE: 35,000 Yds

FUZE: ND

USD WITH: T 256 Gun

HANDLING-SAFETY: See TM3-250

DEVELOPMENT HISTORY:

REFERENCES: TM3-250, TM9-1900, TM9-1901, TM3-200, FM3-5, FM3-8



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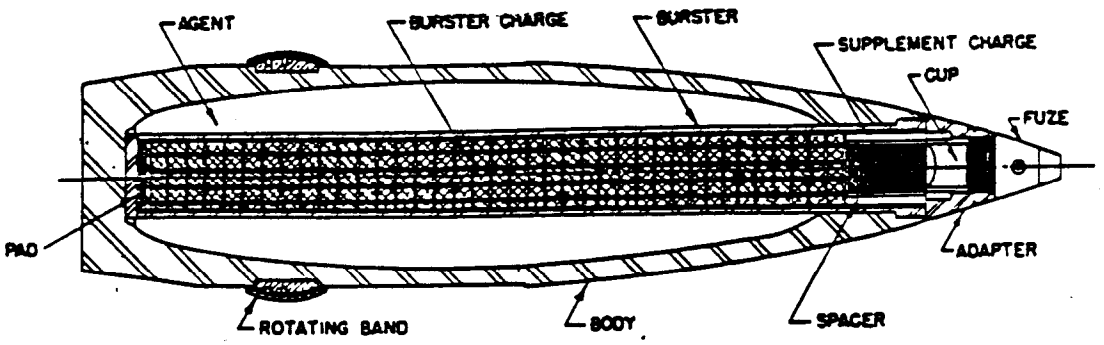


NOMENCLATURE: Projectile, Howitzer, 8",(GB) T 174

TYPE: Separate Loaded - Gas - Central Bursting

PURPOSE: Provide toxic chemical offensive capability

STATUS: Non-Std. USA. In user test.

DESCRIPTION: This is a one piece separate loaded, central. burst gas round for GB agent. Is similar tothe HE round in external configuration but has a burster tube, burster charge and a supplemental charge. The burster tube extends the full length of the cavity and is a press fit. A single rotating band is located about 6.06" from the base end and has two cannelures or grooves. The adapter assembled to the nose end is thrleaded to receive a PD fuze. Used with M2 or M2A1 Howitzer 8 inch.

AREA COVERAGE: Average meteorological conditions used to estimate unit GB capabilities are: neutral temperature gradlent, temperature above 60°F, and wind speed about 8 MPH. Under these conditions a battery of four 8" Howitzers can cover about 2.5 hectares (100 meter squares) with an incapacitating dosage, or about 1 hectare with a lethal dosage of GB in 30 seconds. For specific conditions, see TM3-200.

Ground contamination averages 1500 square meters' for density level of .5 gram per square meter. On one test 0-60 min. showed 35 MG Min/M3 at 1012 ft downwind and 8 MG Min/M3 at 1210 ft downwind.

[redacted]



[redacted]

PROJECTILE, HOWITZER, 8", T 174 (GB) (CHARACTERISTICS)

FIRED WEIGHT: 200# OVERALL LENGTH: 35.11 with fuze

FILLER-WEIGHT: GB 15.7# FILLER/BURSTER RATIO: 2:1

BURSTER CHARGE: 6.95# (Comp B) F.E.: 7.85% Approx.

MUZZLE VELOCITY: 1950 ft/sec RANGE: 18500 Yds Max.

MAXIMUM RATED PRESSURE: 33000 P.S.I. CLOSURE: Press Fit

PROPELLING CHARGE: M2 (28.30#) MAX. DIA: 7.99
M1 (13.30#)

P. E. AT MAX RANGE: 41 Yds PRIMER: MK2A4

FUZE REQ'D: Nose Fuze PD-M51A5 SUPP. CHARGE: 0.263# H.E.

USED WITH: M2, M2A1 Howitzer 8"

HANDLING-SAFETY: See TM3-250. Rough handling, storage, vibration tests indicate that this projectile is safe for normal military handling - shipping and storage.

DEVELOPMENT HISTORY: Shell was developed by Chemical Corps to fulfill an requirement of conarc for a Gas (GB) shell for use with the 8" Howitzer M2 and having external ballistics similar to the 8" H.E. Shell M106 to permit use of same firing tables for both shells.

REMARKS: Shell is similar in design to other standard chemical filled munitions. Eight shells were fired at Yuma, Arizona in November 1958 and were apparently successful. Can use firing tables FT-8-J-1 of M106-HE Projectile.

REFERENCES: DPG #226 Vol I Sept 58, Vol II June 1959 (Conf), TM3-250, FM3-5, FM3-8, TM3-200, TM9-1900, TM9-1901

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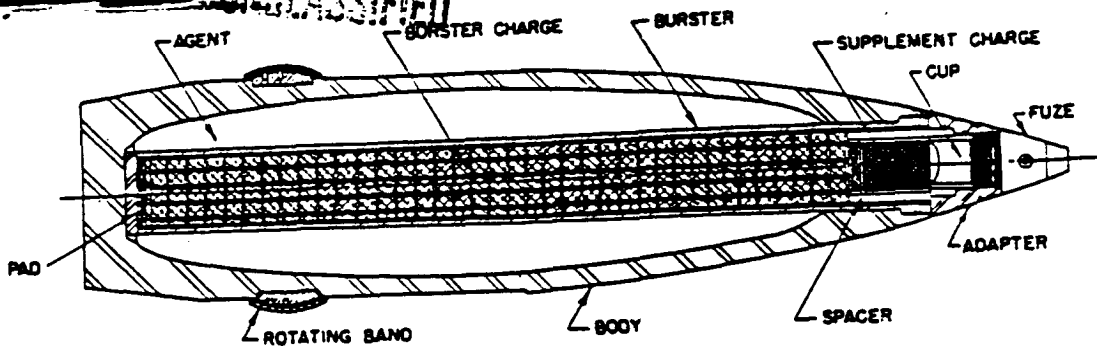


NOMENCLATURE: Projectile, Howitzer, 8", (VX) T 174

TYPE : Separate Loaded - Gas - Central Burster

PURPOSE: Provide toxic chemical offensive capability

STATUS: Non Std. USA. In user test.

DESCRIPTION: This is a one piece separate loaded, central burst gas round for VX agent. Is similar to the [redacted] round in external configuration but has a burster tube, burster charge and a supplemental charge. The burster tube extends the full length of the cavity and is a press fit. A single rotating band is located about 6.06" from the base end and has two cannelures or grooves. The adapter assembled to the nose end is threaded to receive a PD or VT fuze. The VT fuze is used for air burst. Used with M2 or M2A1 Howitzer 8 inch.

AREA COVERAGE: It is estimated that one round well covers approximately 2850 to 10,800 sq. meters horizontal contamination, 2850 to 26,125 sq. meters horizontal plus 1.5 ft. vertical contamination, and 2850 to 29,000 sq. meters horizontal plus 5 ft. vertical contamination at the 100 mgs per sq. meter (and 0.65 mg per vertical sampler) level at a variety of both wind speeds and bursts heights. See DPGR 236 Vols. I and II for more information.

[redacted]

## PROJECTILE, HOWITZER, 8", (VX) T 174 (CHARACTERISTICS)

WEIGHT: 200# (Approx.)

OVERALL LENGTH: 35.11 with fuze

FILLER-WEIGHT : VX (14.1#)

F. E.: 7.05%

FILLER/BURSTER RATIO: 2:1 Nominal

MAX DIA: 7.99

BURSTER TYPE: Central Bursting

BURSTER: 6.95# Comp "B"

MUZZLE VELOCITY: 1950 Ft/Sec

RANGE: 18500 Yds (Max)

MAX RATED PRESSURE: 33000 PSI

P.E. AT MAX RANGE: 20 Yds

CLOSURE: Press Fit

PROPELLING CHARGE: M1 - 13.30#
M2 - 28.30#

FUZE REQ'D: PD51A5

PRIMER: MK2A4

USED WITH: M2, M2A1 Howitzer 8"

SUPP. CHARGE: 0.263# - H.E.

HANDLING-SAFETY: Rough handling, vibration, drop and other tests indicate that the T 174 is safe for normal military handling and storage. See TM3-250.

REMARKS : Projectile is similar in design to M 106 HE filled munitions. Permits the use of firing table FT-8-J-1 which is used with the HE M 106 projectile. Differs from 8"GB projectile only in fuzing.

DEVELOPMENT HISTORY: CCTC item 3464 approved 27 Au3 1958. To fill CONARC requirement for chemical shell for M2 Howitzer.

REFERENCES: TM3-250, FM3-5, FM3-8, TM3-200, TM9-1900, TM9-1901, DPGR #236 Vol I June 59, Vol II July 59 (Conf)

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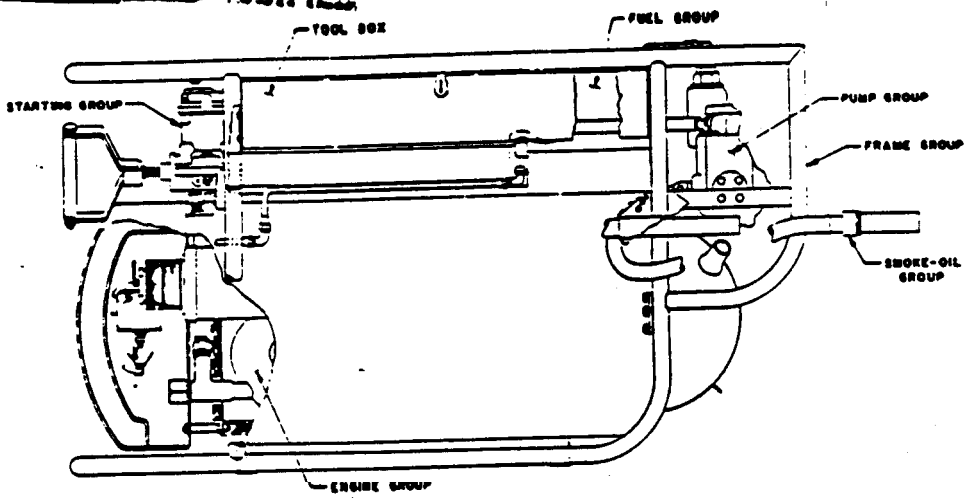


NOMENCLATURE: Generator, Smoke, (SGF) M3A3

TYPE: Gas Engine Driven - Pulse Jet

PURPOSE: To produce large-area smoke screens to conceal installations, cover troop movements, river crossings and landings.

STATUS: Std USA and USMC. 83 on USMC procurement March 1960.

DESCRIPTION: The M3A3 mechanical smoke generator is essentially a gasoline-operated pulse jet engine in which fog oil is vaporized by the heat of combustion gases produced in the engine. Fog oil vapor is expelled through discharge nozzles to the atmosphere, where it condenses into small droplets to form smoke. Components are mounted in a tubular steel frame. Two men can carry the unit when emplacing It.

AREA COVERAGE: Assuming a lapse condition over water, and a wind speed of 9 to 15 MPH with generators placed in a line perpendicular to the wind, a spacing of 30 yards between generators placed 9 times this distance from the rear edge of the target will produce a smoke curtain. To establish a smoke haze double this spacing and place generators farther from target. For a blanket to protect against aerial photography reduce this spacing about one third and place generators closer to the target. For other spacings and conditions, see FM3-5 and FM3-50.

[redacted]

GENERATOR, SMOKE, . (SGF) M3A3 (CHARACTERISTICS)

AGENT USED: SGF Fog Oil (SGF #1 to 40°F, SGF #2 above 40°F)

UNIT WEIGHT: 190# empty. FILLED WT: 207#

AGENT CONSUMPTION: 25 to 40 GPH DR. NO.: D31-15-1029

LENGTH: 42 -1/4" WIDTH: 18-1/2" HEIGHT: 23"

FUEL TANK CAPACITY: 3-1/2 GAL. GEN. PER co: 48

ENGINE FUEL CONSUMPTION: 3Gal. per hr.

ENGINE FUEL: Gasoline 76 octane or higher

FRAME: Tubular Steel. DISPERSION CAPABILITY: 25 to 50 gal/hr.

HANDLING-SAFETY:' See FM3-250

DEVELOPMENT HISTORY: In development this generator was 'designated To E19R5.

REFERENCES: TM3-1040—202-12, TM3-343, TM3-341, FM3-5, FM3-50, FM3-8, FM3-250.



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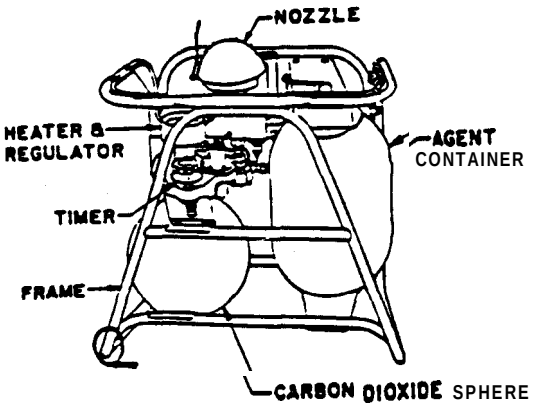


NOMENCLATURE: Generator, BW Portable, Liquid, E22

TYPE : Sack Pack--One Man Portable - Two Fluid Nozzle

PURPOSE: Dissemination of Liquid B Win Aerosol form.

STATUS: Requirement withdrawn by CONARC.

DESCRIPTION: The major components of this unit are an initiator and timer assembly, safety pin, release pin, heater containing two Ignition cylinders, a heater and temperature device, regulator, nozzle, carbon dioxide container, agent container, propane container, check valve, tubing, hardware, aluminum tubular frame, shoulder harness, and cover. The carbon dioxide is stored under pressure and the BW liquid agent is stored in an insulated container.

CAPABILITIES: The E22 can be placed in a desirable position, the timer preset to function some time in the future, the cover removed, the safety pin removed, and the placing personnel can leave the area. At the pre-set time the generator would function generating an aerosol agent into the wind which would drift over the target. Can be air dropped to ground troops for use. In operation the generator is audible at distances up to 60 yards. At night the initiation match flame is visible but is faint and of short duration. Can be operated from the ground, truck, trailer, or boat.

[redacted]

NAVORD REPORT 6954 (FIRST REVISION)

GENERATOR, BW PORTABLE LIQUID, E22 (CHARACTERISTICS)

HEIGHT: 16"2 WIDTH: 18"7 DEPTH: 10"7

FRAME: Tubular Aluminum EMPTY WT: 23"75# F.E.: 32%

FILLED WEIGHT: 35# AGENT USED: BW Liquids

AGENT CAPACITY: 2.62 Liters.

