

VT FUZES FOR BOMBS

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RESTRICTED SECURITY INFORMATION

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RESTRICTED SECURITY INFORMATION

ORDNANCE PAMPHLET 1444 (SECOND REVISION)

VT BOMB FUZES

1. Ordnance Pamphlet 1444 (Second Revision) describes VT Bomb Fuzes for use by the Navy.
2. All available information on VT Bomb Fuzes which is necessary for use by Navy personnel, and is appropriate for promulgation under RESTRICTED SECURITY INFORMATION classification, is included in this publication.
3. This publication supersedes OP 1444 (First Revision) and NAVORD Instruction 0866.2, which should be destroyed.
4. It is not intended that this publication be carried in aircraft for use therein.
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A handwritten signature in cursive script, reading "M. F. Schoeffel", is located in the lower right quadrant of the page.

M. F. SCHOEFFEL,
Rear Admiral, U. S. Navy,
Chief, Bureau of Ordnance.

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1. Introduction

The VT bomb nose fuzes described in this publication are designed to produce air bursts automatically. Except for two models, no preliminary setting or adjustment is required. This type of fuze is actuated by the influence of the target, and detonates the bomb in the air as it approaches its objective. Thus, the burst occurs at the most effective point in the bomb's trajectory, just as it would if a carefully set time fuze were used, figure 1. In contrast with the time fuze which is controlled by the distance the bomb travels along its trajectory (that is, by the elapsed time after release), the VT fuze is governed solely by its proximity to the target.

The VT fuze is essentially a radio transmitting and receiving unit. In free flight, it transmits a radio signal and receives a signal reflected by the target. At the proper time, the reflected signal causes an electronic switch to close and fire an electric detonator.

VT bomb nose fuzes are physically (but not tactically, since they function before impact) interchangeable with Nose Fuze, type AN-M103A1.

This publication contains instructions for using the VT bomb nose fuzes listed in table 1. These fuzes are now included in the allowances of operating forces and are available for issue. Although it has been permanently suspended from issue and use, VT Bomb Nose Fuze, type T92, is included because a few fuzes of this type may still remain in depot stocks.

To supplement information and instructions given in this publication, and if feasible, Department of the Army Film Bulletin No. 197 (Navy No. MA6294), VT Bomb and Rocket Fuzes, should be exhibited for training armament and aircraft operating personnel.

2. Security

VT fuzes give our military forces special tactical and technical advantages over the forces of other nations. These advantages will remain ours alone only while the details of VT fuze design and construction are kept from falling into unfriendly hands.

Every possible precaution must be taken to make certain that neither information about VT fuzes nor VT fuzes themselves fall into enemy hands. For this reason, VT fuzes are given high security classifications (see Bureau of Ordnance Circular Letter NAVORD OCL A9-48, dated 27 July, 1948). NAVORD OCL A9-48 also contains instructions for maintaining security. The importance of VT fuzes makes it essential that all security instructions be strictly adhered to.

Under no circumstances may any publicity regarding VT fuzes be released without approval of the Bureau of Ordnance.

When VT fuzes are issued to combat units for immediate training and/or operational use, or when on board combatant naval vessels as part of their service allowance, they may be down graded to RESTRICTED. However, this down grading applies only to the handling and care of fuzes on board ship, and in no way changes the requirements for guarding technical information on VT fuze design and construction.

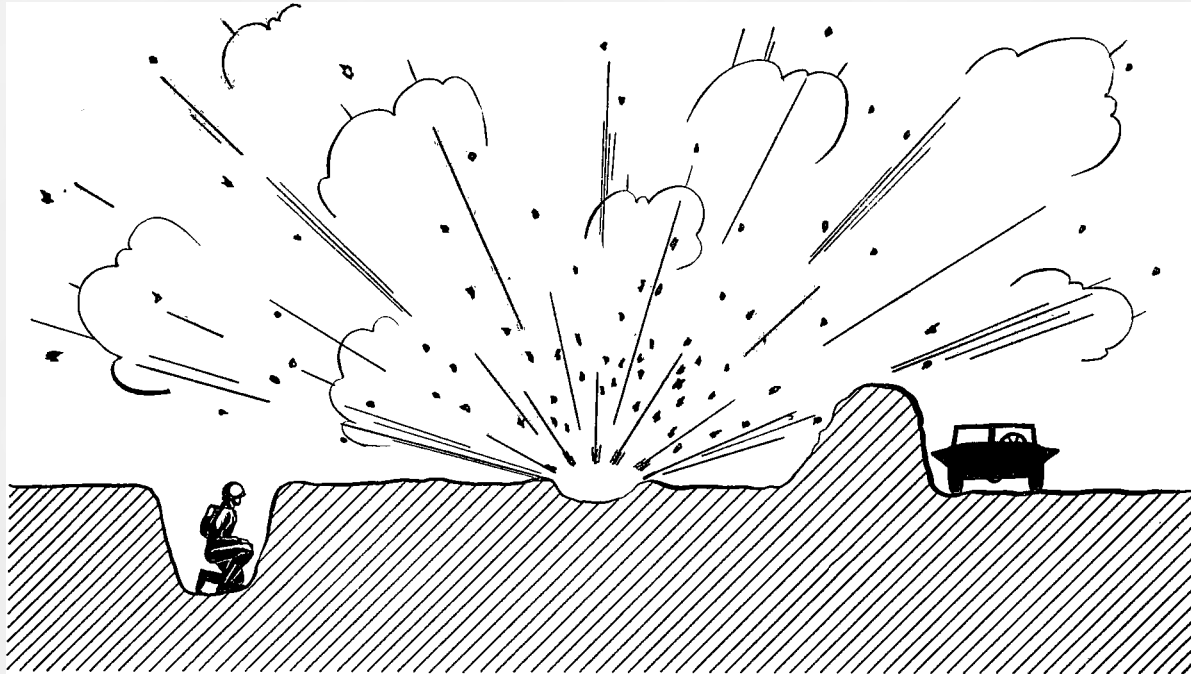
3. Tactical Use of VT Bomb Fuzes

VT bomb fuzes are advantageous in any air-to-ground operation where air bursting the bombs at heights from 20 to 120 feet above the target increases bomb effectiveness. Obviously, these fuzes are distinctly not suitable for use against targets which require penetration and detonation within the target for effective destruction.

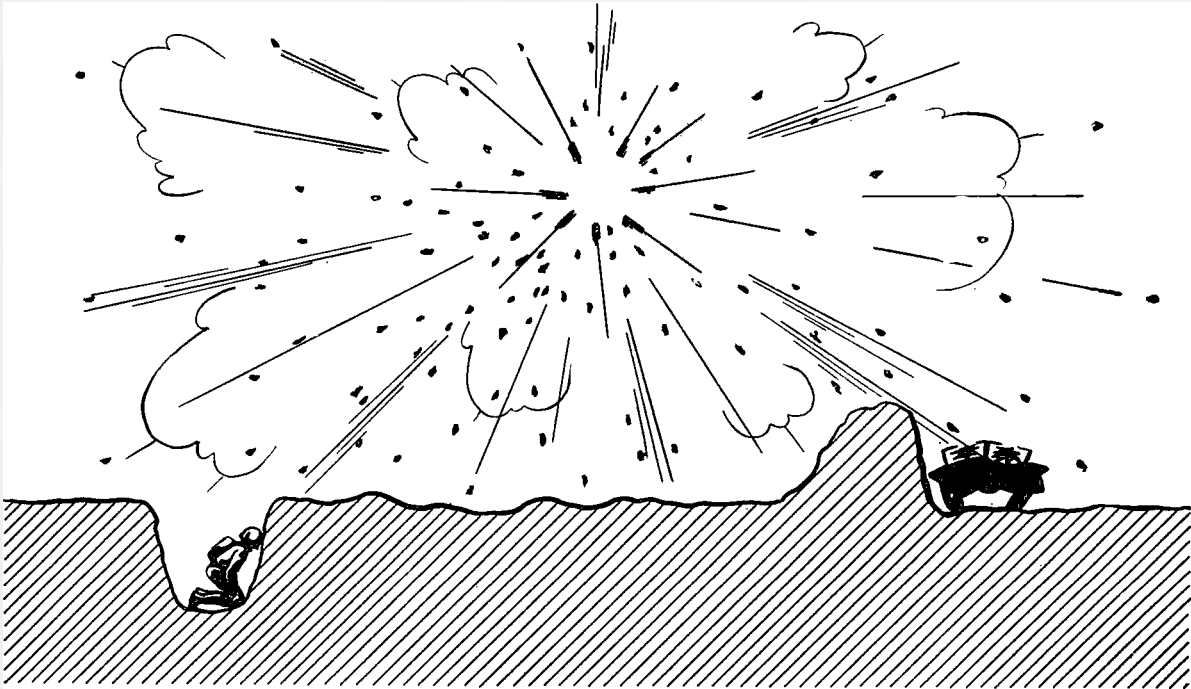
Information and instructions for the tactical use of VT bomb fuzes by naval forces are promulgated only by the Air Warfare Division, DCNO (Air), Office of the Chief of Naval Operations.

4. Characteristics of VT Bomb Nose Fuzes

Fuze Types. Table 1 lists the VT bomb nose fuzes covered herein, and gives basic information on each model. These fuzes are satisfactory for interchangeable use with all bomb sizes listed in the table. For best results with respect to burst heights, however, it is advisable to use the fuze-bomb combinations shown in the table. More complete information on fuze characteristics and features is given in later paragraphs.



INSTANTANEOUS IMPACT PATTERN



AIR BURST PATTERN

Figure 1—Comparison, Instantaneous and Air Bursts.

Table 1
Fuze Models and Characteristics

Fuze model	Minimum safe air travel (MIN SAT) (feet)	Type	Bomb size	Safety pin in booster end	Adapted for arming delay
AN-M168, M-168, T-91E1.	2000	Ring---	GP, AN-M30, 100 lb; GP, AN-M57, 250 lb; FRAG, AN-M88, 220 lb; FRAG, AN-M81, 260 lb; GP, AN-M64, 500 lb; GP, AN-M66, 2,000 lb.	Yes	Yes.
T-91-----	2000	Ring---	Same as AN-M168-----	Yes	Yes.
T-93-----	2000	Ring---	GP, AN-M30, 100 lb; GP, AN-M57, 250 lb; FRAG, AN-M81, 260 lb; GP, AN-M64, 500 lb; GP, AN-M65, 1,000 lb.	Yes	Yes.
*AN-M168E1----	2000	Ring---	Same as T-93-----	Yes	Yes.
T-50E3-----	3100	Ring---	GP, AN-M64, 500 lb; GP, AN-M65, 1,000 lb.	No	Very few.
T-90-----	3600	Ring---	GP, AN-M64, 500 lb; GP, AN-M65, 1,000 lb.	Yes	Yes.
T-89-----	3600	Ring---	Same as AN-M168-----	Yes	Yes.
T-50E4-----	3600	Ring---	GP, AN-M64, 500 lb; GP, AN-M65, 1,000 lb.	No	Very few.
T-50E1-----	3600	Ring---	Same as AN-M168-----	No	Yes.
AN-M166, M166, T-51E1.	3600	Bar---	Same as AN-M168, plus GP, AN-M65, 1,000 lb.	Yes	Yes.
M166E1-----	2000	Bar---	Same as AN-M166-----	Yes	Yes.
T-92-----	2600	Ring---	Permanently suspended from issue and use.		

