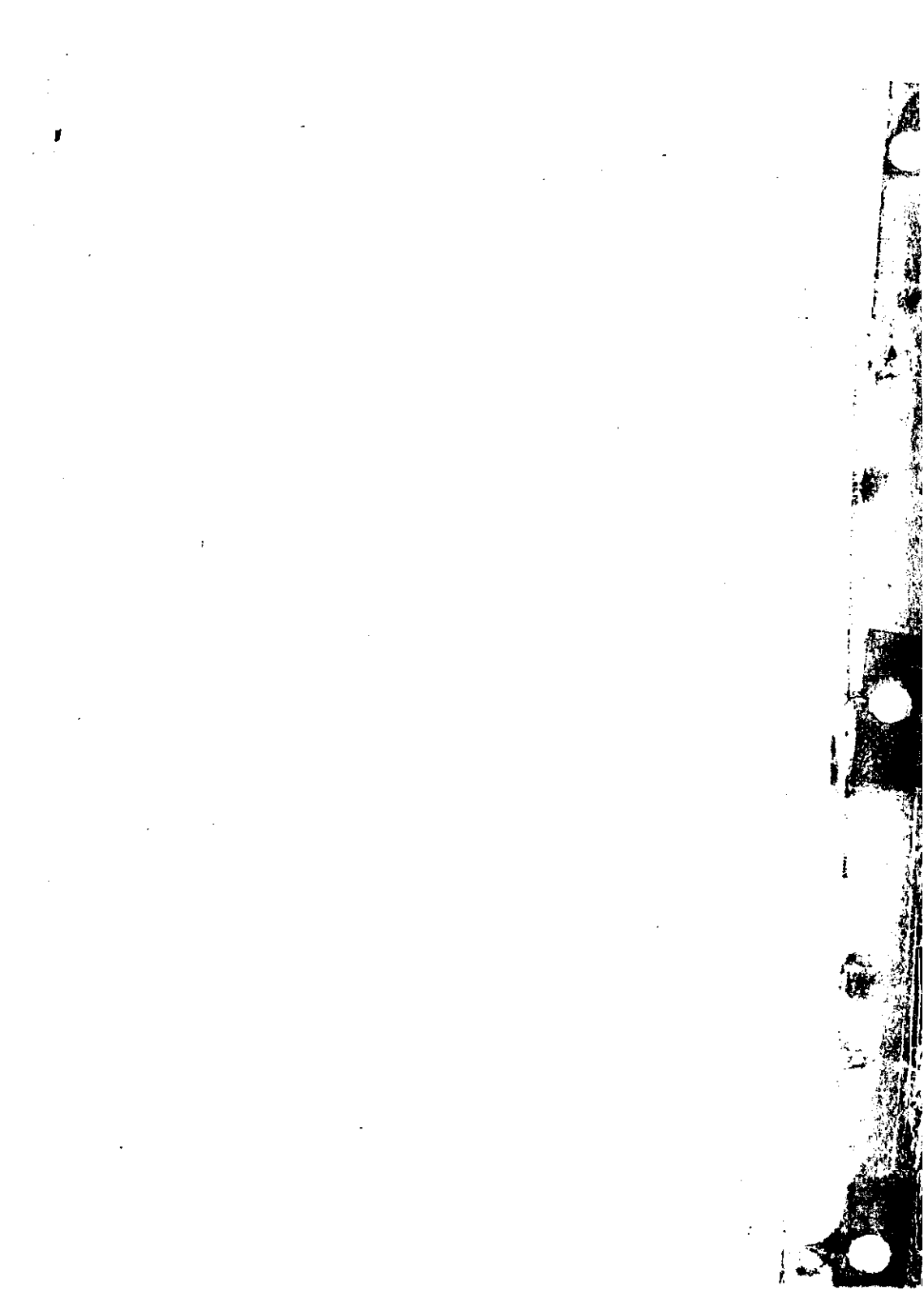
BULLETIN NO.
APRIL, 1945

AFLD

VT FUZES

A/N
[illegible]VANCED FUZE &
[illegible]PLOSIVE ORDNANCE

CONFIDENTIAL



SECURITY

The classification of VT fuzes and descriptive literature concerning them has been reduced by action of Combined Chiefs of Staff, reference, Cominch Confidential dispatch to CinCPOA 272010 Nov. 44. This reclassification has been permitted to implement use of the fuzes in theaters of operation and should not be construed to mean that there has been a reduction in the basic need for security. Phases of reclassification of interest to theaters of operation are as follows:

(a) Equipment when stockpiled and in Operational use . . . . . RESTRICTED

(b) Operational information and instructions, including technical documents & manuals . . . CONFIDENTIAL

(c) AA action reports listing expenditures of ammunition by Mark of fuze and giving results of engagement . . . . . CONFIDENTIAL

(d) Technical information such as diagrams, frequencies, specifications, research & development, countermeasures and publication of information not listed above as Confidential . . . . . SECRET

All fuzes of this type regardless of application or missile in which employed are considered to fall into the classification of VT fuzes. No publicity whatsoever regarding this equipment may be released.

* * * *

This document is issued to the graduates of the Bomb Disposal School and the Advanced Fuze & Explosive Ordnance course by the Officer-in-Charge, Navy Bomb Disposal School, under authority of Bureau of Ordnance letter P41-6(L) dated 22 April 1944. It is for information and guidance only and is not a Bureau of Ordnance publication. This document shall be destroyed by burning when it has fulfilled its purpose.

TABLE OF CONTENTS

INTRODUCTION TO VT FUZES

C O N F I D E N T I A L

Among the problems confronting anti-aircraft artillery men in recent years is one of obtaining shell bursts at that point on the trajectc where fragmentation and blast effect would be most damaging to aircraft. Perfectly accurate fire control using contact fuzes, even with large caliber projectiles, would of course be ideal. However, with the degree of accuracy in fire control prevalent during the early years of this war, air burst with conventional time fuzes was the most effective means of bursting a shell near the target. As fire control equipment under development promised greater accuracy studies indicated that a fuze which upon approach to the target was capable of bursting the shell within damaging range would pay even greater dividends in the effectiveness of anti-aircraft artillery.

Characteristics of such a fuze were laid down prior to U. S. entry into the war. Various means of meeting the proximity requirement were exhaustively investigated. Of these the electromagnetic phenomenon gave the greatest promise of fulfilling the requirements. This principle has since become the basis of operation of VT fuzes.

During the development and testing phases of the anti-aircraf fuze project, it became apparent that the VT principle of fuze operation could also provide a means for obtaining air bursts at uniform heights above ground targets. In this respect they could conceivably be adapted for use in artille shells, bombs, rockets and mortar projectiles. Fuzes of this type have since been developed and will be dealt with in the following pages.

The introduction of VT type fuzes into the field of explosive ordnance represents a significant departure from previous type fuzes. In effe VT fuzes are automatic time fuzes. Without "setting" or adjustment they detona the shells, bombs or projectiles which carry them, on approach to the target a the most effective point on their trajectories. Because of necessary innovati in manufacture and since further design improvements are anticipated in the ne future, the VT fuzes will not immediately be standardized. However, these fuz are ready for operational use and need not be considered as being experimental

The information on VT fuzes in this bulletin will be divided into the following types, one section being devoted to each:

1. VT Bomb Nose Fuzes
2. VT Rocket Nose Fuzes
3. VT Projectile Nose Fuzes

VT BOMB NOSE FUZES

CONFIDENTIAL

DESCRIPTION

VT bomb nose fuzes were designed for use in general purpose, fragmentation or chemical bombs of 100 pounds size or greater. These fuzes will fit the same fuze seat liner that will accommodate the AN-M103 nose fuze. They are capable of producing air burst on approach to any solid target such as aircraft, water, earth, trees, bridges or tall buildings. No fuze setting is required; the air burst feature is automatic at a height from 10-150 feet above the target.

The use of VT bomb fuzes should be applied in any plane-to-ground action only where air burst of the bomb will increase its effectiveness. It is important to note, therefore, that these fuzes are not tactically interchangeable with an impact fuze such as the AN-M103.

There are two distinct types of VT bomb nose fuzes, namely the Ring Type, Fig. 1, and the Bar Type, Fig. 2.

RING TYPE

Fuzes of this type have an upper fuze body 3"4 in diameter which protrudes 5 inches from the nose of the bomb when installed. The lower fuze body resembles that of the AN-M103. A plastic cone is seated on the metal casing of the upper fuze body. This cone carries the vanes and a metal ring which has 4 holes 90° apart to allow for interchangeability of the spring-loaded vane locking pin. This pin is held in the ring by a cotter pin and prevents movement of the vane during shipment and handling. Construction of the vanes may be either --

1) 3 blades--plastic, or
2) 10 blades--metal (See Fig. 2)

Two wrench lugs 180° apart are welded to the upper fuze body to facilitate installation. Above the fuze threads a thin spring steel lock washer is provided to insure a tight fit in the bomb.

These are electric fuzes which develop their energy for functioning from a high speed generator built into the fuze and driven by the arming vane. An important safety feature consists of an out-of-line electric detonator which may be checked to verify that it is in the unarmed or safe position by the booster safety pin. This detonator remains out-of-line with the explosive train and the detonator firing circuit until completion of arming.

BAR TYPE

The external appearance of the Bar Type VT fuzes differs from the Ring Type in that two light metal arms with a span of 10"0 are fitted to the plastic upper fuze body replacing the metal ring. These fuzes have a three-bladed plastic vane. A metal bracket is externally fitted to the upper fuze body to accommodate a spring loaded vane locking arm. The lower body, wrench lugs, lock washer and out-of-line detonator safety feature are the same as found on the Ring Type fuzes.

OPERATION

Operation of both the Ring and Bar type fuzes is the same (except for the range of burst heights) and is discussed jointly. Upon release of the bomb, the arming wire is pulled from the vane locking arm or pin allowing the arm or pin to be thrust away from the fuze by action of its spring, thereby releasing the arming vane. Rotation of the vanes via a gear reduction system turns the out-of-line detonator into the firing position and at the same time completes the electric circuit to the detonator, thus arming the fuze. When the detonator rotor is in the armed position it becomes locked in place by means of a spring loaded detent and simultaneously disengages itself from the drive shaft. Arming may now be considered complete.

to operate the high speed generator which supplies current to an electric condenser for firing the electric detonator as soon as the VT fuze is influenced at the optimum height on approach to the target.

A bomb may be dropped "SAFE", i.e., arming wire released with the bomb, in which case no detonation will result on impact.

TERMINOLOGY

With the development of VT bomb nose fuzes several new terms are used. Particularly significant are the following, as shown in Fig. 3:

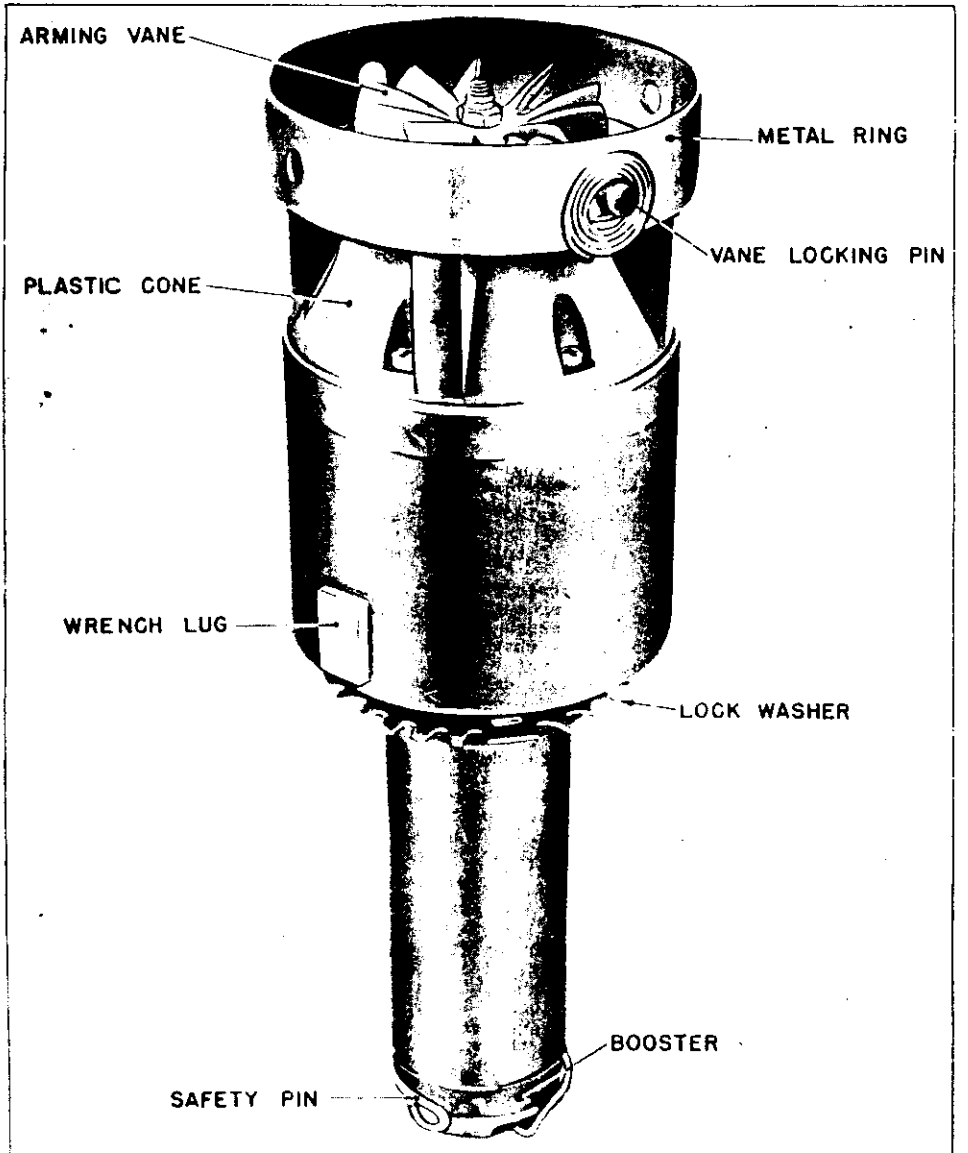


FIG. I RING TYPE VT BOMB NOSE FUZE

1. SAT (Safe Air Travel)

The distance along the bomb's trajectory required to accomplish complete arming is called SAT. Approximately 2000 revolutions of the arming vane are required before a fuze is armed. The required number of vane revolutions, which varies somewhat between fuze models, is preset at the factory and cannot be changed in the field.

2. MinSAT (Minimum Safe Air Travel)

The MinSAT may be defined as that amount of air travel before which no fuze will arm. For example, if the MinSAT indicated as a part of the ordnance nomenclature on each VT fuze is 3600 feet, no fuze in that particular lot (of fuzes) will arm in less than 3600 feet of air travel. Each lot of VT fuzes is tested on a 100-lb GP AN-M30 to evaluate the MinSAT. However, due to manufacturing tolerances the MinSAT may be exceeded by as much as 600 feet of air travel. Hence, all fuzes of a group will be fully armed after the stated MinSAT plus 600 feet of additional air travel. MinSAT will never be less than that printed on each fuze.

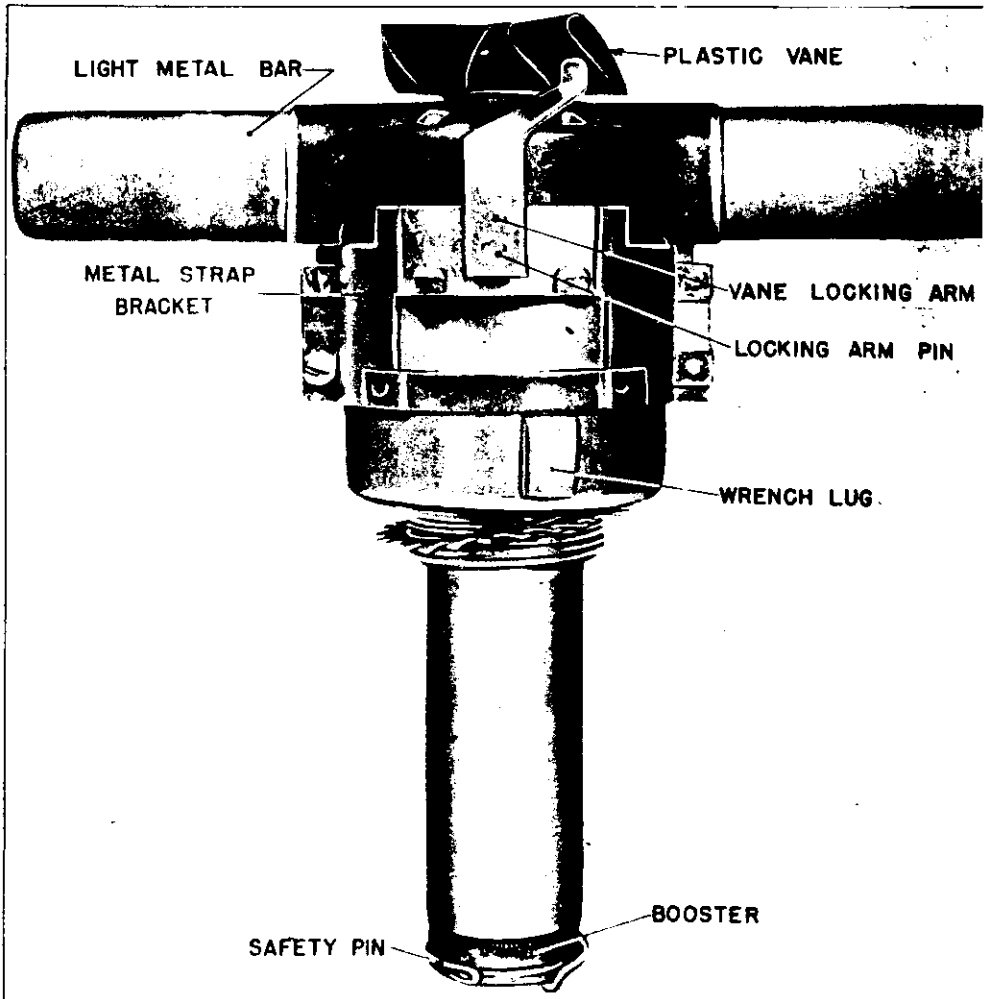


FIG. 2 BAR TYPE VT BOMB NOSE FUZE (T 5I E I)

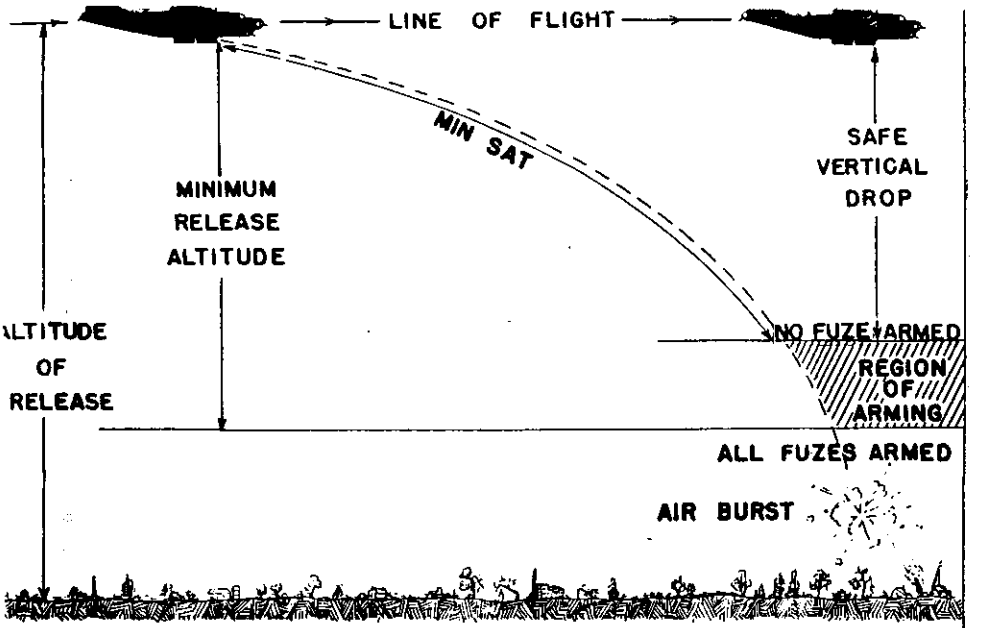


FIG. 3 VT BOMB FUZE FUNCTIONING CHARACTERISTICS

3. SVD (Safe Vertical Drop)

The SVD indicates vertical drop before which no fuze will arm. Determination of SVD is important from two standpoints: (1) SAFETY - SVD prior to arming should be sufficient to provide adequate clearance for both the carrying aircraft and any friendly aircraft at lower altitudes. After a VT fuze is armed, it will fire on the first target it approaches, whether it is friendly or enemy aircraft or ground targets; (2) PERFORMANCE - Caution must be exercised to assure that the altitude of release is such that all fuzes will be armed before approaching the target. Otherwise the VT fuze will not function.