OPERATING TIME: Approx. 7 min. OPERATING PRESS: 137 PSI

DELAY TIME FUZING: 15 min to 8 hrs.

HANDLING-SAFETY: Filled agent containers can be stored and shipped separate from the generator, if desired.

DEVELOPMENT HISTORY: A CONARC requirement. Contract; with Walter Kidde Co. initiated 1 Feb 1955

REFERENCES: Ft. Detrick Tech. study 9 dtd June 1958, III-14, T1-374-40P.



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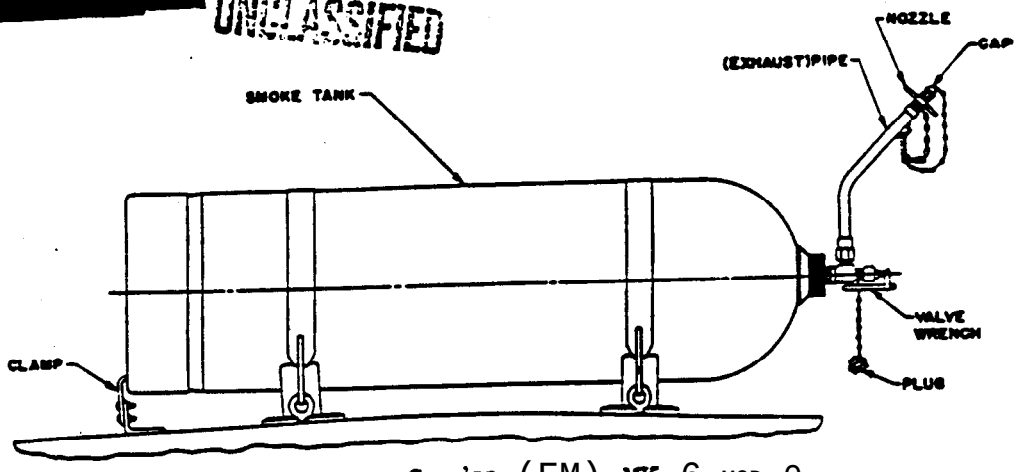


NOMENCLATURE: Generator, Smoke (FM) MK 6 MOD 0

TYPE: Tank and Valve

PURPOSE: Generate smoke screens from surface vessels

STATUS Std USN (2137 MK 2 Tanks on hand as of 31 Dec 1960)

DESCRIPTION: This generator is a Single MK 2 tank unit originally designed for small vessels. such as PT boats. A manual valve and an exhaust tube designed to operate with or without nozzles supplies with the generator. Four size nozzles are furnished. They are designated 2-3-4 and 5 and discharge for 3-1/4. 5-3/4, 8, and 12-3/4 minutes respectively at temperatures of about 75°F. Without a nozzle the discharge time is about 2-1/4 min at about 75°F.

LIMITATIONS: The tank being steel, is magnetic, and therefore nor; suitable for mine sweepers.

AREA COVERAGE: FM is most effective in wind speeds of 5 to 15 MPH. Smoke screen density with the MK 6 generator is determined by the size of the nozzle used. See characteristics or next page for nozzle discharge time. Assuming a lapse condition over water, a wind speed of 9 to 15 MPH, with generators placed in a line perpendicular to the wind, a spacing of approx. 30 yards between generators placed nine times this distance from the rear edge of the target will produce a smoke curtain. To establish a smoke haze double this spacing and place generators farther from the target. For a smoke blanket to protect against aerial observation and photography reduce this spacing about one third and place generators closer to the target. For other spacings and conditions see FM3-5 and FM3-50.

[redacted]



[redacted]

(CHARACTERISTICS)

GENERATOR, SMOKE SCREEN (FM) MK 6 MOD 0

LENGTH: 58" OVERALL HEIGHT: 17"5 DRWG: 389078

DIA: 16" SPACE OCCUPIED: Approx. 7-1/4 Sq. Ft.

AGENT: FM mixed with $CO_2$ for ejection WEIGHT EMPTY: 211# Approx.

OPERATING TIME: See Note 1

TANK CAPACITY: 33 Gal 330# PSI# TEST:

WEIGHT: 544# when filled with 330# of FM and CO2

TANK: MK 2 (commercial ICC-3A480 full spun steel ammonia cylinder)

NOTE 1:

| NOZZLE NO. | DISCHARGE TIME (a) 75°F |
|---|---|
| 5 | Minutes |
| [illegible] | Minutes |
| 3 | 15.75 Minutes |
| 2 | 8.25 Minutes |
| Without Nozzle | 2.25 Minutes |

Nozzle 5 (a) 45°F=25 Min Approx.

FILLING EQPT: MK 1 MOD 4

REFERENCES: OP 2217, FM3-5, TM3-215, FM3-50



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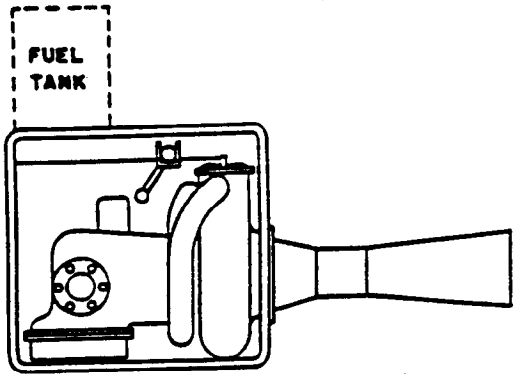


NOMENCLATURE: Generator, Smoke,, Mechanical E 22

TYPE: Gas Turbine

PURPOSE: Produce smoke screens

STATUS: Non Std. Not active at present

DESCRIPTION: A Mars Generator modified for disseminating 12# of tear gas and benzine (SNB) as a 20% solution by weight. It will cover 170 sq. meters with an effective dosage assuming 100% dissemination efficiency. Modified from Mars generator with tank and lines added. Could be placed in radio controlled boat and used for screening shore lines. Has a very high dissemination efficiency and can use fog oil, diesel oil, etc. for fuel.

[redacted]



[redacted]

GENERATOR, SMOKE, MECHANICAL E 22 (CHARACTERISTICS)

DEVELOPMENT HISTORY: Developed for the Navy by ACC.

REFERENCE: CRLR-637



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NO ILLUSTRATION

NOMENCLATURE: Smoke Device, Screening, E-21

TYPE: Engine Exhaust Fog oil ( SGF)

PURPOSE: For screening M48A1 tank and LVTP5

STATUS: Awaiting decision of USMC Equipment Board. Non Std.

DESCRIPTION: This device consists of a storage tank, a rotary pump, with muffler and extensions for dispersing fog oil into the exhaust system to conceal movements of a tank or LVT at speeds up to 20 MPH. The unit can be mounted in various locations, but the recommended location is as near the engine as practicable. Smoke is created when oil is forced into the muffler extentions, is partially vaporized, and completely vaporized by escaping engine exhaust gases. When the vaporized fog oil comes in contact with the cooler outside air, It condenses into a thick, white smoke or fog. The amount of fog oil that is forced into the muffler extensions is controlled by the setting of a stop valve that must be pre-set for a predetermined rate of speed

LIMITATIONS: Changes in wind, humidity, and temperature effect the consumption rate and the distance traveled.

AREA COVERAGE: Not applicable.



[redacted]

SMOKE DEVICE, SCREENING, E-21 (CHARACTERISTICS)

STORAGE TANK: LENGTH: 40"5 WIDTH: HEIGHT: 5"0

TANK CAPACITY: 10 gal. USABLE CAPACITY: 8 gal.

WEIGHT: EMPTY: 31#, FULL: 96.5#

AGENT WT: 65.6#

PUMP: Hydraulic, rotary vane, 1/4 HP, 24 Volt, DC, 1700 RPM, 80 PSI. positive displacement, 80 PSI outlet pressure, 3 gpm at

LENGTH: 10"5 DIA: 4"5 WEIGHT: 8.5#

Total weight of test item empty 157.15# includes pipes, fittings, and electrical connections.

Time required for initial installation: Approx. 9 hours. Can be installed at battalion level.

USED WITH: M48A1 Tank and LVTP5

CONSUMPTION CHART

| | Standing | 5 MPH | 10 MPH | 15 MPH | 20 MPH |
|---|---|---|---|---|---|
| Time to Consume 8 gal. fog oil | 18 Min. 48 Sec. | 14 Min. 18 Sec. | 11 Min. 30 Sec. | 11 Min. 04 Sec. | 6 Min. 12 Sec. |
| Consumption (GPM) | .425 | .560 | .688 | .722 | 1.3 |
| Miles traveled | 0 | 1.2 | 1.9 | 2.8 | 2.0 |

New or used engine oils can be used but are not as satisfactory as fog oil.

REFERENCES: Project ET 1228 Smoke Screening Generator Device for M48A1 Tank dated 17 June 1958.



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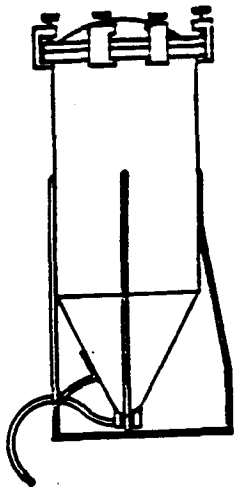


NOMENCLATURE: Disperser, Irritant Gas, Helicopter M4

TYPE: Helicopter Mounted - Powdered Agent

PURPOSE: Dissemination cf CW Powdered Agents

STATUS: Std USA for H-19 Helicopter.

DESCRIPTION: The M4 Helicopter mounted gas disperser is designed to dispense agent in powdered form from a low flying helicopter. It is intended to be filled in the field immediately before use. The disperser consists of a sealed hopper which contains the powdered agent, a pressure tank containing air under pressure, a pressure regulator, a tubular frame, and a hose assy. from which the agent is disseminated.- The pressure regulator reduces the air pressure from the tank. During operation, air bubbles up through the agent in the hopper to keep the agent sufficiently agitated tc insure a steaay flow.

AREA COVERAGE: The first unit has effectively covered up to 21,000 sq. meters with CN-1/DM-1 irritant agent mix. Because of its effectiveness at smaller concentrations, an equivalent weight of CS-1 agent could possibly be disseminated over a considerably larger area.

DISPERSER, IRRITANT GAS, HELICOPTER, M 4 (CHARACTERISTICS)

WEIGHT: LOADED 280# EMPTY:

AGENT--WEIGHT: CN or DM approx. 100#, CS Approx. 80#

HEIGHT: " TANK DIA: 16"

BASE: 30" Square DEPTH: "

DISPENSING RATE: 150# in Approx. 2 minutes

AIR TANK: 2000 PSI (Steel)

AGENT CONTAINER: 50 PSI (Aluminum) HOSE: 3/4" ID

PRESSURE REGULATOR SETTING: 40 PSI

FILLING: A 2000 PSI Air compressor is required for filling.

USED WITH: H 19 Helicopter but can be mounted on other vehicles.

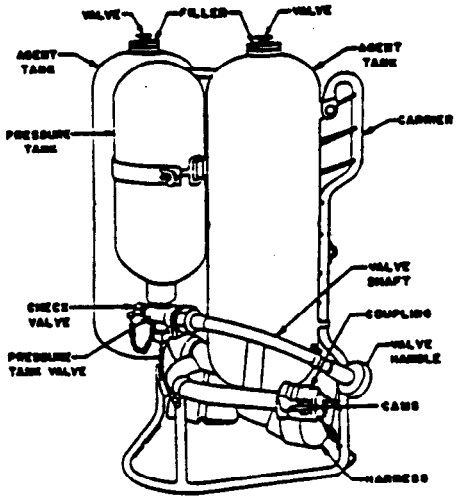
HANDLING-SAF: Protective masks, and rubber gloves must be worn by all personnel who fill or operate the disperser. The helicopter pilot must also wear a protective mask. Do not allow pressure in the hopper to rise above 60 PSI.

DEVELOPMENT HISTORY: Was designated E16R1 in development,

REFERENCES: ACC-TI-319-12



[redacted]




NOMENCLATURE: Disperser; Irritant, Gas, Portable, M 3

TYPE : Back Pack--Portable-Dry Agent

PURPOSE: Provide control for riots, uprisings, and disturbances.

STATUS: Std. USA - USMC.

DESCRIPTION: The major components of this unit are two steel cylindrical tanks, a pressure tank, pressure regulator, safety valve, carrier frame, hose and flame gun. Harness is provided for carrying on the back. Used for riots, uprisings and similar disturbances.

The disperser forces a dry micro-pulverized solid chemical agent into the air by the use of air pressure. Compressed air from the pressure tank is reduced to operating pressure by a regulator and it enters the agent tanks through diffusion pipes. Pressure exerted on the agent in the tanks forces the agent through the hose to the gun. Agent is released from the gun by a trigger which opens a restriction in the rubber tube.

AREA COVERAGE: Agent stream is approximately 40 ft. agent airborne with 10% fallout in 60 yds. Agent cloud observed 250 to 500 Yds. Trials indicated that the unit produced effective area coverages up to 5,000 sq. meters.

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DISPERSER, GAS, PORTABLE, M 3 (CHARACTERISTICS)

WEIGHT: EMPTY 43# . LOADED: 68# F. E.: 38.2%

AGENT CAPACITY: 25# AGENT: DM, CN, CS Micropulverized

PRESSURE TANK: 1700 to 2100 PSI GUN: E18R1

FUEL TANKS: 70 PSI reduced from 2000 PSI by regulator for operation.

OPERATING TIME: Continuous 19 seconds. Short bursts 30 secs.

TANK DIMENSIONS: (Approx.) 27" High, 20" Wide, 11" Deep V

FOR REFILL: Use M1A1 Air Compressor 7cfm power driven

HANDLING-SAFETY: Operator must wear mask, gloves, and other suitable protective clothing.

DEVELOPMENT HISTORY: Was designated E15R2 during development. CCTC-3690.

REFERENCES: ACC-TI389-12, TM3-378.



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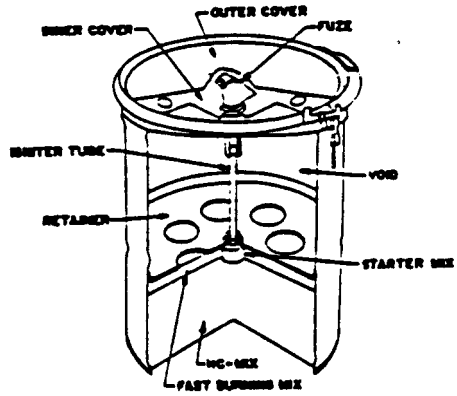


NOMENCLATURE: Smoke Pot, Floating (HC) M4A2

TYPE: Metal--Floating--Smoke

PURPOSE: Provide signalling smoke, produce smoke blankets or screens.