*Same as T-93 except that thumbscrew is omitted.

The two basic types of VT bomb nose fuzes can be identified readily by their external appearance. The ring type fuze, figure 2, has a heavy metal ring around its arming vane; while the bar type fuze, figures 3 and 4, has two heavy metal bars extending radially, like handles, from the fuze nose.

These two types of fuzes differ in behavior as well as appearance. In general, the heights of

normal bursts of both ring and bar type fuzes depend upon a number of independent factors. These factors are target reflectivity, target approach conditions (bomb striking angle and speed), manufacturing tolerances in fuze parts, fuze-bomb combination, and others. Under combat conditions, freedom of control is feasible on the fuze-bomb combination factor only.

Bar type fuzes generally produce somewhat

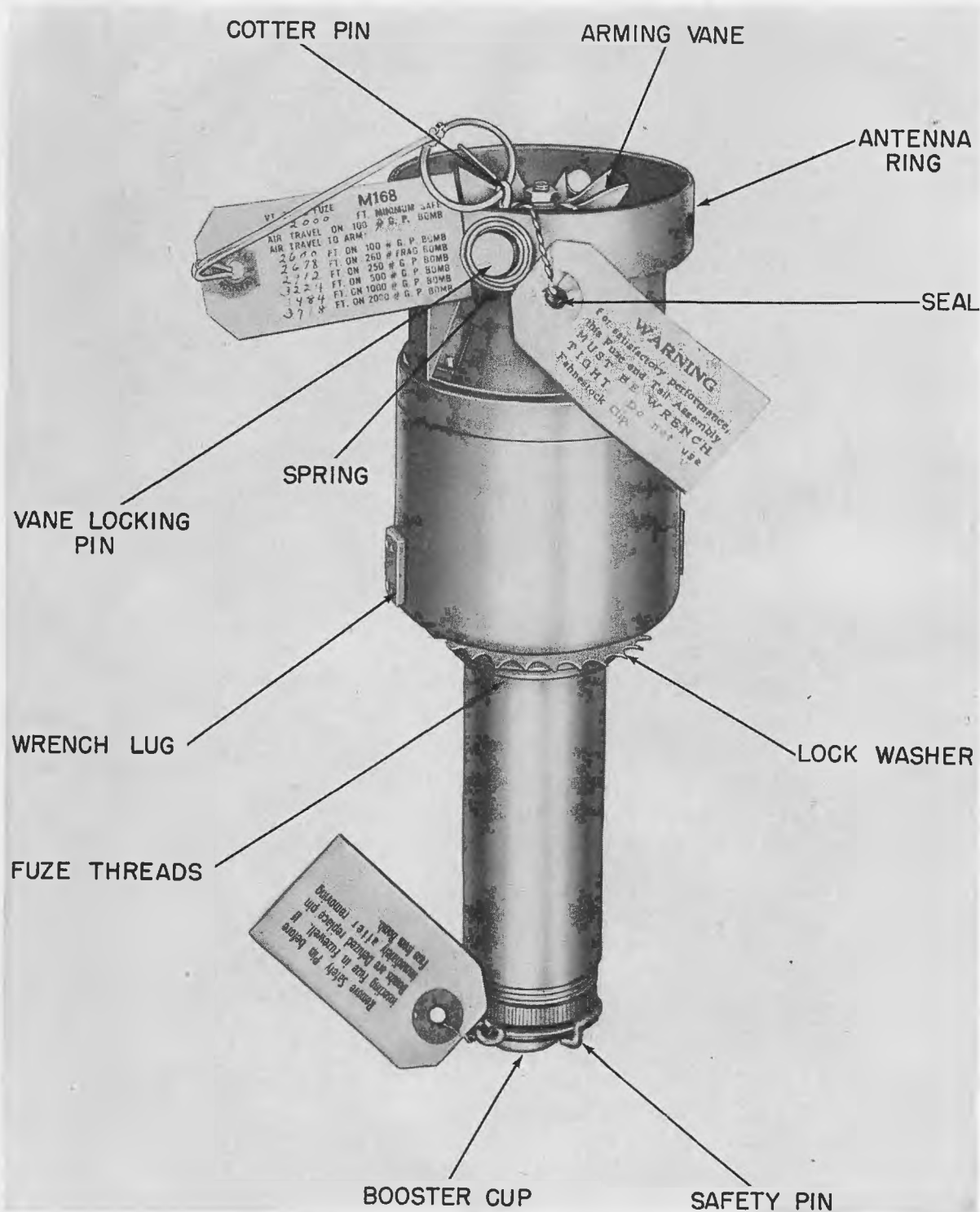


Figure 2—Ring Type VT Bomb Nose Fuze, Model M168.

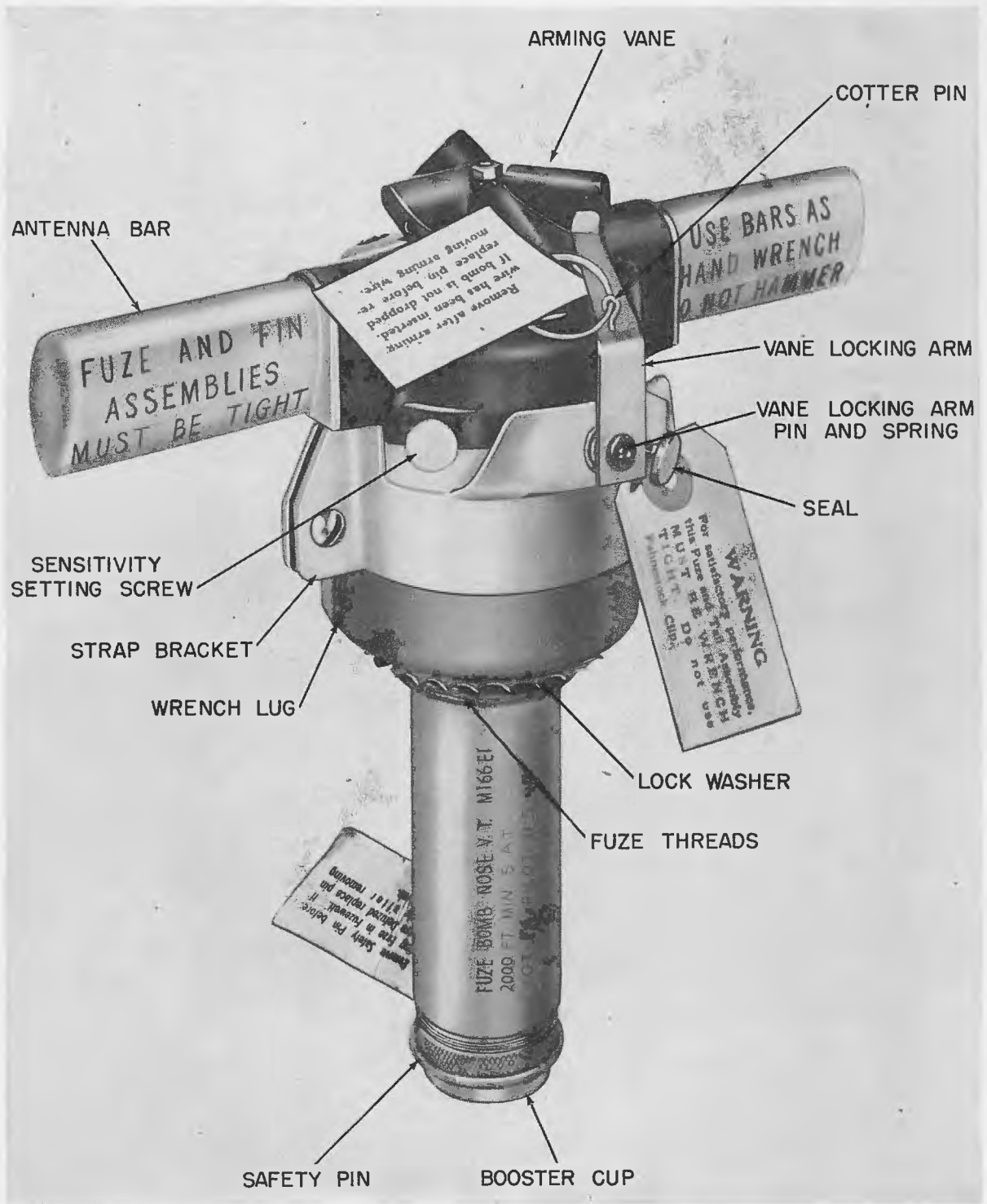


Figure 3—Bar Type VT Bomb Nose Fuzes, Model M166E1.

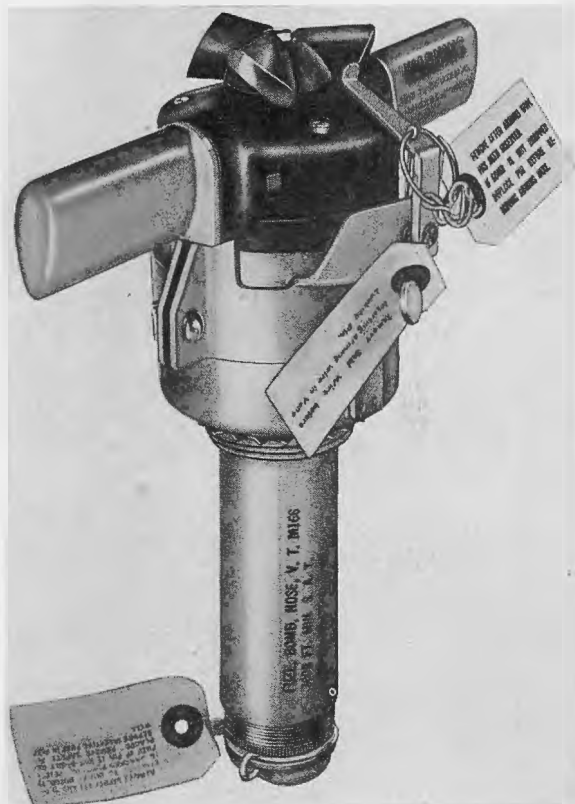


Figure 4—Bar Type VT Bomb Nose Fuze, Model M166.

higher bursts than ring type fuzes, and are less apt to show a variation in burst height as the bomb type is varied. The bar type fuzes give higher burst heights for steep angles of approach to the target; the ring type fuzes produce higher burst heights for shallow angles of approach.

Either type of fuze, when used over average land, and under the conditions covered by these instructions, will burst in a majority of releases within 20 to 125 feet from the target. For both types of fuzes, average burst height over sea water is about twice as great as over average land. Burst heights are somewhat lower over arid land and over snow or ice than over average land.

The burst height function of the M166E1, bar type, fuze can be controlled to give normal or reduced sensitivity. When a clearly labeled thumbscrew, figure 3, is removed (normal

sensitivity), this fuze will give a burst height within the range of 50 to 125 feet, under most release conditions. Under any given set of conditions, use of the M166E1 fuze with the thumbscrew in place (reduced sensitivity), results in burst heights about half those produced with the normal sensitivity setting.

