Instructor
Text

Modular Explosives Training Program

Transportation, Storage and Destruction of Bomb Materials

Bureau of Alcohol,
Tobacco and Firearms

ATF P 7550.9 (3/76)
(replaces ATF T 5145-15)

To be used in conjunction with
module 15 of Instructor Guide

TRANSPORTATION, STORAGE, AND DESTRUCTION OF BOMB MATERIALS

06

C. R. NEWHOUSER

CHARLES S. STEVENSON

CONTENTS

A PUBLICATION OF **The National Bomb Data Center**

Research Division

A program funded by the Law Enforcement Assistance Administration of the United States Department of Justice. Dissemination of this document does not constitute U. S. Department of Justice endorsement or approval of content.

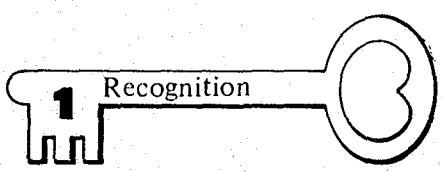
TRANSPORTATION, STORAGE, AND DESTRUCTION OF BOMB MATERIALS

Approximately 20 percent of all bomb incidents in the United States result in the recovery by public safety personnel of explosives or incendiary materials that have failed to detonate or ignite. In addition to the increasing number of bomb incidents producing dangerous materials, law enforcement and fire officials must annually recover hundreds of pounds of abandoned or illegally held explosives, incendiary materials, blasting supplies, hazardous chemicals, and unassembled bomb components. Whatever their source, these materials constitute a safety hazard to the general public, as well as to those who must handle, transport, store, and ultimately destroy them.

The purpose of this publication is to provide public safety personnel with general guidelines for the transportation, storage, and destruction of dangerous materials frequently encountered in the investigation of incidents involving bombs or explosives. In the absence of standardized doctrine, the information, guidelines, and precautions contained herein will serve as background information for training and operations involving these hazardous materials.

GENERAL PROCEDURES

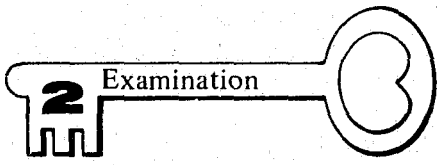
The keys to safe handling of dangerous materials are *recognition, examination,* and *separation.*



Recognition of the nature and potential of an explosive or incendiary material gives the public safety officer a substantial margin of safety in any handling operation. A previous publication in this series, 02 *Introduction to Explosives* and a forthcoming manual, 03 *Recognition of Explosive and Incendiary Devices,* provide considerable information regarding the correct identification of common explosive and incendiary materials and devices.

In any case where recognition is not positive, the suspected material should be handled as though it were obviously dangerous.

Any material suspected of having explosive or incendiary potential should be handled only by trained and fully qualified military or civilian bomb technicians. This is true even where a preliminary identification suggests that the substance is a normally stable explosive material. It is important to recognize that even stable materials may have deteriorated to the point where they have become extremely sensitive to friction, heat, or impact. Items that appear to be relatively safe to handle may, in fact, be extremely dangerous. Safety demands that all unknown materials be treated with suspicion until both their identity and condition have been ascertained.

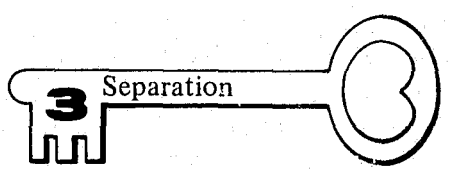


Once a suspected explosive or incendiary material has been tentatively identified, it must be carefully examined by qualified personnel both to determine the condition of the material and to insure that what appears to be an unprimed explosive or incendiary substance is not, in fact, a fuzed bomb.

The deterioration of explosives or incendiary mixtures results from improper handling or storage or from aging and the process is often accelerated by extremes of heat, cold, or moisture. For example, one of the most frequent and dangerous situations encountered is the deterioration of certain dynamites which causes the nitroglycerin content to separate from the remainder of the explosive mixture and seep or settle to the lowest point possible. The nitroglycerin seepage is oily in appearance and, of course, extremely sensitive. When straight dynamite has been stored for a period of several months without rotation of its container, nitroglycerin will often be found concentrated in the lower portion of dynamite sticks, absorbed in cardboard packing cases, or soaked into wooden or earth floors. Thus, it may be necessary to handle degraded dynamite as though it were extremely sensitive nitroglycerin rather than relatively stable commercial dynamite.

Deterioration is also a problem with assembled military and improvised explosive devices. For example, rust and corrosion may attack metallic parts to the extent that what appears to be a grenade with its safety pin in place, may in fact be a grenade that will function when moved or roughly handled. Regardless of the nature of the device, it must be examined to determine both its intended functions *and* any possible alternate functioning patterns permitted or imposed by deterioration or rough handling.

While the technique is rarely employed, it is a relatively simple matter to construct a bomb that is totally contained within its explosive charge. Fuze, batteries, cap, and mercury switch can, for example, be built inside a block of common explosive material. The risk of being exposed to this kind of entrapment is greatest during operations in which explosives are recovered from clandestine bomb factories or illegal explosive caches. Where the circumstances of recovery and the nature of the material suggest the possibility of boobytraping, only a bomb technician should be permitted to examine suspected explosives or incendiaries.



Separation of recovered materials should be conducted by qualified personnel familiar with explosive, incendiary, and dangerous materials. The first phase of separation is the division of the recovered materials into units presenting like hazards. Fuels are separated from oxidizers, acids from organic materials, blasting caps from dynamite, gasoline from flame-producing agents and so forth. As this separation is being made, the entire operation may be simplified by placing the material in *clear plastic* bags of the yard and garden variety. The plastic bag clearly separates the material into

units, reduces direct physical contact, provides a degree of protective shielding from spark and environmental hazards, and still allows excellent visual identification of the material throughout subsequent handling, transport, and storage actions.

As the materials are placed into plastic bags, the amount of material in each container should be controlled so as not to exceed a total of 25 pounds. When they have been bagged and marked, materials should be removed from the building, if possible to an outdoor area. Those bags containing up to 10 pounds of explosive or incendiary material should be grouped by like hazard and placed no closer than *3 feet* to the nearest 10-pound bag. Bags whose weight approximates *25 pounds* should be separated by a distance of *25 feet* from *all* other bags. The 3-foot and 25-foot minimum separation distances serve to eliminate, to a great degree, the probability of explosive propagation from one container to another should an accidental detonation occur. Propagation figures indicate that, in the open, 100 pounds of blasting cap sensitive explosive may be detonated by the detonation of a similar amount of explosive 10 feet away, but will not be detonated if the distance is increased to 25 feet. Figure 1 summarizes the minimum separation rules recommended for use when handling explosive, incendiary or dangerous materials.

- √ Separate materials into units having the same type of hazard.
- √ Package materials in clear plastic bags, mark and seal.
- √ Package no more than 25 pounds of material in any one bag.
- √ Remove all packaged material to outside area if possible.
- √ Position no bag containing 10 pounds or less closer than 3 feet to the next 10-pound bag.
- √ Place no 25-pound bag of material closer than 25 feet to any other bag.

Figure 1
SUGGESTED MINIMUM SEPARATION RULES

A typical encounter involving illegal and dangerous storage of explosive and incendiary materials is illustrated in figure 2. The storage area is a single car garage and the illustration indicates the type and amount of each item found as well as its location inside the garage. As the search of the garage progresses, encountered materials are *recognized, examined,* and *separated.* Materials are placed into plastic bags, removed from the building, and placed outside following the suggested minimum separation rules as illustrated in figure 3. The task of marking, labeling, inventory, photographing, and processing is made easier and safer to accomplish as a result of the separation of the materials. Photographers (with screened flashbulb units) are able to move freely from bag to bag and photograph the contents without touching the recovered material. In addition, laboratory technicians may process selected recovered material, and separation of materials for loading into transport vehicles is greatly simplified.

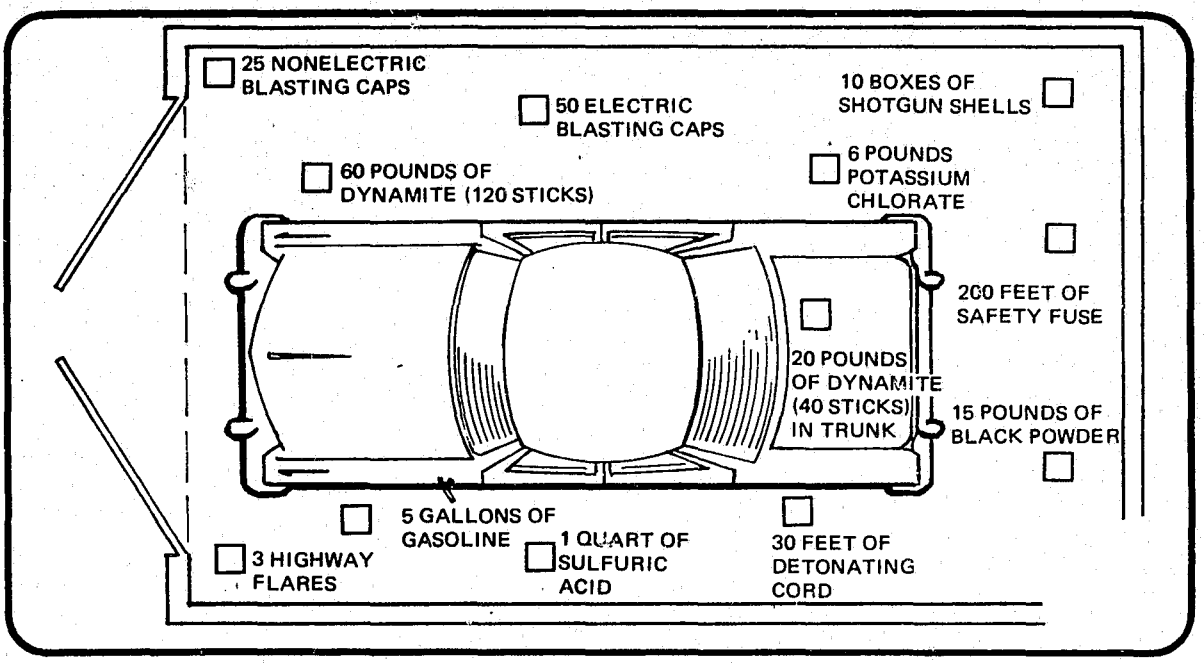


Figure 2
EXPLOSIVE AND INCENDIARY MATERIALS AS FOUND IN GARAGE

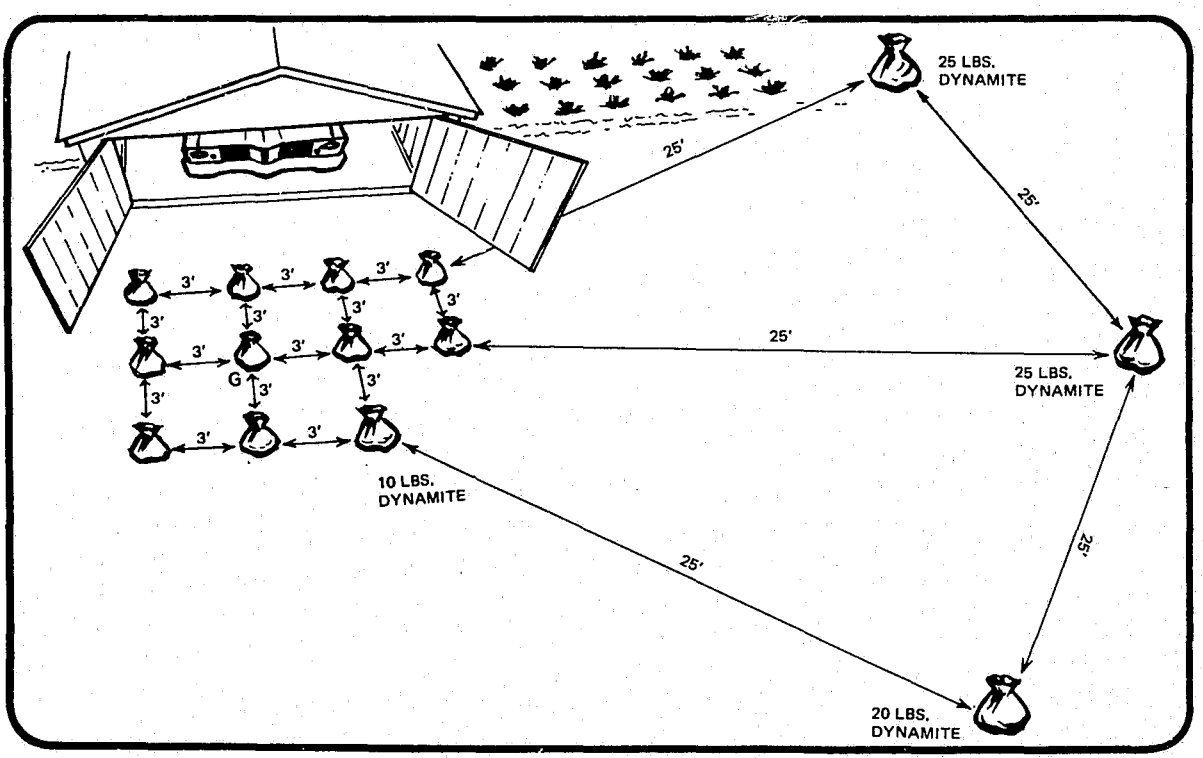


Figure 3
MATERIALS PLACED OUTSIDE GARAGE FOLLOWING SUGGESTED MINIMUM SEPARATION RULES

RECOVERED BOMB MATERIALS

Explosive and incendiary bomb materials recovered by the public safety officer fall into two general categories, those that have been assembled into bombs and those that have not. In each case, several possibilities exist:

- **Unassembled Bomb Materials**

  √ Military or Commercial Explosives or Incendiaries
  - In Original Containers
  - Removed from Original Containers

  √ Ingredients of Improvised Explosives or Incendiaries

  √ Fuzes, Caps, Detonating Cord, and Other Primers or Boosters

- **Assembled Bomb Materials**

  √ Bombs Without Fuzes

  √ Bombs With Fuzes
  - Fuzes Initiated
  - Fuzes Uninitiated
  - Fuzes That Have Failed

  √ Bombs Partially Destroyed by Incomplete Detonation or Ignition

Each of these situations can present unique problems in handling and transportation that must be recognized if injury and property damage are to be avoided.

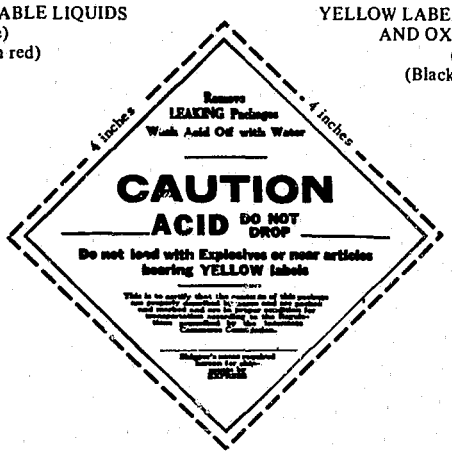
Unassembled Bomb Materials

Unassembled bomb materials are simply component parts that, when correctly combined, make up explosive and incendiary bombs. In their unassembled form, they range in hazard from almost harmless to highly dangerous, but for the most part they constitute predictable risks once they are correctly identified and examined.

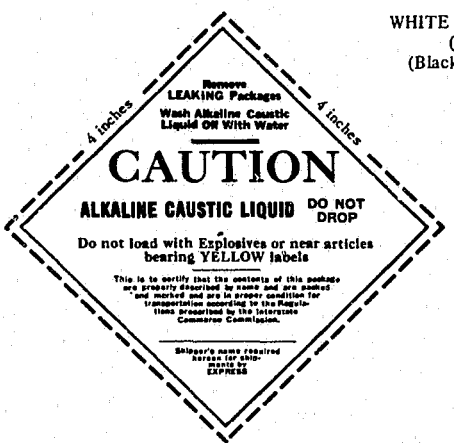
The U.S. Department of Transportation prescribes in the *Code of Federal Regulations (CFR) Title 49,* Chapter 1, the Hazard Identifying Labels which are to be affixed to all shipments of chemical agents, hazardous chemicals, explosives, and other dangerous articles. These labels are attached to the outside of individual packing boxes and shipping containers and serve to identify the type of hazard presented by the contents as well as certain specific handling precautions. The labels are color coded in RED, YELLOW, WHITE, and GREEN to further simplify the hazard identification and to allow for quick visual compatability of storage identification. When such labels are observed on recovered containers, they will provide excellent handling and storage information and should be closely studied. Figures 4 through 6 illustrate the various labels which would normally be found affixed to the containers. Additional larger labels or placards are required on the front, rear, and both sides of trucks and rail cars engaged in transport of all dangerous cargo.

RED LABEL FOR FLAMMABLE LIQUIDS
(Reduced size)
(Black printing on red)

YELLOW LABEL FOR FLAMMABLE SOLIDS
AND OXIDIZING MATERIALS
(Reduced size)
(Black printing on yellow)



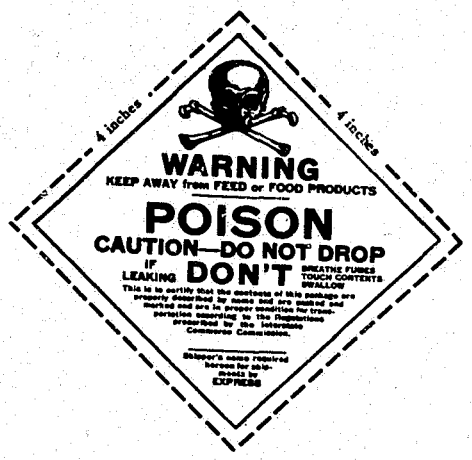
WHITE LABEL FOR ACIDS:
(Reduced size)
(Black printing on white)



WHITE LABEL FOR ALKALINE CAUSTIC
LIQUIDS
(Reduced size)
(Black printing on white)

WHITE LABEL FOR CORROSIVE LIQUIDS
(Reduced size)
(Black printing on white)

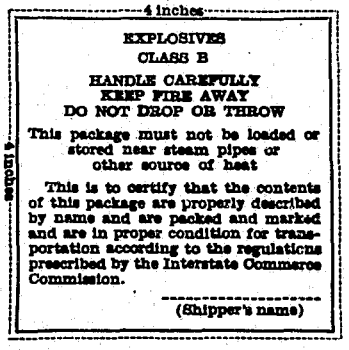
Figure 4
LABELS FOR SURFACE SHIPMENT OF MATERIALS



RED LABEL FOR POISONS
(Reduced size)
(Red printing on white)

RED LABEL FOR SPECIAL FIREWORKS
(Reduced size)
(Black printing on red)

RED LABEL FOR SAMPLES OF EXPLOSIVES
(Reduced size)
(Black printing on red)

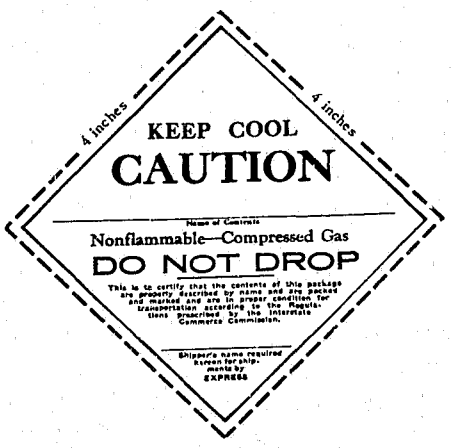


RED LABEL FOR CLASS B EXPLOSIVES
FOR EXPRESS SHIPMENT
(Reduced size)
(Black printing on red)

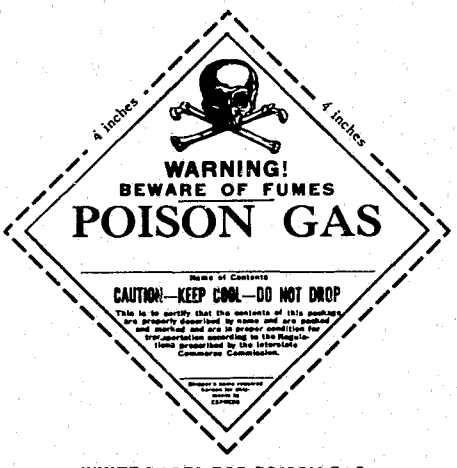
Figure 4 (continued)
LABELS FOR SURFACE SHIPMENT OF MATERIALS

RED LABEL FOR FLAMMABLE
COMPRESSED GASES
(Reduced size)
(Black printing on red)

WHITE LABEL FOR TEAR GAS
(Reduced size)
(Red printing on white)

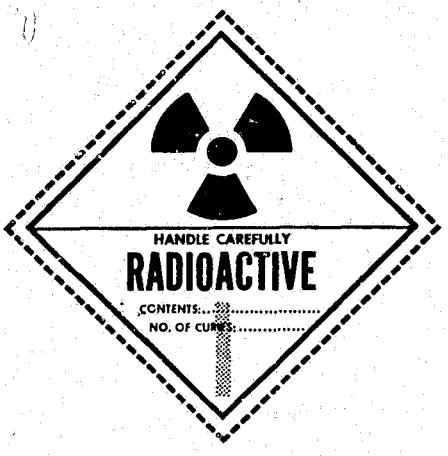


GREEN LABEL FOR NONFLAMMABLE GASES
(Reduced size)
(Black printing on green)



WHITE LABEL FOR POISON GAS
(Reduced size)
(Red printing on white)

Figure 5
GASES AND RADIOACTIVE MATERIAL SHIPMENT LABELS



"Radioactive white-I" label for radioactive materials. Label must be white in color. The single vertical bar on the lower half of the label must be bright red in color.

"Radioactive yellow-II" label for radioactive materials. The upper half of the label must be bright yellow and the bottom half must be white. Two vertical bars on the lower half of the label must be bright red in color.

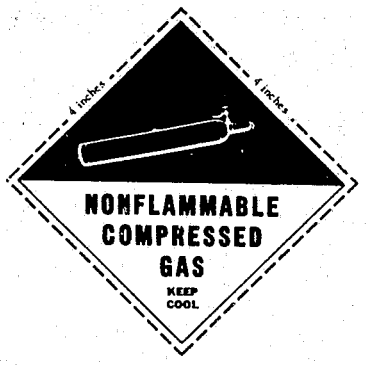
"Radioactive yellow-III" label for radioactive materials. The upper half of the label must be bright yellow and the bottom half must be white. The three vertical bars on the lower half of the label must be bright red in color.

Figure 5 (continued)
GASES AND RADIOACTIVE MATERIAL SHIPMENT LABELS

Red label for shipment of special fireworks by air.

Red label for shipment of samples of explosives by air.

Red label for shipment of class B explosives by air. (Black printing on red)



Red label for flammable liquids for shipment by air.

Red label for flammable compressed gases for shipment by air.

Red and Black with
(black printing on red)

Yellow label for flammable solids and oxidizing materials for shipment by air.

Yellow and black with
(Black printing on yellow)

White label for acids for shipment by air.

White label for corrosive liquids for shipment by air.

White label for alkaline caustic liquids for shipment by air.

White and black with
(black printing on white)

Green label for nonflammable gases for shipment by air.

Green and black with
(Black printing on green)

White Label for poisons for shipment by air.

White and red with
(red printing on white)

Figure 6
LABELS FOR AIR SHIPMENT OF MATERIALS

Military or Commercial Explosives or Incendiaries. Military and commercial explosive and incendiary materials are frequently recovered in their original containers or wrappers. Gasoline, or other fuel, is usually found in a tank or portable container; dynamite, in wrapped sticks; TNT, in half-pound or one-pound blocks; and tear producing agents, in grenades or projectiles in which they are normally used. These materials in normal configurations present hazards that are more nearly predictable than when found in other conditions. Although a lessened requirement may exist for analysis of materials in this condition, great care must be taken to examine them for the presence of concealed initiating devices or for signs of improper handling and storage, or deterioration. Even when recovered in their original state, these materials should be separated and placed in suitable containers prior to movement.

Unfortunately, all military and commercial explosive and incendiary materials are not recovered in their original containers or wrappers. In this condition, some materials may not react the same as they would if they were in their regular containers, often creating different and perhaps greater hazards. Without proper analysis, some materials may not even be recognizable as explosives or incendiary materials, and thus any suspicious material should be regarded as potentially hazardous. Care must be taken in recovery to package these materials in suitable sealed plastic bags, boxes, cans, or wrapping and to keep them separate from one another.