STATUS: Std USA, USMC. 12621 in USMC stock as of 31 Dec 1960

DESCRIPTION: The M4A2 floating smoke pot is a metal container, the lower third of the pot contains about 27 pounds of HC smoke mixture. A waterproof outer cover secured to the pot by a quick-release clamp keeps moisture out of the pot and protects the fuze. A steel carrying handle is attached to the outer cover. A dish-shaned inner cover covers the filling and provides a mounting-for a fuze adapter. Three vent holes in the inner cover are covered with adhesive tape. A steel handle is attached to *the inner cover* for carrying the smoke pot after the outer cover has been removed.

Starter mixture in a plastic cup is embedded in the smoke mixture. The filling is separated from the air chamber above it by a plastic closure disk held in place by a metal retainer.

The M207A1 floating smoke pot fuze is screwed into the fuze adapter in the inner cover. An igniter tube extends downward from the lower end of the fuze adapter to the starter mixture.

AREA COVERAGE: Assuming wind speed of 1 to 8MPH under lapse condition, over water; to establish smoke blanket to protect against *aimed* aerial attack, smoke pots must be placed 25 yards apart and normal to the wind direction. Actual requirements may deviate widely from this estimate and the spacing given should be checked and adjusted by aerial observation. To insure a uniform blanket, the distance between the smoke pots and the rear edge of the area to be blanketed should be at least 9 times the distance between the smoke pots. To portect against aerial photographic reconnaissance this Spacing must be decreased by one third to one half. For other wind and atmospheric conditions, see FM3-5.

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NAVORD REPORT 6954 (FIRST REVISION)

SMOKE POT, FLOATING (HC) M4A2) (CHARACTERISTICS)

FILLED WEIGHT: 38# FILLER-WEIGHT: HC - 27#

DIA: 12" HEIGHT: 13 " FUZE: M207A1

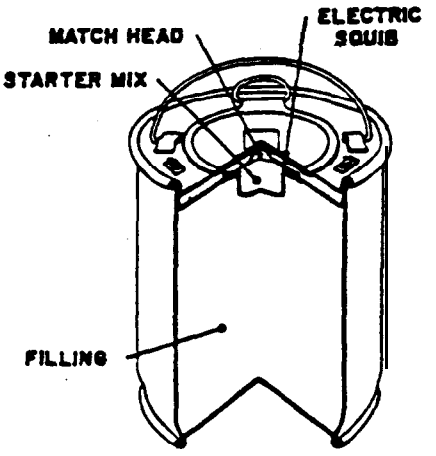
DELAY TIME: 10 to 20 Sec. BURNING TIME: 10 to 15 min.

F. E.: 71.5%

DRWG: C36-1-25, C36-1-26

HANDLING-SAFETY: Should be handled with extreme care during stowage and in shipment. Do not roll, skid, drop, or jolt crated or individual pots. Store right side up. Do not store with ammunition. Use water to extinguish fires in pots; do not use foamite, CO2 or fog nozzles. Have rescue breathing apparatus and gas masks available. See OP 2217.

REFERENCES: FM3-5, TM3-300, OP 2217, FM3-50.




NOMENCLATURE: Smoke Pot, Land (HC) M5

TYPE: Slow Burning - Manual or Electric Fired

PURPOSE: Provide signalling smoke, produce smoke blankets or screens.

STATUS: Std USA

DESCRIPTION: The M5 smoke pot is a cylindrical sheet-metal container, filled with approximately 30 pounds of HC smoke mixture and 1 pound of fast-burning smoke mixture and provided with an ignition device. The button of the container is tapered to permit stable stacking.

The pot is covered by a nonremovable outer cover with a circular tear strip. Two binding posts, which are mounted on the outer cover, are connected internally by two lead wires to two electric squibs. A carrying handle is mounted on the outer cover. An inner cover with a circular hole in its center covers the filling. A plastic cup containing a starter mixture is embedded in the top of the filling under the hole in the inner cover. A matchhead which is centered above the starter mixture is accessible when the tear strip is removed. A scratcher block in a paper envelope is packed between the covers. Intended for land use only.

AREA COVERAGE: Assuming wind speed of 1 to 8 MPH under lapse condition, over water; to establish smoke blanket to protect against aimed aerial attack, smoke pots must be placed 25 yards apart and normal to the wind direction. Actual requirements may deviate widely from this estimate and the spacing given should be checked and adjusted by aerial observation. To insure a uniform blanket, the distance between the smoke pots at the rear edge of the area to be blanketed should be at least 9 times the distance between the smoke pots. To protect against aerial photographic reconnaissance this spacing must be decreased by one third to one half. For other wind and atmospheric conditions, see FM3-5 and FM3-50.

SMOKE POT, LAND (HC) M 5 (CHARACTERISTICS)

FILLED WEIGHT: 33# FILLER-WEIGHT: HC - 30# approx.

DIA: 8-1/2" HEIGHT: 9-1/2" F. E.: 84.24%

IGNITION: Match heap and scratcher block or electrical.

DELAY TIME: 15 to 30 seconds DRAWING: D36-1-17

BURNING TIME: 12 - 22 Minutes

SAFETY-HANDLING: See OP 2217,. Move away from M5 pot within 10 seconds after igniting it electrically, as the tear strip may be blown off with explosive force.

DEVELOPMENT HISTORY: CCTC Item No. 926, Was El5 in Development.

REFERENCES: FM3-5, FM3-50, TM3-300, OP 2217, DPGR-190, MIL-P-13183

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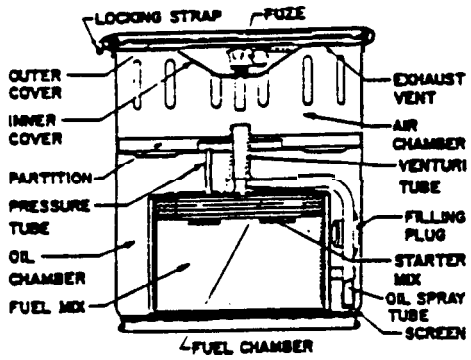


NOMENCLATURE: Smoke Pot, Floating (SGF) AN-M7

TYPE: Slow Burning - Fog Oil

PURPOSE: Provide signalling smoke, produce smoke blankets or screens, identify friendly troops and their positions.

STATUS: Std USA and USN. USN had 235,006 on hand as of 31 Dec 1960.

DESCRIPTION: The major components of the M7 smoke pot are outer cover, inner cover, partition, pressure tube, oil chamicer, fuel mix, fuel chamber, oil spray tube, starter mix, filling plug, venturi tube, air chamber, exhaust vent, fuze, strap, carrying handles and a body.

The body is metal with a carrying handle fastened to the outer cover by a locking strap. The inner cover is dished shaped and provides a seat for the fuze. Three vent holes are spaced around the fuze holder for smoke outlets. The air chamber takes up one third of the upper body.

The oil chamber is separated from the air chamber by a metal partition. Inside the oil chamber is the fuel chamber. venturi tube, pressure tube, and oil spray tube. The fuel chamber contains a fuel mix which consists of a slow burning fuel mix covered by a thin layer of fast burning fuel mix. A doughnut shaped ring of starter mix is in the top of the fuel mix.

AREA COVERAGE: Assuming wind speed of 1 to 8 MPH under *lapse* condition, over water; to establisn smoke blanket to protect against aimed aerial attack, smoke pots must be placed 25 ya apart and normal to the wind direction. Actual requirements. deviate widely from this estimate. and the spacing given shou be checked and adjusted by aerial observation. To incure a uniform blanket, the distance between the smoke pots and the rear edge of the area to be blanketed should be at least 9 t the distance between the smoke pots. To protect against aer photographic reconnaissance this spacing must be decreased b one third to one half, For other wind and atmospheric condi see FM3-5 and FM3-50.

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SMOKE POT, FLOATING (SGF) AN-M7 (CHARACTERISTICS)

DIA: 12"5 HEIGHT: " F.E.: 33.75%

FILLER-WEIGHT: SGF 2 - Approx. 13.5#

FILLED WEIGHT: 40#

DELAYTIME: 8 to 20 seconds

BURNINGTIME: 8 - 13 minutes

FUZE: M 208 mechanical or M 209 electric

DRWG: D36-1-111

SAFETY-HANDLING: See OP 2217.

DEVELOPMENT HISTORY: CCTC Item No. 2767. Was MK 5 MOD 3

REFERENCES: FM3-5, TM3-300, OP 2217, FM3-50



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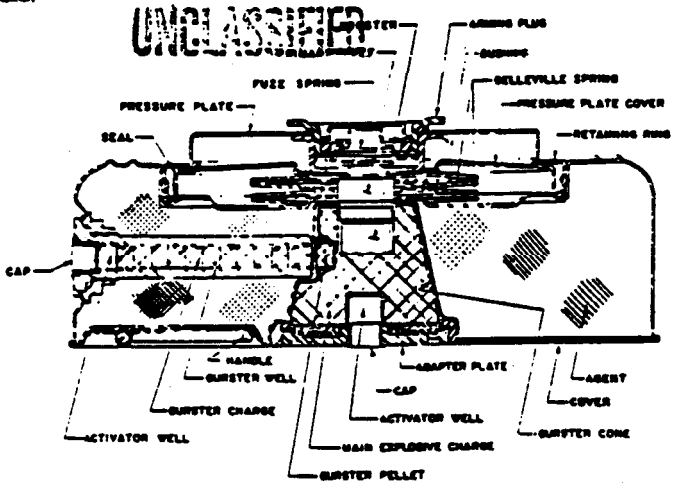


NOMENCLATURE: Mine, Land, Persistent Gas (VX) M 23

TYPE: Belleville Spring - Anti-Tank'or Anti-Personnel

PURPOSE: Provide toxic chemical capability.

STATUS: Std USA

DESCRIPTION: The M23 gas mine is similar to the M15 anti-tank mine in size, shape, and functioning, It consists of a body assembly and a Belleville spring assembly with a primary fuze, a side fuze, and a bottom secondary fuze. The primary fuze is located in the top center of the mine and the side fuze locate in the side fuze well which is part of the burster tube which contains the burster charge. The bottom fuze well is part of a cover adapter plug which holds the burster cone in place. The mine has a carrying handle held in position by a torsion spring.

The mechanical pressure type fuzing consists of a Belleville spring and a pressure plate. An arming plug is screwed in place over the primary fuze. Detailed information on the functioning of the activator, firing devices, booster and fuze are contained in TM9-1940. Used primarily in anti-tank mine fields to deny personnel the area by contamination. The mine can also be boobytrapped for use as an anti-personnel mine. Developed to replace Ml mine and can be used with mine laying machines.

AREA COVERAGE: Contamination densities of .01, .05, .10, 0.5, 1.0, and 10.0 grams per square meter will provide coverage of 7000, 3600, 2600, 1150, 760, and 120 square meters respectively. Tested at temperature 39°F, temp gradient 0.7°F, wind speed of 8 MPH. Deposition recovery was 64% of agent filler measured as ground deposition. Cloud travelled approx. 100 yds before dissipating. Crater size approx: 2 1/2 ft x 4 ft diameter.

[redacted]

MINE, LAND, PERSISTENT GAS (VX) M 23 (CHARACTERISTICS)

LIMITATIONS: Mine employs space *consuming* M 603 fuze which may be replaced with something more compact to increase agent carrying capacity. Design may be changed to eliminate some joints, which would reduce the chances for leakage. It is believed that this mine will be improved.

FIRED WEIGHT: Approx. 22-3/4# F. E.: 50.5%

AGENT-WEIGHT: 11.5# of VX ( gal). BURSTER: 13 oz. Comp B (M-38)

BODY MATERIAL: Thin steel BURSTER RATIO: 5:1

DIAMETER: 13" BOOSTER: M 120

PRESSURE REQUIRED TO EXPLODE: 300 to 400# HEIGHT: 5"

FUZES: Anti-Tank) Primary M 603 with M 120 Booster
Anti-Personnel) M1A1, M2 or M3 with M 1 activator.
Anti-Lift) M5 with M 1 Activator

BURSTER INITIATOR: M 48

SAFETY-HANDLING: The filled mine is shipped with M I.20 booster, the central burst cone, and the burster charge installed. One M 603 fuze and one M 1 activator sealed in individual containers are packed in the shipping container with the mine.

DEVELOPMENT HISTORY: Was E5 during development. Type classified CCTC item 3710 May 25, 1960.

REFERENCES: FM5-31, TM3-250, TM9-1940, TM3-200, TM3-300, TM3-255, FM3-5, FM-38, CML-T1-300-7



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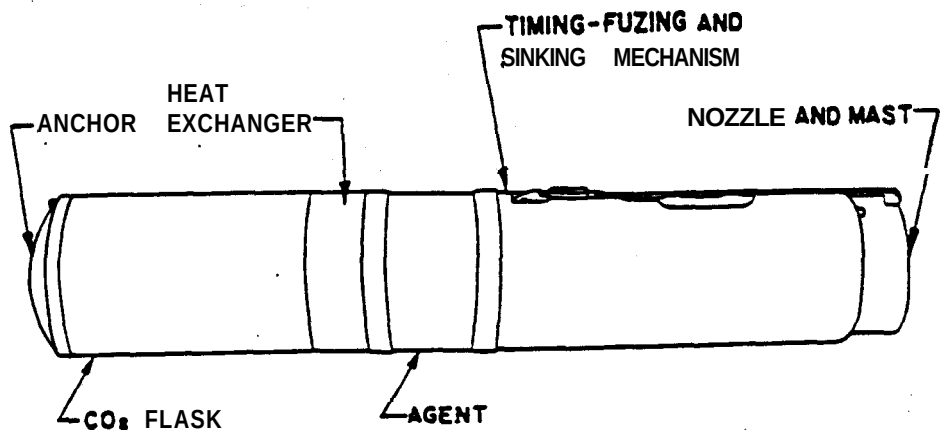


NOMENCLATURE: Mine, BW Submarine, XB-14B

TYPE: Submarine Layed - Surface to Shore

-PURPOSE : Dissemination of BW agents

STATUS: Developed and tested -- Non STD. USN

DESCRIPTION: The mine consists of propellant flask for carbon dioxide, a well for the heat exchange: welded to one end of the flask, attachments on the other end of the flask for an anchor, an external mine casing of stainless steel, an agent flask with fittings, a nozzle manifold, extension mast, and miscellaneous electrical and pressure devices for operation of the mine.