The T-93 fuze, figure 5, is designed to fire on approach to both ground and airborne targets. With respect to ground targets, burst heights for this fuze are the same as other ring type VT bomb fuzes described herein. The T-93 fuze is conditioned to fire on approach to airborne targets, by removal of a clearly marked thumbscrew on the fuze body. **IT IS NOT INTENDED THAT THE AIR-TO-AIR APPLICATION OF THIS FUZE BE USED BY NAVY OPERATING FORCES.**



Figure 5—Ring Type VT Bomb Nose Fuze, Model T93.

When the T-93 fuze is conditioned for air-to-air use by removal of the thumb screw, bomb detonations will take place after about 7500 feet of vertical fall from horizontal release, if the fuze has not been functioned by passing within the influence range of an aircraft target during the drop. In this respect, the fuze has self-destruction action. The vertical fall of 7500 feet will apply after the Arming Delay M1 and M1A1 has functioned and separated from the fuze, if this device is used to obtain longer arming travel distance.

DO NOT REMOVE THE KNURLED-HEAD THUMB SCREW. Once the thumb screw has been removed, it cannot be replaced without possible impairment of the fuze circuit. T-93 fuzes from which knurled head screws have become detached accidentally, or fuzes with knurled head screws missing, shall be considered damaged and handled as Confidential VT fuzes in accordance with the provisions of enclosure (A) paragraph 2 (b) 3 of NAVORD OCL A9-48 of 27 July 1948.

Knurled-Head Thumb Screw

Ideally, the selection of the VT fuze-bomb combination for use against any specified target is dictated by the burst height required to inflict maximum damage on that target. Under operational conditions, however, the desirable burst height is seldom known. Nevertheless, for bombs listed herein, close to maximum damage on a wide variety of tactical targets is obtained from bursts ranging from 20 to 125 feet. Therefore, attempts to exercise rigid control of burst heights by restricting the fuze, bomb, and release conditions, are not advisable. An arbitrary choice—dictated by operational conditions—of any of the VT bomb fuzes, bombs, and release conditions, is usually satisfactory. However, for target conditions (e. g., unshielded personnel and material deployed in open terrain) such that a low burst height results in relatively greater damage, use of the reduced-sensitivity (thumb screw in place) bar type fuze M166E1 is recommended.

Fuze Sensitivity, Figure 6. Ring type fuzes are most sensitive to passing potential targets. That is, they receive the strongest return signals

from objects abreast of the fuze. Bar type fuzes, however, are most strongly affected by targets directly in their paths.

Since they are most sensitive to passing targets, ring type fuzes are affected by the angles at which they approach the target. The approach angle depends on altitude, air speed, and angle of approach of launching aircraft when the bomb is released.

Bar type fuzes are practically independent of any striking angle effect, since they are most sensitive to targets directly in their paths.

There are inevitably small differences between the many corresponding component parts of fuzes and, hence, many small differences in assembled fuzes even of the same type. As a result, there are variations in the actual heights at which individual fuzes function and, in general, fuzes of the same type do not detonate at the same height even when all other conditions are identical. Figure 7 shows the spread of burst heights to be expected with a typical group of VT fuzes.

Reliability of VT Fuzes. Development of VT bomb fuzes has reached a point where more than 85 percent can be expected to function effectively. Fuzes which fail to function effectively: may function too soon, earlies; or may not function at all, duds. Earlies cannot occur until the fuze is fully armed, and do not endanger the releasing aircraft unless the precautions given in this publication are ignored.

Fuze malfunctioning results in either early detonation or a dud. An early occurs when the fuze functions after it is fully armed but before the bomb has reached a point where the target influence is great enough to trigger the fuze. A dud, is a fuze which, for some reason, fails to detonate.

It may be difficult to tell from the releasing aircraft which type of malfunction occurs. However, certain characteristics which can be observed either from the aircraft or in photographs do make identification possible, as explained in the following paragraphs. Reports by combat crews, giving numbers and types of malfunctions, assist ground crews in taking preventive measures.

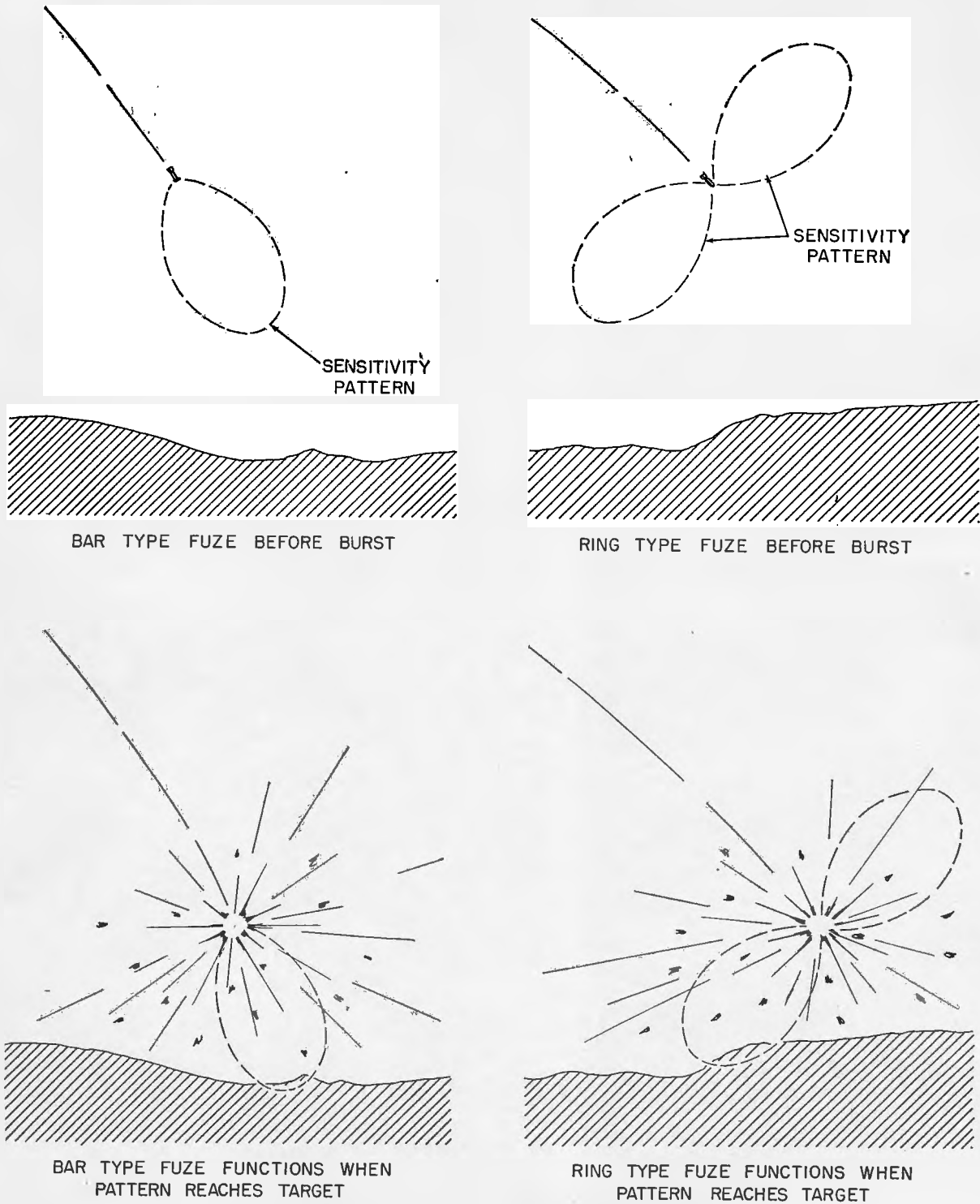
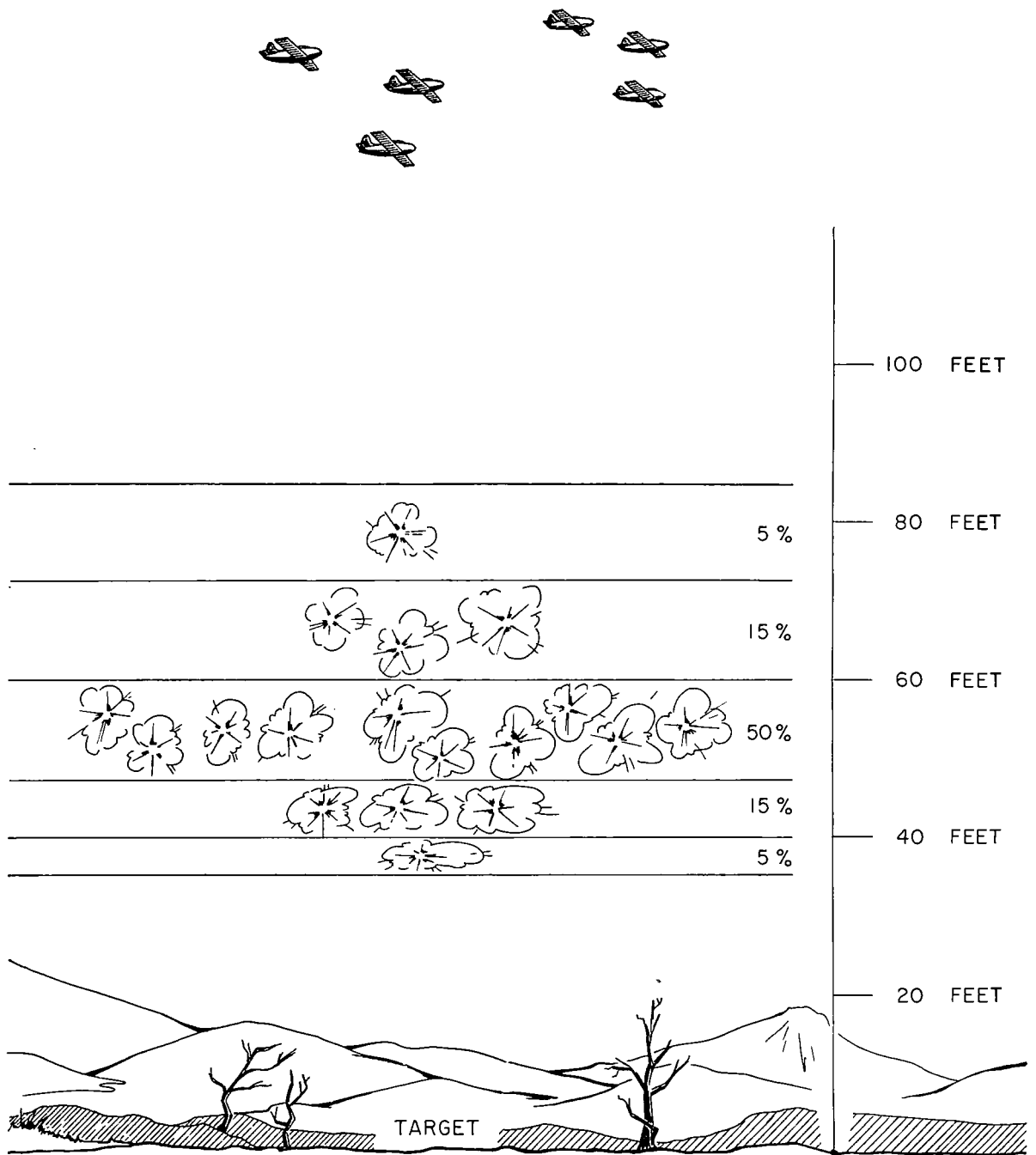


Figure 6—Sensitivity, Ring and Bar Type Bomb Fuzes.