Ingredients of Improvised Explosives or Incendiaries. The ingredients of improvised explosives or incendiary materials may be found in a wide variety of boxes, jars, bags, or cans and in both original or substitute packaging. While some ingredients used to improvise explosives are completely harmless, either alone or when mixed, others become dangerous only when properly mixed with air or other chemicals. Lacking analysis, most suspected bomb ingredients must be regarded as potentially hazardous, unless it is quite obvious from their packaging or appearance that they are in their natural and completely harmless state.

Since it is often difficult to know or suspect what ingredients or combinations of ingredients may pose hazards, care must be taken to keep containers of unknown or suspect ingredients separated from one another, particularly those filled with liquids of any kind. A partial listing of such ingredients is given in figure 7.

When powdered or granulated materials are recovered, inspection should include a search for any smaller bag or container that may have been placed in a mixture of explosive or incendiary material as a chemical delay fuze.

Fuzes, Blasting Caps, Detonating Cord, Primers, or Boosters. Fuzing and priming materials of the commonly available or improvised types are usually easily recognized. When not assembled as part of a bomb, they are relatively safe only if properly handled. If mishandled, they may produce injury ranging from severe burns or loss of fingers or eyesight to death.

Because blasting caps, detonating cord, primers, and boosters employ primary high explosives (the most heat-, shock-, and friction-sensitive of all types of explosives), great care must be exercised in handling these components. Blasting caps, for example, should be protected from shock by packaging them in cloth, foam rubber, shreded paper, or crushed styrofoam. The open end of nonelectric blasting caps should be sealed with tape to prevent entry of foreign material into the

friction- and flame-sensitive mixture inside. Care should be taken that electric blasting caps are properly shunted so as to eliminate the possibility of accidental detonation due to static electricity. All blasting caps should be handled and stored under cool, dry conditions.

In quantities, detonating cord and other primers or boosters are capable of producing explosions greater than those produced by an equal amount of main charge explosives because of their higher detonation velocities. All primary explosives must be handled with great care and afforded all protection possible.

Assembled Bomb Materials

As separate materials, fuzes, blasting caps, boosters, and main charge explosives represent a threat not necessarily related to their destructive potential as components of a fully or partially assembled bomb. The risk of life and property from any assembled explosive or incendiary device demands the attention of a trained bomb technician. In no case should an untrained officer attempt to handle or transport a suspected bomb, except as a last resort in those instances where the risks of detonation and death are acceptable.

Bombs Without Fuzes. Occasionally, a bomb will be encountered that appears to have no fuze. This should never be assumed to be the case, regardless of outward appearance. Not only can fuzes be concealed within the explosive or incendiary mixture, but some bombs may require no fuze to detonate or ignite. For example, a pipe bomb filled with an improvised "match head" mixture may be extremely sensitive to shock, friction, or heat, without any fuzing. In the same way, incendiary liquids or solids may ignite on contact with the air, again requiring no visible fuze system.

Bombs With Fuzes. Bombs with uninitiated, initiated, or defective fuzes present the greatest hazard to public safety personnel and innocent citizens. Such devices must be rendered safe, dismantled, or transported only by qualified bomb technicians.

Incomplete Detonation or Ignition. In some instances partially destroyed devices with portions of explosive and incendiary materials are found at the scene of a bombing. Such situtations are the result of incomplete or partial detonation or ignition of the device, frequently leaving the remaining material in a super-sensitive or dangerous condition. Since the materials involved have already been subjected to the extremes of shock or heat, physical and chemical changes in the materials may have produced unstable and unpredictable substances. Although the fuzing and initiating devices have functioned, the possibility exists that initiating residue may continue to present an unusual hazard. Again, the bomb technician is the only person who should be involved in the handling of such materials.

COMMON MATERIALS USED AS EXPLOSIVE OR INCENDIARY BOMB INGREDIENTS

Material	Physical Appearance	Normal Container	Health Hazard	Reaction with	Safety, Handling and Precautions Transportation
Sulfuric Acid H_2SO_4 Other names: Oil of Vitrol	Colorless, clear slightly oily liquid	Glass or teflon containers	Causes severe deep burns to tissue, very corrosive	Explosive. Incendiary	Wear face shield, acid-resistant rubber gloves and clothing. Separate from all other items. Protect glass bottle.
Black Powder	Dark brown to shiny black in color, powder through large grains	Plastic or light sheet metal flask	Fire and explosion	Violent reaction water organic materials. Attacks most metals. Flame spark, static electricity.	Wear cotton clothing from skin out, use non-sparking tools and packaging materials, beware of static electricity, package in sealed containers. Handle in units no larger than 50 lbs. Protect against flame, spark, shock and static electricity.
Potassium Chlorate $KCLO_3$	Transparent, colorless crystals or white powder	Glass containers	Produces toxic fumes when burned	Explosive reaction Incendiary reaction Powerful oxidizing material	Protect against friction, flame and shock. Separate from combustible, organic or other readily oxidizable materials, acides, ammonium salts, sulfur and flammable vapors. Handle with rubber gloves.
Match Heads	Match head	Box, paper folder	Fire, unpleasant fumes when burned	Incendiary reaction striker board, friction	Protect against friction, package in plastic bags
Red Phosphorous	Reddish-brown powder	Plastic, light sheet metal or glass container	Fires, highly irritating fumes when burned	Explosive and other oxidizing materials. Incendiary when ignited.	Place in air tight container, separate from all oxidizers, wear flameproof clothing, keep material cool.
Potassium Permangnate KM_nO_4	Dark purple crystals with blue metallic sheen	Plastic or glass containers	No inherent hazards	Explosive and hydrogen peroxide. Powerful oxidizing material.	Protect against heat, friction and flame, package in sealed container, separate from 1 and hydrogen peroxide and all combustible, organic or readily oxidizable materials.
Sodium Peroxide Na_2O_2	Yellowish-white powder	Sealed metal cans	Toxic if ingested, avoid breathing dust or contact with the eyes	Will ignite and may explode in contact with water, powerful oxidizer, ignited by friction.	Keep moisture and water free, package in sealed container, use eye protection and rubber clothing, separate from combustibles, protect from friction.
SodiumChlorate NaCLO	Colorless, odorless crystals	Glass containers	Toxic fumes when burned	Forms explosive mixtures with combustible, organic or other easily oxidizable materials. Easily ignited by friction or heat.	Package in sealed container, protect from heat, friction and shock, separate from combustible, organic and readily oxidized materials, acids, ammonium salts, sulfur and flammable vapors, handle with rubber gloves.

COMMON MATERIALS USED AS EXPLOSIVE OR INCENDIARY BOMB INGREDIENTS -- Continued

Material	Physical Appearance	Normal Container	Health Hazard	Reaction with	Safety, Handling and Transportation Precautions
White Phosphorous	Colorless to yellow, translucent, soft waxy solid	Underwater in hermetically sealed cans	Causes severe burns; avoid skin and eye contact. Poison, toxic fumes when burning	Explosive when mixed with oxidizing materials. Ignites spontaneously upon contact with air.	Package underwater, protect container, separate, transport and store alone, wear flameproof clothing when handling.
Gasoline. Ranges from C_5H_{12} to C_9H_{20}	Liquid, color varies depending on dye added	Metal, plastic or glass container	Toxic if ingested, avoid breathing vapors, explosive and flammable vapors, flammable liquid.	Flame, spark, static electricity	Store in sealed container with vent, avoid skin contact protect against flame, spark and static electricity, ventilate storage area.
Carbon Disulfide CS_2 Other names: carbon bisulfide	Clear, colorless to faint yellow liquid with a very strong disagreeable odor of rotten eggs	Small glass or metal containers	Toxic by oral intake, inhalation or prolonged skin contact. Vapor is heavier than air. Dangerously low ignition temperature of vapors.	Vapors may be ignited by contact with an ordinary lightbulb, flame, spark or static electricity.	Wear self-contained breathing apparatus if container is open. Handle with rubber gloves and clothing. Force ventilation of area. Package in sealed container, store in cool area with vapor-proof lighting system away from other materials and possible sources of ignition.
Aluminum Powder	Silver colored powdered metal	Cans, barrels, drums boxes	Respiratory and eye irritant only	Forms explosive mixtures in air, reacts with some acids and caustic solutions to produce hydrogen.	Protect containers against rupture, separate from acids, caustics, chlorinated hydrocarbons, oxidizing materials and combustibles. If handling loose powder, wear goggles and respirator.
Calcium Hypochlorate $Ca(CLO)_2$ Other Names: Bleaching powder	White prills or powder with strong chlorine odor	Airtight cans and drums and bags	Irritating to skin, eyes and respiratory tract	Produces chlorine gas in contact with acids or moisture ignites in contact with combustible and organic materials.	Wear goggles and self-contained breathing apparatus. Store in sealed container in cool, dry, well-ventilated area. Separate from acids and oxidizing materials.
Nitric Acid NHO_3 Other Names: Aqua Fortis	Colorless clear liquid, producing yellow or reddish fumes	Glass containers	Causes severe tissue burns, fumes are toxic, highly caustic and corrosive liquid	Dangerous reaction with many materials. Explosive reaction with metallic powder, carbides, hydrogen sulfide, turpentine, and cyanides.	Wear acid resistant clothing and gloves, protect container against breakage, store away from metallic powders, carbides hydrogen sulfide, turpentine, organic acids and all combustible, organic or readily oxidizable materials. Avoid direct sunlight and provide good ventilation.
Potassium Nitrate Other Names: Saltpeter, nitrate of potash	White crystals or powder	Bottles, bags, boxes, cans, drums or bulk	Produces toxic oxides when burned	Increases flammability of combustible materials.	Store in cool, dry place, separate from combustibles.

Figure 7

COMMON MATERIALS USED AS EXPLOSIVE OR INCENDIARY BOMB INGREDIENTS

BASIC PRECAUTIONS FOR HANDLING EXPLOSIVES AND INCENDIARY MATERIALS

- Do not allow any unauthorized or unnecessary persons to be present when these materials are being handled. Two man teams should always be used.
- Once explosives or incendiary materials are recovered by public safety personnel, they should not be left unsecured or unguarded for any reason in any location.
- Bomb construction materials or devices should not be carried in bare hands. For added protection, use rubber gloves, a box, a clear plastic bag, or special bomb container whenever possible.
- Do not allow smoking or open flame near bomb materials. Observe a 500-foot rule and don't hesitate to double or triple the distance for safety purposes, especially when raw explosives or volatile fumes are involved.
- Never handle explosives or incendiaries together with detonating or initiating devices. *Keep them separate from each other at all times.*
- Carry only a moderate, reasonable load when transporting dangerous materials during recovery processing. The smallest load is the safest load.
- Never hand carry explosive or incendiary materials in places where footing may be unsteady. Select good routes in advance and plan ahead.
- Do not force explosive or incendiary materials into confined spaces or containers.
- Avoid clothing or equipment that may become entangled with materials being handled or that will produce sparks or static electricity.
- Never place blasting caps or other small items or devices in clothing pockets.
- Explosive and incendiary materials should not be accumulated in one place without careful consideration of the safe distances to inhabited buildings, public roads, or railroads.

Figure 8
BASIC PRECAUTIONS FOR HANDLING EXPLOSIVES AND INCENDIARY MATERIALS

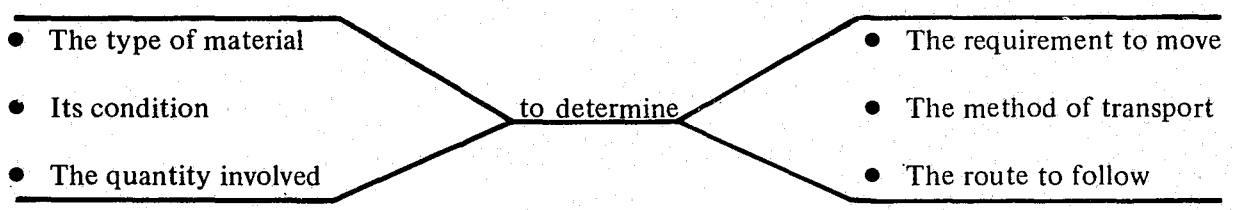
Whenever explosives or incendiary devices or materials are recovered, they must invariably be transported to a storage or destruction area. In the normal course of events, recovered materials are identified, examined, separated, inventoried or recorded, and then removed from the scene. Occasionally, suspected bombs or recovered materials are destroyed in the area where found, but such situations are exceptional rather than routine for most public safety agencies.