CAPABILITIES: The mine is capable of functioning as follows: The mine is loaded into the torpedo tube, anchor end first. When the mine is fired from the tube it sinks to the ocean bed and remains there for a pre-set period of time. At the end of the pre-set delay the mine rises to the surface, disseminates the agent, then it is exploded and sinks to the bottom again. The mine can be released from submarine, torpedo tube, or can be lowered over the side of a ship. Satisfactory performance depends upon sea water temperature, motion of water, and wind velocity, and direction.

AREA COVERAGE: On one line a distance of four miles from the dissemination point recoveries were on the order of 100 organism minutes per liter. In all but one of the successful trials, 1000 organism minutes per liter were detected at the other line two miles from the dissemination point. Cloud patterns may be described briefly as long narrow plumes approximately five miles long, and 1500 to 1800 yards wide at the widest point.

[redacted]

MINE, BW SUBMARINE, XB 14 B (CHARACTERISTICS)

DIA: 21" OVERALL LENGTH: 120"

PROPELLANT USED: Carbon Dioxide PROPELLANT PRESSURE: 3000 PSI

PROPELLANT CAPACITY: 4.8 cu. ft. carbon dioxide (200#)

AGENT FLASK CAPACITY: 1.5 cu. ft. (90#) .

OPERATING TIME: 18 to 25 minutes

AGENT USED: BW Liquid

TOTAL WEIGHT: 1350#

AGENT PRESSURE: 300 PSI

EMPLACED BY: Torpedo Tube, Mooring Raft, or Ship

HANDLING-SAFETY: Safety tests demonstrated that the agent container could be filled, the exterior decontaminated and the filled container shipped in outer package without undue risk of biological leakage.

REFERENCES: FT. Detrick Tech. Study 9 dtd June 1958, NAVORD REPORT 3832

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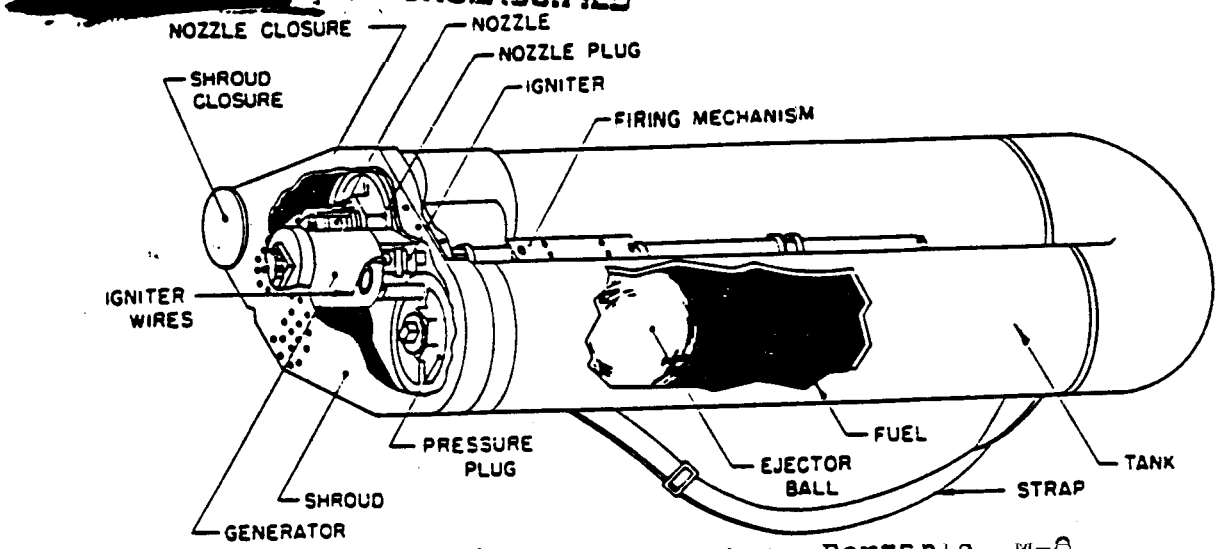


NOMENCLATURE: Flame Thrower, One Shot, Portable, M-6

TYPE: U Tube - Lightweight

PURPOSE: Provide chemical offensive capability

STATUS: Non Std USA

DESCRIPTION: This unit consists of an aluminum U-shaped tube, 3-1/2" ID, welded to a cast aluminum head frame at the open ends of the U. Assembled to the head frame is an aluminum nozzle plug and an aluminum pressurizing plug which carries a steel gas generator, with an integral fuel rod ignitor. The head frame is covered with a plastic shroud, held in place by a "Camloc" fastener. A rubber ball piston separates the propellant gases from the fuel and insures complete explusion of the fuel charge. The unit can be fired mechanically or electrically.

FUNCTION: A trigger ignites the igniter which fires the propellant in the gas generator. Pressure generated by the propellant causes the ejection balls to move the length of the tank rapidly. The ball acting like a piston, forces the fuel ahead of it and out thru the nozzle forming a fuel rod. After the fuel is expended, the gas blows past the ball relieving any pressure in the flame thrower.

LIMITATIONS: Should not be fired into headwinds stronger than 5 MPH with unthickened fuel. Crosswinds shorten the range and disperse the flame.

FLAME THROWER, ONE SHOT, PORTABLE, M-8 (CHARACTERISTICS)

WEIGHT EMPTY AND UNARMED: 14.0# (approx.) LENGTH: 34"

WEIGHT LOADED AND ARMED: 26.0# (approx.) WIDTH: 8-3/4"

FUEL CAPACITY: 2 Gal. DEPTH: 4-1/2"

FUEL TANK: Aluminum

PROPELLANT: Pyrotechnic mix ignites solid type propellant.

FUEL: Gasoline thickened or unthickened

OPERATING PRESSURE -- FUEL TANK: 250 to 300 PSI

OPERATING PRESSURE -- GAS GENERATOR: 1800 PSI

MAX RANGE: 50 Yards

FIRING TIME: 4 seconds (Max.)

FIRING: One continuous burst

OVERALL DIMENSIONS: 4-1/2" x 9" x 34"

HANDLING-SAFETY: Tests have proved that this unit is safe for military use.

DEVELOPMENT HISTORY: In development this item was designated E3OR1.

REFERENCES: CCTC Item 3400. Also ACC Project 4-09-02-020-03 for reports. Also CCTC Items 2962, 338, and 2642 cover military characteristics. TM3-1040-200-12; FM3-5; FM3-8

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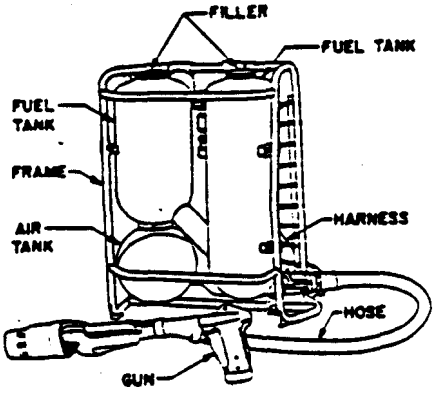


NOMENCLATURE: Flame Thrower, Portable, M9-7

TYPE: Pack Pack - Lightweight - Multi-Shot

PURPOSE: To reduce fortified positions and for close fighting.

STATUS: Std USA. None in USMC stock as of 31 Dec 1960.

DESCRIPTION: Consists of two cylindrical aluminum fuel tanks of unequal lengths. Capacity of fuel tanks is 4-1/2 gal. gross. A steel spherical air bottle, pressurized at 2000 PSI furnishes the propelling force for the fuel. A regulator reduces the high pressure air to operating pressure. This unit is equipped with a M7 gun, and harness for carrying on the mans back.

This portable multi-shot flame thrower replaces the M2A1-M7. Its improved capabilities are in range, accuracy, reduced weight, silhouette, and provides for fuel and pressure restoration in the front line in a minimum of time. It weighs approx. 24# less than the M2A1-M7 and no special tools are required for maintenance.

[redacted]

FLAME THROWER, LIGHTWEIGHT PORTABLE, M9-7 (CHARACTERISTICS)

HEIGHT: 23" WIDTH: 17" 8"PTH:

WEIGHT EMPTY: (With M7 gun and M8 Hose) 24#

WEIGHT LOADED: (With M7 gun and M8 hose) 50#

FUEL-CAPACITY: 4.25Gal. of Gas Gel

FUEL BOTTLES: Aluminum--300 PSI

AIR BOTTLE: Steel--2100 PSI

HOSE: M 8(196-131-656A)

OPERATING PRESSURE: 315 PSI

GUN: M 7 (196-131-649A)

RANGE: 45 to 60 Yards

IGNITION CYLINDER: M1

FIRING TIME: Continuous 5-6seconds

FIRING: In bursts approx. 5-10 bursts

FUEL EXPENDITURE: Approx. 1 gal Per sec

DRWG: D381-1-7945 Fuel - Pressure Unit

ASSY DRWG: D81-1-6929 and D81-1-6928 (196-131-747)

HANDLING-SAFETY: Tests have proved that this unit is safe for military use.

DEVELOPMENT HISTORY: Developed for military forces under ACC Project 4-09-02-020-03. M? was Fuel Group, M7 is Gun Group.

REFERENCES: TI 439-10, TI 439-20, CCTC 3763



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NOMENCLATURE: Flame Thrower, Main Armament, M7A1-6

TYPE: Mechanized - Turret Mounted in Tank

PURPOSE: Anti-personnel Weapon to be used where conventional weapons are ineffective.

STATUS: Std USA and USMC. No stock in USMC as of 31 Dec 1960.

DESCRIPTION: This unit consists of a (M7) fuel-pressure system, flame gun (M6), turret electrical system, fire control system, gun elevating and turret traversing system, and turret structure. The fuel-pressure system includes various cylinders and tanks in which the thickened Fuel, compressed air and gasoline are stored. The flame gun consists of a dummy 90MM gun tube in which are housed two high voltage spark plugs and other components. The fuel, is ignited by 24,000 volts from the compositor units. Fuel-pressure and compressed air units are mounted In the tank turret. The unit is used on the M48 tank.

The flame thrower is designed to fire thickened fuel, using 4 to 8 percent Ml or M2 thickener in clean gasoline.

Increase in the percentage of the thickener increases the firing range and makes the penetration of fuel fires through small openings more effective. Also increases the burning time of the fuel on the target and reduces the diameter of the flame rod in the air.

NOMENCLATURE: Flame Thrower, Main Armament, M7A1-6

TYPE: Mechanized - Turret Mounted in Tank

PURPOSE: Anti-personnel Weapon to be used where conventional weapons are ineffective.

STATUS: Std USA and USMC. No stock in USMC as of 31 Dec 1960.

DESCRIPTION: This unit consists of a (M7) fuel-pressure system, flame gun (M6), turret electrical system, fire control system, gun elevating and turret traversing system, and turret structur The fuel-pressure system includes various cylinders and tanks in which the thickened fuel, compressed air and gasoline are stored. The flame gun consists of a dummy 90MM gun tube in which are housed two high voltage spark plugs and other components, The fuel is ignited by 24,000 volts from the compositor units. Fuel-pressure and compressed air units-are mounted in the tank turret. The unit is used on the M48 tank.

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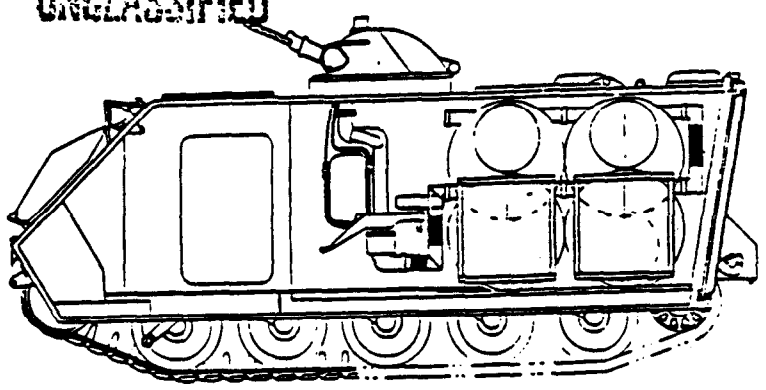

NOMENCLATURE: Flame Thrower Kit, Mechanized, E31-36

TYPE: Mechanized--Infantry Carrier or Tank

PURPOSE: To provide chemical offensive capability

STATUS : Completion date scheduled 1961

DESCRIPTION: This kit was designed for installation on M59 armored vehicle; but may be installed In other type vehicles having comparable space and facilities. The kit consists of an E36 gun mount and E31 fuel system. The E36 unit comprises the gun mount (cupola) gun cradle, flame gun, ignition exciters, adapter ring, fire control box, gasoline tank, hydraulic accumulator, and gunners seat, The #31 unit consists of two fuel containers, two air containers, and a mounting rack. Using four fuel assemblies, an approximate 200 gal can be supplied the flame gun for a continuous period of 40 sec. Each fuel container has a capacity of 50 gallons with three cutlets spaced 90 degrees. apart. Air containers are designed for 3000 PSI operation.

AREA COVERAGE: Not applicable.

FLAME THROWER, MAIN ARMAMENT, M7A1-6 (CHARACTERISTICS)

FUEL CAPACITY: 378 gal thickened fuel with 5% void or 398 gal thickened fuel without void.

FUEL-WEIGHT: 2300 lbs. approx.

MAX. EFFECTIVE RANGE: 200 yds with 3/4" nozzle

FUEL CONTAINER PRESSURE: 255 to 280 PSI

DISCHARGE RATE: 6.7 gal/see with 7/8" nozzle
6.2 gal/sec with 3/4" nozzle

FLAME EMESSION TIME: 61 sec with 3/4" nozzle or 55 sec with 7/8" nozzle.

AIR PRESSURE: 3000 PSI. Reduced to 255 to 280 PSI

FLAME IGNITION: Two high tension spark plug igniters

EXCITERS POWER TO COMPOSITERS: Two - 24 V DC input with 2000 V - AC output.

HIGH TENSION COMPOSITERS: Two - 2000 v - AC input with 24,000 V - AC output.

ELEVATION OF GUN: 45 degrees

DEPRESSION OF GUN: In front ±20° turret travel - Minus 12"
Over rear deck grille - Minus 3°
Front ±20° and front ±90° turret travel - Minus 8.5°

USED WITH: M48A1 tank which becomes M67A1 Flame thrower tank.

REFERENCES: TM3-1040-206-10, TM3-1040-206-20, USMC Ord-MM-7005, TM3-352, TM3-376 .