(REMAINING 10% OF BURSTS ARE WIDELY SCATTERED)

Figure 7—Dispersion of Bursts in Height, Typical Group of VT Bomb Fuzes; Release Altitude 3,000 Feet, Speed 250 Knots, Dive Angle 50 .

EARLIES MUST BE EXPECTED. The nature of these fuzes is such that it may be some time before further development entirely eliminates the tendency of some of them to function too soon. Under clear weather conditions, the number of earlies should not exceed 15 percent of the fuzes used. An excessive number (more than 25 percent) of earlies may result from use under adverse weather conditions or from faulty handling of the fuzes. In those cases in which an excessive number of earlies cannot be ascribed to adverse weather or faulty handling, the fuze lot(s) involved should be considered suspect of reduced quality in performance (but not in safety) and appropriate reports should be made to the Bureau of Ordnance.

When observed from the releasing aircraft, earlies may be recognized by the following indications:

A. Irregular timing sequence of detonations in train.

B. An unusually short time lapse between release and detonation.

C. If the target is visible, by not conforming to the ground disturbance pattern, figure 8.

Occurrence of dud fuzes may be largely compensated for by using a tail fuze, as well, on each bomb. Tail fuzes should always be used to minimize the chances of any undestroyed VT fuze falling into enemy hands.

Observed from the releasing aircraft when a tail fuze is used, the failure of the VT fuze is indicated by the characteristic circular pattern and crater resulting from the non-delay burst of the tail fuze.

Train Spacing. VT fuzes are designed to respond to sudden changes in their surroundings. Hence, an armed VT fuze may function because of bursting of a nearby bomb. This affects the minimum train spacing that can be used with VT fuzed bombs. Since the bursts of large bombs are more violent than

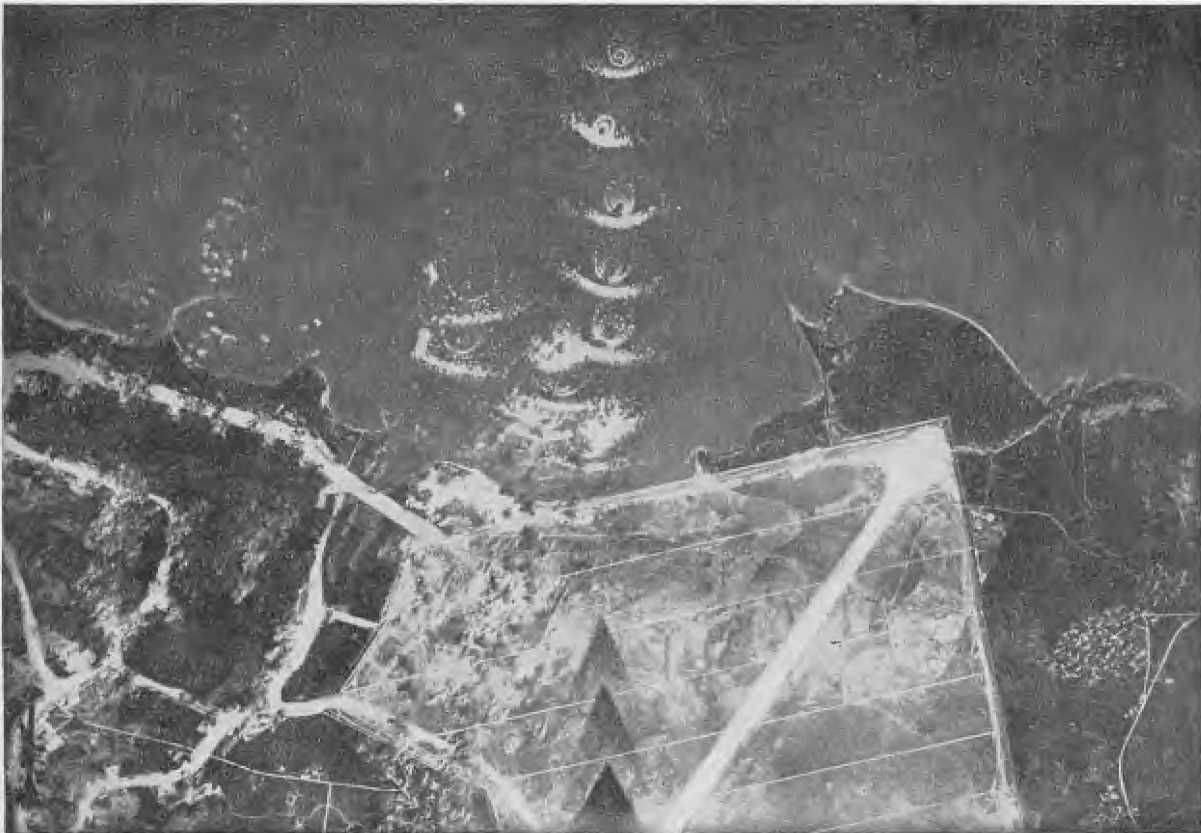


Figure 8—Surface Fragmentation Patterns, Air Bursts.

those of small ones, minimum train spacing must be greater for larger bombs.

"Armed Salvo" and "Minimum Train" releases cause increased numbers of early functions. An intervalometer spacing of 50 feet or more for the 100-pound GP bomb AN-M30 or the 260-pound fragmentation bomb AN-M81, or of 100 feet or more for the 500-pound GP bomb AN-M64 or larger bombs, gives satisfactory results. Intervalometer spacing for bombs filled with chemicals, may be about 50 percent less than for the corresponding HE loaded bombs. Smaller intervalometer spacings than these may cause an excessive number of earlies.

Only one VT fuzed bomb should be released in each dive approach to a target.

Heavy rain falling in large drops, clouds, snow, and hail, are likely to cause an excessive number of earlies. Haze, sunlight, and darkness have no effect on VT fuzes.

Arming Time. VT fuzes cannot function until they are fully armed: the greater the distance the bomb falls while the fuze is arming, the safer is the aircraft, and the fewer are the earlies. There is no restriction on air speed at the time of release. It should, however, be kept in mind that, for a given safe air travel (SAT), the "separation distance" in horizontal flight (the distance from the releasing aircraft to the bomb when the fuze becomes armed) varies inversely, approximately as the square of the release speed. The higher the speed, the closer the bomb will be to the aircraft when the fuze is armed. Separation distances for various conditions of horizontal and dive bombing are given in tables 3 through 9.

Whenever operating conditions dictate reduction in the risk of damage to aircraft by early fuze function, use of Arming Delay M1 or M1A1 will delay fuze arming (see par. 7, Arming Delay, Air Travel, M1 (T2E1) and M1A1 (T2E2)). This device increases fuze safe air travel and thereby provides greater separation distance between the bomb releasing aircraft and the region of fuze arming, figures 11 and 12. As indicated by tables 3 through 9,

added increments of arming delay safe air travel require higher minimum release altitudes for the various bomb-fuze combinations under the listed release conditions, to insure completion of arming so that fuzes can function at effective burst heights over the target.

It is advisable to use the Arming Delay when releasing VT fuzed bombs from high altitudes (10,000 feet and up), because there is less probability of early functioning if the fuze arming is delayed by safe air travel. For release altitudes up to 10,000 feet, however, all fuzes described herein may be expected to perform according to the design characteristics given in paragraph 4 with respect to early functions.

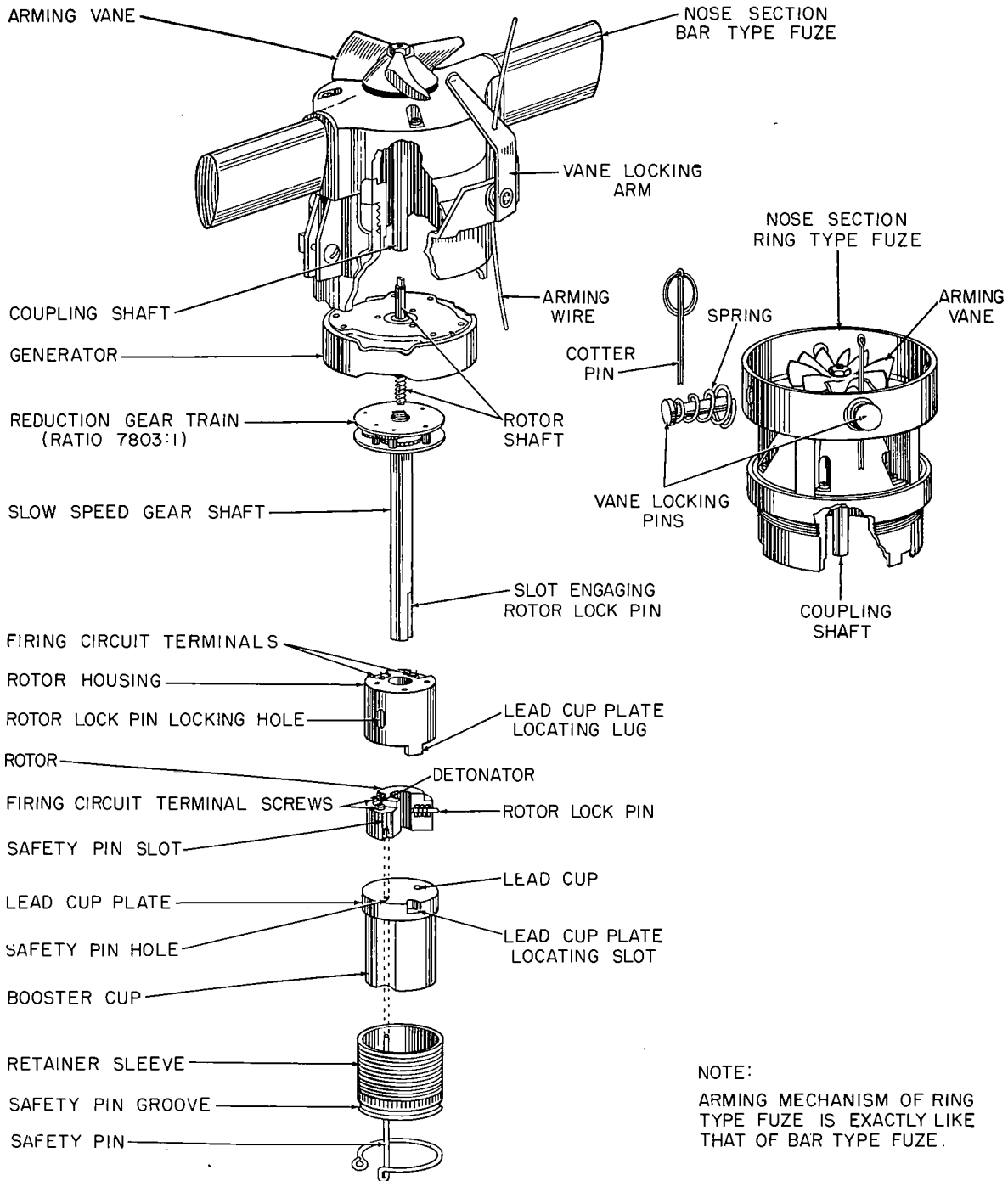
In general, bombs fuzed with VT fuzes will have approximately the same ballistics as those fuzed with AN-M103 or AN-M103A1 fuzes, when released at altitudes not higher than 10,000 feet. At higher altitudes, unknown changes may be expected in bomb ballistics.

