NAVY EODB
ARMY TM 60A-2-1-60
AIR FORCE TO

Revision 1
15 December 1989

TECHNICAL MANUAL

EXPLOSIVE ORDNANCE DISPOSAL PROCEDURES
METHODS OF EXTERNAL FUZE GAGGING/ IMMOBILIZATION

This complete revision supersedes Revision 0 dated 01 March 1984

Published under authority of the Secretaries of the Army, Navy, and Air Force.
(Prepared by the Naval Explosive Ordnance Disposal Technology Division, 2008 Stump Neck Road, Indian Head, MD 20640-5070)

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WARNINGS

Wear goggles and rubber gloves, and avoid breathing epoxy fumes during all mixing and application operations. Epoxy in the eyes could cause blindness. Epoxy and the unmixed components are skin and lung irritants, and can cause systemic poisoning when inhaled or when absorbed through the skin.

Do not remain in the area while plaster of paris (POP) or epoxy is curing. POP and epoxy release heat when curing.

Do not strike or jar ordnance during the external gagging procedure. This may cause the item to function.

Do not permit unnecessary movement of the item being gagged. This may actuate the item.

Perform initial movement of all gagged items remotely.

Be aware that heat-producing gagging materials such as foams, epoxics, POP, etc., used chemical delay action fuzing systems can accelerate the delay times causing the fuze to function before its predetermined delay time.

Be aware that the interior area of some foam gagging materials may not have as uniform a set/hardness as the exterior surface area. As a result, the foam gag may not provide total fuze component immobilization. The foam gag may also shrink away from fuze components allowing room for movement.

CAUTION

Follow manufacturer's directions for preparing epoxy mixtures and make all required preparations for application before mixing the epoxy. Epoxy mixtures will normally begin to set-up and become difficult to work within a few minutes after mixing.

Section I. INTRODUCTION

1. PURPOSE AND SCOPE. This manual is restricted to external fuze gagging. This manual provides a data base from which a gagging procedure and/or materials for a particular procedure can be selected. The number of methods and materials for gagging is extensive, so no attempt is made to cover every one.

2. GENERAL. Gagging is a term used in explosive ordnance disposal (EOD) to describe the immobilization of movable components such as plungers, spring mechanisms, gears, cams, etc., of fuzing systems. The intent of gagging is to prevent additional fuze arming or to render safe a munition. Fuzes encountered may be intact or damaged exposing internal mechanisms which, if disturbed, may function the fuzing system as designed. Keep gagging techniques as simple as possible. For the most part it is left to the ingenuity of the person performing the gagging procedure. The material used for gagging is usually chosen from that at band. Gagging is at best a temporary measure providing an additional degree of safety for the transport of hazardous ordnance.

Section II. DESCRIPTION.

3. MOVEMENT. The term movement has several connotations; as used here it is a mechanism that provides or transmits motion. Only forms of a direct action are considered in external fuze gagging. These can be rotational, sliding, or a combination of both. Examples of combined movement are cam (eccentric) and hinge actions. A cam converts rotational movement into a sliding movement. Movement can be stopped or blocked, or the energy generated by motion may be absorbed. Some materials can absorb the energy of movement, resulting in slowing, stopping, or lowering it to a safe level. However, physical blocks are usually used to restrict the space necessary for movement. Arming vanes can be blocked with wire or tape. Arming vanes usually require locks or wooden chocks to prevent their movement. Safety pins are normally used to lock movable components in place.

4. MATERIALS. Many materials can be used for gagging. The choice of material depends upon the potential force to be gagged, strength of the material, and the availability of materials. However, physical properties of the material will normally determine if a material is suitable for gagging. Some materials that may be used for gagging operations are wooden wedges, paper clips, cotter pins, wire, tape, leather and canvas belts, nails, POP, dental stone, masonary water sealant, rapid-set epoxy, glue, water, mud, rock, and even chewing gum. In summary, if the material is available and it can do the job, use it.

a. Plaster of Paris (POP). POP has been used for moldmaking for many years. It obtains its strength from the formation of interlocking needle-like crystals of gypsum. When gypsum rock is crushed, screened, and heated, three-quarters of the chemical-bound water is removed from the gypsum to form POP. When water is added to POP, crystals are formed, heat is produced, and a slight expansion takes place. POP is hydraulic, that is, it can harden (set) under water. The hardness of POP is controlled by its consistency ratio (CR). CR is the specific component weight of plaster and water. Maximum temperatune generated by POP is at final set.

b. Rapid-Set Epoxy. This epoxy compound has approximately seven times the strength of POP. Some advantages of it over POP are: it is easy to employ, it has a high strength without being brittle, it rapidly reaches a set (rigid state), and it has good adhesive properties. Rapid-set epoxy is composed of two parts, resin and a premixed hardener/accelerator. After mixing equal parts of resin and premixed hardener/accelerator by weight, an epoxy is formed. It changes at room temperature from a liquid to a gel in approximately 3 minutes. After l5 minutes the epoxy is hardened and is as resistant to deformation as is POP after 120 minutes of curing. It will cure at temperatures as low as 0 degrees Celsius (32 degrees Fahrenheit). Epoxy is essentially fully cured 1 hour after mixing; cure times are temperature dependent (table 1). The epoxy curing process releases heat and produces a maximum temperatureapproaching 173 degrees Celsius (343 degrees Fahrenheit). When epoxy heat is absorbed by an external heat sink (a fuze body or water), reaction temperature seldom rises above 50 degrees Celsius respiratory irritants, and should be used in adequate ventilation and with skin and eye (122 degrees Fahrenheit). All components of the rapid-set epoxy are considered skin and protection.