FLAME THROWER KIT, MECHANIZED E31-36 (CHARACTERISTICS)

FUEL CAPACITY: 50 gal (Per Unit) NO. OF UNITS: 4

FUEL USED: Thickened gasoline - M4 (approx. 6 gal per sec.)

MATERIAL: T1 Steel

GROSS WEIGHT ENTIRE UNIT: 3650# (For 200 gal fuel)

AIR STORAGE PRESSURE: 3000 PSI

FIRING PRESSURE: 325 PSI

RANGE: 195 Yards (Max 265 yards dependent upon conditions)

FIRING TIME: Approx. 40 sec.

ELEVATION: +60° and Depression -10°

TRAVERSING: 360°

FLAMEGUN: Co-axial with 30 cal. M.G.

IGNITION: Dual electric spark Ignition on 24V D.C.

USED WITH: M59 and M113 Vehicles but may be adapted to others

REFERENCES: Detail information may be obtained from ACC Project #7-09-02-020-02, CWL Report 2330 CCTC Items 2458, 2804, and 3698, TM9-7002, Aircraft Armaments Report ER1715C

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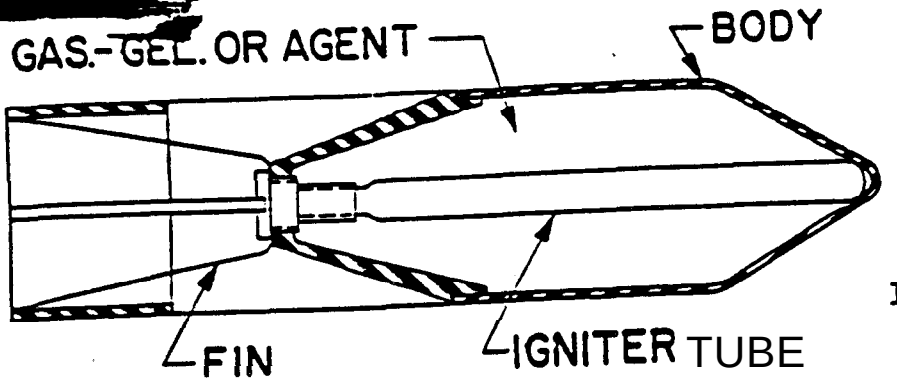


CAPSULE ILLUSTRATED

NOMENCLATURE : Flame Thrower and Incendiary Capsule

TYPE: Portable - Long Range - Capsule - Thickened Fuel

PURPOSE: To project capsules of fuel which will rupture and burn upon impact. Anti-personnel and Incendiary

STATUS : Feasibility study with Armour Research Foundation.

DESCRIPTION: These items are being studied to produce a portable flame thrower than can (1) either be hand fired by one man or (2) can be fired from a fixed tripod. In either case it would be porsable. If hand fired it would weigh approx. 50#, but if fired from a tripod it may weigh 100# and still be portable in sections weighing not over 25# each. Several systems are being investigated to provide pressure for firing. Various ignition systems and capsules are being investigated.

NOTE: Experiments are being made with various types and sizes of capsules such as polyester resin, nylon, etc. The igniter design and the percentage of M-4 thickener have been determined from the polyester capsule firings, and no further changes are expected in the igniter design or the amount of thickener used. The igniter at present is a thin walled glass tube filled with triethyl boron. It is anticipated that the capsules will be made by the injection mold process.

NAVORD REPORT 6954 (FIRST REVISION)

FLAME THROWER, INCENDIARY CAPSULE (CHARACTERISTICS)

WEIGHT OF HAND FIRED UNIT: 50#

WEIGHT OF TRIPOD FIRED UNIT: 100#

RANGE: 200 Yds approx. LENGTH: 8".25

CAPSULE WT: 0.43# approx. CAPSULE DIA: 1".98

LAUNCH VELOCITY: 250 ft/sec

FUEL USED: M4 thickened gasoline (encapsulated)

FIRING: Automatic or semi-automatic

FIRING RATE: 3# fuel per second

FUEL CAPACITY: 50% of total unit weight

CAPSULE FUEL WEIGHT: 0.41#

FUEL USED: M4 thickened gasoline

DEVELOPMENT HISTORY: Contract DA 18-108-405-CWL487 with Armour Hesearcn Foundation 21 July 1959.

NOTE: It may be possible to use toxic or incapacitating agents In these capsules.

REFERENCES: Armour Research Foundation Report ARF 4202



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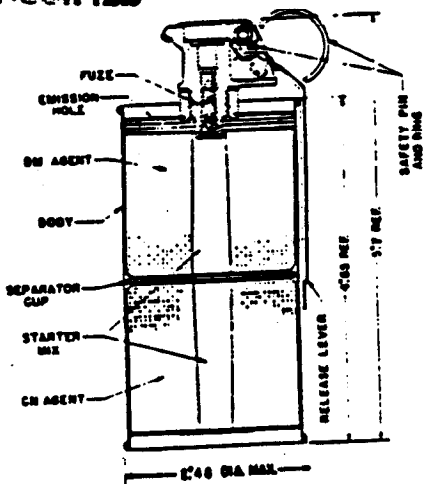


NOMENCLATURE: Grenade, Hand, Gas (CN-DM) M6A1

TYPE: Burning - Intimate Mix - Two Compartment - Hand or Rifle

PURPOSE: o t control and other emergencies - anti-personnel

STATUS: Std -, USA, USN, USAF. 32015 on hand with USN as of 31 Dec 1960

DESCRIPTION: A burning type steel body grenade filled with CN-DM used for riot control, mobs, and similar disturbances, and also for training troops. The body of the grenade ha- ll. A three rows of six emission holes in the body wall. is contained in a zinc or plasti- starter mix, with binder - The fuze leve: cup attached inside the top of the container. is held In an unarmed position with a ringed safety pin. The DM is in the upper compartment and the CN is in the lower compartment.

When the safety pin is removed and the grenade is thrown the fuze begins to function as soon as the pressure on the fuze lever is released. After a delay of about 2 seconds, the fuze sets off the starter mixture which, in turn ignites the main filling. The CN-DM vapors are emitted in the form of smoke. The grenade can be rifle projected with the M2 projection adapter.

[redacted]

GRENADE, HAND, IRRITANT GAS (CN-DM) M6A1 (CHARACTERISTICS)

DIAMETER: 2".48 HEIGHT: 5".7 FILLED WT: 20 oz. approx.

FILLER-WT: CN-DM-11 oz. FUZE: BD-M201A1

BURNING TIME: 20 to 60 seconds VOLUME: 20 cu inches

DELAY TIME: 2 seconds approx. F. E.: 60%

BODY MATERIAL: 28 gage steel BODY TYPE: M8

DRWG: D13-22-9 RIFLE ADAPTER: M2A1

DEVELOPMENT HISTORY: In development was E17R1

SAFETY-HANDLING: See TB3-300-4 .

REFERENCES: TM3-200, FM3-5, OP 2217, FM23-30, TB3-300-4

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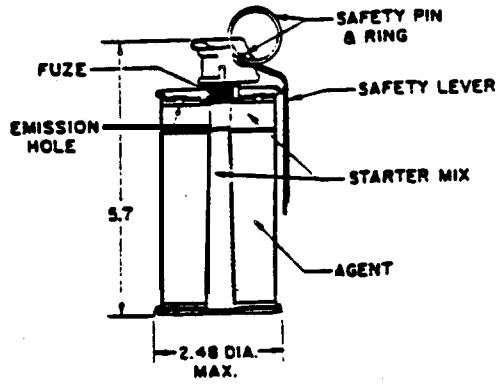


NOMENCLATURE: Grenade, Hand, Gas (CS or CN) M7A1

TYPE: Burning - Hand Thrown - Gas

PURPOSE: Riot control and other emergencies - anti-perscnnel

STATUS: Std "B" USA - USN - USMC - USAF. US:; had 43640 on hand as of 31 Dec 1960. 6993 in USMC stock as of 31 Dec 196

DESCRIPTION: This grenade is a smooth steel cylindrical can, burning type, hand thrown filled with either CS or CN agent. Used for the control of riots, mobs, and similar emergencies and also for training of troops. The top of the grenade has a number of holes evenly spaced around the fuze adapter, and a 1/2" hole in the bottom for the emission of the tear g Holes are covered with waterproof tape which is blown of burned when the grenade functions.

A tapered center hole *in* the *grenade* is surrounded by the tear gas mixture which consists of CS or CN with EC smokeless powder. The starter mixture is poured into the center hole and also distributed over the top of the tear gas mix to insure ever, burning. The grenade functions when the safety pin is pulled and the grenade is thrown. After a delay of about 2 seconds, the smoke emits in vapor form for 20 to 60 *seconds.* Can also be used with Rifle Projection Adapter M2A1.

[redacted]



[redacted]

GRENADE, HAND, GAS (CS or CN) M7A1 (CHARACTERISTICS)

DIAMETER: 2".48 HEIGHT 5".7 FUZE: BD-M201A1

FILLED WT: 18.5 oz. FILLER-WT: $CS_3CN$ 9.5 oz. approx:

BURNING TIME: 15 to 35 seconds DELAY TIME: 2 sec approx.

VOLUME: 20 cu. in. F.E.: 51.3% DRWG: D13-21-7

BODY TYPE: M8 BODY MATERIAL: 28 gage steel

RIFLE ADAPTER: M2A1

SAFETY-HANDLING: FM23-30

DEVELOPMENT HISTORY: During development this grenade was designated E22, and E5.

REFERENCES: TM3-300, FM3-5, FM23-30, OP 2217, MIL-G-11968, TM3-200, TB-CML-57

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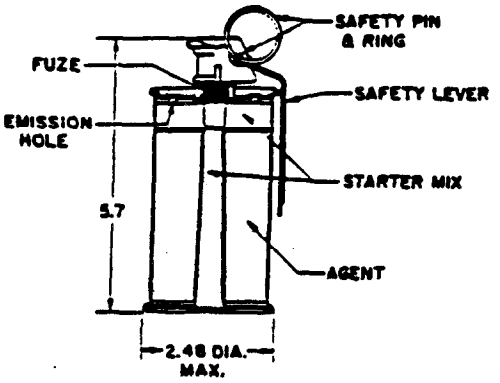


NOMENCLATURE: Grenade, hand, Gas (CS) M7A2

TYPE: Burning -'Gas - Encapsulated

PURPOSE: Anti-personnel - Riot control - and Emergencies

STATUS: Std U.S.A.

DESCRIPTION: This grenade is a smooth steel cylindrical can, burning type, hand thrown, filled with CS agent. To be used for riot control and similar emergencies, and also for training troops. The top of the grenade has a number of holes evenly spaced around the fuze adapter, and a 1/2" hole in the bottom for the emission of the CS agent. The holes are covered with waterproof tape which is blown off when the grenade functions.

A tapered center hole in the grenade is surrounded by tear gas mix which consists of CS in encapsulated form. The starter mix is poured into the center hole and also distributed over the top of the CS agent to insure even burning. The grenade functions when the safety pin is pulled and the grenade is thrown. After a delay of about 2 seconds, the agent emits in vapor form for about 20 to 60 seconds. This grenade is the same as the M7A1 except the agent is encapsulated. Can also be used with Rifle Projection Adapter M2A1.

[redacted]

GRENADE, HAND, GAS (CS) M7A2 (CHARACTERISTICS)

DIAMETER: 2.48

FUZE: BD-M201A1

FILLER-WT: CS - 115 grams, granulated fuel 150 grams.(9.5oz)

~~68%~~:

BURNING TIME: 15 to 35 sec.

VOLUME: 20 cu in .

BODY TYPE: M8

HEIGHT:

FILLED WT: 18 oz

VAPOR EMISSION: 20 to 60 sec.

DELAY TIME: 2 sec approx.

DRWG: D 13-21-7

BODY MATERIAL: 28 gage steel

REFERENCES: TM3-300, FM3-5, FM3-8, OP2217, FM23-30, TM3-200, Mil G-11968



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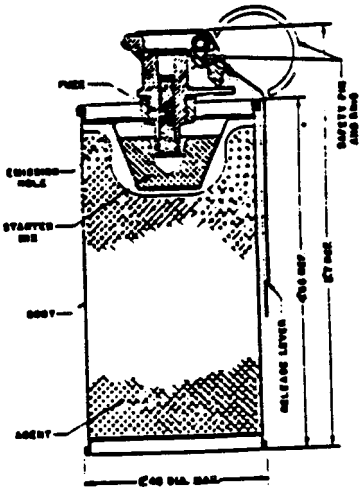

NOMENCLATURE: Grenade, Hand, Smoke (HC) M8

TYPE: Burning - Dense Smoke - Hand Thrown

PURPOSE: To screen small areas and for signaling

STATUS: Std USA and USMC, USN. USN - 10772 on hand as of 31 Dec 1960, 7338 in USMC stock as of 31 Dec 1960

DESCRIPTION: This grenade is a burning type, cylindrical in shape and the body is made of sheet metal. It is the same size and shape as the M7A1 grenade and employs an igniter type fuze. Emission holes in the top allow the smoke to escape when ignited.. The time delay of the fuze is about 2 seconds. A starter mixture is contained in a plastic or zinc cup attached to the inside top of the grenade. The grenade can be rifle-projected with the M2 projection adapter. The emission holes are covered with tape to protect the filling from moisture.

FUNCTION: The grenade is held in the throwing hand with the safety lever pressed firmly in the palm. The safety pin is removed with the free hand and the grenade is thrown. The fuze begins to function as the safety lever is released. Releasing the safety lever allows the strikes to hit the primer which ignites the delay element. The delay in turn ignites the ignition mix, which ignites the grenade starter mix and the filling.

[redacted]

GRENADE, HAND, SMOKE (HC) M8 (CHARACTERISTICS)

DIAMETER: 2".48 H E I G H T : FUZE: 7 BD-M201A1

FILLED WT: 25.5 Oz. FILLER-WT: HC-19 Oz.

BURNING TIME: 105 to 150 sec. DELAY TIME: 2 sec approx.