The VT fuzes covered herein can be stored and used safely and without adverse effects on their operating characteristics, at all temperatures between -65 and $+165$ degrees Fahrenheit.

VT fuzes are likely to deteriorate if exposed to warm and humid atmospheric conditions for more than a few hours. Therefore, fuze containers should not be unsealed until the fuzes are required for assembly with bombs.

5. Fuze Arming

Regardless of target proximity or any other conditions, the VT bomb fuze cannot detonate the bomb until its arming system has completed the arming operation. This operation cannot begin until the arming vane locking pin (or arm) has been released by the withdrawal of the arming wire, thus freeing the vane to rotate. To complete the arming of the fuze, the vane must turn a MINIMUM of 1,000 revolutions. Even after the fuze is fully armed, the electrical firing circuit cannot function unless the arming vane is rotating at a speed equivalent to that which would be induced by an air stream of 80 knots or more.



NOTE:
 ARMING MECHANISM OF RING
 TYPE FUZE IS EXACTLY LIKE
 THAT OF BAR TYPE FUZE.

Figure 9—Arming Mechanism, VT Bomb Nose Fuzes.

Three other features provide additional insurance against premature detonation:

A. Until the detonator rotor is fully aligned, the detonator is not electrically connected to the firing circuit.

B. Until aligned by the arming system, the detonator is separated from the booster charge by a heavy brass lead-cup plate.

C. In most fuze models, a safety pin holds the arming assembly in a safe (unarmed) position until it is withdrawn at the time of assembling the fuze with a bomb.

Mechanical Arming. When the bomb is released from aircraft, the fuze is mechanically armed by the following sequence of operations, figure 9:

A. The arming wire, secured to the bomb rack arming control, is withdrawn from the fuze.

B. The vane locking pin (or arm, in bar type fuzes) is expelled by its spring (if an Arming Delay is used, this occurs later, when the Arming Delay separates itself from the fuze).

C. The arming vane begins to rotate in the air stream.

D. The vane rotation is transmitted by the coupling shaft and rotor shaft to a reduction gear train.

E. The rotation, geared down by the reduction gears (gear ratio: 7803/1), is transmitted to the slow-speed gear shaft.

F. The slow-speed gear shaft, acting through a suitable coupling (the rotor lock pin), slowly turns the rotor containing the detonator, from the safe position to the armed position. This brings the detonator into alignment with the lead cup (hole) in the lead-cup plate, through which it can fire into the booster charge.

G. When the detonator and lead cup are aligned, the rotor lock pin, which couples the rotor to the slow-speed gear shaft, is aligned with the locking hole in the rotor housing. Under the pressure of its spring, the lock pin snaps outward into the locking hole, releasing the rotor from the slow-speed gear shaft and locking it in the armed position.

Electrical Arming. Although mechanical arming aligns the fuze components so that firing of the detonator can set off the booster charge,

the detonator cannot fire unless it is electrically connected to the electronic firing head of the fuze. This, too, is accomplished by rotation of the arming vane, in the following manner:

A. The rotor shaft that drives the slow-speed gear train also drives a generator which supplies electric power to operate the electronic firing head and charge the firing capacitor. The firing capacitor can be charged to a potential high enough to fire the detonator only if the generator is driven at a speed corresponding to a bomb velocity of about 80 knots or more.

B. The movement of the rotor to align the detonator and lead cup, simultaneously aligns the detonator firing-terminal screws with contacts in the rotor housing. These contacts are connected to the firing circuit, figure 10.

C. Once the firing contacts are aligned, the detonator is fired, upon approach to the target, by the operation of the electronic firing switch (thyatron). This switch cannot operate unless voltage is supplied by both the high- and low-voltage output leads of the generator.

Bomb "released safe". A VT fuze bomb is released safe when the arming wire is disengaged from the bomb shackle before release (by means of the arming control mechanism of the aircraft) so that it falls with the bomb. Since the arming wire does not release the vane locking pin or arm (or the arming delay vane), the fuze does not arm, and impacts in an unarmed condition.

An unarmed VT fuze will not detonate on impact under ordinary circumstances, and may be dropped safe under the conditions permitted by the particular bomb with which it is assembled. However, it must be borne in mind that when the bomb is released at extreme altitudes, impact on hard ground, concrete surfaces, solidly constructed buildings, naval vessels, or even on normal ground, can result in detonation of any bomb.

6. Safe Air Travel

The fact that the arming vane must turn at least 1,000 revolutions before the fuze is fully armed, means that, after the vane is released, the bomb must travel a certain distance through the air before the fuze can function. This distance, measured along the bomb trajectory,

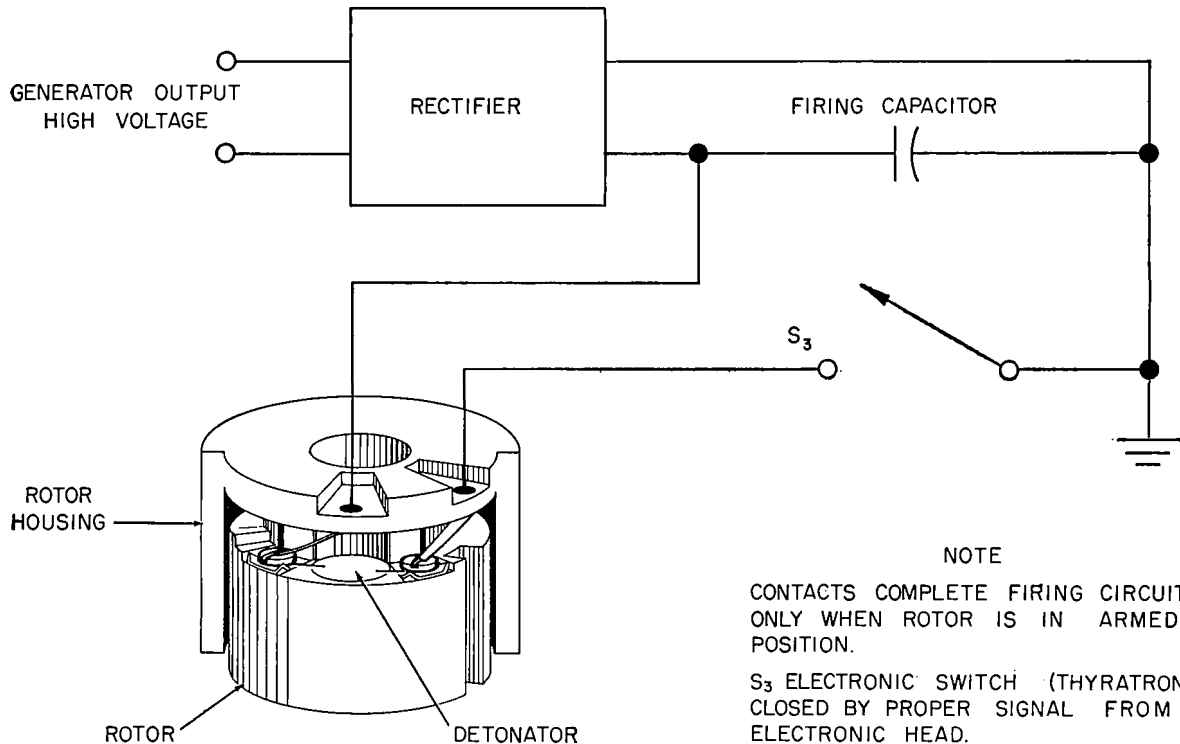


Figure 10—Firing Circuit, VT Bomb Nose Fuzes.

is called safe air travel (SAT), figure 11). The term SAT should be clearly understood. It means: the distance along the trajectory that the bomb travels in unarmed condition. It does not necessarily mean that the aircraft is safe from a detonation occurring immediately after the operation is completed (see par. 8, Separation Distance).

Manufacturers' tolerances in parts and assemblies cause variations of as much as 1,850 feet in the SAT's of fuzes that are presumably identical. Each lot of VT bomb fuzes is tested in the 100-pound GP Bomb AN-M30 to evaluate the minimum SAT. The minimum SAT, that air travel before which no fuze in the lot will arm when used with the 100-pound GP Bomb, is marked on each fuze. On bombs of larger sizes, the minimum air travel required for arming will be greater than the MIN. SAT marked on the fuze, by the percentages listed below.

GP, AN-M57 (250 lbs.) 8%.

FRAG, AN-M88 (220 lbs.) 2%.

FRAG, AN-M81 (260 lbs.) 2%.

GP, AN-M64 (500 lbs.) 15%.

GP, AN-M65 (1000 lbs.) 32%.

GP, AN-M66 (2000 lbs.) 58%.

7. Arming Delay, Air Travel, M1 (T2E1) and M1A1 (T2E2)

The arming delay, air travel, figures 13 and 14, is an accessory device which may be attached to the fuze to delay the start of the arming operation until a preset amount of air travel has been completed (790 feet for each division set on the arming delay dial).

The device is secured to the fuze so as to hold the vane locking pin (or arm) in place. It remains in place until the set amount of air travel is completed and then releases itself. When released, it is forced away from the fuze by the vane locking pin (or arm) spring which simultaneously ejects the locking pin (or arm) so that the arming vane is free to turn.