W RING AND BAR TYPE DIFFER

Ring and Bar type fuzes differ essentially as indicated below:

1. Height of Burst

Ring type fuzes produce average burst heights from 10 to 50 feet (over normal soil) depending on the size of the bomb, nature of the target, altitude of release, and aircraft speed of release.

Bar type fuzes give burst heights from 40 to 80 feet (over normal soil). They are more nearly independent of bomb size, altitude of release, and speed of release than Ring type fuzes.

2. Response to Target

Ring type fuzes are more sensitive to passing a target, while Bar type fuzes are most affected by targets directly in their path.

3. Altitude and Speed of Release (See Fig. 6 and 7)

Ring type fuzes are affected by the striking angle of the bomb which depends upon true air speed and altitude of release. This dependence of burst height on release conditions can be used to advantage since it provides a means of field control of burst height. Bar type fuzes are relatively independent of striking angles.

4. Interchangeability

VT bomb fuzes are not tactically interchangeable with the AN-M103 since they are of value only when air bursts are desired. In the following table the current types of VT bomb nose fuzes are listed giving their T designations. It can be summarized that the T50E1, T89 and T91 fuzes are recommended for use with the 100-lb, 250-lb, 260-lb and 2000-lb bombs while the T50E4, T90 and T92 fuzes are recommended for the 500-lb and 1000-lb bombs unless for some reason a low burst is required. The T51E1 fuze may be used in any of these bombs since the range of burst heights is practically independent of the bomb size.

TYPE		MinSAT (ft)	Bombs in Which Used	Remarks
Bar	Ring			
T51E1		3600	All sizes	Good average burst height in all size bombs when aerial burst is desired. This fuze has booster safety pin.
	T50E1	3600	100-220-250-260-2000	Original models available for service use. Do not have booster safety pin.
	T50E4	3600	500-1000	
	T89	3600	100-220-250-260-2000	Same as T50E1 and T50E4 except booster safety pin has been added. These fuzes are replacing T50E1 and T50E4.
	T90	3600	500-1000	
	T91	2000	100-220-250-260-2000	Especially adaptable to dive bombing and low altitude releases. These fuzes have booster safety pin.
	T92	2600	500-1000	

SAFETY FEATURES

1. Since each of the VT bomb nose fuzes is provided with MinSAT (in feet) they are safe for dive bombing and takeoffs and landings anywhere, including the decks of carriers. However, accidental withdrawal of the arming wire in flight from a wing rack installation would cause the fuze to arm and probably cause a casualty. Therefore, VT fuze wing installations should be carefully inspected before takeoff to insure that the arming wires are properly installed.

2. Seal

To insure that fuzes issued for use have the arming vane which controls the movement of the detonator rotor is in its original position, the vane is sealed at the factory to prevent accidental rotation. If upon receipt of the fuzes the seal is found to be broken they should be handled with caution until destroyed or otherwise disposed of.

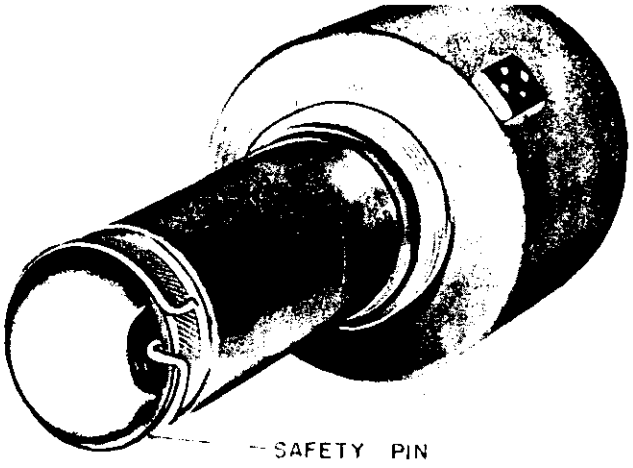


FIG. 4 SAFETY PIN IN BOOSTER END OF ALL VT BOMB NOSE FUZES (EXCEPT T50E1 AND T50E4)

3. Safety Pin

Only two of the early Ring type models, the T50E1 and T50E4, do not incorporate a safety pin. All other models, including the bar type T51E1, have the safety pin feature. The safety pin, Fig. 4, is inserted into the booster end of the fuze and engages a groove in the side of detonator rotor. This pin must be removed before the fuze can be installed in the bomb. If upon removal of the safety pin it cannot be reinserted, the fuze must be considered partially armed, i.e. the detonator rotor may have been turned a sufficient amount to align the firing circuit and hence the fuze should not be used. This condition might possibly result from accidental or deliberate turning of the vanes thus arming the fuze. Remember--the presence of the safety pin and the ability to reinsert it gives visual indication that the fuze is entirely unarmed.

4. VT bomb fuzes in a normal condition, i.e., arming wire in place and fuze showing no signs of external damage are safe to handle. The fuzes may be removed from the bomb and reused at a later date, or if conditions warrant, the fuzed bombs may be set aside for short periods and loaded into planes when needed. This applies particularly to bombs which were not dropped during a strike and remain in the racks of the plane to be removed after landing.

5. VT bomb fuzes, installed in bombs, which have been visibly damaged externally and/or from which the arming wire is missing as a result of enemy fire or accidents in landings and takeoffs, may be safely removed from the bomb but should not subsequently be reused.

6. VT bomb fuzes in bombs which have been dropped with the intention of detonation must be considered sensitive to movement or shock. Such fuzes will not detonate if undisturbed, but should not be moved or handled in any way except by competent bomb disposal personnel.

7. A VT fuze dropped from altitudes below the safe distances cannot produce an air burst function. Under unusual circumstances, impact burst may occur. Each lot of fuzes is checked against this in the acceptance test.

PERFORMANCE CHARACTERISTICS

1. Reliability

At the present time 75% to 85% of VT bomb nose fuzes will function normally as designed. Malfunctions are generally of two types:

(a) Earlies

The nature of VT fuzes does not permit the total elimination of early functions. "Early" implies a detonation after completion of arming but before approach to the target. 10% to 15% earlies can be expected and any above 30%* is generally the result of faulty installation and handling. In this case, assembly procedures should be checked. An early burst of one bomb in a closely spaced train will act as a target to nearby fuzes. Therefore, a minimum intervelometer setting of 50 fe for 100-lb size (including 220-lb and 260-lb fragmentation bombs) and 100 feet for larger size bombs is imperative. Earlies can generally be attributed to:

(1) Fuze or tail fin assembly not being sufficiently tight. Any vibration as a result of loose fins will affect the fuze adversely.

(2) Deformation of fuze vanes causing vibration.

(3) Excessive internal wear in the fuze on bearings, etc., when dropped from high altitudes without use of T2E1 delayed arming device (See page 10).

(4) Manufacturing defects.

(b) Duds

Between 3% and 5% of fuze failures may result from manufacturing defects or from damage in fuze handling and installation. It is highly significant to note that use of Fahnestock safety clips is prohibited on VT fuzes because the clip may lodge in the fuze vanes thereby preventing normal rotation. VT fuzes should not be used in flat nose depth bombs because the speed of the air stream at the vanes would not be sufficient to rotate the vanes at the high speed required. Duds ma partially be compensated for by use of a M100 series tail fuze.

2. Burst Heights

The table, Fig. 5, shows the approximate burst heights that can be expected with the various bomb - VT fuze combinations. In the table heights of burst are based upon approach to normal dry soil, the release altitude being 10,00 feet (except fuzes T91 and T92 which show drops made at 8,000 feet) and true air speed of 200 m.p.h. "Low" means that the burst occurs between 3-10 feet above the target.

FIGURE 5 BURST HEIGHT WITH VARIOUS BOMB - VT FUZE COMBINATIONS (FEET)

Bomb	Fuze T51E1	Fuze T50E1	Fuze T50E4	Fuze T89	Fuze T90	Fuze T91	Fuze T92
100-lb GP, AN-M30	60	15	10	15	10	25	10
260-lb Frag., AN-M81	60	20	low	20	low	30	low
250-lb GP, AN-M57	60	20	low	20	low	30	low
500-lb GP, AN-M64	40	15	20	15	20	20	35
500-lb GP, AN-M43	40	15	20	15	20	20	35
1000-lb GP, AN-M65	40	low	25	low	25	low	45
1000-lb GP, AN-M44	40	low	25	low	25	low	45
2000-lb GP, AN-M66	25	15	low	15	low	35	low
2000-lb GP, AN-M34	25	15	low	15	low	35	low
500-lb SAP, AN-M58	40	15	20	15	20	20	35
1000-lb SAP, AN-M59	40	low	25	low	25	low	45
4000-lb L.C. AN-M56	80	low	low	low	low	low	low
500-lb Incendiary, AN-M76	40	15	20	15	20	20	35
500-lb Chemical, AN-M78	40	15	20	15	20	20	35
1000-lb Chemical, AN-M79	40	low	25	low	25	low	45

mal dry soil, bursts over water or wet earth will be approximately 100% greater; over dry sand they will be about 50% lower. All large solid objects can serve as targets but small objects such as dispersed vehicles will not affect the burst height appreciably. Ring type VT fuzes are extremely sensitive to passing a target while the Bar type is most affected by approach to a target directly in its path.

A dispersion of burst height occurs with VT fuzes, even under closely controlled conditions with the same lot of fuzes. For a given fuze model and type of terrain, approximately half of a group of fuzes functions within a 25 foot (vertical) spread.

Plane speed and release altitudes also affect the burst height. Specific examples are shown below in Fig. 6 where VT bomb fuze T91 is used with an AN-M81 and Fig. 7 using a T92 in an AN-M64.

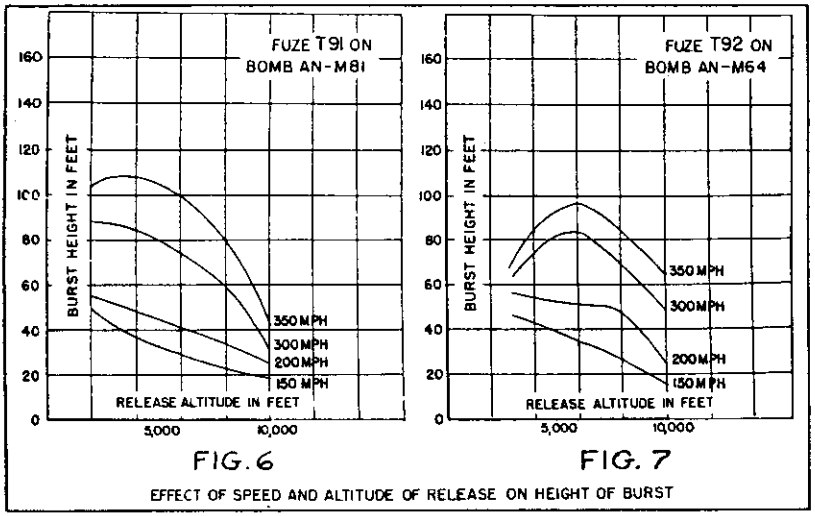


FIG. 6 FIG. 7

EFFECT OF SPEED AND ALTITUDE OF RELEASE ON HEIGHT OF BURST

3. Rain and Weather

Normal weather variations have no significant effect on VT bomb fuzes. However, heavy rain, hail or snow may cause an increase in early bursts.

4. Climatic Effects

Fuzes should be kept in their sealed containers as unpacked fuzes are likely to deteriorate under warm and humid conditions. Unpack fuzes only when required. Fuzes have been stowed and used in temperatures between -40° F. and + 140° F. without seriously affecting fuze performance.

5. Ballistics

VT bomb nose fuzes are ballistically interchangeable with a mechanical bomb nose fuze such as the AN-M103. No special bombing tables are required.

6. Altitude and Air Speed at Release

No maximum altitude of release is specified for the T50E1, T50E4, T51E1, T89 or T90 fuzes. T91 and T92 fuzes, particularly adaptable to dive bombing, are however, recommended to be released at altitudes of 10,000 feet or less. At higher altitudes of release the T91 and T92 give lower bursts than is ordinarily desired. Because of decreased vibration from bearing wear, releases at low altitudes may be expected to yield fewer earlies than releases at high altitudes. The use of the arming delay device, T2E1 (see page 10), will reduce the malfunctions for high altitude releases because of reduction in time during which the fuze falls armed.

INSTALLATION

VT bomb nose fuzes are shipped to the field completely assembled ready for installation in the bomb. Field assembly consists simply of installing the

fuze in the bomb. It is recommended that wherever possible the assembly operation be performed after the bombs are loaded in the plane. It is important to remember in this connection that care must be exercised to insure the fuzes being assembled sufficiently tight without causing damage to the bomb racks or shackles. Where assembly in the bomb bay is impossible or inconvenient and regulations permit, the assembly may be performed with safety before the bombs are loaded.

Inspect the bomb assembly to make certain that tail fins are not bent or damaged and secure the tail fin as tight as possible because any looseness o the fin will probably cause an early function. Inspect the fuze to insure that the vane and vane locking arm (or pin) is not damaged.

If the fuze pocket and the threads on the fuze are free of dirt, rust, or other foreign material, the fuze may be screwed into the nose of the bomb after the safety pin, if one is present, has been removed from the booster end of the fuze. Be sure that the lock washer is in place. Tighten the fuze as much as possible by using Fuze Wrench T4 which is included in each shipping case of VT fuze: as shown in Fig. 8. If this wrench should not be available, another type may be u: that will satisfactorily catch the fuze wrench lugs. Do not hammer the fuze or wre: handle. DO NOT USE BARS of Bar type fuzes as levers or handles. DO NOT STRIKE OR TWIST THE BARS IN ANY MANNER.

Cut the sealing wire and remove it. Move the vane locking pin (arm to the hole in the ring (Ring type fuzes) or strap bracket (Bar type fuzes) nea: est in line with the bomb suspension lugs. Do not permit the arming vane to be tur: during this operation. One or two turns, however, will not appreciably affect the functioning of the fuze.

The arming wire may now be assembled. Thread the short end of arming wire through the front suspension lug and through the hole in the vane locki: pin (or arm) where the seal wire was. Adjust the arming wire to protrude three or four inches in front of the nose as shown in Fig. 9. DO NOT USE A SAFETY (FAHNESTO CLIP. The force of the spring after the cotter pin has been removed is sufficient hold the arming wire firmly in place. The cotter pin in the vane locking pin (or a may now be removed.

A tail fuze of the M100 series (using an non-delay primer detonator) should be installed in the tail as insurance for bomb detonation on grou impact in case the VT fuze is a dud. The tail fuze may be installed in the normal manner but it cannot be overemphasized that the VT nose fuze and the bomb tail fin must be sufficiently tight to prevent any vibration whatsoever.

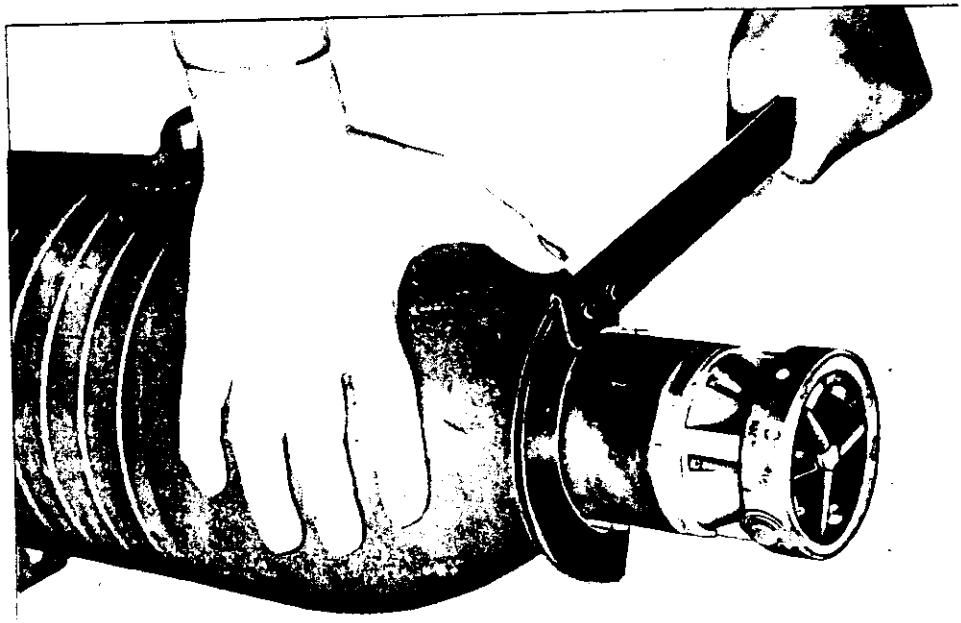


FIG. 8 INSTALLING RING TYPE VT FUZE WITH

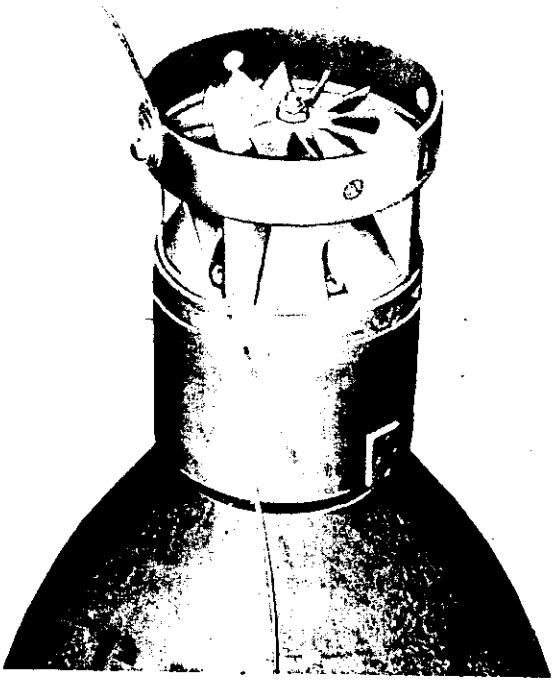


FIG. 9 ARMING WIRE INSTALLED ON RING TYPE VT FUZE

Removal Procedure

If fuzes are to be removed, reinsert the cotter pin in the proper hole in the vane locking pin (or arm). Withdraw the arming wire and reinsert the original sealing wire. The fuze may then be removed with the special fuze wrench. If this appears impossible, further tightening of the fuze to flatten the lock washer will probably facilitate removal.