VOLUME: 20 CU. In. F. E.: 74.6%

BODY TYPE: M8 BODY MATERIAL: 28 gage steel

DRWG: D13-19-2

DEVELOPMENT HISTORY: CCTC item 860

REFERENCES: FM3-5, OP 2217, FM23-30, TM3-300, TM3-200, Q-G-12327



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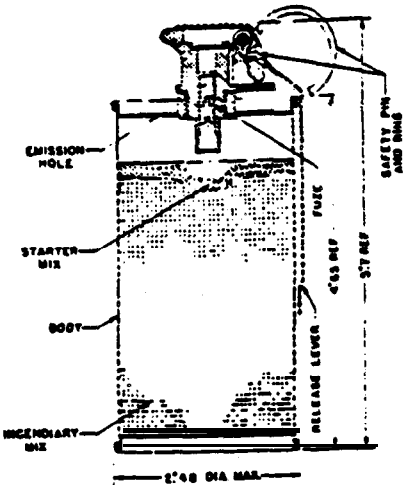


NOMENCLATURE: Grenade, Hand, Incendiary (TH 3) AN-M14

TYPE: Burning - Incendiary - Hand Thrown

PURPOSE: Start fires and destroy equipment

STATUS: Std USA, USAF, USMC - USN - 25,945 on hand as of 31 Dec 1960, 58,139 in USMC stock as of 31 Dec 1960

DESCRIPTION: This grenade is a cylindrical steel can, incendiary type, hand thrown, and filled with Thermate TH3. Emission holes are in the top only. In functioning after a 2 second delay element burns, the igniter sets fire to the filler, which burns for about 40 seconds at a temperature of approx. 4300F. A portion of the thermate filler changes into molten iron and flows out of the grenade to produce an intense heat over a small area. The molten iron ignites or fuses metal parts and will burn through about 1/4" of steel. Can also be used with rifle projection adapter M2A1.

This grenade may mechanically or electrically fired for electrical firing the fuze is replaced by an electric squib which takes approx. 5 min.

OPERATION: Destroying Equipment. Place the grenade in the desired location, preferably on a flat surface. If it is necessary to fasten the grenade In place, use a metal fastening, as the heat from the burning grenade will quickly burn through flammable material. Hold down the safety lever with one hand and withdraw the safety pin with the other, When ready to ignite the grenade, release the safety lever and move away. The safety lever is forced off by the strike: and the striker hits the primer, which ignites the delay element. Upon expiration of the delay time, the fuze ignite: the ignition mixture which, in turn, ignites the grenade filling. The grenade will burn through a sheet of 1/2-inch-thick steel and will weld together steel or iron machinery parts when molten iron released by the burning filling flows between them.

[redacted]

GRENADE, HAND, INCENDIARY, (TH3 ) AN-M14 (CHARACTERISTICS)

DIAMETER: 2".48 HEIGHT: 5".7 FUZE: BD-M201A1

FILLED WT: 32 Oz. approx. FILLER-WT: TH-3-26.5 Oz.

BURNING TIME: 40 sec. approx. DELAY TIME: 2 sec. approx.

VOLUME: 20 cu. In. F. E.: 82.8%

BODY TYPE: M8 BODY MATERIAL: 28 gage steel

DRWG: D13-17-3

REFERENCES: TM3-300, F,3-5, FM23-30, OP 2217,MIL-G-12297

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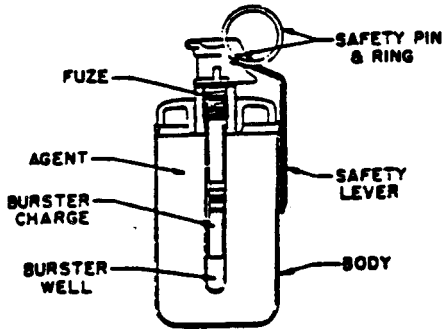


NOMENCLATURE: Grenade, Hand, Smoke (WP) M15

TYPE: Bursting - Smoke - Rand Thrown

PURPOSE: Screening - Casualty and Incendiary

STATUS: Ltd Std USA (Std USN 6431 on hand as of 31 Dec 1960)
Std USMC 215,683 in USMC stock as of 31 Dec 1960

DESCRIPTION: A bursting type grenade, made of smooth sheet metal, that is cylindrical in shape with slightly rounded ends. It is loaded with WP and has a detonator fuze. A burster well with charge extends about 3/4 the length of the grenade body. In functioning the detonator bursts, the body of the grenade to release the WP in small particles which burn on contact with air and give off a dense white smoke. The grenade can be thrown about 25 meters and the effective casualty radius as about 15 meters. The WP will burn for about 60 seconds igniting any flammable material it touches.

AREA COVERAGE: Approx,20 Yard radius

OPERATION: Hold the grenade in the throwing hand with the safety lever pressed firmly against the palm. Remove the safety pin with the free hand and throw the grenade, The fuze begins to function when the grenade is thrown and the safety lever is released. The bursting charge explodes 4 to 5 seconds after the safety lever is released, rupturing the grenade body and scattering burning WP over a 20-yd. radius. Can be used with the grenade projection adapter,



[redacted]

GRENADE, HAND, SMOKE (WP) M 15 (CHARACTERISTICS)

DIAMETER: 2".38 HEIGHT: 4".5 FUZE: M206A2

FILLED WT: 31 oz. FILLER-WT: WP-15 oz. F.E.: 48.3%

BURNING TIME: 60 sec. approx. DELAY TIME: 4.5 sec. approx.

BODY MATERIAL: 18 gage steel

DRWG: D13-19-17

RECOMMENDATION-TO NAVY: Use M34 grenade when exhausted.

DEVELOPMENT HISTORY: Was E2R16 In development.

REFERENCES: TM3-300, FM3-5, FM23-30, OP 2217, MIL-G-12237



[redacted]

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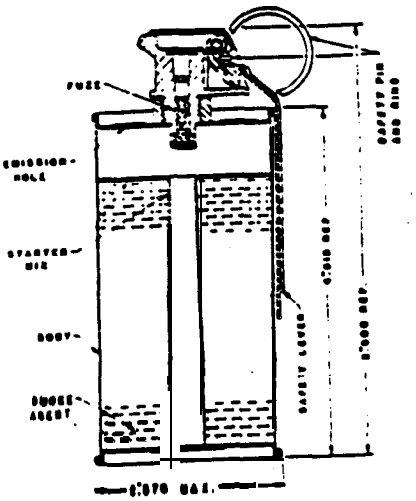

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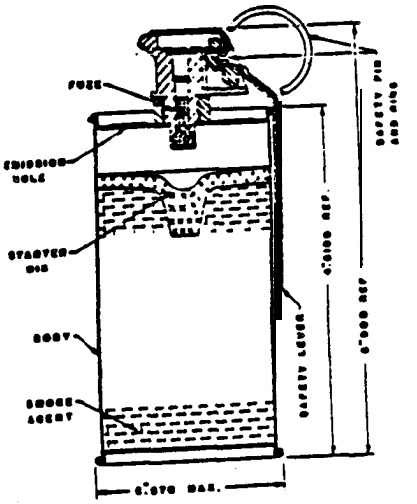

WHITE

NOMENCLATURE: Grenade, Hand, Signal, Smoke, E15R1

TYPE: Burning - Colored Smoke - Tobacco Can Shape

PURPOSE: To provide paratroopers signaling capability

STATUS: Engineering tests complete. Non-Std.

DESCRIPTION: This is a half pint varnish can style "F" nested into a threaded receiver at the top end of the container and sealed with a rubber gasket. There are four vent holes, each activated by a 4 second delay M201A1 Fuze, with waterproof tape (2 at each end of the container) for emission of the smoke. The tobacco can shape was chosen to permit ease of carrying in the paratroopers pocket. There is a difference in the construction of the white and colored smoke containers (see illustrations above). The red and white colors have been recomenaea for type classification but this is being held in abeyance pending possible and new development of a better mixture for yellow, green, violet.

VISIBILITY: At an altitude of 1000 feet, wind speed of 4 MPH, the colored smoke can be seen for 3 miles.

[redacted]

GRENADE, HAND, SIGNAL, SMOKE, E15R1 (CHARACTERISTICS)

COLORS: Green, Red, Yellow, Violet, and White

FILLED WEIGHT: 23 Oz. White, 16 Oz. Red

F. E.: 60% Red, 41.3% White FILLING: Red - 9.6Oz., White 9.5 Oz.

BURNING TIME: 120 ±30 seconds FUZE: BD-M201A1

DELAY TIME: Approx. 2 seconds BODY MATERIAL: Steel

OVERALL HEIGHT: 5"9 MAX VOLUME: 20 cu. In.

WIDTH: 2"87 THICKNESS: 1"48

DRAWINGS: White D13-19-60, Colors D13-19-66

REFERENCES: TM3-300, FM3-5, OP 2217, FM23-30, TM3-200



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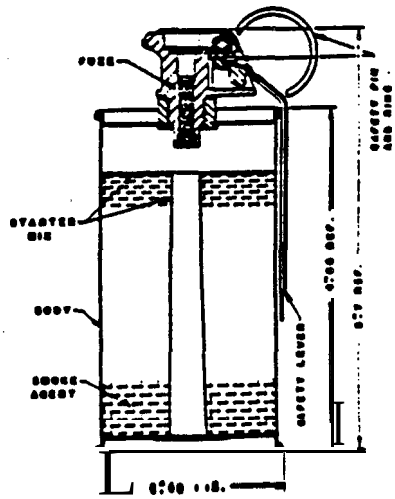

NOMENCLATURE: Grenade, Hand, Colored Smoke, M18

TYPE: Burning - Signal

PURPOSE: To provide signaling capability

STATUS: Std USA, USAF, USMC, USN (Std Navy - 2092 on hand as of 31 Dec 1960) 61,133 in USMC stock as of 31 Dec 1960.

DESCRIPTION: A burning type grenade, cylindrical in shape with a body made of smooth steel. Loaded with colored smoke a is used for signaling. It employs an igniter type fuze. There are emission holes in the top of the grenade body whack emit the smoke when Ignited. These holes are covered with ad hesive tape to protect the filler from moisture during storag In functioning there is a 2 second delay before the igniter functions to release the smoke. The grenade can be loaded with red, yellow, green, or violet smokes. Violet smoke is only used for training.

VISIBILITY: Red is visible 5 miles at 3000 ft. altitude. This is for one grenade under favorable conditions. The green smoke can be identified up to 10,000 ft. and approx. 3 miles on the ground.

OPERATION: a. Throwing Grenade. Hold the grenade in the throwing hand with the safety lever pressed firmly against the pa Remove the safety pin with the free hand and throw the grenac The fuze begins to function when the grenade is thrown and th safety lever is released. Releasing the safety lever allows, the striker to hit the primer, which Ignites the delay elemer Upon expiration of the delay time, the delay element Ignites the ignition mixture, which Ignites the grenade starter mixtu and grenade filling. The grenade emits a white smoke.

b. Launching. [redacted] grenade may be launched from a rifle or carbine by Wing the M2A1 grenade projection adapter.

[redacted]

GRENADE, HAND; COLORED SMOKE, M18 (CHARACTERISTICS)

DIAMETER: 2 "48 HEIGHT: 5"7 FUZE: BD-M201A1

FILLED WT: . 18 Oz. FILLER-WT: 11.5Oz. Approx.

F. E.: 63.7%

FILLER USED: Red, Green, Violet, or Yellow smoke (See MIL-G-12326 for composition)

BURNING TIME: 50 to 90 sec. DELAY TIME: 2 sec approx.

VOLUME: 20 Cu. In. DRWG: D13-19-37

BODY TYPE: M8 BODY MATERIAL: 28 gage steel

REFERENCES: FM3-5, FM23-30, TM3-300, OP 2217, MIL-G-12326, CCTC 3480, TM3-200



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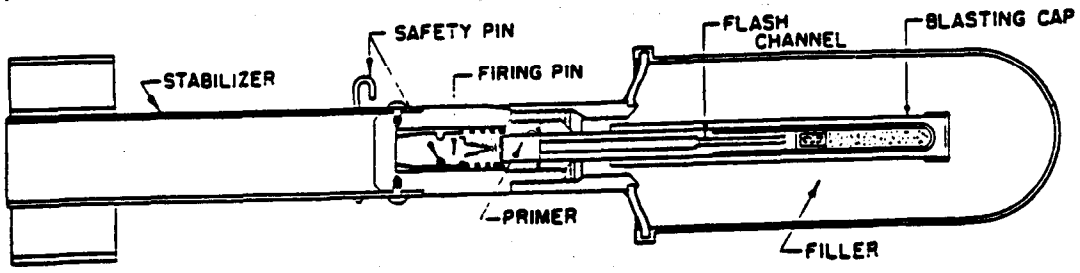


NOMENCLATURE: Grenade, Rifle, Smoke (WP) M19A1 .

TYPE: Bursting - with Stabilizer and Fin

PURPOSE: Anti-Personnel, Smoke Screening, and Incendiary

STATUS: Non-Std USA (Std USMC and USN) USN stock- none on hand as of Dec 1960, 124,160 in USMC stock as of 31 Dec 1960. The army uses M34 Grenade in lieu of this one.

DESCRIPTION: Bursting type grenade, consisting of a body, a stabilizer tube, and a fin assy. made of sheet metal. Weighs approximately 1.5 pounds and contains about 8.5 oz. of WP. A burster well with charge extends about 3/4 the length of the body. The grenade is fired in the same manner as other rifle grenades. It has an impact detonating fur that bursts the grenade upon Impact and throws burning Wi over an area of about 20 yards. Maximum range is about 195 meters. Functions upon impact with a delay cf about 4 to 5 seconds.

AREA COVERAGE: Approximately 20 yard radius with an effective casualty radius of about 10 yaras.

[redacted]



[redacted]

GRENADE, RIFLE, SMOKE (WP) M19A1 (CHARACTERISTICS)

DIAMETER: 2"0 — 11-1/4" — E. : 32.6%

FILLED WT: 26 oz. — FILLER-WT: WP-8.48 Oz.

FUZE: Inertia type — DELAY TIME: None

BODY TYPE: — BODY MATERIAL: Sheet Steel .

DRWG: 82-1-109 — RANGE: 155 to 310 Yds.

IGNITER : M18 Detonator

USED WITH: M7 Rifle Grenade Launcher

DEVELOPMENT HISTORY: Was T5E1 in development

REFERENCES: FM3-5, FM23-30, OP 2217, TM3-300, FM21-6, TM3-200, TB-CML-58

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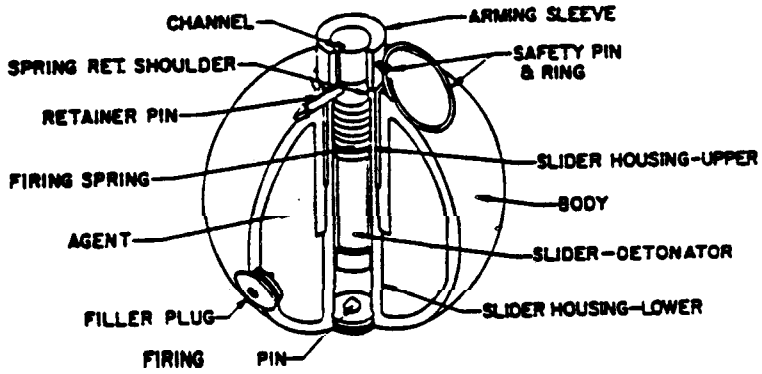


NOMENCLATURE: Grenade, Hand, Riot, (CN-CS-DM) M25A2

TYPE: Bursting - Hand Thrown - Spherical

PURPOSE: For riots and similar emergencies

STATUS: Std USA, USAF, USMC. (No USMC stock as of 31 Dec 1960)

DESCRIPTION: This is a bursting type grenade, spherical in shape, filled with CS or DM. It is hand thrown, approximately the size of a baseball and has a molded plastic body. A burster well is formed by upper and lower slider housings molded as parts of the upper and lower body. The fuze with a delay of about 2 seconds is integrally contained in a slider which extends almost from top to bottom of the burster well to impact on the firing pin.