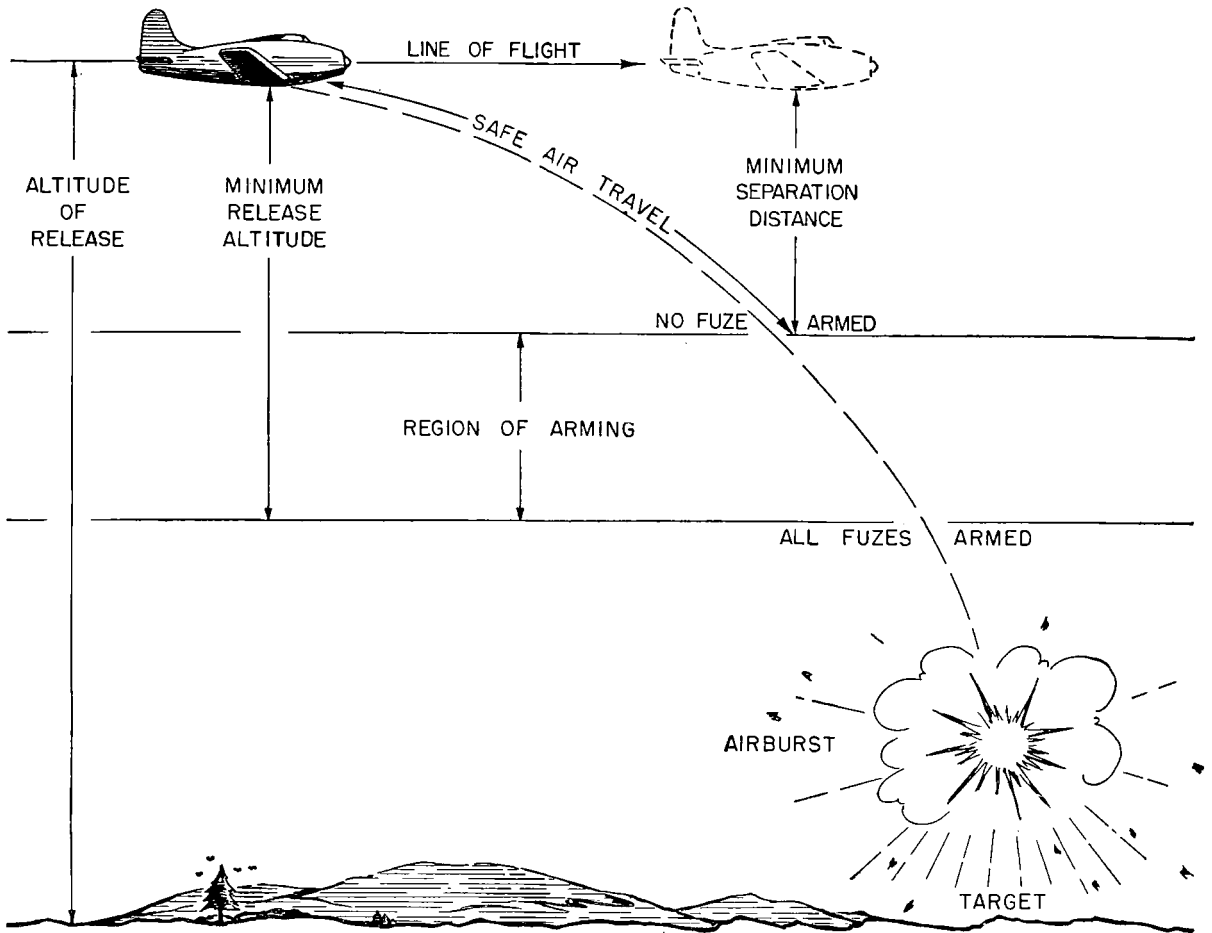


Figure 11—Safe Air Travel.

The arming delay contains an air vane, a reduction gear train, a setting dial, and a latch for attaching the assembly to the antenna ring or strap bracket of the fuze. The latch consists of two fixed hooks and one movable hook. The movable hook is attached to a spring-actuated release bar which is held in the latched position by the flange of the setting dial. When the set air travel is completed, the setting dial returns to zero, where a notch in the flange releases the bar. The setting dial is mounted on one end of a geared shaft which is held engaged with the gear train by a spring.

Arming Delay M1 (T2E1), figure 13, was manufactured in large quantities during World War II, and is currently issued with all VT bomb fuzes of wartime manufacture. On this type,

the free end of the dial shaft protrudes through a slot in the housing and forms a stud which may be depressed to disengage the shaft and permit rotation of the setting dial.

Arming Delay M1A1 (T2E2), figure 14, has been standardized to supersede Arming Delay M1. Both types function equally well, but the newer model is more easily assembled to the fuze and is more easily set to the desired arming delay distance. To set the delay, it is only necessary to depress the setting dial to disengage it from the shaft so that it can be rotated through the proper angle.

With both types of arming delay, the safe air travel of the fuze and arming delay is the sum of the arming delay setting and the minimum SAT marked on the fuze.

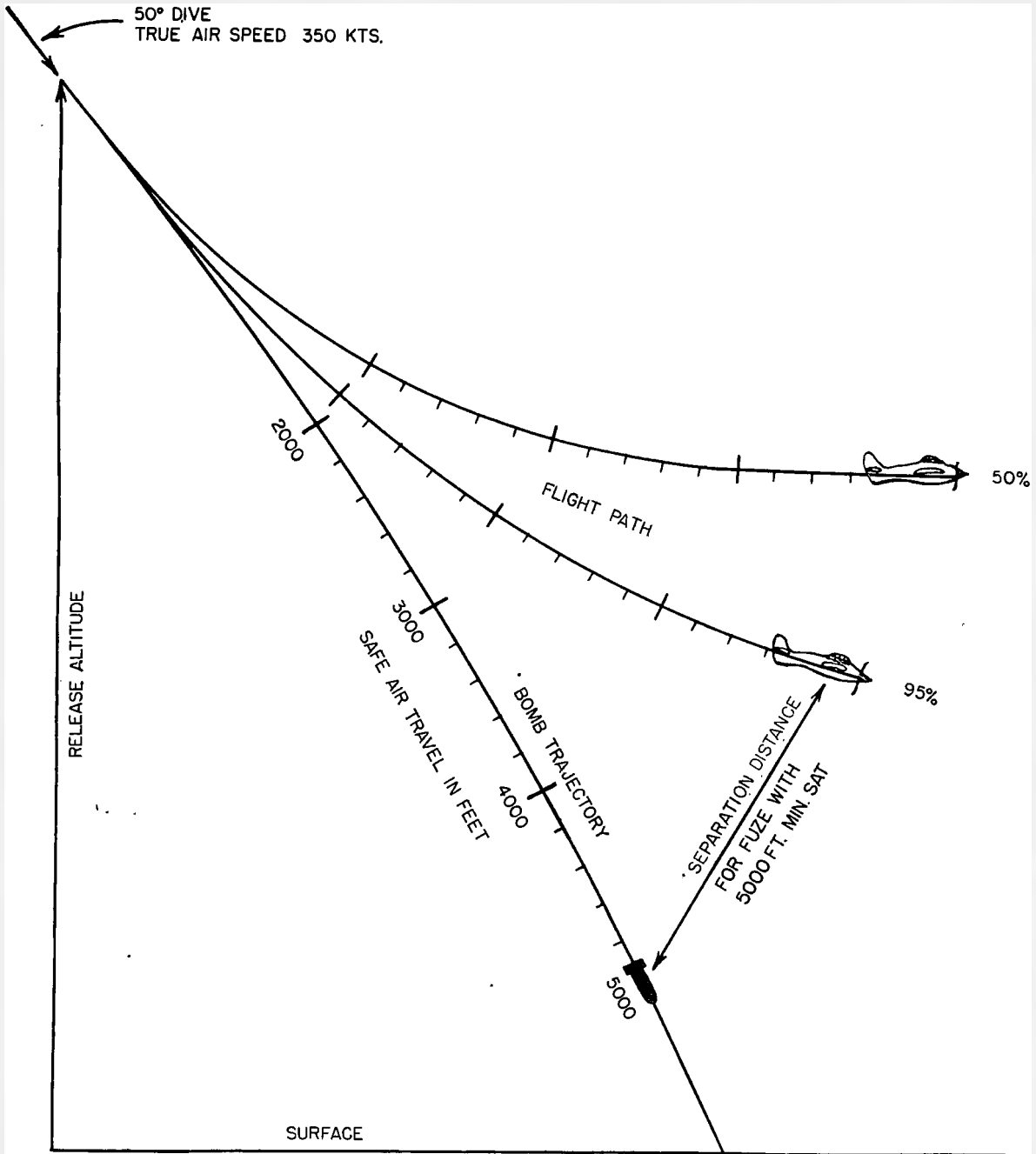


Figure 12—Separation Distance. Flight Paths Shown are Results of Tests Conducted by the Bureau of Aeronautics to Obtain Typical Pull-Out Data.

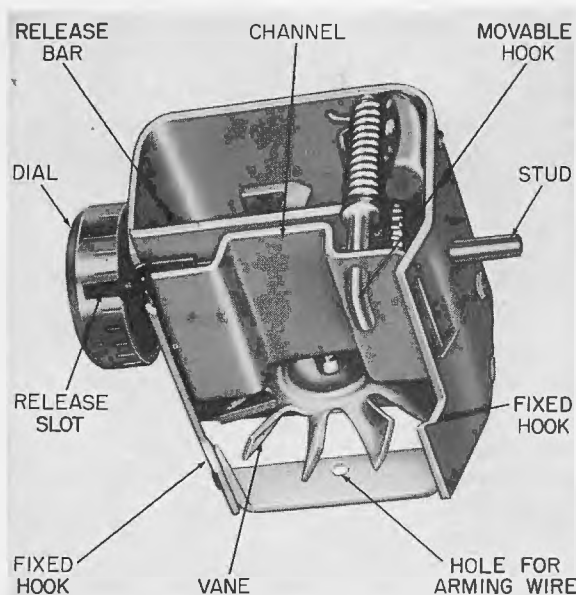


Figure 13—Arming Delay, Air Travel, Model M1.

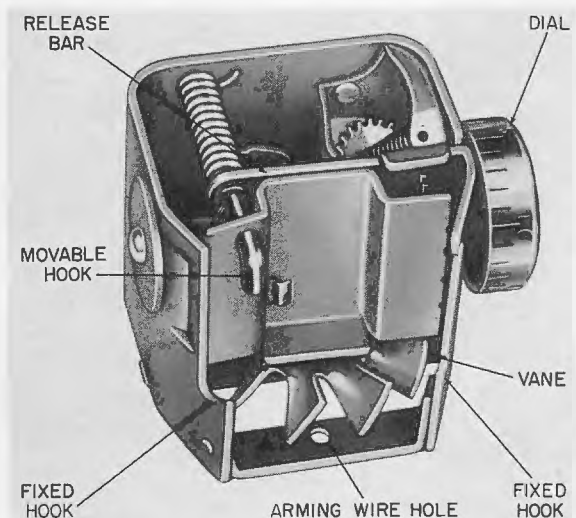


Figure 14—Arming Delay, Air Travel, Model M1A1.

8. Separation Distance

The "separation distance," figures 11 and 12, is the straight line distance between the releasing aircraft and the bomb. This corresponds, approximately, to the vertical drop when the bombs are released in horizontal flight. Separation distance varies with aircraft speed and altitude at the time of release. The determination of separation distance is important from

the standpoints of both safety and bomb performance.

Safety. After a VT fuze is armed, it may detonate on the first target that comes within its range of influence, whether that target is the releasing aircraft, other friendly aircraft, enemy aircraft, or ground targets. It is vitally important that the minimum separation distance at which arming occurs be sufficient to provide adequate clearance not only for the releasing aircraft but for any friendly aircraft at lower altitudes.

The permissible minimum separation distances between an armed fuze and the releasing aircraft are specified by operations authorities. Table 2 gives, as advisory information on this subject, the recommended minimum separation distances under armed-fuze conditions for the various sizes of bombs with which VT fuzes are used. These recommended minimum distances are based on what is conventionally called a 1-percent risk. That is, it may be expected that, with bombs bursting at the listed separation distances, there will be at least one fragment perforation in each 25 square feet of horizontal aircraft surface, in one out of each 100 bomb releases. This fragment will impact with sufficient force to perforate 1 inch of pine board and may be capable of causing a casualty.

Table 2
Minimum Recommended Separation Distances

Bomb	Separation distance (feet)
AN-M30, 100-lb. G. P.-----	500
AN-M57, 250-lb. G. P.-----	500
AN-M64, 500-lb. G. P.-----	650
AN-M65, 1000-lb. G. P.-----	750
AN-M66, 2000-lb. G. P.-----	850
AN-M88, 220-lb. Frag-----	650
AN-M81, 260-lb. Frag-----	650

Performance. It is important that the bombs be released at altitudes not less than the minimum release altitudes given in tables 3 through 9. If they are released at lower altitudes, the VT fuzes may impact in the unarmed condition and may not function. In this situation, the tail fuze installed in the bomb to ensure detonation, having a shorter arming distance than the VT fuze, will govern safety.