After removal of the fuze replace the safety pin in the booster end. If this pin cannot be reinserted, destroy the fuze. The fuzes may then be repacked in their containers and sealed.

CAUTION: NO DISASSEMBLY OF FUZES IS PERMITTED UNDER ANY CONDITIONS BY USING PERSONNEL.

DELAYED ARMING DEVICE T2E1

The delayed arming device, T2E1, Fig. 10, is a vane driven gear reduction unit which can be attached to any VT bomb fuze (except early production of T50E4). The T2E1 is used for operations which require longer safe air travel than that provided by the MinSAT of the fuze itself. Use of the T2E1 device increases by about 700 - 20,000 feet the Safe Air Travel (SAT) of the fuze.

The gear reduction system which is vane driven is similar to that in the VT fuze. The setting dial has a graduated scale, each division representing approximately 700 feet of air travel.

The T2E1 device is locked to the ring on Ring type fuzes, and to the strap bracket on Bar type fuzes in such a way that it retains the vane locking pin (or arm) securing the fuze vanes. (See Figs. 11, 12, and 13.) As the bomb is released, the arming wire is pulled from the T2E1 device and the vane locking pin (or arm). The vane on the T2E1 device is then rotated by the air stream. When the

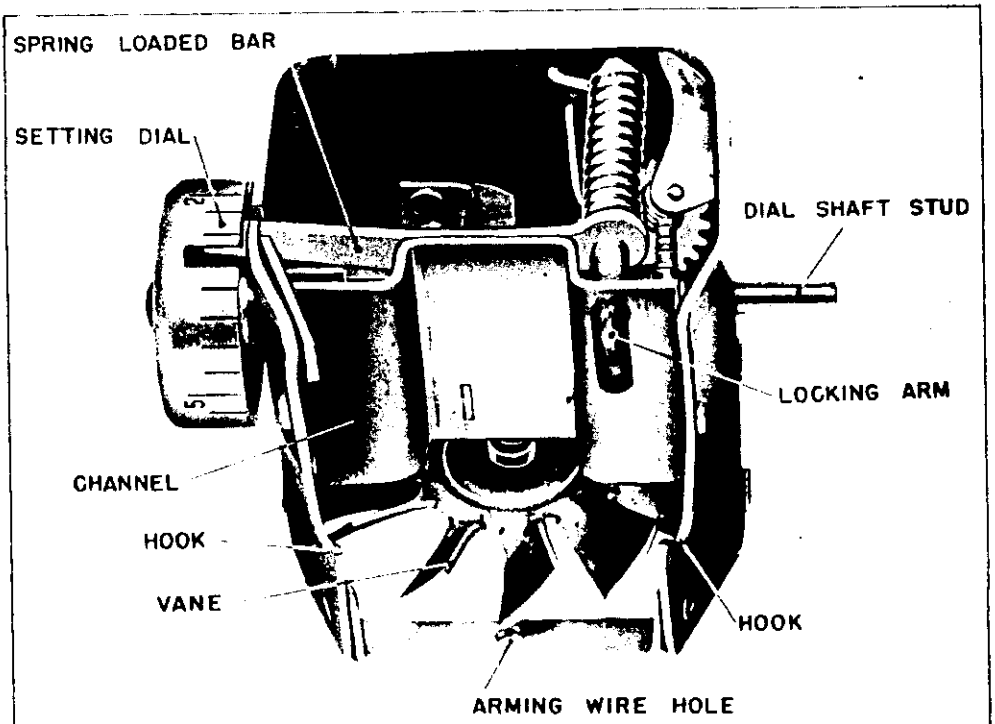


FIG. 10 DELAYED ARMING DEVICE T2E1

amount of air travel indicated by its setting dial has been traversed, the cutaway notch in the setting dial presents itself to the spring loaded bar. The spring loaded bar can then snap back to disengage the locking arm from the ring (on Ring type) or strap bracket (on Bar type). The vane locking pin spring on the fuze then thrusts the T2E1 device as well as the vane locking pin (or arm) free of the fuse, thereby allowing the vane of the fuze to commence rotation. Only after the T2E1 device has become disengaged from the fuze does the MinSAT stated on the fuze start. THUS, THE TOTAL SAFE AIR TRAVEL TO ARM THE FUZE IS EQUAL TO THE MINSAT MARKED ON THE FUZE PLUS THAT OF THE ARMING DELAY.

Use of the T2E1 device will reduce the number of malfunctions for high altitude releases to some extent because of the reduction in time during which the fuze itself becomes operative and falls armed.

ASSEMBLY OF T2E1 TO FUZE

Press the dial shaft stud toward the vanes and rotate dial. When the cutaway section in the dial is presented to the spring loaded bar, carefully release to avoid injury to the fingers from the spring action.

Thread the short end of the arming wire through the front suspension lug, through the arming wire hole in the strap on the vane end of the arming delay and then through the arming wire hole in the vane locking arm (or pin) where the seal wire was.

Place the arming delay with its vane end toward the bomb tail so that its channel is over the vane locking arm (or pin) and hooks of the delay arming device engage the bottom of the fuze ring or strap bracket. (See Fig. 11).

Pivot spring loaded bar on the T2E1 back in place through the slot in the setting dial. Press the stud forward as before and turn the dial to the desired setting. (See Fig. 14 and 15)

Adjust the arming wire to protrude three or four inches in front

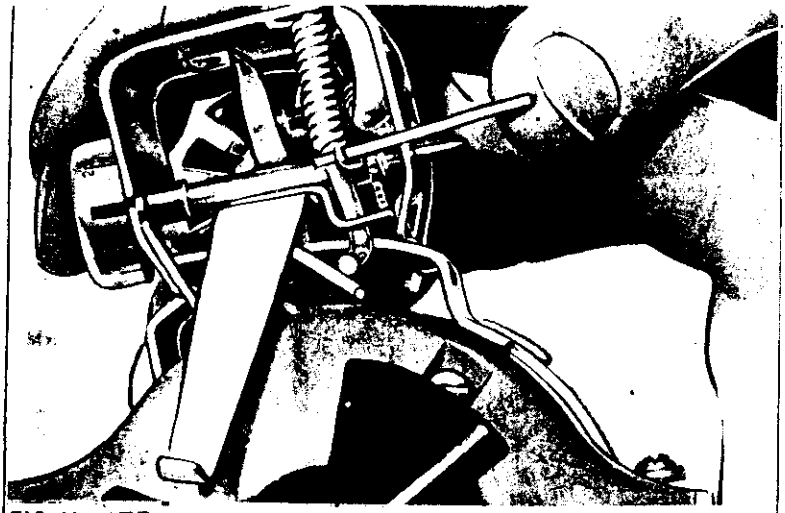


FIG. 11 ATTACHING T2E1 DEVICE TO BAR TYPE VT FUZE. NOTE LOCKING ARM BEING TURNED BY SPRING LOADED BAR TO LOCK DEVICE TO STRAP BRACKET

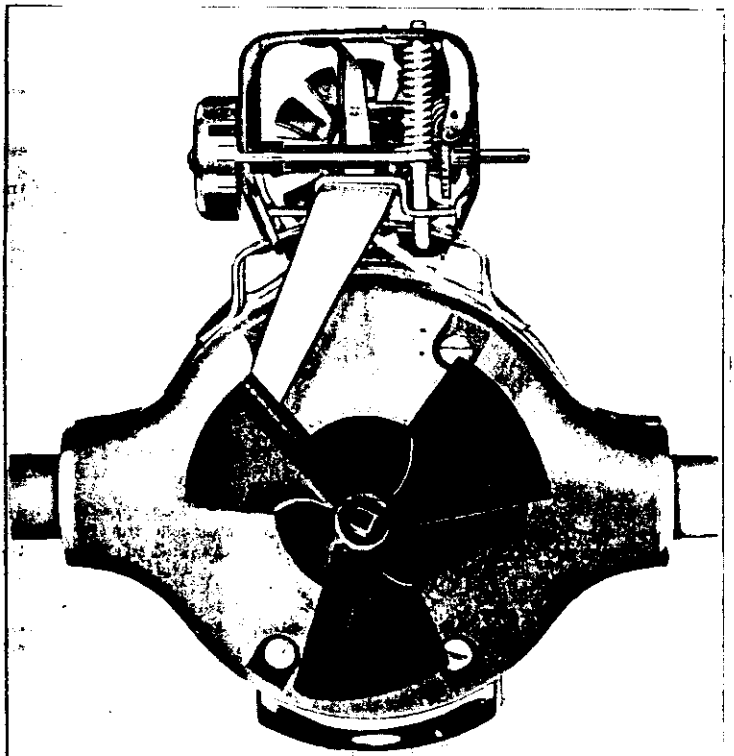


FIG. 12 T2E1 DEVICE ASSEMBLED TO BAR TYPE VT FUZE

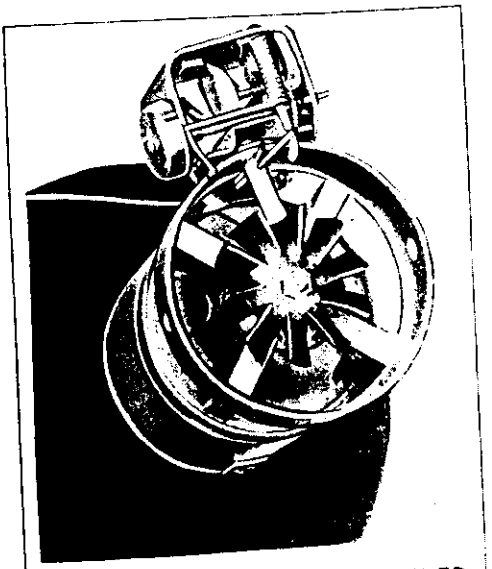


FIG. 13 T2E1 DEVICE ASSEMBLED TO RING TYPE VT FUZE

pin spring after the cotter pin has been removed is sufficient to hold the arming wire firmly in place.

The tables, Figs. 14 and 15, indicate the correct T2E1 dial settings to be used for various level flight release altitudes when employing the bombs listed in the captions. Fig. 14 covers VT fuzes marked for 2000 and 2600 feet MinSAT while Fig. 15 deals with fuzes marked for 3600 and 4500 feet MinSAT. (Note: These two tables are cited as specific examples. For other bomb-fuze combinations in connection with the T2E1 device, additional tables would be necessary but it is presumed that activities having direct need for such information will have access to them. Hence they are omitted here.)

STOWAGE AND HANDLING

Packaged VT bomb fuzes may be stowed for extended periods in the original packing containers provided they remain unopened. The containers are hermetically sealed and moistureproof. Unpackaged fuzes are likely to deteriorate under warm, damp and humid conditions. Accordingly, fuzes should be unpacked only as required. Fuzes which are returned to stowage must be kept in a cool, dry place or otherwise protected from dampness and repacked in their original containers.

Packaged VT bomb fuzes may be subjected to the same type of handling applicable to other bomb fuzes provided proper security regarding them is maintained. Rough and abusive handling of unpacked fuzes has a tendency to increase malfunctions but will not decrease fuze safety.

PACKING AND MARKING

Ring type fuzes are shipped nine per box as shown in Fig. 16, each fuze contained in a shock resistant, hermetically sealed can. Each can also encloses one T2E1 arming delay device and a lock washer. In the case of early models of Ring type fuzes, T5OE1 and T5OE4, separate shipments of the T2E1 device may be found. A special fuze wrench, T4, is also included in the shipping box, Fig. 16, together with an instruction sheet.

Minimum Release Altitude	150 mph*		200 mph*		250 mph*		300 mph*		350 mph*	
	Min. SVD	Dial Setting	Min. SVD	Dial Setting	Min. SVD	Dial Setting	Min. SVD	Dial Setting	Min. SVD	Dial Setting
1,000									450	1
2,000					900	1	970	2	1100	3
3,000	1570	1	1700	2	1800	3	1880	4	1940	5
4,000	2200	2	2300	3	2380	4	2490	5	2400	6
5,000	2900	3	2950	4	2950	5	3500	7	3450	8
6,000	3600	4	3700	5	4200	7	4100	8	4020	9
7,000	4300	5	4960	7	4850	8	4700	9	6600	10
8,000	5750	7	5640	8	5540	9	5350	10	5800	12
9,000	6500	8	6380	9	6200	10	6650	12	6430	13
10,000	7220	9	7080	10	6900	11	7320	13	7060	14
11,000	7960	10	7800	11	7600	12	8000	14	7720	15
12,000	8690	11	8400	12	9000	14	8700	15	9060	17
13,000	9380	12	9250	13	9700	15	9400	16	9730	18
14,000	10100	13	10650	15	10300	16	10650	18	10260	19
15,000	10900	14	11400	16	11050	17	11400	19	10920	20
16,000	11620	15	12100	17	11750	18	12050	20	12300	22
17,000	12350	16	12830	18	12500	19	12800	21	13000	23
18,000	13100	17	13600	19	13200	20	13500	22	13720	24
19,000	13850	18	14300	20	13900	21	14200	23	14410	25
20,000	15330	20	15050	21	15400	23	14950	24	15100	26
21,000	16100	21	15800	22	16150	24	15650	25	15800	27
22,000	16860	22	16550	23	16850	25	17000	27		
23,000	17620	23	17300	24	17600	26				
24,000	18380	24	18050	25	18400	27				
25,000	19100	25	18800	26						

* True air speed. NOTE: Do not drop fuzes T91 and T92 above 10,000 ft. altitudes.

FIG. 14 T2E1 DIAL SETTING TABLE WHEN USING VT FUZES MARKED FOR 2000 and 2600 FEET MinSAT IN BOMPS, 100 lb. GP AN-M30, 250 lb. GP AN-M57, AND 260 lb FRAG. AN-M81.

7,000	3500	3	1	3400	4	2	3500	5	2	3400	5	4	3000	6	5
8,000	4100	4	2	4400	5	4	4300	6	4	3600	6	5	3600	8	6
9,000	4800	5	3	5000	6	5	4500	7	5	4100	7	6	4500	9	8
10,000	5800	6	5	5700	7	6	5400	8	6	4800	9	7	5000	10	9
11,000	6600	7	6	6300	8	7	6300	10	7	5800	10	9	5500	11	10
12,000	7100	8	7	6900	9	8	7300	11	8	6400	11	10	6300	13	11
13,000	7800	9	8	7600	10	9	7900	12	10	7000	12	11	6700	14	12
14,000	8500	10	9	8400	12	10	8500	13	11	7500	13	12	7700	15	14
15,000	9100	11	10	9000	13	11	9100	14	12	8300	15	13	8300	16	15
16,000	9800	12	11	9700	14	12	9700	15	13	9300	16	15	9000	18	16
17,000	10400	13	12	10300	15	13	10300	16	14	9900	17	16	9700	19	17
18,000	11300	15	13	11400	16	15	11200	18	15	10400	18	17	10300	20	18
19,000	11900	16	14	12100	17	16	11800	19	16	11200	19	18	11300	21	20
20,000	12600	17	15	12600	18	17	12500	20	17	11800	20	19	11900	22	21
21,000	13300	18	16	13400	19	18	13600	21	18	12400	21	20	12500	23	22
22,000	13900	19	17	14000	20	19	14200	22	20	13200	23	21	13100	24	23
23,000	14600	20	18	14700	21	20	14900	23	21	13900	24	22	14000	26	24
24,000	15300	21	19	15300	22	21	15500	24	22	14500	25	23	14600	27	25
25,000	16400	22	21	16000	23	22	16200	25	23	15600	26	25	15200		26
									24	16300	27	26			

* True air speed. SAT figures are minimum and are in feet.

FIG. 15 T2E1 DIAL SETTING TABLE WHEN USING VT FUZES MARKED FOR 3600 and 4500 FEET MinSAT IN BOMBS, 100 lb GP AN-M30, 250 lb GP AN-M57 and 260 lb FRAG. AN-M81

At the present time Bar type fuzes are not provided with individual containers but are packed in hermetically sealed boxes of four. A fuze wrench and instruction sheets are included in each box.

Each fuze, its container and the packing box are completely marked with nomenclature, including the MinSAT, lot number, date of loading and other pertinent data.

DISPOSAL OF VT BOMB FUZES

The Bomb Disposal School has under preparation for Bomb Disposal officers specific procedures for disposal of VT bomb fuzes in the event such procedure becomes necessary. Under normal circumstances the best methods of disposal are either by lowering into deep water or destruction by explosives.

Should wilful destruction of the fuzes become necessary due to the possibility of stock piles falling into enemy hands, destruction of the nose section with a hammer will make the fuze inoperable but will not satisfy security requirements unless complete destruction of the nose section is effected. Under such circumstances burning and crumbling the ashes of all literature is imperative.

AVAILABILITY OF VT BOMB FUZES

Of the fuzes described in this Bulletin, Fuzes T91 and T92 are especially designed for Navy use and are the only fuzes of this type that are at all suitable for dive bombing. With these fuzes shallow dives and high altitude pull-outs must be used. The T91 and T92 are now being made available and until distribution is effected on these two fuzes in accordance with requirements the following fuzes are available for issue:

VT Bomb Nose Fuze T50E1 (3600 ft. MinSAT and 3100 ft. MinSAT)
VT Bomb Nose Fuze T50E4 (3600 ft. MinSAT)

SAFETY PRECAUTIONS

While VT bomb fuzes deserve the same degree of caution and respect as other items of explosive ordnance, the following points are particularly noteworthy:

1. The utmost care will be taken to make sure that neither information concerning these fuzes nor the fuzes themselves fall into enemy hands. Information concerning these fuzes should be disclosed only to those persons whose duties require such knowledge.

2. VT bomb fuzes are not operationally interchangeable with the AN-M103; they are of value only when air bursts are desired.

3. Due to the possibility of VT fuzes on wing rack mounted bombs on F6F-3 and F6F-3N being damaged by the catapult bridle at the end of the catapult run, the use of these fuzes is not recommended as it is not advisable to employ the usual nose fuze protectors. A suitable protector is being designed and is expected to be ready shortly.