OPERATION: When the safety pin is withdrawn, and the grenade thrown, pressure is removed from the top of the arming sleeve is forced from the end of the slider. With the arming sleeve removed, pressure of the firing spring causes the retainer pin and slider to pass through the middle of the firing spring as the firing spring forces the slider downward against the firing pin. The detonator explodes, releasing the agent.

AREA COVERAGE: Approximately 15 to 25 yards in diameter.

[redacted]

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## GRENADE, HAND, RIOT (CS-CN-DM) M25A2 (CHARACTERISTICS)

DIAMETER: 2-15/16"

FUZE TYPE: Integral

DETONATOR: Cl2

DELAY TIME: 2.2 ±0.8 Sec.

FILLED WT: 7.5 Oz.

FILLER-WT: 3 Oz. CS-CN, 3.5 Oz. DM

%E.: CS-CN, 46.6% DM

DRWG: D13-25-2

BODY MATERIAL: Plastic

DEVELOPMENT HISTORY: Was E21R1 in development

REFERENCES: FM3-5, FM23-30, OP 2217, TM3-300, Tl-300-12, M&G-10280, TM3-250, TB-CML-58



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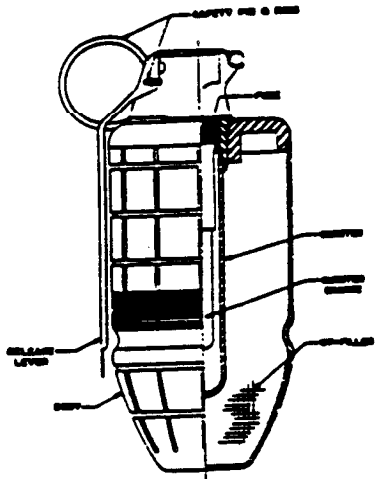

NOMENCLATURE: Grenade, Hand or Rifle, Smoke (WP) M34

TYPE: Bursting - Smoke - Hand Thrown

PURPOSE: Anti-Personnel, Smoke Screening, and Incendiary

STATUS: Std USA and USMC

DESCRIPTION: A bursting t-ype hand or rifle grenade designee co replace the M19 hand grenade. The body is cylindrical cast steel with a tapered bottom so that it can be fitted into a rifle grenade projection adapter. The body is serrated so that it will burst easily when detonated. The complete grenade when loaded weighs about 27.2 ounces and contains about 12 ozs. of WP. Can be hand thrown as far as 30 meters and has a delay element of about 4.5 seconds. The cast body is made with 60 serrated sections.

OPERATION: In functioning the detonator bursts the body of the grenade and spreads small white [illegible] of WP. These particles on contact with air, burns at a very high temperature and give off a dense white smoke and will also Ignite any flammable material it contacts.

AREA COVERAGE: 30 to 50 yards radius.

NOTE: The Army uses this grenade In lieu of the M19A1.

[redacted]

GRENADE, HAND OR RIFLE, SMOKE (WP) M34 (CHARACTERISTICS)

DIAMETER: " 2-3/8" HEIGHT: FUZE: M206A2

FILLED WT: 27.2 OZ. FILLER-WT: WP - 12 Oz.

F. E.: 44.15 DELAY TIME: 4 to 5 Sec. Approx.

BODY MATERIAL: 18 Gage Steel

RIFLE ADAPTER USED: Ord M1A2 DRWG: D13-7-4

RANGE: 30 Meters by hand, 175 Meters with rifle

SAFETY-HANDLING: TB3-300-5

DEVELOPMENT HISTORY: Was E16R2 In development

REFERENCES: FM3-5, FM23-30, TM3-200, OP 2217, CCTC 3553, TB3-300-5



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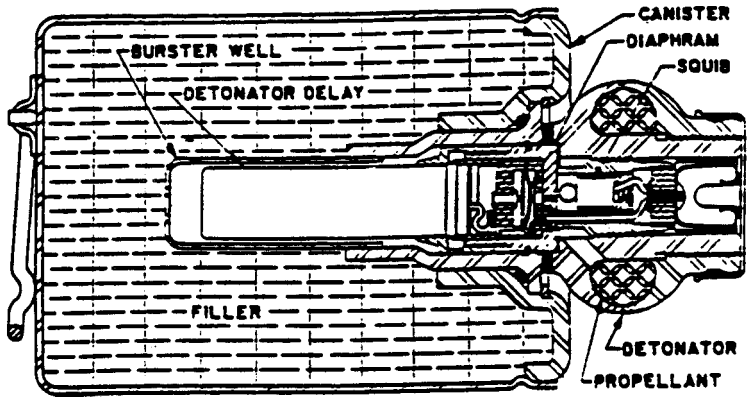



NOMENCLATURE: Grenade, Tank, Smoke (SWP) T36E1

TYPE: Burning - Combat Vehicle Launched

PURPOSE: To produce smoke screens for combat vehicles

STATUS: Non-Std USA. Successfully passed Eng. Tests

DESCRIPTION: A cylindrical canister which is filled with WP and steel wool. The steel wool delays the WP dispersion. The grenades are launched from launchers mounted on the front, rear, and sides of a tank. The burst occurs approximately 6 feet above the ground, 35 yards from the tank, about 0.9 secs after firing. Single or multiple firings are possible.

AREA COVERAGE: The smoke cloud from a single grenade is sufficient in size and density to conceal a tank for 30 sec 3 min depending upon the meteorological conditions. On one test 24 grenades were fired in two salvos and clouds ranged from 150 to 200 fet high by 100 to 800 ft long. One grenade produced a cloud about 15 ft high by 150 ft long, while two others produced clouds about 20 ft high by 300 ft long.

FUNCTIONING: Selective firing of any one of 24 grenades may be ootained by use of a console mounted inside the tank turret, The console consists of a selector switch for choosing 2 bank of grenades (front, rear, left, or right) for firing, and a panel of 6 control buttons for firing individual grenades Within the selected bank. When any one of the six control buttons on the electrical console is depressed, an electric pulse is sent to the selected grenade, initiating the electric squib. The flash from the squib ignites the M9 propellant. Expansion of the M9 propellant causes gases to escape through an orifice depressing a diaphragm switch onto a bayonet. This process causes initiation of the delay train in the electric delay detonator by the electric pulse from the firing console. All the above firing sequence takes place within a few milli-seconds just before the grenade begins to move forward. The grenade then moves forward and bursts approximately 0.9 seconds later when the delay detonator functions.

[redacted]

GRENADE, SMOKE (SWP), TANK T36E1 (CHARACTERISTICS)

NO. OF LAUNCHERS PER STATION: 3 to 6

GRENADES PER LAUNCHER: 12 to 24

RATE OF FIRE: 7 rds/sec

MAX. RANGE: 35±5 yards

LENGTH: 6-7/8" DIA: 3-1/2"

WEIGHT LOADED: 4-3/4# approx. F. E.: 36.8%

FILLER-WT: 1-3/4#WP (Includes 1 Oz. steel wool)

PROPELLANT: M9 - 32.5 grains

DELAY DETONATOR: AC - 6 Electric 0.9 sec.

SQUIB: M2 Electric FUZE: Integral

VELOCITY: 110 to 125 ft/sec DRWG: 5-01-11

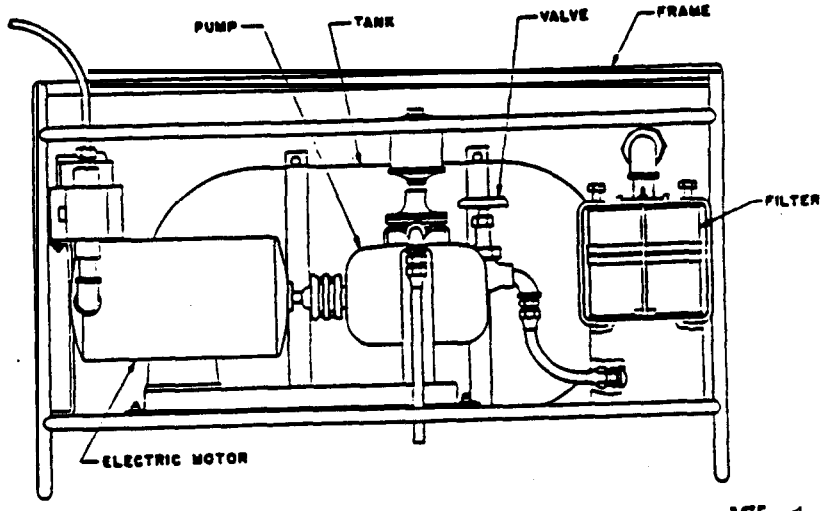
LAUNCHER: T42

SAFETY-HANDLING: Drop, transportation, vibration, humidity, and temperature tests indicate the grenade is safe for normal military handling, shipping, and storage.

REFERENCES: Feltman R & E Labs, Picatinny Arsenal, Dover, N. J. Tech report #2618 Nov 1959. OCM 29826, Ord Project TA1-4054. TM3-300, FM3-5, FM23-30, OP 2217



[redacted]




MK 1 MOD 0

NOMENCLATURE: Filling Unit, Chemical Vacuum,

TYPE: Electric Motor Driven - Vacuum System

PURPOSE: For filling smoke or toxic spray tanks

STATUS: USN, USMC. Recommended for T. C. - Non Std

DESCRIPTION: This unit consists of an electric motor, a vacuum pump, and a filter assembled within an aluminum tubular frame. All hose lines are teflon sheathed in flexible stainless steel mesh. The unit pulls 25 inches of vacuum to fill E33 spray tank In approximately 10 minutes Pump is deep anodized aluminum with telefon piston and stain less discharge valves.

The pump is designed so that it will not explode when smoke agent FS and water are mixed in the pump, and is sufficiently durable to withstand corrosive action of the acid smoke agent. Lightweight for field operation. can be used for land based or carrier based aircraft.

[redacted]

NAVORD REPORT (FIRST REVISION) UNCLASSIFIED [redacted]

FILLING UNIT, CHEMICAL VACUUM TANK, MK 1 MOD 0 (CHARACTERISTICS)

EMD UNIT WEIGHT: 110#

LENGTH: 0 "

HEIGHT: "

HOSE LINES: Teflon

PUMPING RATE: 159 PM

CRDL DRWG: A318-64-2582

WIDTH: 22"

FRAME: Tubular Aluminum

FILLING TIME: 10 min. approx.

VACUUM PULLED: 28 Inches ,

DEVELOPMENT HISTORY: In development this Item was designated E21-EMD

NOTE: ECOM will prepare Navy Drwgs, OP, and a proposed MIL Spec.

REFERENCES: TM3-255, CWL Tech Memo 30-55

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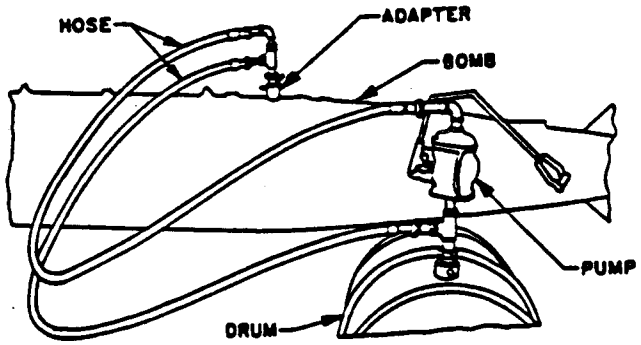


NOMENCLATURE: Filling Unit, Chemical Tank, MK 2 MOD 0

TYPE: Hand Operated Piston Pump

PURPOSE: For filling aero 14 tank with smoke agent but may be adapted to fill toxic spray tanks.

STATUS: Non-Std, USN, USMC. Drawings and specifications have been prepared and 25 units have been furnished for user tests by USMC.

DESCRIPTION: This unit consists of a hand operated piston pump, filling and vapor vent hoses. The hose is teflon sheathed In flexible stainless steel.

FILLING UNIT, CHEMICAL TANK, MK 2 MOD 0 (CHARACTERISTICS)

UNIT WEIGHT; 35#

CAPACITY: 1 pint per one way stroke or 1 qt. for a full cycle stroke approx. 15 gpm

PUMP BODY MATERIAL: Aluminum

CYLINDER LINER MATERIAL: Stainless steel

SUCTION AND DISCHARGE VALVES: Stainless steel

HOSE FITTING: Stainless

PISTON: Teflon

HOSE: Teflon In stainless casing

FILLING TIME: Approx. 20 min.

BUORD DRWG: LD 539243

DEVELOPMENT HISTORY: Was designated E22 during development

REFERENCES: TM3-255, OS 12363



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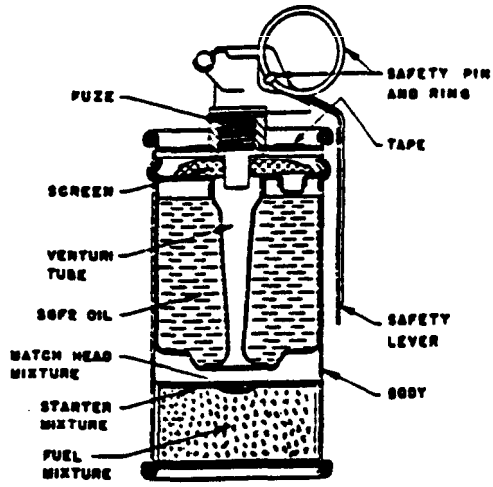



NOMENCLATURE: Smoke Pot, oil, Training (SGF 2) M 6

TYPE: Metal - Grenade Size - Training Candle

PURPOSE: For simulating fires in damage control exercises and related training.