9. Separation Distance and Minimum Release Altitude

Tables 3 through 9 list the following information for both horizontal and dive bombing with various combinations of bomb, VT fuze, and airspeed:

A. Safe Air Travel—the distance the bomb travels along its trajectory before the fuze arms (i. e., before the bomb becomes dangerous). Safe air travel is shown for various arming delay settings. No fuze will arm short of this distance when properly used (see par. 6, Safe Air Travel).

B. Separation Distance—the separation distances listed are those that will exist between

the bomb and the releasing aircraft at the end of the given safe air travel, figures 11 and 12. Separation distance depends on the bomb and the path taken by the aircraft after bomb release. For release in horizontal flight (0 degree dive angle), it has been assumed in the tables that the aircraft continues on the same course. Separation distances for dive releases are based on information prepared by the Bureau of Aeronautics, from the results of tests conducted to obtain typical pull-out data. The separation distances given in the tables are relative to the 95-percent flight path as shown in figure 12. This means that 95 percent of the time the separation distances can be expected to be greater than those tabulated. Separation distances printed in italics in the tables are less than the recommended minimum values listed in table 2.

C. Minimum Release Altitude—the release altitude required to make arming of the fuze before impact reasonably certain. The tabulated values allow sufficient air travel to ensure that at least 95 percent of the fuzes will be armed.

Table 3

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 100-lb. G. P. Bomb (AN-M30A1)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
<u>FUZES MARKED 2000 MIN SAT</u>								
No Arming Delay—Safe air travel 2000 ft.								
250-----	370	510	410	360	1020	2280	2900	3300
350-----	200	250	190	160	570	2080	2540	3250
450-----	140	140	100	60	360	1940	2740	3250
Arming Delay Set at 1—Safe air travel 2750 ft.								
250-----	690	1040	860	810	1490	2930	3630	4080
350-----	410	550	420	360	870	2630	3500	4030
450-----	260	320	220	180	550	2460	3430	4020
Arming Delay Set at 2—Safe air travel 3450 ft.								
250-----	1050	1600	1430	1380	2030	3600	4370	4880
350-----	610	900	720	670	1230	3240	4220	4830
450-----	400	550	380	340	790	3000	4120	4800

Table 3—Continued

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 100-lb. G. P. Bomb (AN-M30A1)

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True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
<u>FUZES MARKED 2000 MIN. SAT—Continued</u>								
Arming Delay Set at 3—Safe air travel 4100 ft.								
250.....	1440	2120	1990	1970	2620	4310	5160	5690
350.....	860	1330	1100	1040	1630	3880	4960	5630
450.....	580	830	620	570	1080	3580	4840	5600
<u>FUZES MARKED 3600 MIN. SAT</u>								
No Arming Delay—Safe air travel 3600 ft.								
250.....	1130	1710	1540	1500	2330	3950	4750	5280
350.....	660	970	790	730	1480	3550	4580	5240
450.....	440	600	430	380	920	3280	4470	5200
Arming Delay Set at 1—Safe air travel 4350 ft.								
250.....	1600	2340	2250	2240	2920	4640	5500	6060
350.....	960	1510	1270	1220	1830	4160	5300	6010
450.....	610	940	730	670	1220	3850	5160	5970

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Table 3—Continued
Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 100-lb. G. P. Bomb (AN-M30A1)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
<u>FUZES MARKED 3600 MIN. SAT—Continued</u>								
Arming Delay Set at 2—Safe air travel 5070 ft.								
250.....	2090	2960	2980	3040	3550	5350	6280	6850
350.....	1300	2050	1770	1770	2300	4800	6040	6810
450.....	900	1320	1110	1020	1540	4450	5880	6770
Arming Delay Set at 3—Safe air travel 5750 ft.								
250.....	2590	3560	3640	3790	4230	6080	7050	7660
350.....	1660	2600	2320	2360	2830	5470	6770	7600
450.....	1180	1740	1480	1410	1900	5070	6610	7560

Table 4

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 250-lb. G. P. Bomb (AN-M57A1)

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True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
<u>FUZES MARKED 2000 MIN. SAT</u>								
No Arming Delay—Safe air travel 2160 ft.								
250-----	420	600	490	470	1100	2490	3140	3560
350-----	230	300	230	200	640	2240	3040	3530
450-----	150	170	130	100	410	2100	2980	3510
Arming Delay Set at 1—Safe air travel 2970 ft.								
250-----	770	1190	1040	950	1590	3190	3920	4410
350-----	430	630	500	450	970	2860	3790	4370
450-----	280	370	270	230	620	2670	3700	4340
Arming Delay Set at 2—Safe air travel 3730 ft.								
250-----	1170	1790	1630	1600	2270	2960	4750	5290
350-----	680	1050	860	810	1380	3530	4580	5240
450-----	450	640	480	450	910	3270	4460	5210
Arming Delay Set at 3—Safe air travel 4430 ft.								
250-----	1600	2370	2270	2280	2910	4690	5540	6130
350-----	950	1530	1300	1270	1820	4212	5370	6100
450-----	610	950	760	710	1210	3890	5230	6050

Table 4—Continued

Release Data 2000 ft. and 3600 ft. Min. SAT Fuzes with 250-lb. G. P. Bomb (AN-M57A1)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
<u>FUZES MARKED 3600 MIN. SAT</u>								
No Arming Delay—Safe air travel 3890 ft.								
250-----	1260	1930	1780	1750	2570	4290	5140	5700
350-----	740	1150	960	900	1600	3870	4980	5650
450-----	480	710	540	500	1040	3570	4830	5620
Arming Delay Set at 1—Safe air travel 4700 ft.								
250-----	1780	2590	2540	2570	3210	5040	5950	6490
350-----	1070	1720	1480	1460	2040	4520	5730	6490
450-----	700	1080	900	830	1370	4200	5580	6460
Arming Delay Set at 2—Safe air travel 5480 ft.								
250-----	2310	3250	3330	3440	3910	5820	6720	7340
350-----	1440	2320	2040	2060	2570	5230	6520	7360
450-----	990	1510	1300	1250	1720	4850	6380	7330
Arming Delay Set at 3—Safe air travel 6210 ft.								
250-----	2840	3890	4000	4190	4630	6620	7550	8210
350-----	1820	2890	2660	2700	3130	5960	7320	8200
450-----	1270	1980	1720	1690	2130	5500	7180	8180

Table 5
Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 500-lb. G. P. Bomb (AN-M64A1)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 2000 MIN. SAT								
No Arming Delay—Safe air travel 2300 ft.								
250.....	460	680	560	530	1250	2670	3350	3790
350.....	250	350	280	250	700	2400	3240	3760
450.....	180	200	150	130	450	2250	3170	3750
Arming Delay Set at 1—Safe air travel 3160 ft.								
250.....	840	1320	1150	1110	1810	3420	4200	4710
350.....	470	710	580	550	1070	3060	4050	4670
450.....	300	430	320	300	670	2860	3950	4620
Arming Delay Set at 2—Safe air travel 3970 ft.								
250.....	1270	1960	1830	1760	2450	4200	5040	5610
350.....	740	1180	980	950	1480	3770	4890	5570
450.....	470	720	590	550	970	3490	4740	5520
Arming Delay Set at 3—Safe air travel 4710 ft.								
250.....	1730	2580	2520	2560	3140	5010	5850	6450
350.....	1020	1670	1480	1470	1980	4510	5730	6490
450.....	660	1060	890	840	1300	4170	5570	6450

Table 5—Continued
Release Data 2000 ft. and 3600 ft. Min. SAT Fuzes with 500-lb. G. P. Bomb (AN-M64A1)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 3600 MIN. SAT								
No Arming Delay—Safe air travel 4140 ft.								
250.....	1370	2100	1980	1970	2780	4590	5430	6020
350.....	790	1310	1110	1070	1720	4120	5290	6020
450.....	510	800	640	600	1130	3820	5150	5980
Arming Delay Set at 1—Safe air travel 5000 ft.								
250.....	1920	2810	2800	2870	3470	5390	6230	6840
350.....	1150	1920	1660	1670	2210	4830	6130	6920
450.....	760	1190	1020	970	1450	4480	5970	6880
Arming Delay Set at 2—Safe air travel 5840 ft.								
250.....	2490	3500	3600	3750	4210	6210	7070	7720
350.....	1500	2530	2280	2330	2770	5590	6900	7780
450.....	1030	1670	1470	1440	1850	5160	6790	7800
Arming Delay Set at 3—Safe air travel 6610 ft.								
250.....	3050	4190	4270	4490	4970	7070	7930	8610
350.....	1940	3130	2960	3050	3360	6350	7710	8650
450.....	1320	2180	1930	1930	2290	5860	7660	8720

Table 6

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 1000-lb. G. P. Bomb (AN-M65-A1)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
<u>FUZES MARKED 2000 MIN. SAT</u>								
No Arming Delay—Safe air travel 2640 ft.								
250.....	600	920	770	720	1550	3140	3880	4380
350.....	320	480	380	350	920	2810	3760	4340
450.....	210	270	220	190	580	2630	3670	4320
Arming Delay Set at 1—Safe air travel 3630 ft.								
250.....	1030	1680	1530	1510	2290	3990	4850	5420
350.....	610	970	810	770	1370	3590	4670	5350
450.....	390	590	460	430	880	3330	4550	5310
Arming Delay Set at 2—Safe air travel 4550 ft.								
250.....	1620	2440	2360	2380	3060	4930	5750	6370
350.....	960	1600	1360	1350	1910	4420	5650	6400
450.....	610	970	810	770	1250	4100	5490	6360
Arming Delay Set at 3—Safe air travel 5410 ft.								
250.....	2180	3140	3220	3310	3890	5900	6700	7350
350.....	1320	2210	1950	1970	2520	5270	6570	7440
450.....	880	1420	1220	1190	1670	4880	6460	7450

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Table 6—Continued

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 1000-lb. G. P. Bomb (AN-M65-A1)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 3600 MIN. SAT								
No Arming Delay—Safe air travel 4750 ft.								
250	1750	2600	2560	2590	3450	5390	6220	6830
350	1030	1730	1500	1490	2200	4830	6130	6930
450	660	1070	900	850	1440	4480	5960	6880
Arming Delay Set at 1—Safe air travel 5740 ft.								
250	2390	3400	3510	3660	4000	6010	6830	7480
350	1480	2450	2200	2230	2600	5400	6690	7550
450	980	1610	1410	1390	1720	4980	6590	7600
Arming Delay Set at 2—Safe air travel 6700 ft.								
250	3110	4250	4320	4550	5140	7290	8140	8840
350	1970	3180	3020	3120	3500	6550	7930	8860
450	1330	2210	1970	1980	2390	6050	7840	8950
Arming Delay Set at 3—Safe air travel 7590 ft.								
250		5060	5130	5430	6050	8270	9190	
350	2470	3900	3830	4020	4240	7450	8880	9880
450	1690	2870	2580	2650	2940	6890		

Table 7

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 2000-lb. G. P. Bomb (AN-M66A2)