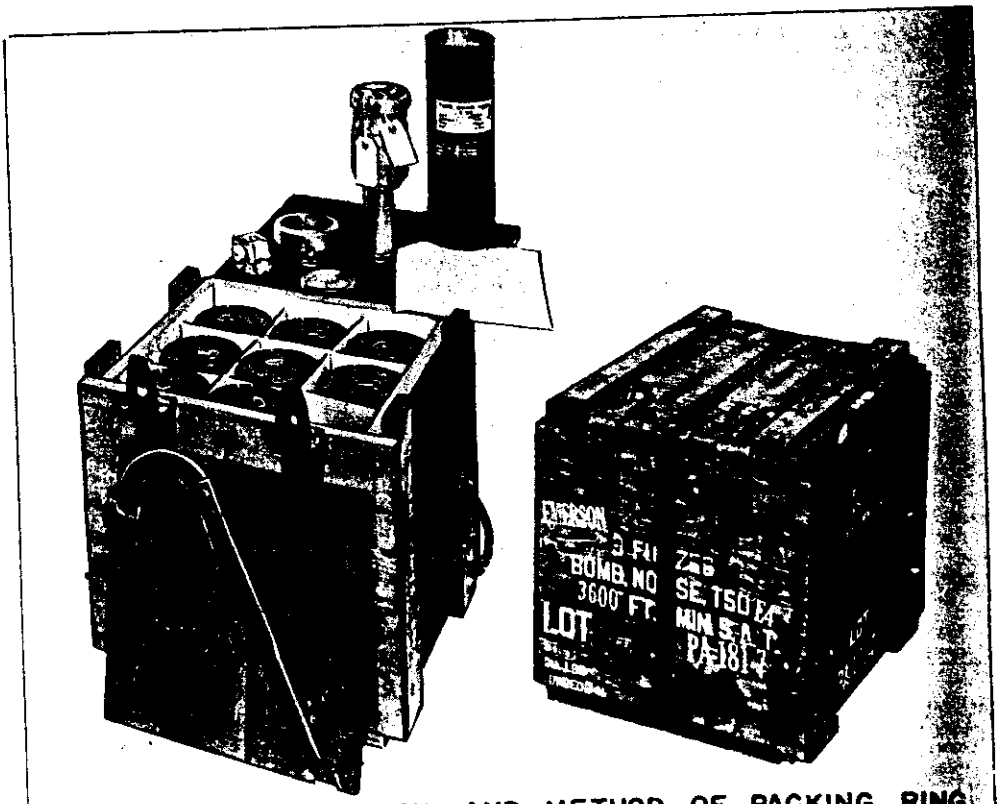


FIG. 16 SHIPPING BOX AND METHOD OF PACKING RING TYPE VT BOMB NOSE FUZES

4. Be sure that a lock washer is used when installing a VT fuze. Wrench tighten the VT fuze, and the tail fin. Failure to tighten these components will cause a high percentage of early functions.

5. Fahnestock clips should not be used because of the possibility of the clips wedging in the arming vanes.

6. The disassembly or alteration of any VT bomb fuze by field personnel is not authorized.

7. Assemble arming wire on wing rack installation with utmost care because an accidentally pulled arming wire while the plane is in flight will arm the fuze and probably cause a casualty.

8. Be sure to select the proper VT fuze for the correct bomb size as shown in Fig. 5. Remember "Armed salvo" and "minimum train" releases will result in mass detonation of all bombs with salvo or train if one early burst occurs. An intervelometer spacing of 50 feet or more for 100-lb GP's AN-M30, and 260-lb fragmentation bombs AN-M81, or 100 feet or more for 500-lb GP's AN-M64 should be considered the minimum.

9. Do not use fuzes that appear to be damaged or those in which the booster safety pin cannot be reinserted upon withdrawal. Any bending or distortion of the vanes in handling may unbalance their careful adjustment and cause malfunctioning.

10. Extremely heavy rain (large drops), clouds, snow and hail may cause an increase in early functions.

11. Stow fuzes in sealed containers and open only in accordance with require-

260-lb AN-M81	- 5%	of MinSAT
250-lb AN-M57	- 12%	" "
500-lb AN-M64	- 24%	" "
1000-lb AN-M65	- 33%	" "
2000-lb AN-M66	- 43%	" "

If a T2E1 device is used, there will be an additional increase in total safe air travel by the amount indicated on its setting dial.

13. An armed VT fuze damaged while the vane was turning at high speed is dangerous. It should not be handled except by authorized Bomb Disposal personnel for necessary disposal, because it may be sensitive to shock, jar or approach.

14. Under no circumstances are the bars on Bar type VT fuzes to be used as levers or handles during installation.

15. Be sure to remove the safety cotter pin from the vane locking arm or pin after the arming wire has been installed.

16. Disposal of duds should never be attempted by unauthorized personnel.

- - - - - - - - - - -

REFERENCES: TB 9X-106
O.P. 1444 (Preliminary)

* * * * * * *

CONFIDENTIAL

VT ROCKET NOSE FUZE MK 172 MOD 0

INTRODUCTION

The Mk 172 Mod 0 is a VT rocket nose fuze for Navy type fin stabilized rockets designed to function automatically upon approach to the target. It is used only where air burst of the rocket would be most effective to spray exposed personnel in foxholes and light materiel with fragments.

The complete fin stabilized rocket round is known as "Rocket Assembly Mk 1 Mod 5" which comprises the following components:

1. VT Rocket Nose Fuze Mk 172 Mod 0.
2. 5"0 Rocket Head Mk 1 Mod 1 (Fig. 17). This head differs from the normal 5"0 head (Mk 1 Mod 0) in that the nose is especially cavitized to take the Mk 172 Mod 0 which is larger than the Mk 149 or other rocket nose fuzes and is therefore not interchangeable with them.

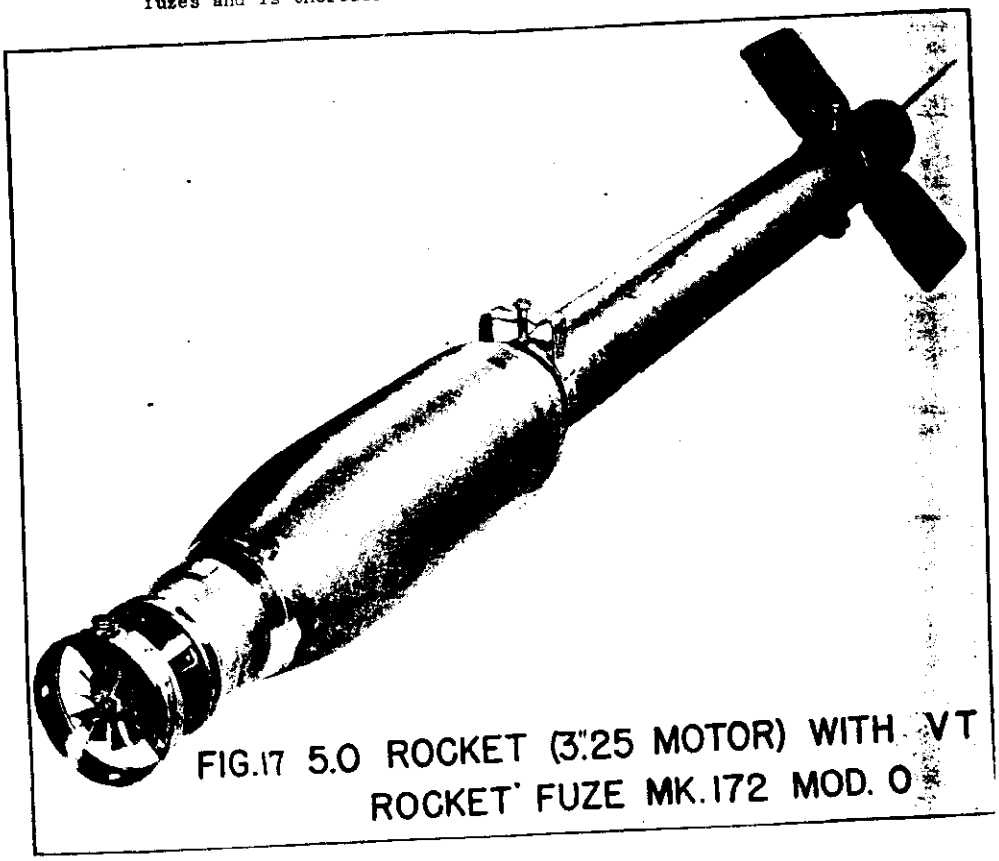


FIG.17 5.0 ROCKET (3".25 MOTOR) WITH VT ROCKET FUZE MK.172 MOD. 0

... ROCKET MOTOR, MK 7.

(Note: The Mk 172 Mod 0 has not proved entirely satisfactory to date when used in current service type of 5"0 rockets with 5"0 motors. Tests have indicated that the 5"0 motor tends to produce "after-burning" which adversely affects the VT fuze causing early bursts.)

DESCRIPTION

In appearance the Mk 172 Mod 0 is the same as the VT Ring type Bomb Fuze T50 (see Fig. 1, page 2), and while the fuze will be properly marked, care must be taken that they are not inadvertently mistaken for one another. (The Mk 172 Mod 0 fuze may also be marked as T2004 fuze for issue by the Army.) Internally, the fuzes are also similar except that in the Mk 172 Mod 0 a set-back feature is added.

OPERATION

On firing, the arming wire withdraws from the arming pin allowing it to spring off. At the same time, the set-back produced by sudden acceleration frees the set-back mechanism which in turn permits the vanes and vane shaft to rotate. The vanes rotate for about 300 feet of air travel permitting the detonator rotor to turn half the amount necessary for arming. As acceleration ceases, at the end of burning of the rocket motor, the detonator rotor is further rotated lining up the detonator with a tetryl lead-in to the booster. The arming vane continues to rotate operating the high speed generator which supplies electrical power to operate the fuze upon approach to the target. A delay of 0.7 to 1.4 second after the detonator rotor is fully in line is necessary to build up sufficient energy to operate the fuze.

INSTALLATION

Each fuze Mk 172 Mod 0 is shipped as a complete unit including a seal wire and booster safety pin. It will be recalled that the booster safety pin in this application, like that on the bomb fuzes, gives a visual indication that the detonator rotor is in its original or safe position, if upon removal of the pin it can be fully reinserted. If it cannot be reinserted, the detonator rotor will have moved out of position and hence, the fuze should be disposed of.

After the safety pin check has been performed, the fuze should be inspected for possible damage. This is particularly significant with respect to the fuze vanes. They have been carefully adjusted and balanced at the factory. If they are bent or damaged, erratic functioning may result. The fuze cavity and all mating threads should be clean.

The fuze may then be screwed into the head. No lock washer is necessary in this application but the fuze must be installed wrench tight, prior to loading the rocket on the plane, with the special wrench included in the shipping box.

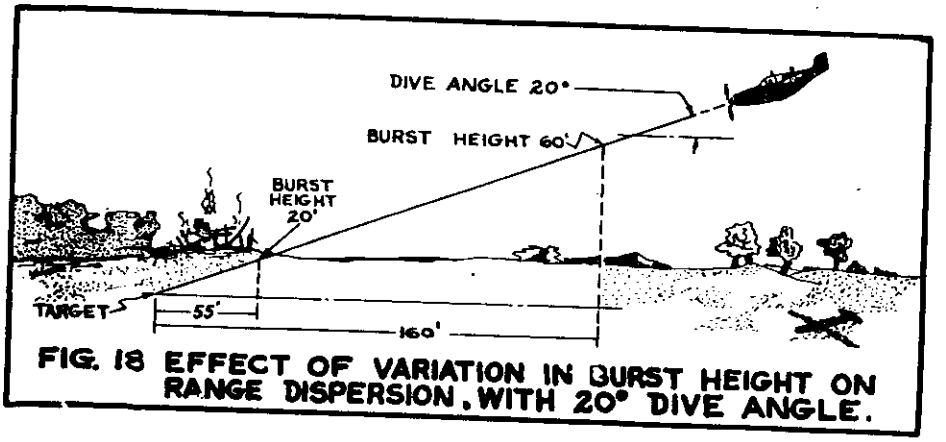


FIG. 18 EFFECT OF VARIATION IN BURST HEIGHT ON RANGE DISPERSION. WITH 20° DIVE ANGLE.

Make sure that the other rocket components, including the fins, lug bands, etc., are also tight. Any looseness of these parts may cause functioning after the fuze has armed but before approach to the target.

The seal wire is then removed from the arming pin. The arming pin can be inserted in any of the four holes in the metal ring, the object being to locate the pin in the hole nearest the top of the round so that the arming wire will be properly aligned for attaching to the forward launcher post with the least amount of twist. Don't permit the vane to rotate during this operation. A standard arming wire is used. The spring on the arming pin provides adequate pressure to hold the arming wire in place. The Fahnestock clip must not be used because it may foul the vanes upon withdrawal of the arming wire. Remove the cotter pin in the arming pin after the arming wire has been installed. The arming wire should extend about three or four inches beyond the fuze.

REMOVAL PROCEDURE

If the rocket is brought back unexpended and is not to be used within twenty-four hours, the VT nose fuze should be removed from the rocket.

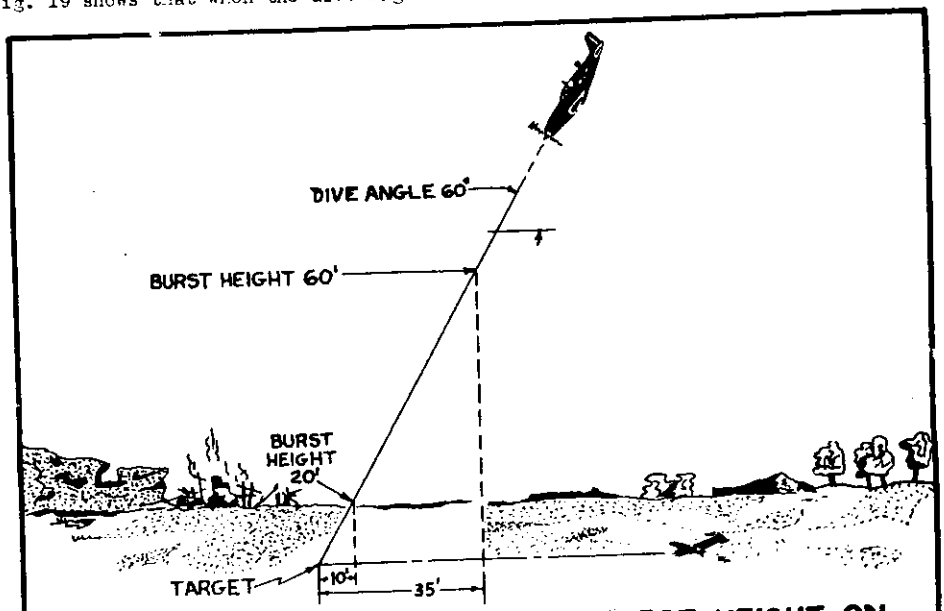
The cotter pin should be inserted in the outboard hole in the arming pin and the arming wire then withdrawn. Unscrew the fuze and insert the booster safety pin. Do not use force; if the pin cannot be reinserted, destroy the fuze. Pack the safe fuze in its can and seal the lid with adhesive tape.

PERFORMANCE

The Mk 172 Mod 0 can be used either day or night and at any temperature at which the rocket may be used. It is not affected by clouds, fog, snow, or light rain. However, it may be affected by heavy tropical rains or hail but this has not been definitely established.

The fuzes are designed so that the average fuze of a lot will function thirty (30) to forty (40) feet above a normal soil target when fired from a plane in a 40° dive. However, functions between fifteen (15) and sixty (60) feet above normal soil or double that over water may be expected due to variations in the nature of the target and slight variations in manufacturing tolerances in the fuzes themselves. Terrain irregularities, trees, and light materiel targets will cause bursts to occur at slightly greater heights than would occur over level terrain.

This variation in burst height will cause a dispersion in range which may be serious if the rocket is fired while the plane is in a very shallow dive. Fig. 18 shows that with a dive angle of 20° a fuze functioning at 20 feet from the ground will function about 55 feet short of the target, while one functioning 60 feet from the ground will function 160 feet short of the target. In contrast, Fig. 19 shows that when the dive angle is increased to 60° with burst heights of 20



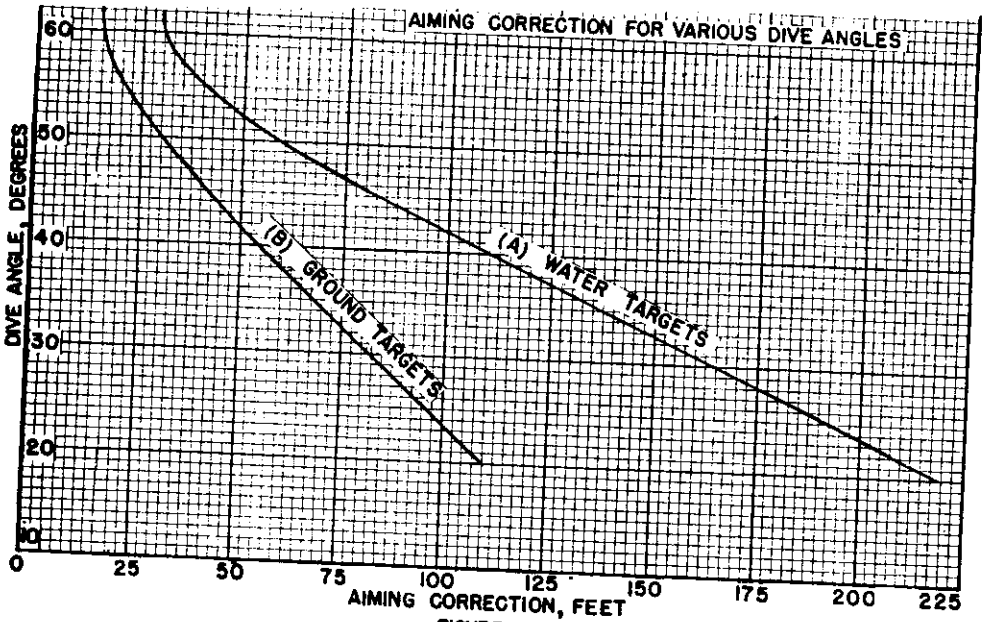


FIGURE 20

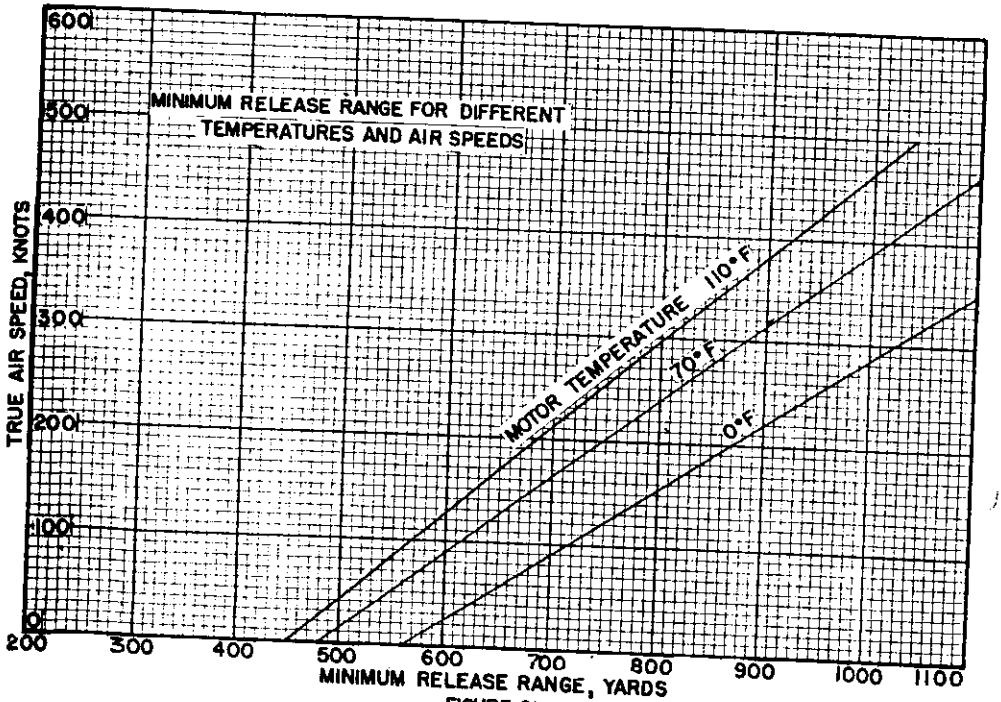


FIGURE 21

above 30° when using this fuze. [illegible] as steep as practical, preferably make allowances for an aiming correction in range which will vary with different dive angles and also with (A) Water, and (B) Ground targets as shown in Fig. 20. The pilot should aim beyond the target by the number of feet indicated to obtain the most effective burst height and accuracy.