STATUS: Std USN? 3298 on hand as of Dec 1960

DESCRIPTION: A cylindrical metal body with fuze and smoke agent compartment. A Venturi tube passes through the smoke compartment to the fuel block at the bottom of the container. At the throat of the Venturi tube is an opening into the fog oil container. A second opening is located in the venturi tube at a point above the surface of the oil. The. Both openings are sealed with low melting metal plugs. Venturi tube exists to three vents at the top of the candle which are covered with pressure sensitive tape.

FUNCTION: Functioning of the fuze ignites the starter mixture then the fuel block. Heat from the burning fuel melts the solder' plugs in the Venturi tube allowing the combustion gas to'draw oil into the Venturi tube where it is vaporized. Passage of the oil vapor through the three emission holes in the top of the candle results in the condensation of the fog oil to produce a dense white smoke.

AREA COVERAGE: Not applicable.

[redacted]



[redacted]

SMOKE POT, OIL, TRAINING, (SGF 2) M 6 (CHARACTERISTICS)

DIA: 2"5

HEIGHT:

ASSY DRWG: C11-18-3, C36-1-39

FILLED WT: 1.82#

FILLER WT: SGF2-0.22#

F. E.: 12.2%

DELAY TIME: 2 seconds

SMOKE EMISSION TIME: 1 to 2 minutes

FUZE: M201A

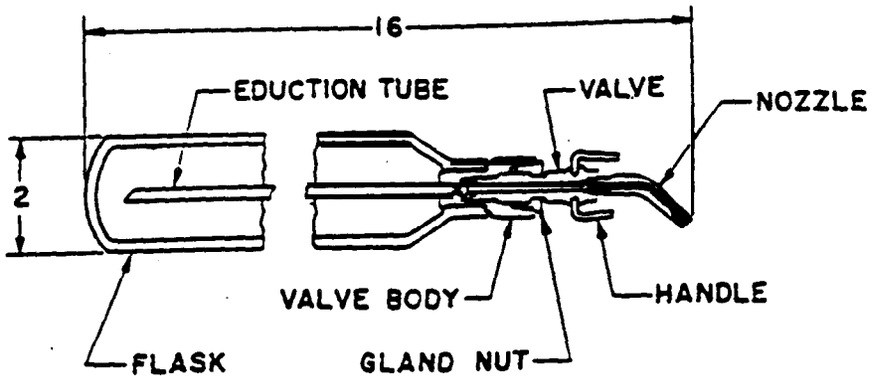
SAFETY-HANDLING: OP 2217

DEVELOPMENT HISTORY: Was E21R3 in development

REFERENCES: FM3-5, OP 2217, MIL-C-11141, TM3-300, CCTC Item #2170 and 2416



[redacted]




NOMENCLATURE: Gun, TRAINING (CN) MK 1 MOD 0

TYPE: Pressure charged Lacrimatory vapor

PURPOSE: Used aboard ship for training purposes and for riot control

STATUS: Std USN. 10435 on hand as of Dec 1960

DESCRIPTION: The spray gun completely assembled consists of a flask, a valve assembly, an eduction tube, and a nozzle.

The flask contains the chemical filling and the expellent charge. It is a small size commercial $CO_2$ cylinder, ICC-3E, having a total capacity of 26.5 cubic inches (420 cc),, and an approximate empty weight of 3 pounds.

The valve assembly consists of a threaded closing valve, a valve body, and a packing gland. The threaded valve has a series of orifices around its lower circumference which opens into a central outlet hole, and a composition sealing disc at its lower end. The valve body, which secures the valve assembly in place in the cylinder, has a port in its lower section which is opened or closed by rotation of the threaded valve. The packing gland secures this valve in place in the valve body and holds it tight against leakage. A wire valve handle is hinged to the valve to facilitate its turning.

The eduction tube is a small internal pipe attached to the inner end of the valve body. It extends nearly to the bottom of the cylinder and provides a means of delivering the solution to.the nozzle when the valve is opened.

The nozzle is a curved member attached to the valve and provided with a spiral in its outlet hole to Increase atomization of the solution,

[redacted]

GUN, TRAINING (CN) MK 1 MOD 0 (CHARACTERISTICS)

GENERAL ARRANGEMENT DRWG: 267708

LIST OF DRAWINGS: SK 58336

LENGTH (IN.): 16.0

DIAMETER (IN.) 2.0

WEIGHT, FILLED (LB) 4.0

CN SPRAY GUN CHARGING DEVICE:

MK 1 MOD 0
General Arrangement Dwg: 267713
List of Drawings: SK 58337
Flask CO2 Cylinder ICC-3E

CAPACITY (CU. IN.): 25.5

CAPACITY (CC): 420

LACRIMATORY SOLUTION: CN in $CCl_4$

Amount of solution:(cc): 200
CN (by weight): 1 part
$CCl_4$ (by weight): 10 parts

EXPELLENT CHARGE:

Type: Liquid co2
Weight (oz.): 5-1/2 to 6-1/2

SAFETY PRECAUTIONS: Do not refill or recharge a flask without first ascertaining whether or not it is empty. If for any reason the CO2 has escaped and the carbon tetrachloride evaporated from the solution, the valve assembly should be removed by unscrewing the valve body from the flask and the solidified CN should be removed with a sharp tool.

Under no circumstances should a flask whose contents have not been completely exhausted be subjected to a vacuum.

The solution used is not flammable; however, because it contains carbon tetrachloride (only 10 Oz.), its use against open flames, hot boiler fronts, or uninsulated steam pipes may result in the carbon tetrachloride breaking down into gases which are poisonous. This caution should not be construed to prevent the use of the gun in engine rooms and firerooms.

Prepare the lacrimatory solution or fill the flasks in a hood or other well-ventilated place. Otherwise, a suitable location out of doors will suffice.

Remove spilled lacrimatory solution from the skin with a cloth wet with carbon tetrachloride, and follow with a liberal application of soap and water.

Hospitaiize anyone who gets solid CN or the lacrimatory solution into the eyes.

Do not aim the spray from this gun to-ward the face of anyone, Gas mask protection should be available at all times.

REFERENCES : OP 2217

[redacted]

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No Illustration

NOMENCLATURE: Pellet, Gas (CN) M 2

TYPE: Tablet form

PURPOSE: To familiarize troops in training with the characteristics of tear gas.

STATUS: Std. USA, USN (USN - 40813 as of 31 Dec 1960)

DESCRIPTION: Pellet is in the form of a tablet, containing 93% CN and 7% zinc oxide is used as a binder. When a pellet is placed on a heated can within a gas chamber measuring 25 x 25 x 9 ft., the concentration of CN is sufficiently irritating to require the wearing of a gas mask is produced. For use in gas chambers for familiarization of troops with gas and testing gas mask fit.

NOTE: For composition, see specification MIL-P-14240(Clmc)

DIMENSIONS: 1/2" Dia. x 1/4" thick, approx.

WEIGHT: 1 gram plus or minus 0.1 gram

DEVELOPMENT HISTORY: Was designated E10 in development.

REFERENCES: CCTC Item 2541 September 1952, MIL-P-14240



UNCLASSIFIED

## ABBREVIATIONS

Section "5"

| | |
|---|---|
| AC | HYDROGEN CYANDE (NPA) (or ACCELERATION TIME FUZE) |
| ACC | ARMY CHEMICAL CENTER OR ARMY CHEMICAL CORPS |
| ACRC | AMMUNITION COMPLETE ROUND CHART |
| AD | AUXILIARY DETONATNG |
| ADM | ATOMIC DEMOLITION MUNITIONS |
| AGI | ALL GLASS IMPINGER |
| ALTER | ALTERNATE |
| AMMO | AMMUNITION |
| AP | ARMOR PIERCING |
| APG | ABERDEEN PROVING GROUND, ABERDEEN, MD. |
| BD | BASE DETONATING |
| BW | BIOLOGICAL WARFARE |
| BUWEPS | BUREAU OF NAVAL WEAPONS |
| CAL | CALIBER |
| CCTC | CHEM. CORPS TECHNICAL COMMITTEE |
| CHEM | CHEMICAL |
| CG | PHOSGENE (NPA) |
| CX | CYANOGEN CHLORIDE (NPA) |
| CL | CHLORINE |
| CMLC | C&M. CORPS |
| CN | CHLORACETOPHENONE |
| CNB | CHLORACETOPHENONE SOLUTION (NP) |
| CNO | CHIEF OF NAVAL OPERATIONS |
| CNS | CHLORACETOPHENONE SOLUTION (NP) |
| CPE | CIRCULAR PROBABLE ERROR |
| CONARC | CONTINENTAL ARMY COMMAND |
| CS | OCHLORBENZALMALONONITRILE |
| CRLR | CHEM. AND RADIOLOGICAL LABORATORIES REPORT |
| CW | CHEMICAL WARFARE |
| DA | DIPHENYLCHLRASINE |
| DC | DIPHENYLCYANOARSINE |
| DIVSAW | DIVISION SUPPORT ARTILLERY WEAPON |
| DM | ADAMSITE |
| DP | DIPHOSGENE |
| DPGR | DUGWAY PROVING GROUND REPORT |
| DRWG | DRAWING |
| EA | EDGEWOOD FURNISHED AGENT |
| ED | ETHYLDICHLORARSINE or ENGINEERING DESIGN |
| ET | ENGINEERING TEST |
| EX | NAVY EXPERIMENTAL (BEFORE TYPE CLASSIFICATION) |
| F.E. | FILLING EFFICIENCY (RATIO OF FILLER WEIGHT TO GROSS WT) |
| FET | FINAL ENGINEERING TEST |
| FF | FOLDING FIN |
| FM | TITANIUM TETRACHLORIDE or FIELD MANUAL |
| FNH | NITROCELLULOSE POWDER WITH FLASH-REDUCING ADDITIVES |
| FS | SULFUR TRIOXIDE (or FEASIBILITY STUDY) |

FT/SEC - FEET PER SECOND
FY - FISCAL YEAR
FUNC - FUNCTIONING
g - ACCELERATION DUE TO GRAVITY
G - NERVE GAS SERIES
GA - DIMENTHYLAMINOETHOXCYANOPHOSPHINE OXJDE (TABUN)
GB - ISOPROPYL-METHYLPHOSPHONOFLUORIDATE (SARIN)
GD - METHYLPINOCOLYLOXFLUPOPHOSPINE OXIDE (SOMAN)
GRAN - GRANULATION
H - LEVENSTEIN MUSTARD
HC - HEXACHOLRATHANE MIXTURE (NPA)
HD - DISTILLED MUSTARD (PA)
HE - HIGH EXPLOSIVE
HL - MUSTARD PLUS LEWISITE (PA)
HN - NITORGEN MUSTARDS
HT - MUSTARD T MIXTURE (PA)
HVAR - HIGH VELOCITY AIRCRAFT ROCKET
IGN - IGNITER OR IGNITION
IM - GASOLINE + ISOBUTYLMETHACRYLATE
INST - INSTRUCTION OR INSTANTANEOUS
K - KNOTS
KIAS - KNOTS, INDICATED AIR SPEED
L - LEWISITE (PA)
LAC - LARGE AREA COVERAGE
LFB - LANDING FORCE BULLET-IN
LTD STD - LIMITED STANDARD (STD "C")
LSD - LYSERGIC ACID DIETHYLAMIDE
M - MACH NUMBER
MMD - MASS MEDIAN DIAMETER
MAT'L - MATERIAL
MT - MECHANICAL TIME FUZE
MG.MIN/M3 - MILLIGRAM MINUTES PER CUBIC METER (OR MAGNESIUM)
MOD - MODIFICATION
MPH - MILES PER HOUR
MSG - MESSAGE
NAOTS - NAVAL AVIATION ORDNANCE TEST STATION, CHINCOTEAGUE, VA.
NATC - NAVAL AIR TEST CENTER, PATUXENT RIVER, MD.
NAVORD - NAVAL ORDNANCE
'ND - NOSE DETONATING OR NOT DETERMINED
NOTAL - NOT TO ALL
NOTS - NAVAL ORDNANCE TEST STATION, CHINA LAKE, CALIF.
NP - NAPALM OR NON PERSISTENT
NPA - NON PERSISTENT AGENT
NPG - NAVAL PROVING GROUND, DAHLGREN, VA.
OCM - ORDNANCE COMMITTEE MINUTES
OP - ORDNANCE PAMPHLET
ORD - ORDNANCE
OTCM - ORDNANCE TECHNICAL COMMITTEE MINUTES
PA - PERSISTENT AGENT



[redacted]

| | |
|---|---|
| PD | - POINT DETONATING (or PENYLDICK GAS) |
| PE | - PERCENTAGE OF ERROR |
| PIBD | - POINT INITIATING - BASE DETONATING |
| PS | - CHLOROPICRIN |
| PT | - MAGNESIUM + GASOLINE + IM |
| PWP | - PLASTICIZED WHITE PHOSPHORUS |
| R&D | - RESEARCH AND DEVELOPMENT |
| REF | - REFERENCE |
| REP'T | - REPORT |
| REQ'D | - REQUIRED' |
| REV | - REVOLUTIONS |
| | - RELATIVE HUMIDITY |
| E M | - REVOLUTIONS OR ROUNDS PER MINUTE |
| SB | - SUPPLY BULLETIN |
| SEC | - SECONDS |
| SGF | - FOG OIL (SMOKE GENERATOR FOG) |
| SK NO | - SKETCH NUMBER |
| SM | - SUPPLY MANUAL |
| SNL | - STANDARD NOMENCLATURE LIST |
| SQ YDS | - SQUARE YARDS |
| SS | - SPIN STABILIZED |
| STD A | - STANDARD |
| STD B | - SUBSTITUTE STANDARD |
| STD C | - LIMITEDSTANDARD |
| STDE | - PLANNED STANDARD |
| TACWIF | - TECHNICAL ASPECTS OF CHEMICAL WARFARE N THE FIELD |
| TAS | - TRUE AIR SPEED |
| TC | - TYPE CLASSIFICATION |
| TB | - TECHNICAL BULLETN |
| TM | - TECHNICAL MANUAL |
| TECH | - TECHNICAL |
| T. O. | - TECHNICAL ORDER |
| TSQ | - TIME, SUPER QUICK |
| TH3 | - THERMATE |
| USA | - UNITED STATES ARMY |
| USAF | - UNITED STATES AIR FORCE |
| USMC | - UNITED STATES MARINE CORPS |
| USN | - UNITED STATES NAVY |
| VT | - PROXIMITY FUSE (VARIABLE TIME) |
| VOL | - FOLUME |
| VX | - LIQUID NERVE GAS (PA) |
| W/O | - WITHOUT |
| WP | - WHITE PHOSPHORUS |
| WT | - WEIGHT |
| YDS | - YARDS |