The safe transport of explosive and incendiary materials and associated devices and components involves a high degree of common sense coupled with adequate planning. This is especially true because of the wide range of emergency and routine situations that may give rise to the need to transport dangerous materials.

In *emergencies,* the transport of known or suspected bombs in specially designed vehicles from an incident site to safer, more remote areas may be required. Public safety agencies may also be requested to assist in the removal of large quantities of explosive or incendiary materials from the scene of accidents involving common carriers or from structures endangered by fire or damaged by natural disasters.

In *routine* situations, transportation may often be required to pick up explosive or incendiary material reported or voluntarily submitted by citizens. Transport may also be required if these materials are confiscated in connection with illegal activities or when found in the course of normal public safety operations. In some instances, depending on the quantity and condition of the material, a police patrol car may be completely adequate to carry properly processed and packaged smaller items. If the quantity is greater and the material is in safe condition and properly packaged, a general purpose truck may be used. Even in routine situations, however, a bomb transport vehicle should be used if the condition of the material is hazardous or unknown.

Some typical transport situations are summarized in figure 9. From these examples it is obvious that both the quantity and quality of recovered materials may vary from one blasting cap to several hundred pounds of boxed explosives, and range in condition from completely safe to extremely hazardous. Each situation must be evaluated carefully, with full consideration given to:



The Requirement to Move

The decision to transport explosives, bombs, or other dangerous materials should be based upon an estimate of relative risk. It may, for example, be less hazardous to the public to attempt to disarm a bomb in the target area rather than to attempt to transport it fully assembled through crowded city streets. Even where transport is possible, it may be wise to delay such movement until traffic or weather conditions are more favorable. The essential question is always whether the risk of movement is greater or less than the risks of alternative courses of action.

TYPICAL TRANSPORTATION SITUATIONS AND PRACTICAL SOLUTIONS

Scene of Incident	Type of Material	Condition of Material	Quantity of Material	Vehicle	Action Taken
Items found by children	Electric blasting caps	GOOD—in original packing	5 nonelectric blasting caps	Patrol car	Caps packed in cloth, put in cardboard box and placed in a trunk of car. Taken to storage facility.
Small shack loacted in remote area	Old deteriorated leaking dynamite	POOR—individual sticks	10 sticks	Bomb vehicle	Carried in box or plastic bag and lowered into bomb vehicle. Taken to disposal area and destroyed by burning.
College campus	Molotov cocktails	GOOD—ready to use	6 quart bottles	1 police pick-up truck	Bottles kept in upright position and packed carefully in cardboard box. Transported to city dump, photographed, processed and liquid samples taken for evidence. Remainder of gasoline destroyed by burning.
Local church	Explosive and incendiary bomb with fuse	POOR—leaking gasoline has soaked dynamite	1 gallon of gasoline and 2 sticks of dynamite	Bomb vehicle	Cracked and leaking bottle placed in plastic bag, lowered into bomb vehicle. Transported to disposal area, photographed and destroyed.
Courthouse	Suspect bomb in briefcase	UNKNOWN	Estimated 15 pounds	Bomb vehicle	Lowered into bomb vehicle and transported to secluded holding area. Bomb detonated while awaiting arrival of bomb squad.
Bombing scene	Broken sticks of dynamite	POOR—sticks crushed and flattened	3 sticks	Bomb vehicle	Placed in box and lowered into bomb vehicle. Taken to disposal area, photographed, processed and destroyed by burning.
Derailed freight car blocking public highway	Boxes of military explosive	All but 5 boxes undamaged	700 boxes of TNT blocks	2 police trucks 1 police pick-up truck	Military assistance requested. Trucks prepared with mattresses on truck bed. One layer of boxes (total of 15 boxes) per load. Five damaged boxes taken separately. Turned over to military or placed in temporary storage.

TYPICAL TRANSPORTATION SITUATIONS AND PRACTICAL SOLUTIONS -- Continued

Scene of Incident	Type of Material	Condition of Material	Quantity of Material	Vehicle	Action Taken
"Bomb" at local high school chemistry laboratory	Suspected nitroglycerin	UNKNOWN	1 bottle (pint)	Bomb vehicle	Placed in bomb vehicle and taken to secured holding area. Photographed and analyzed. Later found to be mineral oil.
Near airport that was a WW II military training base	Motar projectile, fired but did not explode	UNKNOWN	1 pound	Sandbagged military vehicle	Area cleared and military EOD personnel requested to respond.
Raid on headquarters of extremist group	Boxed dynamite, boxed blasting caps, safety fuse	GOOD	50 pounds of dynamite, 100 blasting caps, 500 feet of safety fuse	Police pick-up truck– patrol car	Dynamite placed in pick-up truck, blasting caps and fuse placed in trunk of patrol car. Taken to storage facility, photographed, processed and placed in storage.
Items discovered by firemen during fire fighting operation	Souvenir hand grenades	UNKNOWN–in fire residue	2 hand grenades	Bomb vehicle	Placed in bomb vehicle and transported to holding area. Later found to be empty. Turned over to military EOD personnel.
Citizen reports ammunition abandoned by former tenant	Military small arms ammunition	FAIR–broken boxes	2,000 rounds	Patrol car	Placed in box and put in trunk of patrol car. Taken to military base and turned over to EOD personnel.
State Capitol building	Dynamite bomb with clockwork fuse	UNKNOWN–Clockwork fuze stopped by bomb technician	5 sticks of dynamite	Bomb vehicle	Lowered into bomb vehicle. Taken directly to secure holding area and dismantled by bomb technician.

FIGURE 9

TYPICAL TRANS PORTATION SITUATIONS AND PRACTICAL SOLUTIONS

The Method of Transport

Vehicle options for the transport of bombs or bomb materials usually consist of patrol cars, utility trucks, and specially designed bomb transport vehicles. Cars and trucks are used where the risk of detonation is extremely remote or where such detonation would produce only minor risk of injury or property damage. In all other cases, a specially designed or modified bomb transport vehicle should be employed.[1]

Bomb Transport Vehicles. When a bomb or sensitive explosive material has to be transported from the scene of an incident to a safer area, it should be placed in some sort of container which will minimize the effects of blast pressure, fragmentation, and heat, as well as reduce any secondary blast pressure effects.[2] While it would be ideal to completely contain all the blast pressure, fragmentation, and heat resulting from the detonation of any type of explosive, it is neither possible nor practical to construct such a container, since its size, weight, and cost would be prohibitive. Consequently, what is generally attempted is the reduction or control of the explosive effects rather than complete containment.

Blast pressure may be controlled by diffusing the blast pressure wave, causing it to dissipate in force as it travels outward, or by causing the wave to be deflected in a way that avoids intensification of the wave through a focusing effect characteristic of some explosions. Similarly, fragmentation may be controlled by deflecting the paths of the fragments and/or by attempting to slow down or capture the fragments in some kind of material. The effects of the heat generated by a detonation can generally be safely ignored if only noncombustible material is selected for the construction of the bomb container and its accessories.

In the design of bomb containers, the term *nondirectional* is used to describe those units which attempt total containment of fragmentation and total or partial containment of blast pressure. An example of a nondirectional bomb transporter is shown in figure 10. On the other hand, containers that attempt to vent or direct fragmentation and blast pressure are referred to as *directional* units. Obviously, the nondirectional container would have to be larger and heavier because of th large volume of gases and the total fragmentation to be contained. However, this weight and size may have to be accepted if the container is intended for use in high-rise and heavily populated areas where the risk of releasing any significant blast pressure and fragmentation would not be acceptable. Directional containers are smaller and lighter and are usually mounted vertically, as shown in figure 11. The blast pressure and fragmentation are vented either upward or both upward and downward, depending upon whether the container has a closed bottom or has been left open at both ends.

Thus, both nondirectional and directional containers are designed to deflect and/or entrap the fragmentation and to control the venting of the blast pressure wave.[3] They may additionally be equipped with accessory fragmentation blankets or shields which, when placed over openings or

[1] For further information on various types of bomb transport vehicles, see *Bomb Transport Vehicles* by C.S. Stevenson, available from the International Association of Chiefs of Police, Information Services Division, 11 Firstfield Road, Gaithersburg, Maryland 20760.

[2] For a review of explosive effects, see *Introduction to Explosives* by C. R. Newhouser, available from the International Association of Chiefs of Police, Information Services Division, 11 Firstfield Road, Gaithersburg, Maryland 20760.

[3] Even nondirectional containers currently in use do not attempt to fully contain the blast wave, but generally attempt to diffuse or break up the full force of the wave.