The Mk 172 Mod 0 has neither self-destructive or impact functioning features.. However, if the VT fuze is a complete dud the base fuze Mk 157 Mod 0 will cause detonation after impact.

While the Mk 172 Mod 0 is designed primarily for air to ground firing, it could be used, though less effectively, for air to air firing. In this application the rocket would have to come within 20 feet of the aircraft target in order to function. (Note: VT Rocket Fuze Mk 171 Mod 0 is under development for air-to-air use.)

MINIMUM RELEASE RANGES

Delayed arming of the Mk 172 Mod 0 insures that an early burst will not occur at a distance that would be hazardous to the firing plane and the pilot. The exact distance in front of the firing plane at which the fuze will arm depends on the rocket motor temperature and varies from 340 yards at 0° F to 255 yards at 110° F.

Because of this delay, it is necessary to fire rockets using the Mk 172 Mod 0 at range sufficient to insure that all fuzes are armed upon approaching the target. The minimum release range depends upon the temperature of the rocket motor and the speed of the plane as shown in Fig. 21.

MALFUNCTIONS

The VT Fuze Mk 172 Mod 0, like the Ring type bomb VT fuzes, is of such nature that total elimination of malfunctions cannot be guaranteed with normal rocket motor burning. Approximately 80% of the fuzes may be expected to function properly upon approach to the target; about 10% will function after arming but before approaching that target; and about 10% will be duds, not functioning at all.

Under any circumstances, the arming delay built into the fuzes insures that functioning cannot occur until the rocket is far enough from the firing airplane to prevent damage even if the fuze fires at the moment of arming.

SHIPPING AND STOWAGE

In general, data on shipping, stowage, handling, etc., for the Mk 172 Mod 0 is the same as that for the VT Ring type bomb fuzes (See page 13).

SAFETY FEATURES AND PRECAUTIONS

A normal VT rocket fuze is entirely safe to handle, install and remove from the rocket if necessary.

A seal wire through a hole in the arming pin inserted at the factory prevents the vanes from rotating and insures that the arming mechanism is in the proper position. Any turning of the vanes, unless accompanied by set-back will cause the rotor system to jam, stripping its gears, so that the fuze will be a dud. For this reason, the fuze cannot be pre-armed. If the seal wire is broken when the fuze is originally removed from the container, do not use the fuze. Fuzes in this condition could be disposed of in accordance with security regulations by lowering in deep water or by explosive demolition.

The safety pin inserted in the booster end engages the arming mechanism. It cannot be reinserted unless the arming components are in the safe, unarmed position. Hence, a visual check can be made to determine that the fuze is unarmed.

High speed rotation of the vanes is necessary to produce the current to fire the fuze. Therefore, the fuze is actually only armed when in flight on the rocket at speeds in excess of 80 knots. Damaged fuzes may hold the electrical charge in the condenser for quite some time. For this reason, damaged fuzes and duds found on the ground should preferably be handled only by qualified Bomb Disposal personnel.

No disassembly of the Mk 172 Mod 0 is authorized by field personnel

AVAILABILITY

It is expected that the Mk 172 Mod 0 and its rocket assembly will be available in limited quantities by the early part of this summer.

REFERENCE: O. P. 1470 (Preliminary)

VT ROCKET NOSE FUZES T5 & T6

INTRODUCTION

VT fuzes, T5 and T6, are designed for use in the Army's 4".5 fin stabilized rockets, Fig. 22. These fuzes operate on the VT principle and function automatically giving air burst upon approach to the target. The fuzes are similar in appearance and differ essentially in their application, delay time to arm, and self destruction action as indicated in the table below.

DESIG.	TYPE	USE	DELAY TO ARM	SELF DESTRUCTION FEATURE	4".5 ARMY ROCKETS* USED IN
T5	Electro-Magnetic	Plane to Plane Plane to Ground Plane to Water	1 sec	Acts 6-12 sec. after launching	M8, M8A3, T22, T74 (M8A1, M8A1B1, M8A2)
T6	Electro-Magnetic	Ground to Ground	3-6 sec	None	M8, M8A3, T22, T74 (M8A1, M8A1B1, M8A2)

* With most of the rockets listed, the Army supplies either "Fin Notching Tool, T4" or "Aircraft Rocket Kit T23" for tightening and adjusting the fins to prevent any looseness causing vibration which results in erratic functioning of the VT fuzes. Instruction sheets for notching and adjusting the fins are included in fuze shipments.

The T5 and T6 screw directly into all standard loaded 4".5 Army rockets and are directly interchangeable with P.D. M4 series rocket fuzes (See "U.S. Rockets and Fuzes", page 32, published by BDS,) both physically and ballistically.

These fuzes as issued are not complete. A battery must be installed and the components assembled prior to use.

DESCRIPTION OF T5 and T6

The T5 and T6 consist of four basic components; nose, battery, switch and booster housing (with booster enclosed). (See Fig. 23)

Nose MC-382 ( )

The nose model number may be followed by the manufacturer's code letter in parenthesis. Noses MC-382 ( ) with the letters A, B, C, D, and E are interchangeable. The nose unit contains the basic electric equipment which initiates the air burst by influence of the target. It is completely sealed and requires no adjustment.

The nose also contains equipment to initiate self destructive action 6-12 seconds after launching. However, when issued for the T6 fuze, this element is short circuited externally by a clip across #1 and #3 contact pins which protrude from the base of the nose.

Externally the nose has a plastic ogive with a metallic cap. The shoulder is provided with four slots for the fuze wrench. The base of the

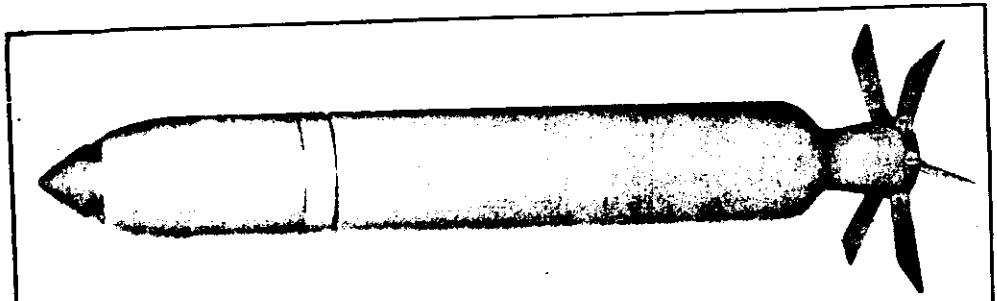
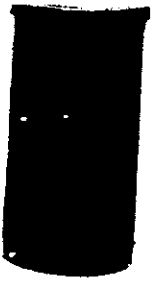


FIG 22 ARMY 4".5 ROCKET WITH VT NOSE FUZE

NOSE

BATTERY

SWITCH



BOOSTER HOUSING

NOSE, BATTERY, & SWITCH ASSEMBLED.

ASSEMBLY COMPLETE

FIG.23 VT ROCKET FUZES T5 AND T6 FOR ARMY'S 4.5 ROCKET

nose has two sets of threads, the smaller diameter threads being for assembly to the booster housing, and the larger diameter threads for assembly to the rocket. Seven electrical contact pins project from the base for connection to the battery. A red guide mark and groove provide a means for proper alignment and assembly in daylight and also at night.

Battery BA-75

The battery unit provides the power supply for operation of the fuze. It is encased in a black bakelite cylinder. Externally the top plate is marked "AMP" and provides a 7-pin socket to receive the nose pins. The bottom plate of tan fiber contains a 6-pin socket to receive the switch pins. This plate has a notch for proper assembly to the switch in the dark. A colored transfer is fixed to the side of the unit giving battery identification, a red guide strip for alignment with the nose and a green guide strip for alignment with the switch

Switch SW230A or SW230C

(Note: Either of these switches may have a 1 second or a 5 second delay. The 1 second delay switch is shipped with the T5 while the 5 second delay switch is shipped with the T6).

The switch unit contains mechanical and electrical devices necessary to arm the fuze, an electric detonator and a firing train interrupter for safety during handling and launching. Externally the unit has contact pins on top for assembly to the battery. A fiber terminal disc supports the contact pins. A top plate and safety key must be removed before assembly in accordance with instructions on the plate or attached to the key. A bakelite plug at the center of the fiber disc holds the electric detonator in place. The metallic case forms a

sturdy protector for the enclosed mechanism and explosive. A green guide mark and groove are located on the side of the switch to assist in aligning switch pins and battery. The bottom plate contains a small tetryl pellet for detonating the booster charge.

Booster Housing M-381

The booster housing forms a case for the battery and switch. This unit screws onto the lower threads of nose MC-382 ( ). In the bottom of this housing is a chamber containing a tetryl booster charge.

TESTING AND ASSEMBLY OF PARTS

The T5 and T6 are not ready for use as shipped. Batteries will be packed separately and must be assembled to fuze components before use.

Since the batteries may partially deteriorate after a period of several months, depending on stowage temperature, and since some of the fuze components may be defective as a result of damage or other reasons, the Army recommends testing of all parts. The testing equipment is known as IE-28 and instructions for its use are furnished in the Army's TM-11-2502.

Testing of fuze components is recommended but may be omitted without seriously impairing fuze performance if batteries are known to be reasonably fresh.

After the testing has been completed, the fuze components are simply fitted together in the manner shown in Fig. 23. No tools are required for this assembly but hand tight fits are important.

The fuze may then be installed and securely tightened in the rocket with the special fuze wrench furnished, provided the fins have been properly adjusted and notched as required. The battery must not be below + 20° F at the time of use. When the fuze has been screwed into the rocket, set screws are tightened to secure it in the rocket body.

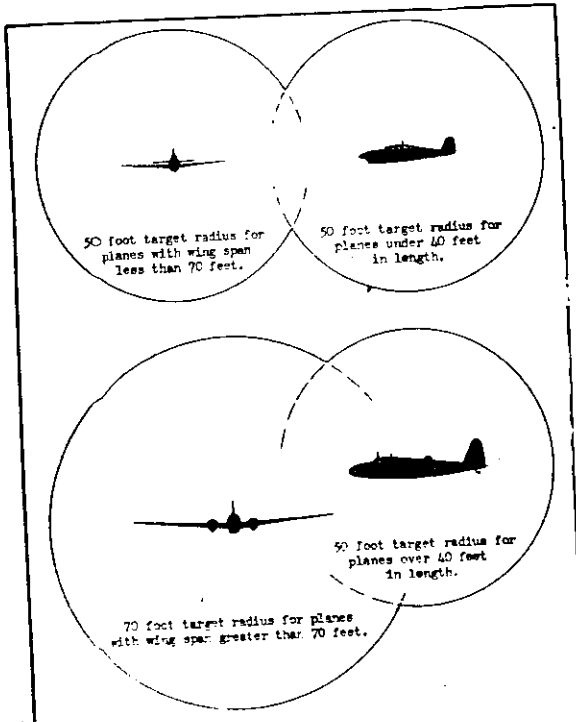


FIG. 24

FUNCTIONING

The T5 and T6 VT rocket fuzes do not require an arming wire. When launched, prolonged set-back starts the arming process in operation by properly aligning the firing circuits.

VT Fuze T5

Arming of the T5 is delayed for at least 0.76 seconds time of flight. Although the exact time varies between a group of T5 fuzes they will all arm before 1.0 second time. Once the fuze has armed, it fires electrically if it comes within the maximum influence radius of the target.

The T5 incorporates the self-destroying feature in the nose which will detonate the rocket approximately 6-12 seconds after being fired if the fuze does not pass within operating range of a target (enemy aircraft), Fig. 24, or does not closely approach the earth.

Plane to ground use of the T5 will result in an airburst at a height most lethal to personnel and most effective against light materiel targets. Terrain irregularities, trees and materiel targets will cause bursts to occur at greater heights than

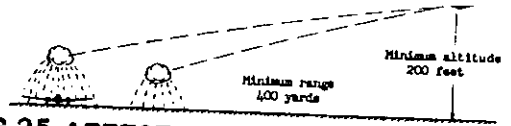


FIG.25 AFFECT OF MATERIAL OBJECTS ON BURST HEIGHT OF VT FUZE T5.

...ave angle will not alter the effectiveness, but low altitude approach, or approach below 10° from horizontal will result in increased range dispersion. Minimum range (arming distance) in plane to ground use is about 390 yards at 300 mph, and 430 yards at 400 mph.

The table below gives the minimum range for the T5 in plane to plane use.

MINIMUM RANGE FOR PLANE TO PLANE USE
(Both Planes Same Speed)

Plane Speed (mph)	Minimum Arming Distance - yds Plane to Armed Rocket	MINIMUM RANGE - YDS			
		Head On Approach	Tail Approach	Rearward Firing	Deflection Shooting
300	189	537	243	255	390
400	182	625	235	245	430

The T5 may be used during day or night and is not affected by fog or clouds.

VT Fuze T6

The T6, used only for ground to ground firing, arms like the T5 except that the arming time is at least 3 seconds (800 yds of flight). This will vary between approximately 3-6 seconds. The minimum usable range for the T6 is 1600 yards (8° quadrant elevation). After arming, influence of the target functions the fuze to give air burst. Fig. 26 below shows the affect of angle of elevation on average burst height. It will be noted that the height of burst will vary with changes in angle of fire in order to maintain nearly optimum effect over average level terrain. However, bursts will occur higher over water and lower over extremely dry soil. Burst height dispersion will not materially change the lethal effectiveness.

Terrain irregularities and materiel objects such as trees, crests, streams, towers, parked aircraft, mechanized equipment, etc., will cause functions at heights greater than indicated in Fig. 26. This characteristic may be used to advantage in that fire power may be easily concentrated on such irregularities. When targets are beyond such irregularities, clearance of at least 250 feet should be allowed to assure maximum effect over the target area (Fig. 27)

The T6, like the T5, is suitable for use either day or night and remains unaffected by fog or clouds.

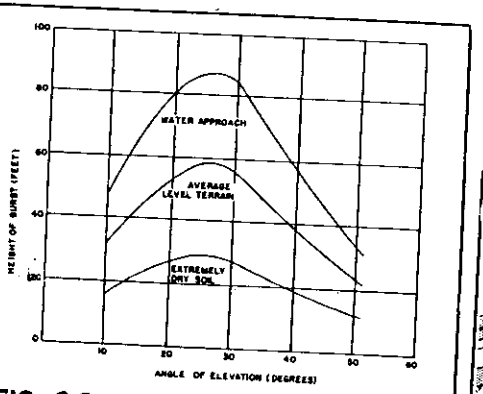


FIG. 26
AFFECT OF ANGLE OF ELEVATION ON AVERAGE HEIGHT OF BURST.

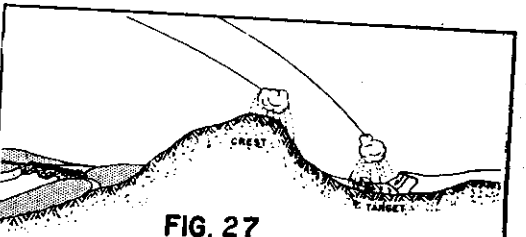


FIG. 27
ADEQUATE CLEARANCE IS REQUIRED TO AVOID WASTING ROUNDS ON CREST.

It is important to note that the T6 does not incorporate the self destructive feature of the T5.

SAFETY

Both the T5 and T6 can withstand rough handling and dropping without reducing safety but a higher percentage of malfunctions will result from abusive treatment.

Rocket separations or motor blow-ups are not likely to arm a fuze and there is no case on record of such an occurrence. Nevertheless, it is recommended that a qualified Bomb Disposal officer handle a situation of this nature.

MALFUNCTIONS

Under normal conditions, 75% to 85% of these fuzes will function properly. Malfunctions can be attributed to duds, mid-flight functions and impact functions.

DUDS

CAUSE	REMEDY	
	T5	T6
Defective Components	Eliminate by testing; replace with good parts.	
Approach to Target Before Arming	Use at ranges to give flight time to target in excess of 1.0 second	Do not use at ranges less than 1600 yards.
Close passage to obstacles in latter stages of arming (4-6 seconds of flight)		Increase angle of elevation to obtain at least 250 feet clearance over obstacles short of target.
Firing in rain	None	None

MID FLIGHT FUNCTIONS

CAUSE	REMEDY	
	T5	T6
Loose fins	Tighten fins	Tighten fins
Loose assembly of fuze	Tighten fuzes with wrench and tighten set screws	Same as for T5
Operation of self destructive mechanism	Use at range to give less than 6 sec. flight time	
Close passage to obstacles after arming		Increase angle of elevation to obtain at least 250 feet clearance over obstacles short of the target
Firing in rain	None	None

IMPACT FUNCTIONS

CAUSE	REMEDY	
	T5	T6
Crushing of electrical components on fuzes that would otherwise be duds	Impact functions in excess of 10% usually can be eliminated by applying remedies outlined under "Duds".	

[illegible] sealed metal containers, 15 per wooden box. A cardboard cylinder and silica gel moisture absorber are packed in place of the batteries.

The batteries are shipped in separate wooden boxes. Each box contains 24 sealed fiber cylinders with 5 batteries per cylinder. All units are properly marked for easy identification.

Fuzes in their original sealed containers may be stowed as other fuzes. Opened containers, of course, provide access to moisture which should be prevented. Guard against dampness.

All fuze components except batteries may be stowed at temperatures between -20° F and + 120° F.

Batteries may be stowed at temperatures between -20° F and + 70° F; 0° F to + 40° F being the recommended stowage temperature limits. At temperatures below + 40° F, battery life will be 6 to 8 months. From + 40° F to + 70° F, battery life will be 3 to 6 months.

DESTRUCTION

In the event that destruction of fuzes becomes necessary, the Army has recommended the following methods:

1. Individual opened cans can be disposed of in deep water.

2. Explosives may be used. In this instance, a box of fuzes is opened and one fuze near the center of the box is removed. Two one-half pound blocks of TNT are used with 5 feet of safety fuze attached. The removed fuze is then replaced and the TNT detonated. Electric detonation may be used as an alternate method.

DISPOSAL OF DUDS

Duds may be sensitive to shock, jar or approach, and disposal should be made only by authorized personnel such as Bomb Disposal officers.

AVAILABILITY

Although production of T5 and T6 fuzes has been stopped, there is a large quantity of these fuzes available for the Army's service use.

- - - - - - - - - -

REFERENCE: T5 Fuze: TB 9X-94
T6 Fuze: TB 9X-93

* * * * * * *

VT PROJECTILE NOSE FUZES

C O N F I D E N T I A L

INTRODUCTION

VT projectile fuzes, like those for bombs and rockets, are electric fuzes which function automatically on approach to the target. When a VT projectile fuze passes within a certain distance of the target, an electrical impulse in the fuze discharges a condenser through an electric detonator or squib. The blast of the squib sets off a standard type auxiliary detonating fuze located at the base of the VT fuze. The auxiliary detonating fuze in turn causes detonation of the projectile. No setting is possible on these fuzes; they function automatically on approach to the target.