Section III. EXTERNAL GAGGING PROCEDURES.

5. GENERAL. When using a liquid composition that must cure, set, or harden, keep a test sample to determine its set time. This sample should be taken from the same batch, and have an approximate volume of that used in the gagging procedure. When possible, keep the test sample under the same environmental conditions as the gag.

6. SELECTION OF TECHNIQUE. The following is a list of the gagging techniques that can be used for various components of ordnance.

Item	Gagging Technique
Arming vanes	Wire, rope, or tape
Tilt rods	POP or epoxy
Close-fitting items	Glue, epoxy, or deformation.
Loose-fitting items	Spacer (block)
Exposed firing pins	POP or epoxy
Openings	Tape, plugs, or liquid rubber or plastic
Striker plates	POP, epoxy, or wedges
Jump-out pins and plungers	Tape or epoxy
Military firing devices	Cotter pins, nails, foam, or epoxy

7. USE OF GAGGING MATERIAL.

WARNINGS

Wear goggles and rubber gloves and avoid breathing epoxy fumes during all mixing and application operations. Epoxy in the eyes could cause blindness. Epoxy and the unmixed components are skin and lung irritants, and can cause systemic poisoning when inhaled or when absorbed through the skin.

Do not remain in the area while POP or epoxy is curing. POP and epoxy release heat when curing.

Do not strike or jar ordnance during the external gagging procedure. This may cause the item to function.

Do not permit unnecessary movement of the item being gagged. This may actuate the item.

Perform initial movement of all gagged items remotely.

Be aware that heat-producing gagging materials such as foams, epoxies, POP, etc. used on chemical-delay-action fuzing systems can accelerate the delay times causing the fuze to function before its predetermined delay time.

Be aware that the interior area of some foam gagging materials may not have as uniform a set/hardness as the exterior surface area. As a result, the foam gag may not provide total fuze component immobilization. The foam gag may also shrink away from fuze components allowing room for movement.

The following is a list of gagging materials and their uses.

Material	Remarks
Wire, rope, and tape, POP bandage	Wrap to prevent rotation/movement
Glue and liquid rubber or plastic	Follow manufacturer's instructions; clean surface prior to application
Spacers and wedges	Secure arming vanes, etc
POP	Use when high strength is not required
Two-part epoxy	Use when high strength is required
Cotter pins, nails, paper clips	Use as a physical block; secure in place

8. CONTAINMENT. Containment is usually associated with liquid gagging techniques. To contain the liquid, attach some form of cofferdam to the munition. This can be accomplished by cutting the bottom or sides out of a paper or plastic (styrofoam) cup, or by improvising with the use of plastic bags. Tin cans, cardboard boxes, or jars can also be used. Support cofferdams/containment vessels or tape in place, keeping in mind that final weight will increase. Natural contaimnent materials such as sand or dirt may be used, however, it may be required to line with plastic or pre-wet the dirt/sand so that water from the POP mixture will not be absorbed.

9. MIXING.

WARNINGS

Wear goggles and rubber gloves and avoid breathing epoxy fumes during all mixing and application operations. Epoxy in the eyes could cause blindness. Epoxy and the unmixed components are skin and lung irritants, and can cause systemic poisoning when inhaled or when absorbed through the skin.

Do not remain in the area while POP or epoxy is curing. POP and epoxy release heat when curing.

CAUTION

Follow manufacturer's directions for preparing epoxy mixtures and make all required preparations for application before mixing the epoxy. Epoxy mixtures will normally begin to set up and become difficult to work within a few minutes after mixing.

Use clean containers for mixing. Bowls, cans, jars, or zip-lock bags can be used.

Manufacturer's instructions should be followed when using unknown compounds. Always pour the POP into water, and mix to desired consistency. Depending on the flow-like properties desired and the situation at hand, the mixing ratio or consistency ratio of water to POP will determine the curing time and also the strength of the set. A mixture of 40 parts water to 60 parts of POP will provide a stronger and a more uniform set than a 50-50 mixture of water and POP, i.e. for a strong set use less amounts of water to POP. The addition of 3 to 4 percent of potassium sulfate to the water before adding the POP water before adding the POP will also decrease the curing set time of POP. Salt will also decrease the set time of POP and reduce the chance of the mixture freezing in cold weather.

Table 1. Epoxy Set Time as a Function of Temperature.

Temperature*	Set time (minutes)
-18°C (0.4°F)	288
0°C (32°F)	30
16°C (60.8°F)	5.2
24°C (75.2°F)	3.3
50°C (122°F)	1.8

*Preferred working temperature range for epoxy is 0° to 50°C (32° to 122°F). Below 0°C (32°F) epoxy is too viscous to allow good mixing or flow.

Table 1