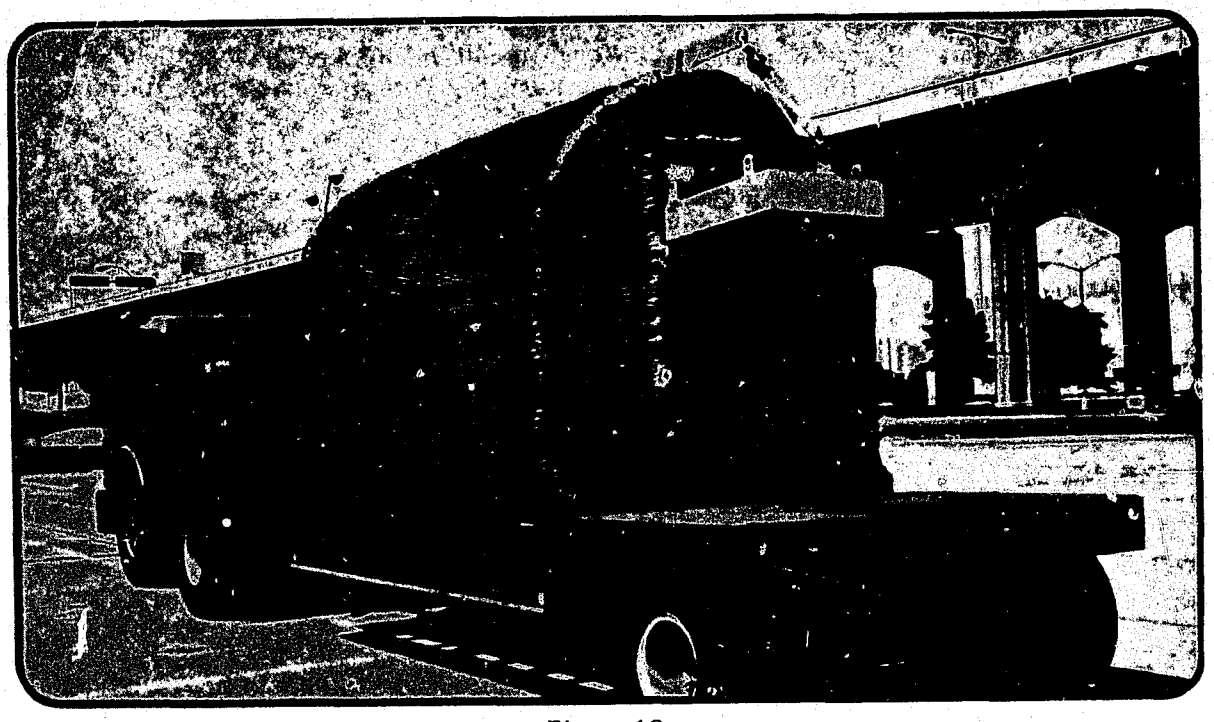


Figure 10
A NONDIRECTIONAL BOMB TRANSPORT VEHICLE

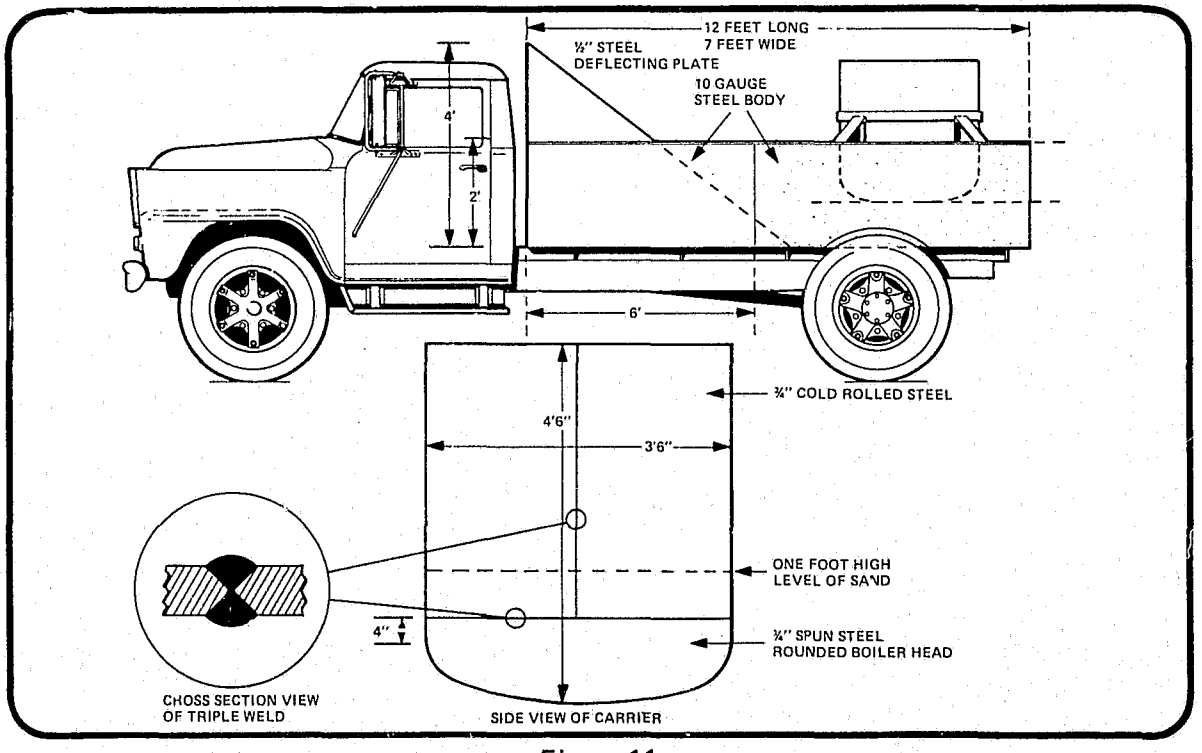


Figure 11
A DIRECTIONAL BOMB TRANSPORT VEHICLE

vents, further confine or reduce the velocity of the fragments. Reduction or elimination of the secondary blast pressure effects is attempted through mounting the container in sand or other super-absorbent material, and through the suspension system and tires of the vehicle on which the container is mounted.

The nature of the bomb transport problem involves more than merely a consideration of the bomb container itself. Ideally, there should be some means, either designed as part of the bomb transporter or improvised, to lower the bomb into the bomb container remotely and to safely remove it from the bomb container after arrival at a safe area.

Another important factor in the bomb transport problem is the vehicle itself. Without considering tracked vehicles, which are not believed to be practical in this role, there are three types of vehicles that can be utilized to provide mobility for bomb containers:

- *Semitrailer.* Depending upon its size and construction, a semitrailer can support great weight and bulk, but has the disadvantage of having to be pulled by a truck-tractor, the absence of which, when needed, may delay response time. See figure 12.

- *Trailer.* The full or towed trailer, depending upon size, has the advantage over the semitrailer of being towable by a wide range of general purpose trucks or cars and is shown in figure 13. Like the semitrailer, it must be tested for roadability and maneuverability to assure that it is functional for the jurisdiction in which it is to be used.

- *Truck.* The bomb container, illustrated in figure 13, is either mounted on the normal truck bed or on a specially-reinforced structure mounted on the chassis. Truck-mounted bomb containers have the advantage of great mobility, depending upon the size and capacity of the truck. They have the disadvantage that if the truck is not serviced and driven regularly, it may not start or operate properly, thus putting both the container and transporter out of operation when needed. An example of a truck bomb transport vehicle is shown in figure 14.

In many instances, the cost of designing, testing, and manufacturing a suitable bomb transport vehicle may be prohibitive. In fact, some of the more desirable and even necessary features of a bomb transporter may have to be sacrificed if cost is the overriding factor in its construction or procurement. What is needed is a safe and functional bomb container and an efficient bomb transporter at a reasonable cost.

Caught between the conflicting values of full protection and budget limitations, the public safety official must reach some compromise regarding the acquisition of bomb transport capability. While decisions of this kind can only be made on the basis of local conditions, several points should be considered.

- *Need.* The actual or potential need for a bomb transport vehicle can only be based upon local bomb and explosives experience and the availability of outside bomb incident support. If a nearby public safety agency is willing to share a transport vehicle, it may be difficult to justify the procurement of a special-purpose vehicle even when the level of bomb activity suggests that a need exists.

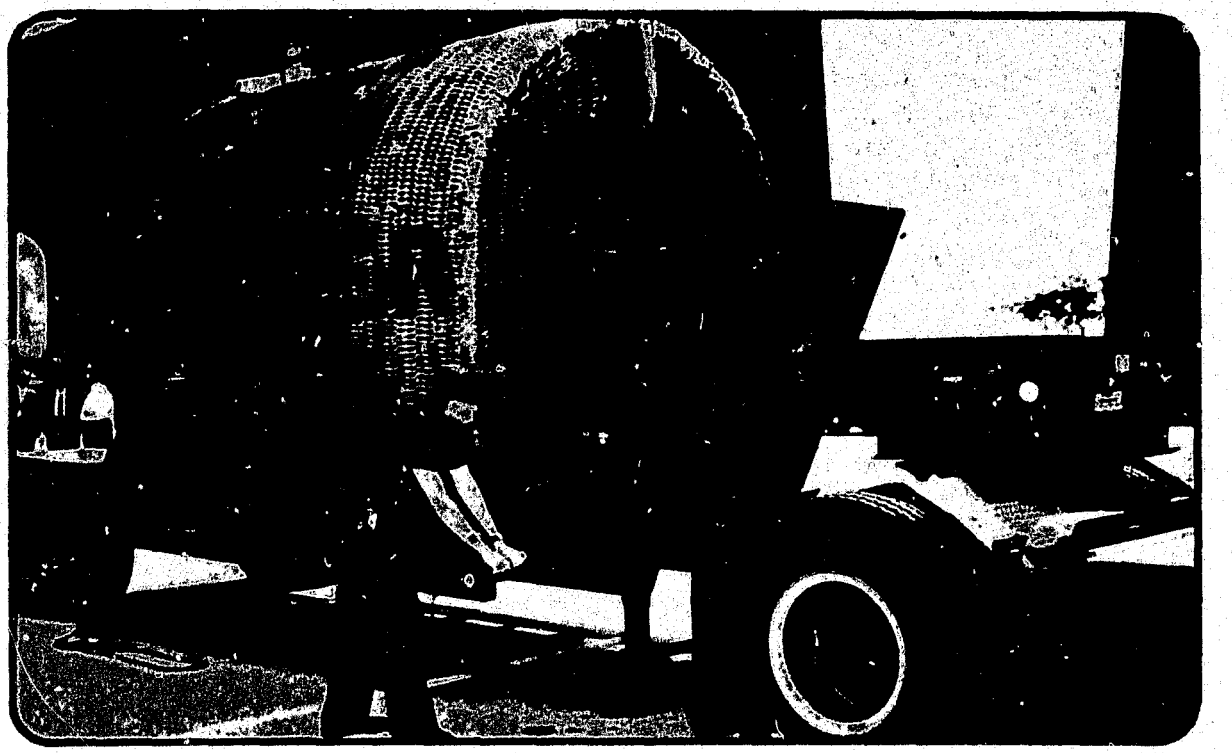


Figure 12
SEMITRAILER BOMB TRANSPORT VEHICLE

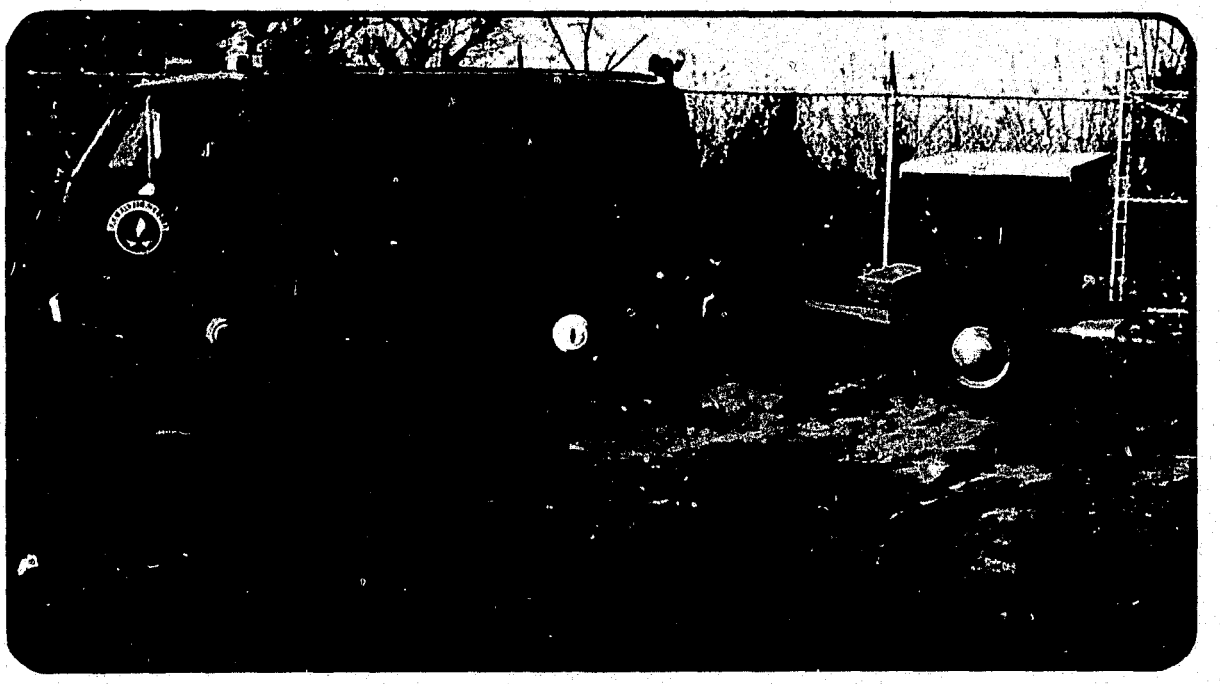


Figure 13
TYPICAL TRAILER BOMB TRANSPORT VEHICLE

- *Protection.* Perhaps the greatest single factor affecting the cost of a bomb transport unit is the level of protection desired. Since it is generally agreed that the current state of the art in explosive containment precludes the design of a practical mobil unit that will meet the threat of all bomb or explosive problems, some decision must be made regarding the level of protection that will be acceptable.

As a purely practical matter, the amount of explosive in a homemade bomb would probably not exceed the weight that could be carried to the target by a single person. Consequently, the outer practical limit of desirable protection would appear to be about a case, or 50 pounds, of 60 percent dynamite. If larger quantities of recovered or hazardous explosives must be transported, the total load should be broken down into smaller units for transport. While the 50-pound level of protection may not always be possible within cost limitations, it is technically feasible and serves as a point of reference.

Evaluation and rating of a bomb transport vehicle should be carried out whether the unit is constructed locally or purchased. The explosive rating should be based upon the weight of an explosive, 60 percent dynamite for example, that can be detonated repeatedly in the unit without causing permanent deformation of the container.

It is also essential in the rating of a bomb container and vehicle that the container and vehicle be evaluated as a complete unit, as both are subjected to blast pressures during detonation of bombs or explosive devices. The container is directly exposed to the rapidly expanding gas from the explosion and possibly the fragments, and the vehicle is subjected to a downward reactive thrust equal to the upward thrust of the blast.

- *Cost.* The total cost of a bomb transport vehicle is largely established by the size, containment capacity, and material of the container as well as the type and size of the truck or trailer required to transport the container. Labor costs must also be absorbed if the unit is constructed locally by public or private enterprise. Because of their high cost and infrequent use, a bomb transport vehicle is a poor investment for most communities. In urban areas, however, regionalization or sharing of a bomb transport vehicle can result in considerable savings to individual agencies. In those jurisdictions where bombing activity or explosive recovery is rare, a transporter can be improvised from such materials as sand-filled aircraft tires. Such a device can be fabricated from local materials, and when built to the specifications contained in NBDC Technical Bulletin 5-70, will contain or divert blast and fragmentation from pipe bombs containing up to two sticks of 60 percent dynamite or 2 pounds of black powder. Package bombs containing four sticks of 40 percent or three sticks of 60 percent dynamite were also contained in operational tests of the improvised bomb transporter illustrated in figure 15.