The application of VT fuzes to projectiles differs in several respects from those VT fuzes for bombs and rockets. VT projectile fuzes must be constructed to withstand both sudden setback forces, increasing the weight of each part as much as 20,000 times, and rapid acceleration to rotational velocities up to 24,000 r.p.m. These fuzes utilize dry or wet batteries in place of vane driven generators. They are built with rugged construction to withstand mechanical abuse and yet incorporate sensitive electrical circuits to obtain good influence action against the relatively small targets encountered in AA fire. In addition, certain electrical refinements have been included to meet service problems unique to projectile fuzes.

VT projectile fuzes may be divided into three groups, namely Navy AA fuzes, Army AA fuzes and Army howitzer and field gun fuzes. The current status of these fuzes is indicated below.

	In Service But Production Discontinued (Obsolescent)	In Production and in Service	In Development, Ready for Production and Issue, Shortly
Navy AA Fuzes	Mk 32 (5"/38) Mk 40 (5"/38) Mk 45 (3"/50)	Mk 53 (5"/38) Mk 58 (3"/50)	Mk 47 (6"/47) Mk 59 (5"/54)
Army AA Fuzes		T74E6 (90 mm AA) T152 (90 mm AA)	T73E6 (75 mm AA) T75E6 (120 mm AA)
Army Howitzer Fuzes		T76E6 (155 mm 8" and 240 mm Howitzers) T80E6 (75 mm and 105 mm Howitzer and 90 mm field gun)	

VT fuzes for major caliber projectiles are under development but since they are not ready for service use, detailed information on them is not available at present.

ANTI-AIRCRAFT VT FUZES

The maximum distance that a VT fuzed round will burst from an aircraft target is known as the maximum influence radius. The maximum influence radius for a three-inch projectile is about 50 feet while that of a five-inch projectile is about 80 feet. In anti-aircraft fire the VT fuze does not function at a specific distance from the target but causes detonation only when the target will be struck by the highest concentration of lethal fragments. One or two VT fuzed five-inch projectiles can be expected to bring down an enemy fighter or small bomber.

The use of VT fuzes in AA projectiles eliminates "fuze error" which is a common characteristic in anti-aircraft fire with mechanical time aerial burst fuzes.

NAVY VT FUZES MK 32 AND MK 40 - See Fig. 28

These fuzes for 5" projectiles are classed as obsolescent since production has been converted to fuzes of improved design. However, they are the most numerous types aboard naval craft at the present time. The Mk 32 was originally released for service in November 1942. Both the Mk 32 and Mk 40 fuzes will remain in service until expended or replaced by the Mk 53. (See page 33)

Description

Externally, the Mk 32 and Mk 40 fuzes are identical. The fuze body is made of steel, is 2".5 in diameter, and with a Mk 17, Mk 46, or Mk 54 auxiliary detonating fuze threaded into the lower end, the complete fuze assembly is 12".0 long overall. Eight inches of the fuze extends into the projectile. The external portion of the fuze matches the ogive of the projectile and consists of two steel rings surmounted by a black plastic nose section. These parts are fastened together by hollow head set screws, four in the lower ring and three in the upper ring. Wrench slots are provided in the lower ring for tightening the fuze in the projectile. The black plastic nose section may have a large aluminum cap on it (Mk 32 only), a small solder button on its tip, or it may be capless (Mk 40 only).

Markings are stamped into the lower base ring of the external protion of the fuze. Typical markings are "Mk 32 Mod 30, Model EETC, Lot 628".

Safety Features

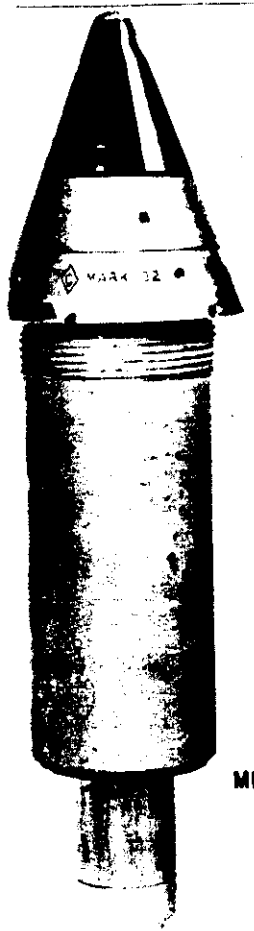
The Mk 32 Mods 0-20 and Mod 40 fuzes are energized with dry batteries. Upon setback, three switches close the power supply circuits. The Mk 32 Mod 30 and the Mk 40, all mods, however, are energized with wet batteries of the reserve type. In these latter fuzes the battery does not become operative until the round is fired. Setback breaks a glass vial which releases the electrolyte of the battery, thereby making up a fresh battery as the round is fired. They also contain the setback switches which close the power circuits.

All Mk 32 and Mk 40 fuzes have a centrifugal action mechanical clock which operates for approximately 0.4 seconds. At the end of that time the clock unshorts the electrical primer and removes a block from the flash channel leading down to the auxiliary detonating fuze. In addition to these safety features, an electrical arming delay is incorporated. A high resistance circuit is used for charging the condenser which accumulates electrical energy for activating the electrical squib. During the first 0.6 seconds not enough energy has accumulated on the firing condensers to activate the squib even if the fuze attempted to function.

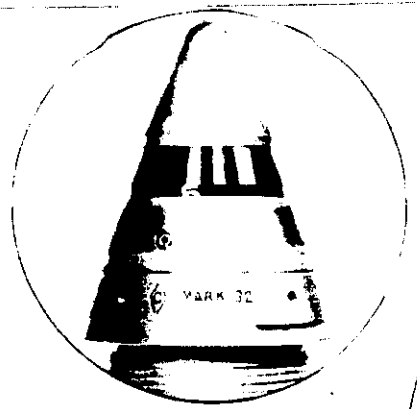
Ninety percent of the Mk 32 dry energizer Mods are fully armed at about 700 yards range. The Mk 32, with the wet energizer, arms a little more slowly requiring about 1100 yards. The Mk 40 fuzes are armed between 700-900 yards, depending upon the particular Mod.

Target Response and Employment

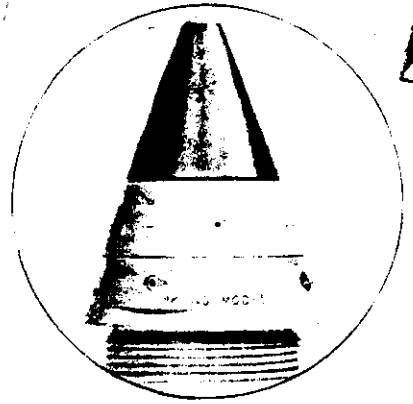
The maximum influence radius of Mk 32 fuzes is about 60 feet, whereas the Mk 40 fuzes will operate on target misses as high as 70 feet. The early Mods of the Mk 32 fuzes function from 50-200 feet above water on approach to it. There is a tendency for these Mods to malfunction when fired at very low flying planes such as torpedo bombers or small surface craft. These malfunctions may consist of firing immediately upon arming or not operating at all. These early Mods are sensitive to the influence effect of choppy water or waves but can be used with good success against low flying planes over calm or smooth water. The Mk 32 Mod 40 and Mk 40 all Mods, contain a refined electrical circuit, called a Wave Suppression Feature (WSF), which discriminates between large targets such as the surface of the sea or earth and small targets such as aircraft. This reduces the sensitivity of the fuzes to waves and makes them effective against low flying planes and small surface craft. The Mk 32 Mod 40 and Mk 40 all Mods have normal sensitivity to aircraft targets above 200 feet altitude and somewhat reduced sensitivity below this level. Burst heights over water range between 5-25 feet. Breakdown of Mk 32 and Mk 40 fuzes with Wave Suppression Feature is as follows:



MK. 32 FUZE



ALTERNATE
MK. 32



ALTERNATE
MK. 40

MK. 40

FIG. 28 EXTERNAL VIEWS OF MK. 32 & MK. 40 FUZES. COMPLETE WITH AUXILIARY DETONATING FUZES.

32	0-20	Dry	No
32	30	Wet	No
32	40	Dry	Yes
40	0-5	Wet	Yes

Depending upon the age, lot number, condition of the energizers, and the range to the target, 50% - 75% of the fuzes will function properly on approach to a target. The remainder of the fuzes may function spontaneously after arming but before approaching the target or else they will be duds.

Installation, Handling and Stowage

Due to the large size of these fuzes, they will not fit in the normal nose fuze cavity of a 5-inch AA common projectile. In order to accommodate these fuzes it was necessary to remove the nose fuze adapter ring and to cut a larger, deeper cavity in the explosive. With VT projectile nose fuzes of this type, no base fuze or tracer is used. A base plug is substituted as a gas check. A projectile with VT fuzing is ballistically interchangeable with an AA common round having a mechanical time nose fuze. Therefore, no correction to firing tables is necessary.

The 5-inch AA common rounds which can be adapted to accommodate these fuzes are as follows:

MK 32, ALL MODS		MK 32, ALL MODS (Except Mod 30)		MK 40 MODS 0-5	
Rounds	Gun Size	Rounds	Gun Size	Rounds	Gun Size
Mk 28 Mod 9 Mk 36 Mod 2,3,4 Mk 31 all mods Mk 34 Mod 10 Mk 35 all mods	5"/25 5"/25 5"/38 5"/38 5"/38	Mk 35 all mods	5"/51 (to be used at 2600 ft/sec reduced charge only.)	Mk 28 Mod 9 Mk 36 Mod 2,3,4 Mk 31 all mods Mk 34 Mod 10 Mk 35 all mods	5"/25 5"/25 5"/38 5"/38 5"/38

It should be noted above that the wet energizer types of the Mk 32 and Mk 40 are not used in the 5"/51 gun. Only dry energizer types may be used in the 5"/51 gun and propellant charges must be reduced to give not more than 2600 feet/sec muzzle velocity.

VT fuzes may safely be handled in the same manner as other type fuzes. The wet energizer is considered the weakest element from a handling viewpoint. Some of the glass vials in the Mk 32 Mod 30 and some Mods of the Mk 40 are broken by a drop of the fuzed projectile on armor plate in excess of two feet. However, this does not make the round unsafe to fire but a dud will probably result if broken more than 30 seconds before firing. If the plastic nose should be broken by an accidental blow, the round will probably be a dud but again in this instance is not unsafe to fire.

The Mk 32 fuzes with dry energizers must be re-energized every few months due to slow deterioration of the battery. Normal practice is to conduct monthly test firings of each lot aboard ship and when less than 50% of the fuzes operate properly on approach to water, arrangements must be made to have them re-energized. Specially trained BuOrd personnel with the proper tools handle this job.

NAVY VT FUZE MK 45 MOD 11 and 12 - See Fig. 29

This fuze is used in the 3"/50 round but is obsolescent and has been discontinued but some of them are still in service. They are being recalled at the present time or being replaced with Mk 58 fuzes. (See page 33).

Description

The Mk 45 was the first VT projectile fuze of smaller design. Mods 11 and 12 are the only models issued for Navy use. They are identical in appearance except that the lower fuze body of the Mod 12 is approximately 0"75 shorter overall than Mod 11. The Mod 12 is 7"75 overall. The portion extending inside of the projectile is 4"0 long including the auxiliary detonating fuze, and is 1"75 in diameter. The upper fuze body outside the projectile comprises a steel base ring and a plastic nose molded integral to it. A perforated steel nose cap is molded inside the forward end of the plastic cone.

The Mk 45 Mods 11 and 12 do not have the Wave Suppression Feature nor a self destructive element.

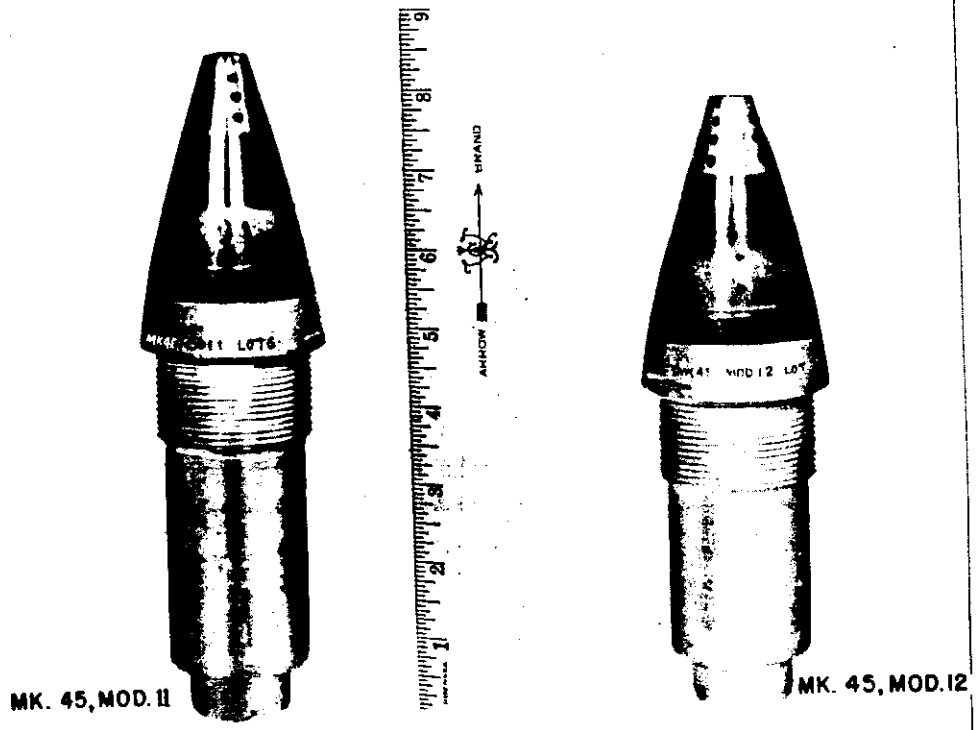


FIG. 29 EXTERNAL VIEWS OF MK. 45, MOD. 11 & 12 FUZES COMPLETE WITH AUXILIARY DETONATING FUZES.

Typical markings stamped to the base ring of the fuze are "Mark 45 Mod 12, Lot 20". Most models of the Mk 45 fuze have been manufactured under "T" numbers and issued to the Army for AA, howitzer, and field gun applications.

Safety Features

This fuze has a wet energizer of the reserve type. Therefore, there is no electrical energy in the fuze until the round is fired from the gun. It is equipped with the Mk 44 auxiliary detonating fuze and has a centrifugal switch and mercury unshorters as covered in more detail under the discussion of Mk 53 and Mk 58 fuzes. It will not fire in the bore or muzzle of the gun and is safe for all handling. The fuze is armed at about 600 yards range.

Target Response and Employment

The Mk 45 fuze was designed especially for anti-aircraft work and has a maximum influence radius of about 60 feet.

Since this fuze does not have the Wave Suppression Feature incorporated in later models, it is not very effective against low flying torpedo bombers and small surface craft except over a smooth sea. Burst heights over water range from 30-150 feet depending on range and water surface conditions. Its usefulness in shore bombardment at short ranges is limited because of the wide dispersion in burst heights in such an application.

The efficiency of the Mk 45 Mods 11 and 12 is about 50%

45 Mod 12 fuze than for the Mod 11 because of its shorter body. No individual fuzes (without projectiles) of this type have been supplied to the service although the Mk 58 fuze may later be supplied as a replacement for the Mk 45 Mod 12 for refuzing aboard ship.

No special handling of rounds fuzed with Mk 45 fuzes is necessary although dropping the ammunition more than 2 feet onto armor plate in certain positions may cause the electrolyte vial in the reserve energizer to break. This may result in a dud but does not make the round unsafe to fire.

NAVY VT FUZES MK 53 AND MK 58 - See Fig. 30

The Mk 53 and Mk 58 fuzes are used in the following guns:

Mk 53	Mk 58
5"/38	3"/50
5"/25	
5"/51	

These are the production models of VT fuzes for Navy AA guns. They have the highest efficiency of Navy VT projectile fuzes in their respective guns. (Ordnance specifications 3405 of 29 Jan 1945 stipulate that a 1/2 inch red band will be painted around Navy projectile bodies located 1/2" abaft a VT fuze. This, however, is not a positive recognition feature because the color of the band may be changed depending upon results of current discussions.)

Description

The Mk 53 fuze for the 5-inch projectile is replacing the Mk 32 and Mk 40. The lower fuze body is 5"0 long and 2"0 in diameter. Overall length is approximately 9"0 including the Mk 44 auxiliary detonating fuze. The upper fuze body consists of a steel base ring to which is molded a plastic cone. The tip may have a perforated steel nose cap molded inside it, or it may be capless.

In appearance the Mk 58 VT fuze is similar to the Mk 53 except that it is smaller in size. In fact, it is the smallest VT projectile fuze developed to date being only 7"75 long overall including the Mk 44 auxiliary detonating fuze. This fuze extends into the projectile 4"0 and this portion is 1"75 in diameter. The nose of the fuze is shaped to match the ogive of the 3-inch projectile.

Typical markings stamped into the base ring of the fuze are "Mk 58 Mod 0, Model JBlEa, Lot 3151". These fuzes are powered with wet energizers and have the Wave Suppression Feature to make them useful against low flying planes and surface craft. A positive self-destruction device is available for both these fuzes but has not been included in production to date. The self-destruction feature, if installed in later mods, will cause the AA projectile to burst after a certain time lapse if it misses the target and in that way protect outlying friendly ships and shore installations which otherwise might be struck if within range.

Safety Features

The Mk 53 and Mk 58 fuzes will not cause detonation in the bore or muzzle of the guns and are completely safe to handle. Besides the mechanical safety provided by the Mk 44 auxiliary detonating fuze, electrical safety is provided by the following arrangements:

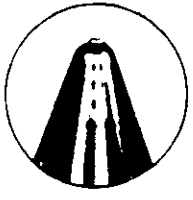
1. Wet energizer of the reserve type which is inert until the electrolyte vial is broken by forces of setback.

2. Mercury switches which short out the electrical squib until the projectile has rotated at a definite speed for a certain length of time; for example, 208 revolutions per second for 0.5 second in one Mod of the Mk 53 fuze.

3. A centrifugal switch which prevents a charge from accumulating on the firing condenser unless the projectile is rotating at a specific rate. This switch remains closed during normal handling but opens when the projectile is spinning at above a preset rate, thereby allowing the firing condenser to become charged.

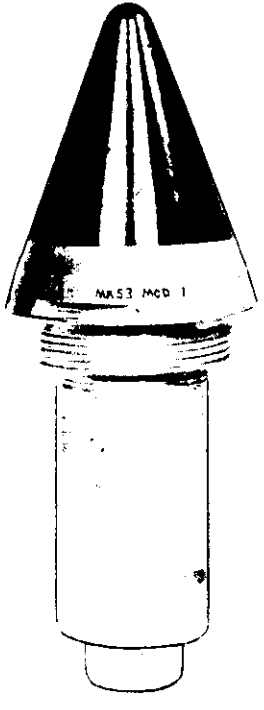
4. A high resistance in the firing condenser charging circuit, preventing sufficient energy to fire the squib from collecting on the condenser for a half second or so after the wet energizer is activated.

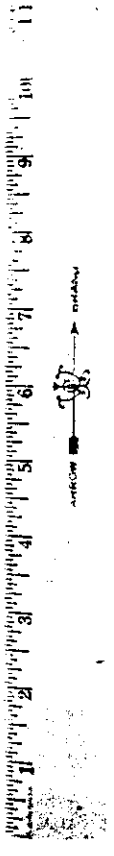
Except for possible blows on the fuze which might break or damage the nose, no special handling precautions need be taken. When projectiles equipped with Mk 53 or Mk 58 fuzes are dropped more than 4 feet against armor plate in certain positions, breakage of the electrolyte vial in the reserve



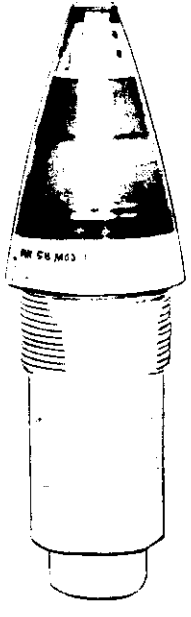
ALTERNATE
MK. 53 HEADS

MK. 53

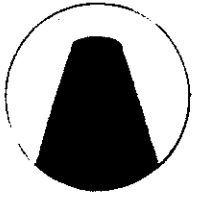




MK. 58



ALTERNATE
MK. 58 HEADS



. 30 EXTERNAL VIEWS OF MK. 53 & MK. 58 FUZES COMPLETE WITH AUXILIARY DETONATING FUZES

round may be a dud but is nevertheless safe to fire.

The Mk 53 Mods 0-2 fuzes are armed at about 800 yards while the Mod 3 is armed at about 500 yards from the gun. The Mk 58 fuze is armed at about 600 yards.

Target Response and Employment

The Mk 53 fuze for the 5-inch projectile has a maximum influence radius of about 80 feet while that of the Mk 58 fuze for the 3-inch projectile is about 60 feet. The Wave Suppression Feature is incorporated in both fuzes, in order to distinguish between the influence effect of a plane and that of waves or choppy water. They are fully effective against aircraft at altitudes above approximately 200 feet and are reasonably effective against aircraft flying close to the water. These fuzes are also useful in shore bombardment at all ranges and burst heights follow the contour of the terrain, bursting 10-25 feet above the surface.

Use of VT fuzes in 3-inch projectiles has not proven to be as efficient as in 5-inch projectiles. Approximately 80% of the Mk 53 fuzes will operate properly as new fuzes, while only 65% of the Mk 58 can be expected to function properly. Malfunctions likely to occur consist of approximately 10% duds. The remainder will be premature functions, i.e., functions spontaneously after arming but before approaching a target. After a considerable period of stowage in the fleet, the percentage of proper functions may decline somewhat due to aging of the fuze components.

Installation and Handling

The Mk 53 and Mk 58 fuzes fit specially cavitized projectiles with the adapter ring. The rounds in which they may be used are as follows:

Fuze	Round	Gun
Mk 53 Mods 0-3	Mk 36 Mod 2,3,4	5"/25
	Mk 31, all mods	5"/38
	Mk 35, all mods	5"/38
	Mk 35, all mods	5"/51
Mk 58	Mk 31, all mods	3"/50

All fuzes have been supplied in complete rounds to date. However, a booster adapter (Fig. 31) has been developed for the Mk 53 fuze to make it interchangeable with the Mk 32 or Mk 40. Replacement of Mk 32 fuzes with the Mk 53 Mods 1, 2 and 3 has been recommended wherever feasible. Substitution of the Mk 58 fuze for the Mk 45 Mod 12 is desirable wherever possible because of the Wave Suppression Feature in the Mk 58 and the better operation of the fuze. No supplementary charge is needed for installing the Mk 58 as a replacement for the Mk 45 Mod 12. The Mk 58 fuze is not interchangeable with the longer Mk 45 Mod 11.

To date the Mk 53 fuze has been issued in projectiles with no base fuze but the Mk 28 base detonating fuze may be authorized for use in this round shortly. No tracer will be used.

NAVY VT FUZE MK 47 AND MK 59 - See Fig. 32

The Mk 47, all Mods, and Mk 59, all Mods, fuzes are used with the following guns:

Mk 47	Mk 59
6"/47	5"/54
6"/53	

These fuzes are undergoing their final developmental phase and will be ready for production and issue shortly.

(Ordnance specifications 3405 of 29 Jan 1945 stipulate that a 1/2 inch red band will be painted around Navy projectile bodies located 1/2" abaft a VT fuze. This, however, is not a positive recognition feature because the color of the band may be changed depending upon results of current discussions.)

Description, Safety Features and Target Response

These fuzes are similar in appearance and construction to the Mk 53 fuze. The Mk 59 differs essentially from the Mk 53 in that its nose section is shaped to conform to the ogive of the 5"/54 projectile. Both units are wet energized, have the Wave Suppression Feature, and all of the safety features of the Mk 53.

Maximum influence radius will be 80 feet or slightly better for both fuzes. Like the Mk 53, they will have somewhat

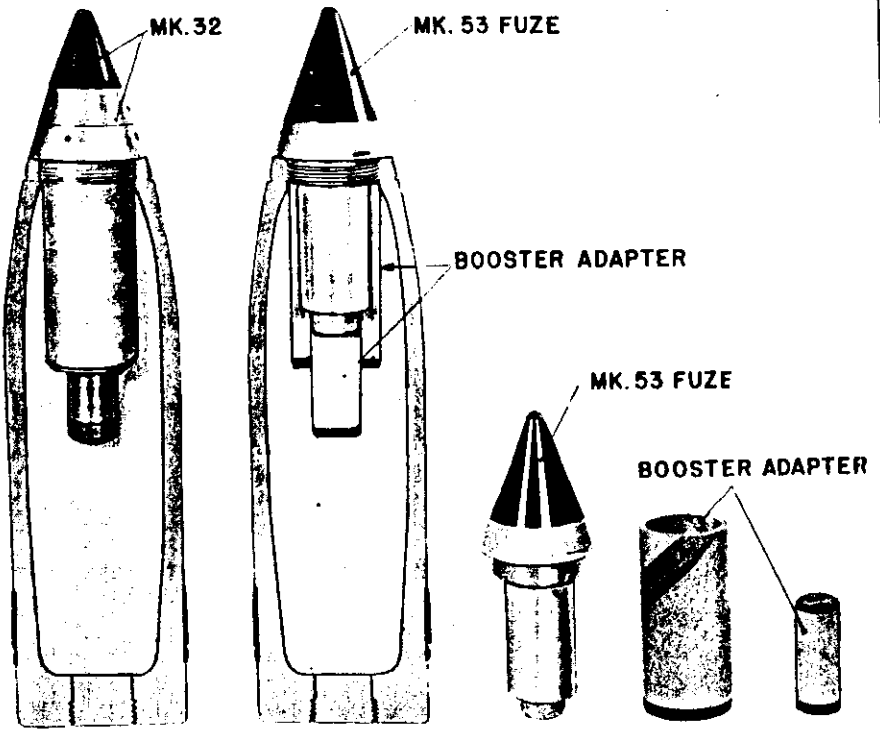


FIG. 31

CUTAWAY VIEWS SHOWING THE MK 53 FUZE AND BOOSTER ADAPTER ASSEMBLY REPLACING THE LARGER MK 32 FUZE IN A 5" PROJECTILE. THE BOOSTER ADAPTER PARTS ARE OF LAMINATED WOOD AND CONTAIN A TETRYL PELLET AS AN ADDITIONAL BOOSTER CHARGE.

flying aircraft (below 200 feet) due to the Wave Suppression Feature.

These fuzes are designed for AA firing but also have good properties for shore bombardment, giving burst heights 10-25 feet above the ground where effective fragmentation damage to personnel and light equipment can be achieved.

Installation and Handling

The Mk 47 fuze will be supplied to the service in deeply cavitized Mk 34 6-inch HC projectiles. These rounds may be issued with a Mk 28 base detonating fuze installed or may have only a gas checked base plug. No tracer can be used. While the Mk 47 fuze is physically interchangeable with the Mk 53, it is not functionally interchangeable and neither fuze will operate properly in the wrong round. The Mk 59 fuze will be used in the Mk 41 HC round

to the same rounds with standard fuzing so that no correction to the firing tables need be made. No changes in handling procedure for VT fuzes rounds are necessary. Standard nose caps for protection of the fuze in handling the ammunition are provided.

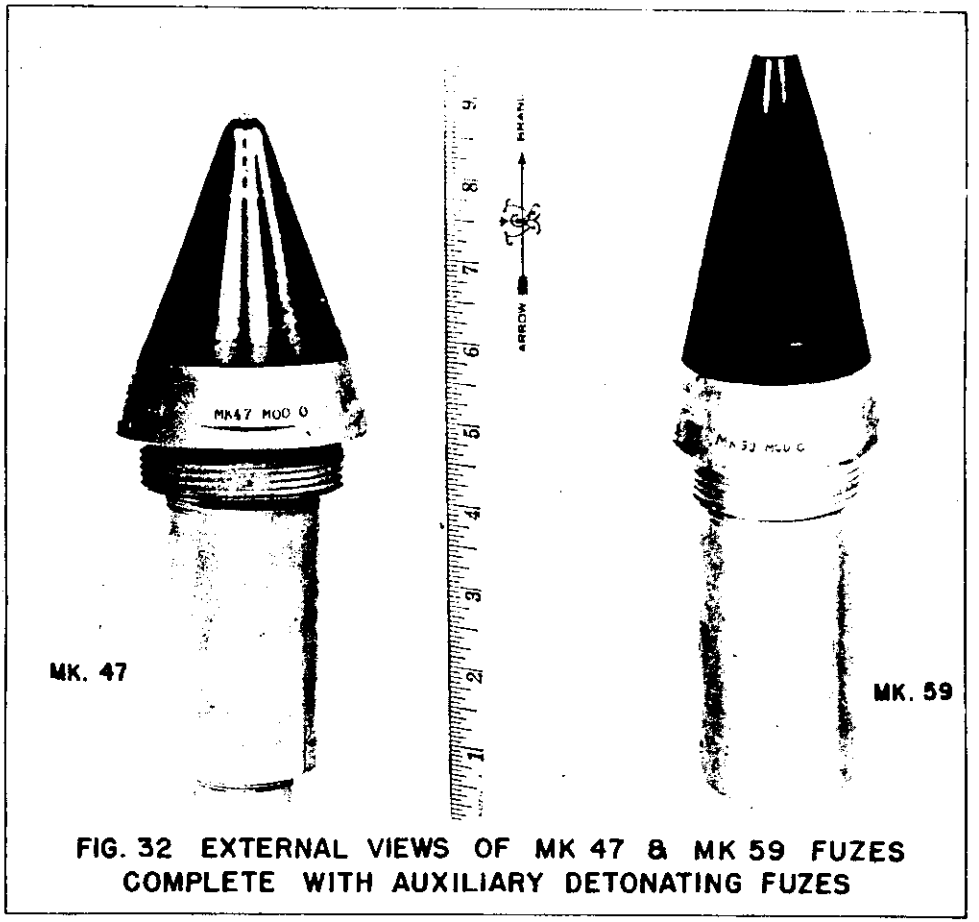


FIG. 32 EXTERNAL VIEWS OF MK 47 & MK 59 FUZES COMPLETE WITH AUXILIARY DETONATING FUZES

ARMY VT FUZES T74E6 and T152 - See Fig. 33

The T74E6 and T152 are designed for the Army's 90 mm AA gun. They are modifications of the Navy Mk 45 (3"/50) fuze and are in large scale production and service.

Description

Externally, these fuzes are identical to the Navy's Mk 45 Mod 11. They are 8".5 overall, including the Mk 44 auxiliary detonating fuze. That portion extending inside the projectile is 1".75 in diameter and 4".75 long. The nose of the fuze is composed of a steel base ring with a plastic cone molded to it conforming to the ogive of the projectile. A perforated steel nose cap may or may not be molded inside the nose tip.

The T74E6 and T152 VT fuzes have wet energizers of the reserve type and also incorporate a self-destruction element which causes the projectile to burst in the air on the downward branch of the trajectory if no target is encountered to protect outlying friendly troops and installations. They do not have the wave suppression feature.

Markings consist of numbers stamped into the steel base ring. A typical example of markings is "T74E6 B Lot 4013".

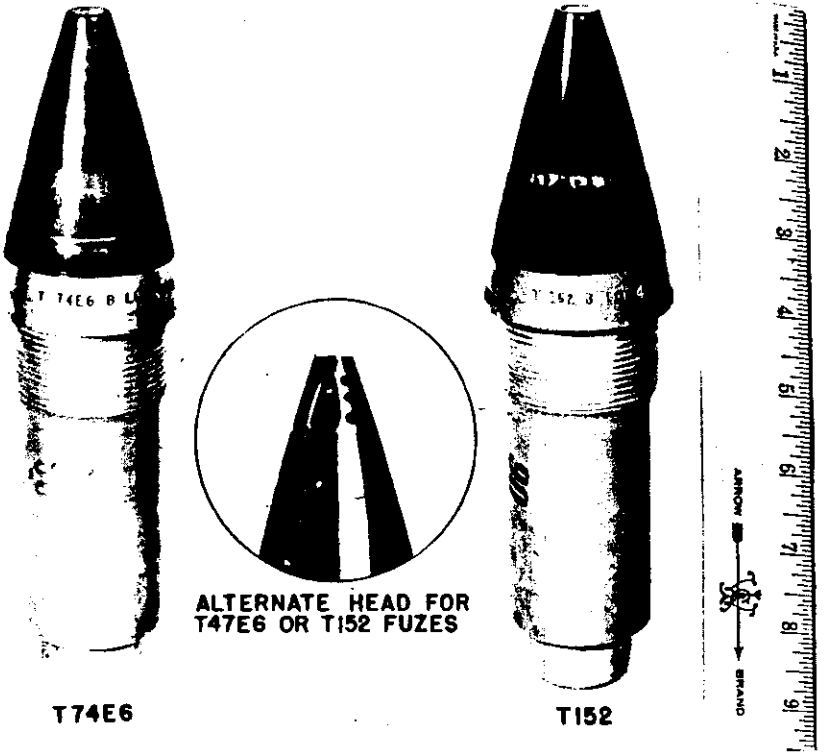


FIG. 33, EXTERNAL VIEWS OF T74E6 & T152 FUZES COMPLETE WITH AUXILIARY DETONATING FUZES

Safety Features

The T74E6 and T152 fuzes are entirely safe to handle. Safety features are the same as those of the Navy's Mk 53 type, including wet energizer, resistance-condenser electrical delay, mercury unshorters across the electrical squib, and the bore and muzzle safe features of the Mk 44 auxiliary detonating fuzes. They have a self-destruction switch instead of the centrifugal switch found in the Mk 53 fuze.

The self-destruction switch closes a circuit between the firing condenser and squib when the rate of spin of the projectile decreases to a certain preset value. It does not cause self destruction at any preset time after firing since in high angle firing, spinning decreases more slowly than on low trajectory firing. The only difference between the T74E6 and the T152 is the setting on the self-destruction switch. The T74E6 is set so that the switch will close and self destroy before the round is low enough to cause fragmentation damage to friendly troops if fired at gun elevations above 400 mils (22° 30'). This occurs after about 20 seconds at 400 mils elevation and may occur as late as 50 seconds at elevations approaching the vertical. The T152 fuze is designed for AA work against low flying planes and will cause self destruction at safe altitudes if fired at gun elevations above 200 mils (11° 15'). This occurs after about 8 seconds at 200 mils and after longer flight times at higher elevations runs up to 18 seconds. This somewhat reduces effective range of this fuze but is satisfactory against low flying targets.

detonate upon impact.

Target Response and Employment

The maximum influence radius of these fuzes with respect to most operational aircraft is about 60'. When fired at elevations below those recommended for self destruction, burst heights over terrain will range between 50' and 150'.

Since the T74E6 and the T152 are designed primarily for AA firing, they should not be used against enemy troops or ground installations. The reason for this is that the burst heights will be too high for effective fragmentation results. (The T80E6, page 43, is particularly adapted for use on the 90 mm projectile against terrestrial targets.) The T74E6 and T152 should always be fired at gun elevations high enough to allow self-destruction.

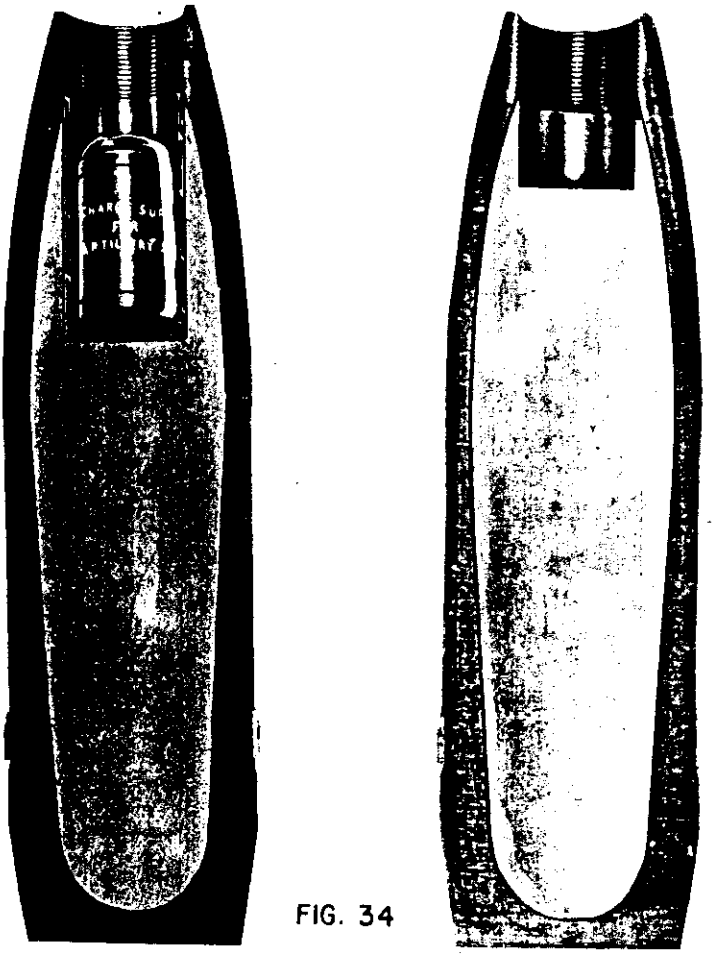


FIG. 34

ARTILLERY SHELL ON LEFT SHOWS DEEP FUZE CAVITY FOR VT FUZE. NOTE SUPPLEMENTARY CHARGE IN PLACE TO ADAPT SHELL FOR IMPACT OR TIME FUZE. SHELL ON RIGHT SHOWS STANDARD FUZE CAVITY WHICH IS TOO SHALLOW FOR VT FUZE.

Under normal conditions, 75% of the rounds may be expected to function normally, 15% may function after arming but before approaching a target, and the remainder will be duds. About 90% of these fuzes will be armed at 600 yards from the gun.

Installation, Handling and Stowage

The T74E6 and T152 VT fuzes are supplied to the Army in hermetically sealed containers. In order to accommodate one of these fuzes in an M71 90 mm projectile, the supplementary charge in the fuze cavity, shown in Fig. 34, must first be removed. Then the VT fuze can be screwed in and wrench tightened with the special wrench furnished. In case the VT fuze is to be replaced by a standard mechanical time nose fuze, the supplementary charge must be reinserted in the fuze cavity so that no space exists between the fuze and the HE filler.