However, local fabrication of steel containers should be attempted only if expert advice and craftsmanship are available. For example, the material selected for the construction of the container should be based upon the following considerations: toughness as defined by the Charpy V-notch impact values and the Nil Ductility Temperature as defined by the Naval Research Laboratory, weldability, availability, cost, heat treatment, and yield strength. The steel to be selected should be ASTM grade A537A pressure-vessel steel in the normalized condition. This steel, when properly welded, exhibits high levels of strength and toughness at the range of ambient temperatures normally encountered throughout the United States.

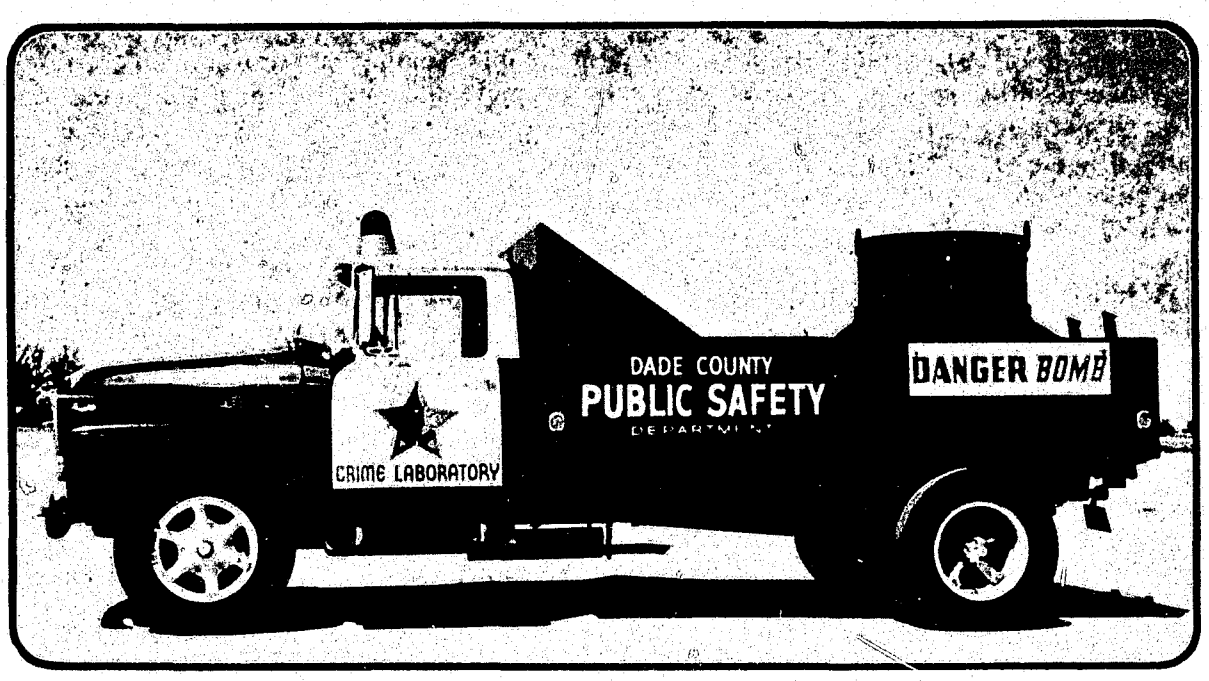


Figure 14
TYPICAL TRUCK BOMB TRANSPORT VEHICLE

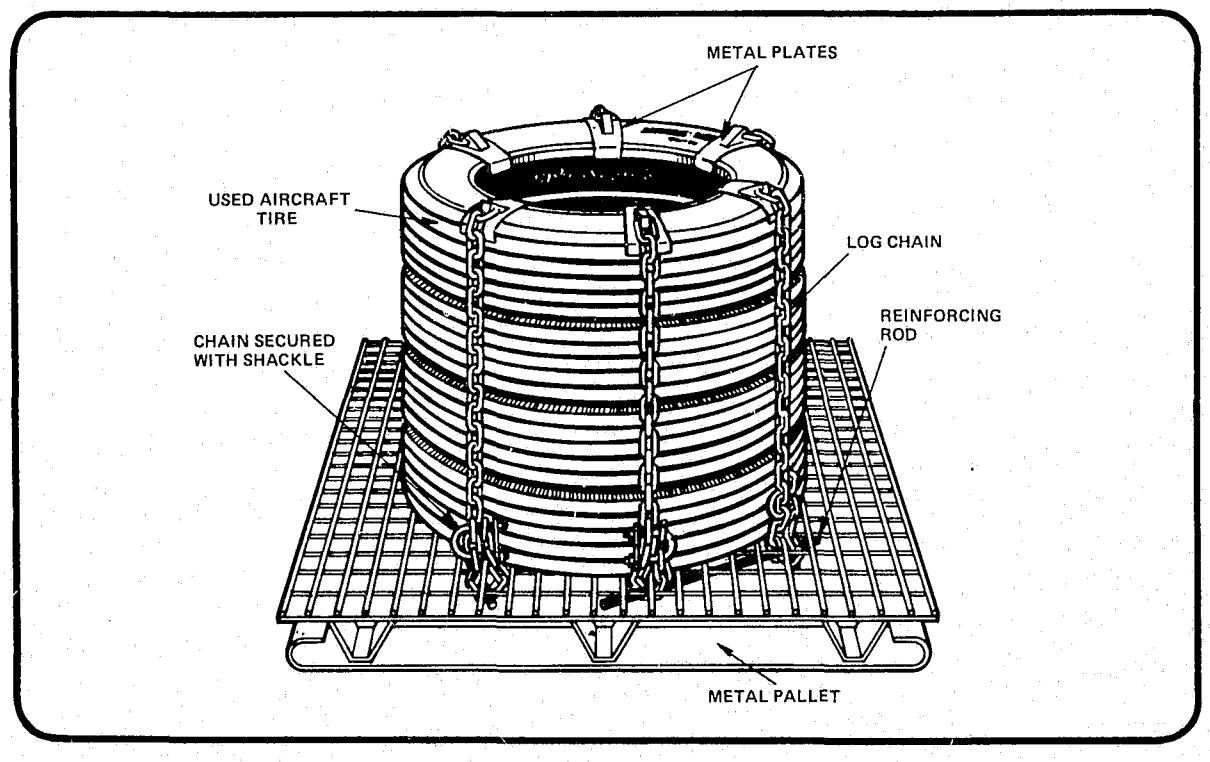


Figure 15
IMPROVISED BOMB TRANSPORTER

- *Implementation.* Finally, it should be recognized that the bomb transport vehicle is only one component of what should be a total system for the handling of suspicious materials or bombs. Trained personnel must be available to remove the actual or suspected dangerous materials from buildings and to disarm or destroy them once they have been transported to the disposal site. Without effective procedures and skilled personnel, the specialized bomb transport vehicle will make little contribution to the quality of public safety response to explosives incidents.

General Purpose Vehicle. Where risk assessment indicates that a special bomb transport vehicle is not required, patrol cars or other general purpose vehicles can be used to transport bomb materials if the proper precautions are taken to prevent accidental detonation or ignition.

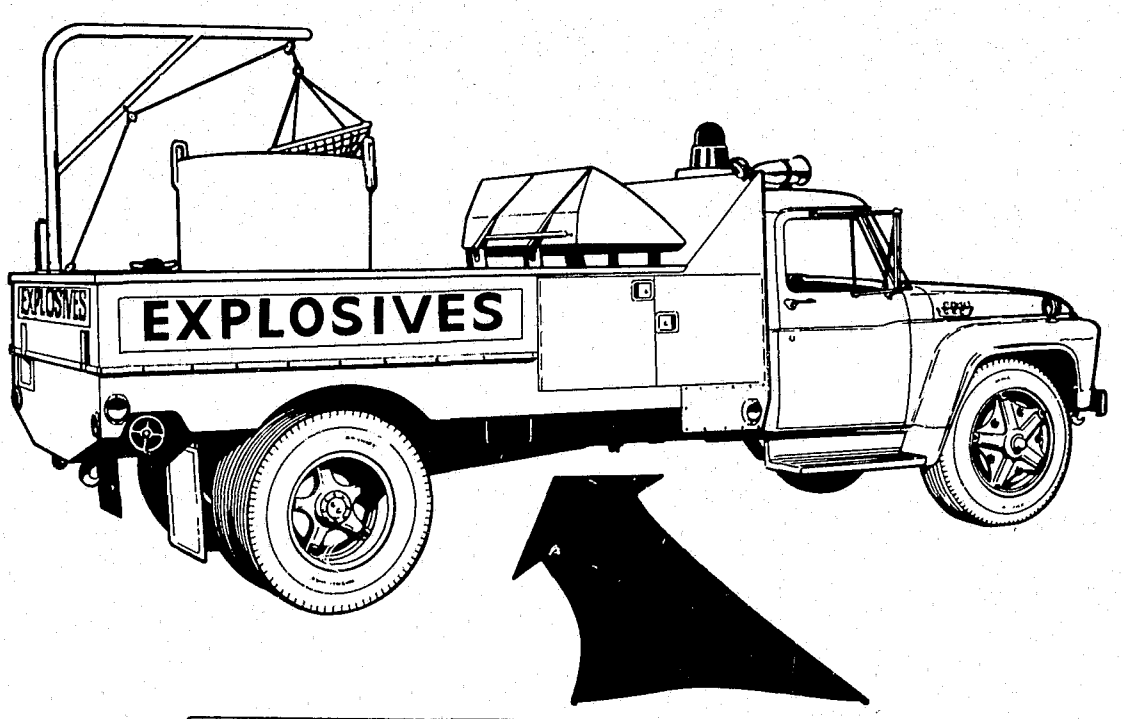
Under no circumstances should any explosive or incendiary materials or associated devices and components be handled or transported without being placed in suitable containers. Recovered explosive or incendiary material should be placed in boxes protected from shock and movement by crumpled paper, cloth, or other types of packing materials. It may not be necessary to repack materials if they are in an original container or box, but they should be inspected to insure that they remain securely packed during transport.

Once placed in the vehicle, the container should be tied down or braced to prevent unnecessary movement during transport. This is especially true in the case of light boxes that could be blown clear of the vehicle by wind or easily shifted during stops and turns. The hazardous cargo should be covered by some means to protect it from wind or inclement weather during transport. It is both inconvenient and dangerous to attempt to carry explosives in a cardboard container that is watersoaked, with weakened bottom or sides.

Materials that are subject to detonation from shock should be placed on a prepared bed of mattresses, foam rubber, or other suitable cushioning material. Care must be taken to prevent mixing different hazard groups of materials during transportation. Again, it should be noted that all material known to be hazardous or in doubtful condition should be carried in a bomb transport vehicle.

Vehicle condition is a matter of importance especially when general purpose transport is used. If a vehicle is not in top operating condition it may break down on a public street or highway and increase danger to the public. The condition of tires, brakes, steering, and lights must be carefully inspected and the presence of required emergency equipment such as fire extinguishers and emergency markers must be double checked. The Department of Transportation requires that all motor vehicles transporting chemical agents, hazardous chemicals, explosives, and other dangerous articles be marked or placarded on the rear, front and on each side with a reflecting placard, reflecting sign, or reflecting letters not less than 8 inches high on a contrasting background. Figure 16 illustrates the placards in place on a transport vehicle and the placards required for various dangerous articles.

General purpose automobiles or trucks used to transport hazardous materials should be driven only by drivers who have received special instruction in operating vehicles with such cargos. Drivers and passengers, transporting explosive or incendiary materials, should be familiar with the applicable hazardous materials laws.



Red Letters on White Background

EXPLOSIVES 8"

Commodity	*Type of marking or placard*
Explosives, class A, any quantity or a combination of class A and class B explosives.	EXPLOSIVES A (Red letters on white background).
Explosives, class B, any quantity	EXPLOSIVES B (Red letters on white background).
Poison, class A, any quantity; Poison, class B, 1000 pounds or more gross weight.	POISON (Blue letters on white background).
Flammable liquid, 1000 pounds or more gross weight; flammable solid, 1000 pounds or more gross weight.	FLAMMABLE (Red letters on white background).
Oxidizing material—1000 pounds or more gross weight.	OXIDIZERS (Yellow letters on black background).
Nonflammable compressed gas—1000 pounds or more gross weight	COMPRESSED GAS (Green letters on white background).
Corrosive liquid—1000 pounds or more gross weight	CORROSIVES (Blue letters on white background).
Flammable compressed gas—1000 pounds or more gross weight.	FLAMMABLE GAS (Red letters on white background).
Radioactive material requiring "radioactive yellow-III" label, any quantity	RADIOACTIVE (Black letters on yellow background).
Mixed ladings	DANGEROUS (Red letters on white background).