Like other VT projectile fuzes, the T74E6 and T152 require no special care in handling. The plastic nose, however, should be protected from physical abuse for maximum fuze performance. They are best protected in their sealed containers and only enough fuzes should be opened for immediate require-

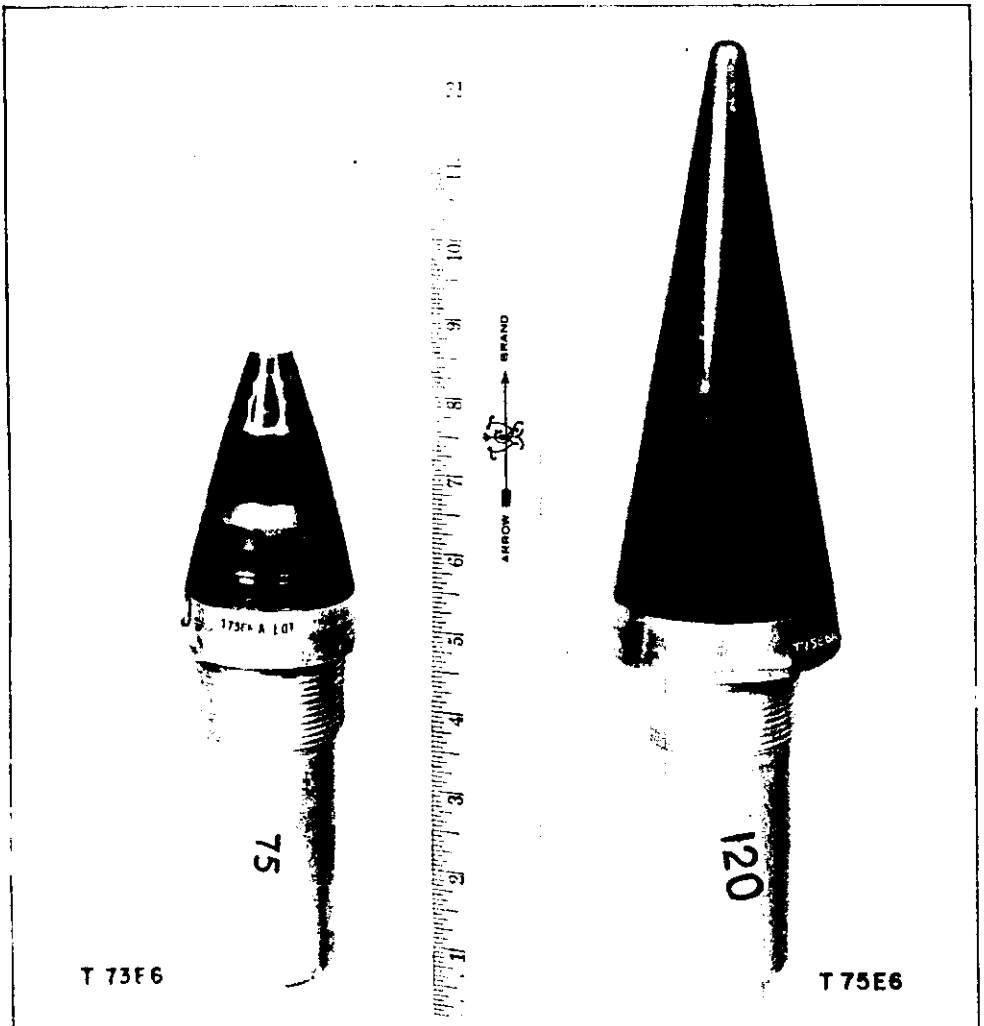


FIG 35 EXTERNAL VIEWS OF T73E6 & T75E6 FUZES

ments. Stowage temperatures should preferably be as close to normal as possible but the fuzes will function satisfactorily if their internal temperature is between 0-120° F. An increase in premature functions can be expected in heavy rain, but fog, smoke or darkness have no adverse effects on fuze behavior.

The size of projectile for which a fuze is suitable is indicated on the lower fuze body in the form of a rubber stamped impression; in this case it is "90" - for the 90 mm projectile.

ARMY VT FUZES T73E6 and T75E6 - See Fig. 35

These VT fuzes are for the following Army guns:

T73E6	T75E6
75 mm	120 mm

They are near the end of the development stage and will be in production and ready for issue shortly.

Description

The T73E6 fuze is identical in appearance to the T74E6. Typical markings are "T73E6 A Lot 437". The lower fuze body is marked in large numbers with the projectile size in which it is used--"75" - for the 75 mm projectile.

The T75E6 fuze has a long capless plastic nose to conform to the ogive of the 120 mm HE round. It is the largest Army AA fuze of the VT type. Dimensions of the lower fuze body are the same as for the T73E6 and T74E6 and include the Mk 44 auxiliary detonating fuze. Typical markings are, "T75E6 A Lot 746". The lower fuze body is marked "120" to designate the 120 mm round for which the fuze is designed.

These fuzes do not have the Wave Suppression Feature of the Navy AA fuzes but have the self-destruction switch.

Safety Features

Safety features of these fuzes are identical with the T74E6, namely, wet energizer, resistance condenser electrical delay, mercury unshorters on the squib, and centrifugal switch in the firing circuit. The self-destructio action has not been evaluated as yet but probably will be similar to the T74E6 (self-destruction when fired above 400 mils quadrant elevation) rather than the type in the T152 (self-destruction above 200 mils upon elevation).

Target Response and Employment

The maximum influence radius of the T73E6 fuze for the 75 mm round probably will be about 50' while the T75E6 fuze for the larger 120 mm round will probably be about 80'. These fuzes are not designed for firing against ground targets and will not be used for other than anti-aircraft work.

The T73E6 has been considered for use with the 75 mm aircraft cannon as well as the new T22 75 mm AA mount which has train control in sighting reaching a possible speed of 60° per second.

At their present stage of development, about 75% of the fuzes function properly on approach to a target. Approximately 15% may burst spontaneously some time after arming but before approaching a target and about 10% may be duds. These fuzes should be armed within 600 - 800 yards from the gun.

Installation and Handling

The T73E6 and T75E6 are furnished to the service in hermetically sealed cans and the rounds are fuzed in the field as needed. The T73E6 fits the M48, 75 mm, HE round and is installed in the deep fuze cavity after first removing the supplementary charge. The T75E6 fuze is used in the M73, 120 mm HE rounds after first removing the supplementary charge from the fuze pocket. If the VT fuze is to be removed and an impact or mechanical time fuze substituted, the supplementary charge must be reinserted before installing the shorter fuze.

These VT fuzes are completely safe to handle and are bore and muzzle safe. They should be stowed for use at temperatures between 0° F and 120° F and best results will be obtained if internal temperature of the fuze is in the more moderate portion of the range. At temperatures outside of this range, more malfunctions may be expected but safety is not reduced.

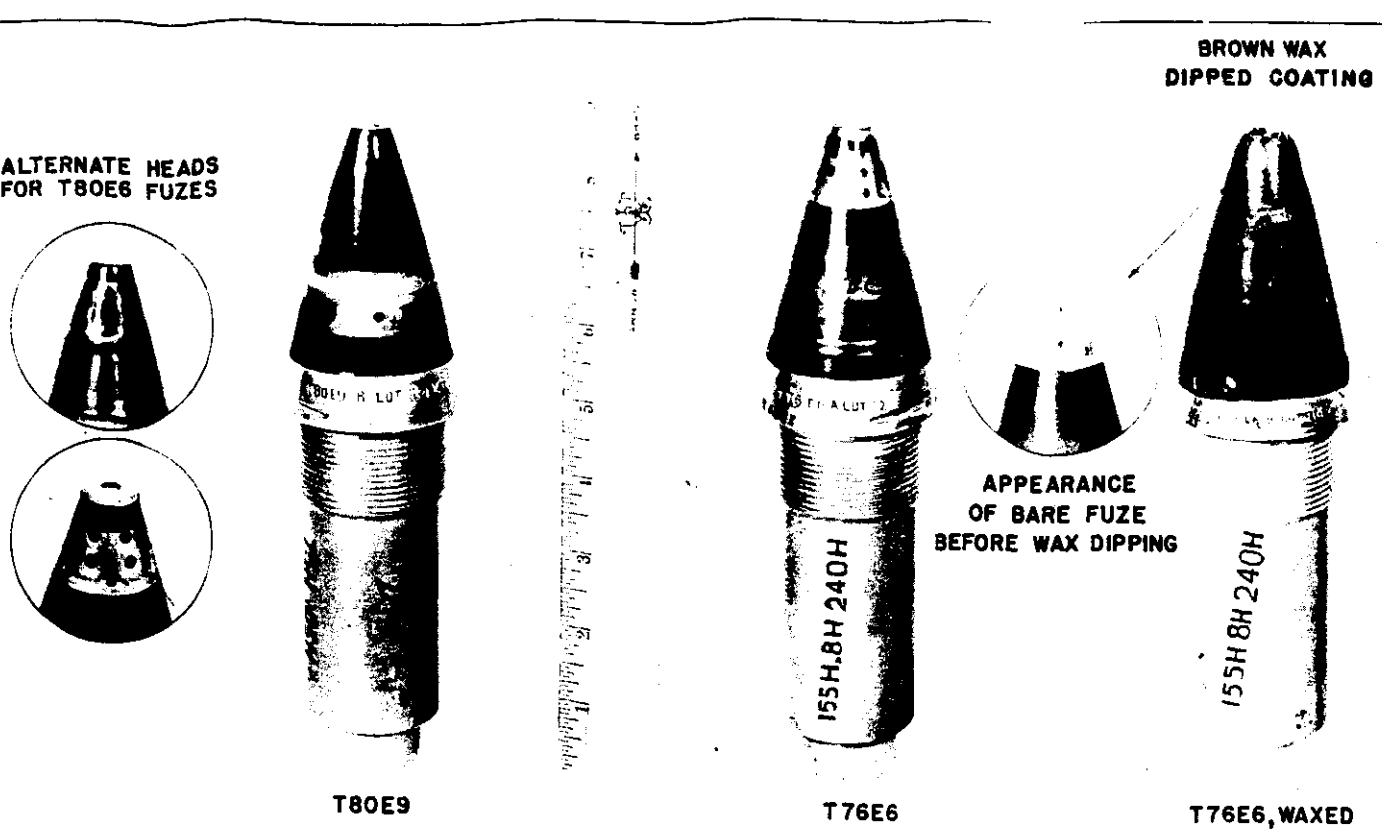


FIGURE 36,
EXTERNAL VIEWS OF T76E6 & T80E6 FUZES COMPLETE WITH AUXILIARY DETONATING FUZES

CONFIDENTIAL

These fuzes are used in the following Army guns:

T76E6	T80E6
155 mm Howitzer	75 mm Howitzer
8" Howitzer	105 mm Howitzer
240 mm Howitzer	90 mm Field Gun

Description

The T76E6 and T80E6 are identical in appearance to the T74E6 except for numbering on the upper fuze body. Typical numbering for the T76E6 is as follows:

"T76E6 A Lot 4651". This fuze is also issued as E8 and E9 mods. The classification letter may be A, B or C.

The T80E6 is marked similarly to the T76E6 but is issued also in Mods E7, E8 and E9.

The lower fuze body is marked with numbers indicating the rounds in which they are used. The T76E6 is numbered "155", "8", "240" while the T76 is numbered "75", "105" in large figures applied with a rubber stamp.

The upper body of these fuzes may be coated overall with brown wax which should not be removed prior to use.

These fuzes do not have the Wave Suppression Feature of Navy AA fuzes nor do they have the self-destruction feature of the Army AA fuzes.

Safety Features

Safety features of these fuzes are the same as for the T74E6 anti-aircraft fuzes and include the wet energizer of the reserve type, resistance condenser electrical delay, and mercury unshorter across the squib. A centrifugal switch designed for handling safety is also included in their safety features. This switch is similar to the self-destruction switch of the Army AA fuzes except that it opens at very low spin values and will not close while the projectile is in normal flight. However, it prevents an electrical charge accumulating on the firing condenser when the round is not spinning.

In order to protect friendly troops supported by artillery fire from early bursts occurring after arming, howitzer VT fuzes incorporate long arming delays. The length of arming delay varies with modifications E6, E7, E8 and E9. The shortest arming time is found in the E6 and the longest arming time in the E9. Actual arming time of a fuze in a certain weapon will depend on the propellant charge used because the propellant affects the rate of rotation (thereby affecting the time required for the mercury unshorter to run out) as well as the velocity of the projectile.

Minimum usable ranges of the T76E6 and the T80E6 fuzes in various weapons are as follows:

Fuze	Weapon	Min. Range
T80E6	75 mm Howitzer	1900 yd
	90 mm Field Gun	6000 "
	105 mm Howitzer	2400 "
T76E6	155 mm Howitzer	4000 yd
	8" Howitzer	6000 "
	240 mm Howitzer	9000 "

(NOTE: The E8 and E9 modifications have considerably longer minimum ranges.)

Target Response and Employment

The T76E6 and T80E6 are automatic aerial burst fuzes designed to initiate detonation of the round at such heights upon approach to the earth that maximum fragmentation damage against the target will be obtained. Burst heights over the ground vary between 10' and 100' depending on the angle of approach and rate of approach. In general, the steeper the angle of approach, the closer the burst will be to the surface. For burst heights obtained for each fuze in various rounds with different charges, see the Army's TB-9X-91.

Sensitivity of these fuzes is lower than that of AA fuzes in order to obtain optimum burst heights for best fragmentation effect. Although these

fuzes will mechanically fit in rounds used in AA fire, (as for instance, the 90 mm), they are not useful in AA work because of lower sensitivity and lack of the self-destruction feature to protect friendly ground troops.

Optimum heights of burst can be expected over average soil. Burst heights over moist soil will be slightly higher and burst heights over water will be approximately double those over average soil. The affect of soil and water in varying burst height is averaged over a rather large area and the fuzes do not burst high over small brooks, mud puddles, etc. Dense tree foliage will increase burst heights over land somewhat but will not raise burst heights by the amount of the height of the trees. At steep angles of fall, most bursts will occur below tree top level.

These fuzes do not arm or function properly with low howitzer charges as insufficient spin is imparted to the projectile. Charge numbers which are satisfactory are as follows:

Gun	Proper Charges
75 mm Howitzer	2, 3, 4
105 mm Howitzer	4, 5, 6, 7
155 mm Howitzer	5, 6, 7
8" Howitzer	6, 7
240 mm Howitzer	3, 4

In most howitzer applications, 90% of the rounds will function normally upon approach to the target, 5% will function prematurely (but after arming) and about 5% will be duds. A mechanical impact feature is being designed for VT howitzer fuzes to detonate upon impact those rounds in which VT action did not take place. At the higher velocities of the 90 mm field gun, approximately 75% of the T80E6 fuzes will function normally.

Burst heights of VT fuzes follow the contour of the terrain, producing a rolling barrage effect which is very useful in getting shrapnel into hollows, behind crests, and protected places. They are equally effective in fog, smoke and after dark. Heavy rains tend to increase the percentage of malfunctions of some models although not enough to render them ineffective.

Another advantage is that they are effective far beyond the range of mechanical nose time fuzes and will operate to the maximum extent of range.

When firing over crests, clearances should be 70 yards to prevent the fuze from functioning on the crest and wasting the round.

Installation and Handling

The T76E6 and T80E6 fuzes are supplied to the service in hermetically sealed containers packed 12 to a paper board carton and transported in steel shipping boxes. The nose of the fuzes may be coated with brown wax which should not be removed prior to use.

Special deeply cavitized shells are required for these fuzes. The supplementary charge must be removed from the fuze pocket before insertion of the VT fuze. Appropriate rounds are as follows:

Fuze	Round	Gun Size
T76E6, E8, E9	M107	155 mm Howitzer
	M106	8" Howitzer
	M114	240 mm Howitzer
T80E6, E7, E8, E9	M48	75 mm Howitzer
	M1	105 mm Howitzer
	M71	90 mm Gun

The fuzes should be maintained at temperatures between 0° F and 120° F in readiness for firing. They may be stowed at temperatures between -20° F and 150° F but should not be fired when at the extremes of the temperature range because more malfunctions will result. Safety is not decreased by firing at the extremes of temperature range, however.

- - - - - - - - - - -

REFERENCES: U. S. NAVY - OP 1480 (Preliminary) VT Fuzes for Projectiles, Description and Operational Use of.
U. S. ARMY - TB-9X-91, Fuzes T76E6 and T80E6
TP-9X-89, Fuze T74E6
TP-9X-83, Charge, Supplementary, T-2 for Artillery Shell
TB-9-1901-8, Shell, Artillery, for Fuze, VT

OTHER VT FUZES

CONFIDENTIAL

Since service use of VT type fuzes is relatively new to the field of U. S. explosive ordnance, many new, improved design features and applications can be expected in the near future. A few of these, together with one (T4) older model, are dealt with briefly below.

VT ROCKET NOSE FUZE MK 171 MOD 0

This fuze is designed for Navy type fin stabilized rockets particularly in air-to-air use. This fuze is still undergoing advanced development and should be ready in the near future for service. In appearance, operation, and handling, it will be very similar to the Mk 172 Mod 0 ring type, generator powered rocket fuze discussed previously in this bulletin.

PHOTO-ELECTRIC ROCKET NOSE FUZE T4

The T4 fuze is a photoelectric VT fuze for the M8 Army rocket. It is interchangeable with the T5 fuze for use from aircraft but is caused to function by changes of intensity of light falling on an annular electric eye mounted in the fuze ogive. A number of these fuzes have been manufactured and distributed to the service but probably will not be used extensively because of certain limitations. They are not satisfactory for use between 1 hour before sunset to one hour after sunrise, tend to malfunction when the trajectory is such that the direct rays of the sun hit the electric eye, and tend to function on changes of color or light intensity reflected from changing terrain beneath them. Production has been stopped on this fuze and will probably not be resumed. For more specific information, see the Army's TB-9X-94.

VT BOMB FUZE T82

This is a Bar type bomb nose fuze, differing from the T51E1 in the absence of rotating vanes and a shorter overall length. The vane drive of the electric generator is replaced by an air turbine drive, with the turbine closely coupled to generator in the lower part of the fuze body. An air entry port is located in the center of the fuze face and air exit ports in the body near the fuze base. By this arrangement, a more smoothly running, quieter mechanical system is obtained which is reflected in higher operating efficiency and greater freedom from early bursts.

Sensitivity is such that 75% of the bursts will fall between 40 feet and 60 feet when dropped from an altitude of 10,000 feet at plane speeds of 200 m.p.h. in the 260-lb M81 fragmentation bomb. Burst heights are relatively independent of release altitude, release speed, and bomb size.

The fuze incorporates the booster safety pin and the delayed arming device, T2E1, can be used to increase SAT. Present operating temperature range is -40° to 160° F and efforts are being made to extend the range to -65° F.

Installation of the fuze is similar to the T51E1 fuze except that no vane arm is used. The spring loaded arming pin fits in a bracket near the base of the fuze and extends into the fuze, preventing the air turbine from rotating until the arming wire is pulled.

These fuzes may be encountered in field service tests within a few months.