Figure 16
DANGEROUS VEHICLE PLACARDS

BASIC RULES FOR HAZARDOUS MATERIALS TRANSPORT

- Plan for all movement of explosive and incendiary materials.
- Transport only material that has been recognized, examined, and separated.
- Package the material prior to movement.
- Select the suitable vehicle for the job.
- Secure material on or in the vehicle.
- Be sure the vehicle is in good condition.
- Select a trained, alert driver.
- Plan and follow the safest route.
- If in doubt about the condition of the material, use a bomb transport vehicle.

Figure 17
BASIC RULES FOR HAZARDOUS MATERIALS TRANSPORT

In the event of vehicle or cargo fires while transporting these materials, drivers should attempt to fight the fire as long as it has not reached the cargo. The burning vehicle should be stopped, away from inhabited structures if possible, and fire-fighting personnel summoned.

The Route

Routes for the transportation of explosive and incendiary material should avoid congested areas, tunnels, and underpasses wherever possible. The use of police escorts should be planned for both routine and emergency movements. The location of all secured holding areas or other open spaces along the route should be designated on the route map or in routing instructions. Fire departments should be notified for all routine movements and must be alerted to all emergency routing.

STORAGE

There are several circumstances under which public safety agencies may become involved in the temporary storage of explosive and incendiary materials. Primarily, storage is necessary to physically secure the material pending legal action, analysis, or destruction. Such storage is only temporary in nature, and the material is usually destroyed after it has been processed as evidence. Once in the custody of the public safety agency, however, steps must be taken to insure that, should the material detonate or burn, no hazard to life or property is created. Any public safety agency that handles explosive or bomb incidents will require both a *holding area* and a *storage facility.* While local military or commercial facilities may be temporarily utilized by public safety personnel, this practice is not popular with owners of these facilities, especially when improvised or deteriorated materials and devices are involved. Thus, most police or fire agencies will ultimately be forced to plan and develop their own holding and storage capability.

- *Storage Facility.* A "storage facility" is a small structure in which explosive materials may be temporarily stored. It is preferably sited in hilly terrain, but if only flat land is available, it may be surrounded by a protective barricade of earth. It is located a safe distance from habitation and is secure and often fenced. It has an established rating which limits the type and quantity of materials that may be stored. In *no* instance is a suspect bomb *ever* placed in a storage facility, nor are incendiary devices or materials placed in storage facilities with explosive materials.

- *Holding Area.* A "holding area" is an open and isolated private or public area for which arrangements have been made for use in emergencies. Such an area is used to park bomb transporters with explosive cargos for short periods, and may also be used to handle, investigate, or dispose of explosives and incendiaries or associated devices and components. The holding area is protected by public safety personnel during its use. The size of the area is determined by the type and quantity of the materials involved, and the nature of the emergency. The secured holding area is used only under emergency conditions to "hold" the item for a very short period prior to moving it either to temporary storage or to destruction.

The Temporary Storage Facility

The important considerations in planning an adequate storage facility are, of course, the *size of the structure* and the *safety distances* to habitation. Both are based on the quantity of explosives to be stored at any given time. Incidental to the size and location of the storage facility are matters such as *what materials may be stored at the facility, the quantity to be stored,* and *facility security.*

Siting and Construction. Increased safety, as well as reduction in construction costs, can be realized if the storage site can be located in hilly terrain. Such a location will afford natural shielding from blast pressure and fragmentation. However, natural or man-made caves should generally be avoided due to the presence of excess moisture. Protection may also be afforded by locating the facility in an area where substantial dense timber surrounds the site provided that adequate fire protection is available. Either form of protection can be defined as *barricaded.* If no hilly terrain or dense woods can be found locally, the structure may be located on flat terrain, and depending upon the distances to roads or dwellings, may be either *barricaded* or *unbarricaded.*

DISTANCES IN FEET, WHEN STORAGE IS BARRICADED[1]

Pounds Over	Pounds Not Over	Inhabited Buildings[2]	Passenger Railways	Public Highways	Other Explosive Storage Structures[3]
2	5	70	30	30	6
5	10	90	35	35	8
10	20	110	45	45	10
20	30	125	50	50	11
30	40	140	55	55	12
40	50	150	60	60	14
50	75	170	70	70	15
75	100	190	75	75	16

[1] A "barricade" is either a natural (hills or dense timber) or artificial mound of a minimum thickness of 3 feet. "Barricaded" is when a building is effectively screened from another "target" by a barricade so that a line from the top of any sidewall of the building to the eave line of another will pass through the barricade.

[2] "Inhabited" means a building regularly occupied in whole or part for habitation or use, except those buildings where explosives are made, stored, or used.

[3] When two or more storage structures are located on the same property, each structure must comply with the minimum distances specified.

NOTE: *When a building containing explosives is not barricaded, the distances shown in the table should be doubled.*

Figure 18
TABLE OF STORAGE DISTANCES FOR EXPLOSIVES

For recommended safety distances, see figure 18, which is an abbreviated table of distances for storage of explosives. Although this table is designed for use with permanent-type storage facilities, the distances shown are adequate for temporary storage. It should be noted that the distances shown in the table are for barricaded structures and should be *doubled* when structures are *not* barricaded.

The structure itself may be built of sheet metal, wood frame, or concrete block; however, any construction style chosen should have double walls filled with dry sand, or with a dry sand cement mixture, for bullet resistance. An auxiliary structure for storage of initiating devices may be built against an exterior, common double wall, which is also constructed of sand-filled concrete block and equipped with a substantial door or cover and a sound hasp and lock.

The site itself is prefereably located on an all-weather road. If the structure is on flat terrain and land is at a premium, a barricade is desirable. This barricade is easily made by mounding earth on three sides to above the height of the walls of the structure following guidelines contained in footnote 1 of figure 18. Two sketches of a typical storage structures are shown in figure 19.

Finally, the temporary storage facility should be inspected at least annually, or more frequently, to assure that new buildings have not been constructed or that public areas do not exist at distances closer to the storage facility than when originally surveyed. If such encroachments have occurred, they may call for a reduction in the amount of stored explosives, or may require relocation of the facility to a new area where safe distances can be maintained.

More specific requirements for storage structures are found in Publication No. 17 of the Safety Library, published by the Institute of Makers of Explosives, 420 Lexington Avenue, New York, New York 10017.

Storage Control. Different types of explosive and incendiary materials react in different ways in fires or detonations, forming a basis for determining what should be stored, either separately or in combination, and how it should be stored. Although it is not necessary to go into great detail in this publication about these explosive storage groups, a brief explanation of some of the groups will provide a greater understanding of problems that can result if proper storage practices are not observed. For example:

- Small arms ammunition forms the bulk of one group, the items which are principally a fire hazard. Low-velocity projectiles may be generated in fires involving this group.

- Military grenades, on the other hand, are in another group that is made up of items that are expected to explode progressively, only a few at a time, with low order or incomplete detonations to be expected.

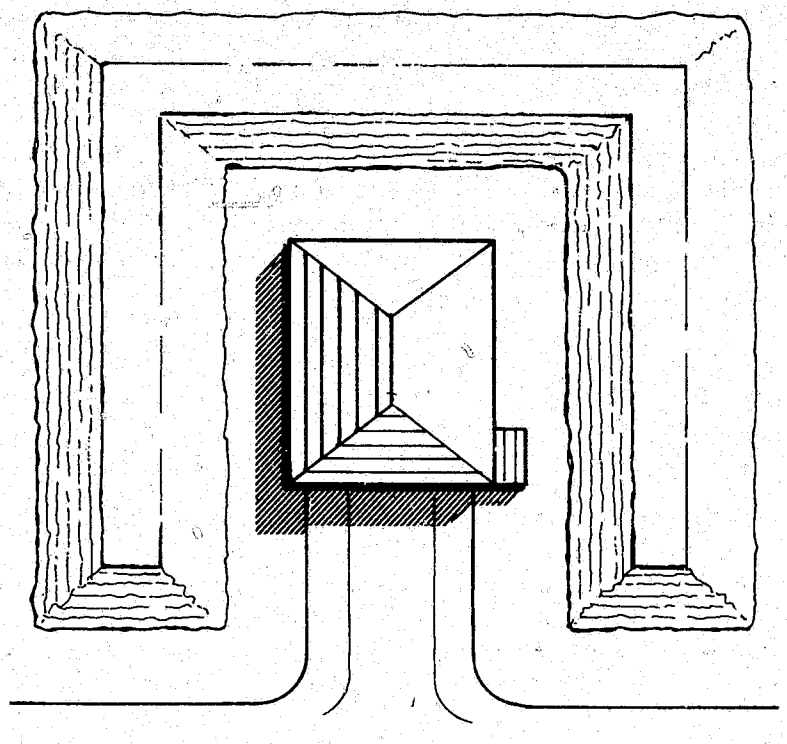
- Blasting caps are in still another group which is made up of items which may detonate all at one time if involved in fire, but which will produce little fragmentation.

- Black powder, primacord, dynamite, and demolition blocks of Composition C or TNT are in yet another group of items which will probably detonate en masse, producing less fragmentation and greater structural damage due to blast pressures.

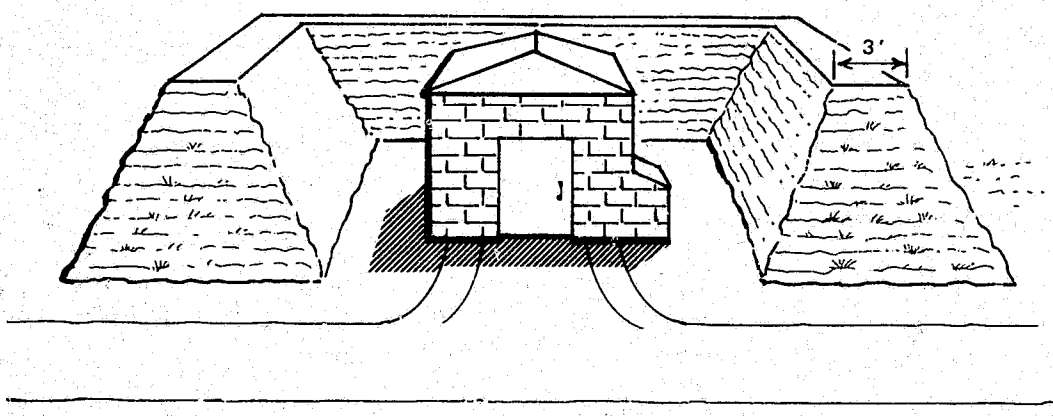
- Irritant, smoke, or tear gas grenades are in a group by themselves, as they are apt to burst open in intense heat, either burning or spreading the filler material, and produce annoying and dangerous effects for fire fighters.

- Incendiary items and materials are also separately grouped, because they are highly susceptable to fires which will produce very intense heat. Special methods are required to successfully fight fires involving these materials.

- Although of less interest to public safety agencies, there is another group which involves military aircraft bombs and artillery shells. This group is made up of items which detonate en masse, producing great hazards to fire fighters from fragmentation as well as blast pressure.



TOP VIEW



FRONT VIEW

Figure 19
TYPICAL STORAGE STRUCTURES

These different explosive storage groups are mentioned to emphasize the importance of segregating such explosive groups in handling, transport, and storage.

In all instances, incendiary materials must be separated from any of the above explosive groups while being handled, moved, or stored. In general, those things which burn must be strictly separated from those which explode, and, additionally, initiating devices of all types must be kept away from materials which either burn or explode. Segregation in storage is also a must for all explosive or incendiary materials that are known or suspected to be unserviceable or deteriorated.

Surprisingly, all of the above rules and precautions can be observed even when a public safety agency has only one storage facility.

- *First,* destroy any materials which are known or suspected to be unserviceable or hazardous. This must be done in the interests of public safety, and legal or investigative considerations involving rules of evidence and analysis should be carefully observed prior to destruction.

- *Second,* incendiary materials, such as gasoline or other fuels, should be stored in secure locations separate from the explosive storage facility, using accepted fire prevention precautions.

- *Third,* render safe all fuses or initiating devices. Those that are *safe* and contain no explosives need only be placed in secure cabinets for storage. Those containing explosives must be positively *safe* mechanically and electric blasting caps and other electric devices must be "shunted" prior to storage, if retention is necessary. Effort should be made to photograph or otherwise document these devices, especially if they are scheduled to be destoryed. Photographs are also invaluable aids in training for bomb recovery or disposal operations if the actual items cannot be obtained or if they have been rendered safe and disassembled.

  Blasting caps should be stored in special cap boxes, placed in substantial wooden boxes. Other *safe* initiating devices should also be stored in separate and substantial wooden boxes, all of which are stored in the auxiliary storage structure, *not* in the main structure.

- *Fourth,* what remains to be stored are only the explosive materials, which may be placed in the main storage structure.

Obviously, the temporary storage facility is necessary for some serviceable explosive material for which retention is required for one reason or another. As the structure will be limited in size, it is practical to store different explosives by making small compartments within the main structure. This is an allowable and safe practice, as the quantities of different explosives to be stored will be small. The use of internal compartments also contributes to good housekeeping practices. These compartments can be made by using wooden boxes lined with heavy paper or plastic and filled with dry sand. The sand-filled boxes should be piled to make internal walls that *are at least 1½ times as high as the stacks of explosives to be protected.*

Housekeeping Practices. There are a few very basic housekeeping rules that should be observed when storing explosives. These include:

- Store only explosives in the storage structure.

- Store initiating devices in the auxiliary storage structure.
- Never open packages inside the storage structure.
- Clear an area around the structure of grass and undergrowth for at least 25 feet in all directions.
- Keep flooring clean and uncluttered.
- Do not keep tools or other material in storage structure.
- Keep a basic record of what is stored; one copy in the storage structure and one copy in a separate location.
- Containers should be well marked as to identity of contents and case numbers, if appropriate.
- Keep storage structures dry and well ventilated.

Security. The public safety afforded by a temporary storage facility is only as great as its security. It would be preferable that all temporary storage facilities be surrounded by high security fences, but this may be a budgetary impossibility. The structure itself must be sound, with a strong door, and a substantial lock. An inspection of the facility should be included on at least a daily patrol, particularly if located in a remote area. Additional safeguards and precautions should be taken if materials are being retained as evidence. When the structure is known to contain evidence, the possibility exists that it may be broken into to destroy such evidence. Separate, secure storage within the facility may be required for evidence materials.

The Holding Area

Preplanning for emergency handling of explosive and incendiary material and associated devices and components should also include arrangements for obtaining and using an adequate holding area or areas.

The purpose of a secured holding area is to provide a place to park the bomb transporter, when loaded with a known or suspected bomb. The area may also have to be used as a location to off-load a bomb and place it in a sand bagged or otherwise protected site, so that the bomb transporter can respond to other emergency calls. The improvised bomb transporter, previously illustrated in figure 15, may be employed in the holding area as a containment device for items placed in a holding status.

Whether the bomb remains in the bomb transport vehicle or is placed in a pit or holding device, the area must be large enough to withstand the detonation of a bomb. In emergency situations, the secured holding area may also be used for field investigation or even for destruction, in the event that the material or device is thought to be too hazardous to attempt further movement.

Examples of areas that can be used in times of emergency as secured holding areas are public parks, public or institutional athletic fields, very large parking lots, and similar open areas, both public and private.

The holding areas must be made secure by public safety personnel. The use of ropes, posted signs, and roving or posted patrolmen is often necessary. The size of the area is dictated by the potential of the suspected bomb, regardless of whether it is in a bomb transporter or a protected site. The size of the holding area should be extended to at least 1,000 feet if the material or item is estimated to be over 50 pounds of explosive.

Effort must be made, soon after the bomb threat is over, to clear all secured holding areas by removing all bombs and materials to more suitable areas for storage, if retention is necessary, or for destruction. If suitably isolated and secure, the holding area may also be a suitable location for destruction.

General precautions regarding previously mentioned explosive storage groups, rules, and practices in their segregation, and special precautions regarding incendiaries and initiating devices, apply equally to secured holding areas.

DESTRUCTION

It is often necessary to destroy explosive and incendiary materials and associated devices and components which are in the possession of public safety agencies. Circumstances under which these materials or items are destroyed include:

- Deteriorating or damaged materials presenting hazards to public safety.
- Explosive devices which cannot be safely disarmed.
- Hazards resulting from the recovery of a large quantity of materials and an inability to store them safely.
- Materials for which there is no legal or investigative basis for retention.

The safe and effective destruction of explosive and incendiary materials should be accomplished *only* by public safety personnel who have had special training and experience in the techniques required. Even trained public safety personnel should observe two precautions. *First,* deteriorated or damaged explosives and incendiary materials; those that have been tampered with; those that are improvised; and those in unknown condition are potentially much more hazardous, and require *special* care in handling and destruction. *Secondly,* military ordnance of all types should be referred to the appropriate military Explosive Ordnance Disposal (EOD) unit for disposition. Grenades, shells, rockets, and aerial bombs are extremely dangerous and require special skills for safe disposal.

Safety is of paramount importance in any operation involving the destruction of dangerous materials. It must not be sacrificed for speed since some incendiary and explosive materials are unstable and when treated improperly will respond violently. For this reason, only properly trained and experienced persons are assigned to the task. Important also are the matters of *destruction site selection, security of the site during operations,* the *destruction method chosen,* the *cleanup of the site after the operation,* and *recording* the destruction procedure.

Site Selection

As the preferred method of destruction is by burning, it must *always* be assumed that a detonation *may* occur. This fact makes the selection of the destruction site very important, in that it must be far enough from habitation or public roads to eliminate the possibility of damage to property or injury to people, should a detonation during burning occur. The site should be located in an isolated area, but in no case less than 1,000 feet from habitation or public roads and should preferably be located in hilly terrain. This distance would provide reasonable protection from blast pressure and fragmentation from explosives or devices of no more than 20 pounds in weight.

Even at distances of 1,000 feet it is possible that some fragments may be projected into the "safe" area and so efforts must be made to keep the quantities being destroyed as small as practicable. Some blast pressure and fragmentation hazards can be further reduced through the use of sandbagging, depressions formed by natural hills or gullies, and special fragmentation blankets. Suitable cover near the perimeter of the area should be provided for operating personnel.

As discussed previously, the secured holding area may, under emergency conditions, have to be used for destruction when circumstances or the condition of the material dictate. The same 1,000-foot rule should apply to secured holding areas, but additional precautions should be taken if the holding scene is located near populated areas. Bomb transport vehicles, sandbag barricades, pits, or natural depressions will increase safety factors and should be used whenever available in the holding area.

The destruction area must have security provided while the operation is being conducted. This may be accomplished by roping off, posting, and where necessary, assigning roving guards. All accesses to the site should be guarded during and after the operation through completion of the clean-up phase. Fire departments should be alerted to such operations and the availability of a fire truck is desirable in the event of an uncontrolled fire within the destruction area.

Methods of Destruction

Destruction by burning or detonation are recommended for all common explosive and incendiary materials.

The preferred method of destruction for most of these materials is by burning. There are several basic rules that must be followed to assure a safe burning operation:

- Destroy only one type of material at a time.
- Positively assure that explosive or incendiary material is free of all detonators, blasting caps or other fuzes or initiating devices.
- Limit amounts of any materials being burned to 10 pounds.
- Separate the material awaiting destruction by at least 500 feet.
- Clear the destruction area of dry grass, leaves, and other flammables for at least 200 feet.
- Burn only one layer of material at a time.
- Ignite all burning trains on the downwind end.
- Never burn on ground previously used for burning unless a positive check is made to insure that ground is completely cold and free of embers.
- Never burn explosives in shipping cartons or boxes. Burn individual items only.

Under some circumstances, destruction by *detonation* may be required. The basic rules below must be followed to assure a safe detonation destruction operation:

- Destroy only one type of material at one time.
- Positively assure that the material is free of secondary initiating devices.

- Limit the amounts of any material being detonated to 10 pounds whenever possible.
- Separate the material awaiting destruction by at least 500 feet.
- Clear the destruction area of dry grass, leaves, and other flammables for at least 200 feet.
- If destroying blasting caps or fragment producing items, burial to at least one foot is advisable to trap fragmentation.
- Priming and firing by electric means is recommended.
- Never detonate using the same hole unless the entire inside surface of the hole is cool to the touch.
- Never detonate explosives in shipping containers or boxes. Detonate individual items only.

The following procedures are recommended for the destruction of common materials:

Dynamite. Burning is preferred, although small amounts may be destroyed by detonation, if appropriate basic rules are observed. Cartridges should be individually slit and spread over a layer of loose paper or excelsior. Ignition of the material will be aided by a covering of kerosene or diesel fuel oil, *(do not use gasoline)* especially if the dynamite is wet. The layer should be ignited by a burning train of wood shavings, excelsior, or paper arranged so that before it reaches any part of the dynamite, it will have to burn several feet. Arrange the burning train so that is it ignited downwind from the pile. Dynamite boxes should be opened only with wooden mallets and wooden wedges, using special caution if there are any risks of nitroglycerin leakage. Do not approach the burning site until absolutely positive that all burning is completed. After all dynamite burning is completed, plow the ground under at the burning site, as the residue from burning dynamite contains salts which are dangerous to livestock and other animals.

Water Slurries or Water-Gel Explosives. Slurry or water-gel explosives are best destroyed by burning. Use a generous supply of kindling and fuel oil and follow the procedures and precautions given for dynamite.

Blasting Caps. Blasting caps of all types are best destroyed by detonation. Caps to be destroyed should be collected in a small box or bag and placed in the bottom of a hole. The blasting caps should be primed with at least one-half pound of dynamite placed *on top* of the blasting caps. Cover the material with paper and then dry sand or fine dirt and fire remotely with an electric blasting cap. No more than 100 caps should be destroyed at one time. The ground around the hole should be thoroughly examined after detonation to be sure that no caps have been blown clear without being destroyed.

Black Powder. Black powder is destroyed by burning, using the basic rules and the precautions recommended for burning dynamite. Special attention should be given to wind direction as black powder is very easily ignited and burns rapidly with great heat. Several feet of burning train are recommended.

Incendiary Materials and Devices. Destroy all incendiary materials by burning, observing basic rules. Remove all materials, if possible, from containers, especially liquids. Be sure to separate initiating devices from filler materials before destroying.

Detonating Cord. Destroy by burning, following basic rules. *Do not* burn on the spool, and burn only the detonating cord itself. It should be strung out in parallel lines more than an inch apart, on top of the paper or excelsior that will feed the fire.

Boxes or Containers and Packing Materials. Burn all boxes, containers, and packing materials not required, particularly if any have absorbed liquid explosives or contain loose explosive dust or residue. Examine all such material for presence of any sticks or containers of explosives.

Nitroglycerin. If floors, truck beds or other surfaces become stained with nitroglycerin, they should be scrubbed well, using the solution shown in figure 20.

- √ 1-1/2 quarts of water
- √ 3-1/2 quarts of denatured alcohol
- √ 1 quart of acetone
- √ 1 pound of sodium sulfide (60% commercial)

Dissolve the sodium sulfide in the water before adding the alcohol and acetone. Use plenty of the solution to dissolve the nitroglycerin and scrub well with a broom or brush. Give a final scrubbing with water and a detergent.

CAUTION: Do not add this solution to a standing pool of unabsorbed nitroglycerin. The heat reaction which results when this solution is mixed with large quantities of nitroglycerin could produce detonation.

Figure 20
SOLUTION FOR REMOVING NITROGLYCERIN

Recovered containers of nitroglycerin or containers suspected of holding nitroglycerin (glass bottles, liquid filled balloon, etc.) should be carefully transported to a large disposal area and if not required as evidence, should be destroyed as soon as it is practical. Disposal is most easily accomplished by securing a blasting cap to the container and detonating the blasting cap. If the liquid is nitroglycerin, a large detonation will occur, if the liquid is not nitroglycerin, the container will be ruptured and the contents will be spread and will soak into the earth.

Maintenance

The destruction area should be kept free of debris before and after each burning and detonation operation. It should be kept secure until after an inspection is made of the destruction site and all material is cleaned up. Any materials remaining that are used for starting or fueling fires should be removed from the site. Holes created by detonation should be refilled with earth and any residue should either be carried away or buried to discourage the curious.

Records

In most instances, photographic and written records are necessary to properly document the destruction. Such records should include the case number, if applicable, the type and quantity of the material, the method of destruction, names of witnesses, the date and time, and a post-destruction inspection statement.

END