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True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
<u>FUZES MARKED 2000 MIN. SAT</u>								
No Arming Delay—Safe air travel 3160 ft.								
250 -----	830	1300	1140	1090	2170	3860	4710	5250
350 -----	460	710	580	550	1290	3470	4530	5190
450 -----	290	430	330	310	839	3220	4410	5160
Arming Delay Set at 1—Safe air travel 4340 ft.								
250 -----	1490	2270	2180	2180	3040	4920	5760	6370
350 -----	870	1430	1230	1200	1910	4430	5660	6420
450 -----	530	890	730	700	1240	4100	5510	6370
Arming Delay Set at 2—Safe air travel 5450 ft.								
250 -----	2200	3180	3260	3360	4030	6050	6880	7530
350 -----	1330	2230	2000	2010	2630	5430	6740	7630
450 -----	880	1460	1250	1210	1730	5020	6650	7650

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Table 7—Continued

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 2000-lb. G. P. Bomb (AN-M66A2)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 3600 MIN. SAT								
No Arming Delay—Safe air travel 5690 ft.								
250	2350	3360	3460	3600	4540	6620	7450	8560
350	1440	2390	2160	2190	3010	5960	7290	8200
450	950	1580	1360	1330	2040	5490	7200	8270
Arming Delay Set at 1—Safe air travel 6870 ft.								
250	3240	4410	4480	4730	5560	7750	8640	9340
350	2060	3330	3180	3300	3830	6990	8360	9340
450	1390	2340	2100	2100	2630	6440		
Arming Delay Set at 2—Safe air travel 8020 ft.								
250		5450	5500	5830	6660	8930	9880	
350	2720	4250	4190	4410	4690	8050	9490	10540
450	1860	3200	2890	3280	3300	7440		

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Table 8

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 220-lb. Frag. Bomb (AN-M88)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 2000 MIN. SAT								
No Arming Delay—Safe air travel 2040 ft.								
250-----	370	530	430	400	1020	2330	2960	3370
350-----	200	260	210	180	570	2100	2850	3330
450-----	130	150	110	80	360	1980	2800	3310
Arming Delay Set at 1—Safe air travel 2800 ft.								
250-----	690	1050	880	830	1490	2980	3700	4160
350-----	380	550	440	400	860	2680	3570	4130
450-----	240	320	240	210	550	2500	3490	4110
Arming Delay Set at 2—Safe air travel 3520 ft.								
250-----	1040	1620	1450	1410	2040	3670	4470	5000
350-----	590	920	750	700	1220	3290	4310	4950
450-----	390	560	420	390	780	3060	4200	4920
Arming Delay Set at 3—Safe air travel 4180 ft.								
250-----	1430	2150	2030	2020	2630	4380	5220	5790
350-----	840	1350	1130	1100	1610	3930	5050	5750
450-----	550	820	650	670	1060	3640	4920	5710

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Table 8—Continued
Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 220-lb. Frag. Bomb (AN-M88)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 3600 MIN. SAT								
No Arming Delay—Safe air travel 3670 ft.								
250-----	1130	1740	1580	1550	2340	4000	4850	5390
350-----	650	1000	840	780	1410	3600	4670	5330
450-----	420	610	470	430	910	3340	4550	5310
Arming Delay Set at 1—Safe air travel 4440 ft.								
250-----	1580	2370	2270	2290	2900	4700	5540	6130
350-----	940	1530	1310	1280	1810	4230	5400	6130
450-----	600	940	760	710	1200	3910	5250	6090
Arming Delay Set at 2—Safe air travel 5180 ft.								
250-----	2080	2980	3010	3090	3540	5430	6300	6910
350-----	1260	2060	1810	1810	2300	4870	6140	6940
450-----	850	1320	1030	1080	1510	4520	5980	6900
Arming Delay Set at 3—Safe air travel 5860 ft.								
250-----	2550	3570	3660	3810	4210	6180	7060	7740
350-----	1600	2590	2340	2380	2810	5560	6870	7760
450-----	1100	1730	1510	1470	1870	5130	6740	7740

Table 9

Release Data, 2000 ft. and 3600 ft. Min. SAT Fuzes with 260-lb. Frag. Bomb (AN-M81)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 2000 MIN. SAT								
No Arming Delay—Safe air travel 2040 ft.								
250.....	370	530	430	400	1010	2320	2960	3370
350.....	200	260	210	180	560	2100	2850	3330
450.....	130	150	110	90	350	1970	2800	3310
Arming Delay Set at 1—Safe air travel 2800 ft.								
250.....	680	1050	880	830	1470	2980	3690	4160
350.....	370	550	440	400	850	2670	3560	4130
450.....	240	320	240	210	540	2490	3490	4100
Arming Delay Set at 2—Safe air travel 3520 ft.								
250.....	1030	1610	1450	1410	2030	3,660	4470	5000
350.....	590	910	750	710	1200	3,290	4310	4950
450.....	380	550	420	390	770	3,050	4200	4920
Arming Delay Set at 3—Safe air travel 4180 ft.								
250.....	1410	2150	2020	2020	2600	4370	5200	5790
350.....	830	1340	1130	1100	1590	3920	5050	5750
450.....	530	820	650	620	1040	3640	4920	5710

RESTRICTED SECURITY INFORMATION

OP 1444 (2ND REV)

RESTRICTED SECURITY INFORMATION

Table 9—Continued
Release Data, 2000 ft. and 3600 ft. SAT Fuzes with 260-lb. Frag. Bomb (AN-FM81)

True airspeed (knots)	Separation distance in feet (dive angle)				Minimum release altitude in feet (dive angle)			
	0°	30°	50°	70°	0°	30°	50°	70°
FUZES MARKED 3600 MIN. SAT								
No Arming Delay—Safe air travel 3670 ft.								
250-----	1120	1730	1570	1540	2330	3990	4850	5390
350-----	640	1000	830	780	1390	3590	4660	5330
450-----	410	610	470	440	890	3330	4540	5300
Arming Delay Set at 1—Safe air travel 4440 ft.								
250-----	1570	2360	2260	2280	2880	4690	5530	6120
350-----	930	1520	1300	1270	1790	4220	5400	6130
450-----	590	930	760	720	1180	3900	5250	6080
Arming Delay Set at 2—Safe air travel 5180 ft.								
250-----	2060	2960	2990	3070	3510	5420	6270	6880
350-----	1240	2050	1800	1810	2280	4860	6140	6940
450-----	820	1310	1120	1080	1480	4500	5980	6900
Arming Delay Set at 3—Safe air travel 5860 ft.								
250-----	2530	3550	3640	3800	4180	6160	7020	7710
350-----	1570	2570	2320	2370	2770	5540	6850	7740
450-----	1070	1690	1490	1460	1840	5110	6730	7740

10. Safety Provisions

Seal. The arming vane is sealed at the factory so that it cannot rotate. This ensures that the arming mechanism will remain in the safe position until the seal is removed. IF THE SEAL OF ANY FUZE IS FOUND TO BE BROKEN WHEN RECEIVED, THE FUZE SHOULD BE HANDLED WITH CAUTION AND INSPECTED IN ACCORDANCE WITH THE INSTRUCTIONS GIVEN BELOW UNDER "SAFETY PIN".

Safety Pin. All models of VT bomb nose fuzes described in this publication, except the T-50E1 and the T-50E4, are equipped with a safety pin, inserted into the arming mechanism through a groove in the booster cup. The pin prevents movement of the arming mechanism and must be removed prior to fuzing the bomb.

An important advantage of the safety pin is that it makes possible the checking for safety of the arming mechanisms of fuzes whose seals have been removed. The presence of the pin, or the ability to reinsert it, gives positive indication that the arming components are in the safe (unarmed) position. If the safety pin cannot be reinserted, the fuze must be destroyed in accordance with the instructions given in paragraph 24, Destruction.

11. Handling of Damaged VT Fuzes

Unarmed Fuzes. An unarmed VT fuze cannot fire. Normally, dropping a packaged VT fuze will not injure it. Dropping an unpackaged fuze or a VT fuzed bomb may injure the fuze but will not render it unsafe. UNARMED VT fuzes cannot fire and are entirely safe to handle and remove from bombs. However, the functioning of a damaged VT fuze cannot be predicted. Hence, DAMAGED FUZES SHOULD BE DISPOSED OF (see par. 24, Destruction).

Armed Fuzes. An armed dud VT bomb fuze (see par. 5—Fuze Arming) may be sensitive to shock and jar, for a period of 24 hours. Such a fuze may be sensitive to the approach of personnel only if the vane is still turning at high speed (equivalent to air speeds greater than 80 knots). Even though the fuze is badly crushed from impact, these possibilities will prevail. DO NOT HANDLE AN ARMED VT BOMB FUZE FOR AT LEAST 24 HOURS AFTER

IMPACT. WHEN 24 HOURS HAVE PASSED, IT WILL BE SAFE FOR NECESSARY DISPOSAL OPERATIONS (see par. 25, Disposal of Dud Fuzes). DO NOT REMOVE FUZE FROM BOMB.

Fuzes Damaged in Landing and Take-off Accidents. In cases where a VT fuze is damaged when a hung bomb is carried away in landing or, due to malfunction of gear, separates from the aircraft during take-off, it is unlikely that the vane will make sufficient turns and spin fast enough to fully arm the fuze. Such a fuze is not dangerous provided the vane has stopped turning or is restrained from turning before fuze arming has been completed.

SECURE VANE WITH ANY AVAILABLE LASHING AND DISPOSE OF FUZED BOMB IMMEDIATELY (see par. 24, Destruction). DO NOT REMOVE FUZE FROM BOMB.

12. Fuze Testing by Tactical Organizations

Field Testing. VT bomb fuzes are tested before acceptance and issue. Only one method of testing VT bomb fuzes is practicable under field conditions. If desired, each fuze lot may be tested for operational efficiency by dropping a representative group of sample fuzes. The sample fuzes should be taken from as many different boxes as possible.

Test Conditions. Tests should be conducted over water or level terrain, if possible, in order to assess fuze performance under uniform conditions (see paragraph 4, Characteristics of VT Bomb Nose Fuzes). Burst heights over water will be about double those obtained over normal soil.

13. Assembly of VT Bomb Nose Fuzes with Bombs, Figures 15 and 16

VT bomb fuzes are shipped to using organizations, completely assembled and ready for assembly with bombs. The assembly of the fuze with the bomb consists of installing the fuze and, if tactics require it, adding an arming delay. The most important point to be borne in mind is that the fuze must be tightly screwed into the fuze well of the bomb.

NOTE: The following instructions are basic for assembly of VT fuzes with



Figure 15—Ring Type Fuze on Bomb.

bombs, and apply in all cases. Additional instructions are given by paragraphs 14 through 18 for the particular conditions described by those paragraphs.

Inspection of Bomb and Fuze Before Assembly

BOMB. BOMBS WITH BENT OR DAMAGED FINS SHOULD NOT BE USED. SEE THAT FIN ASSEMBLIES ARE AS TIGHT AS POSSIBLE. USE HEAVY GAGE .060" TO .075" METAL FINS IDENTIFIED BY MARKING M—A1, AN—M—A1, OR THE PREFIX "A" BEFORE "M" NUMBER. USE APPROPRIATE SIZE SET SCREW EQUIPPED WITH FIN LOCK NUTS M1, M2, AND M3. Inspect the fuze-well and see that it is free of dirt, rust, and other foreign materials.

FUZE. Inspect the fuze to make sure that

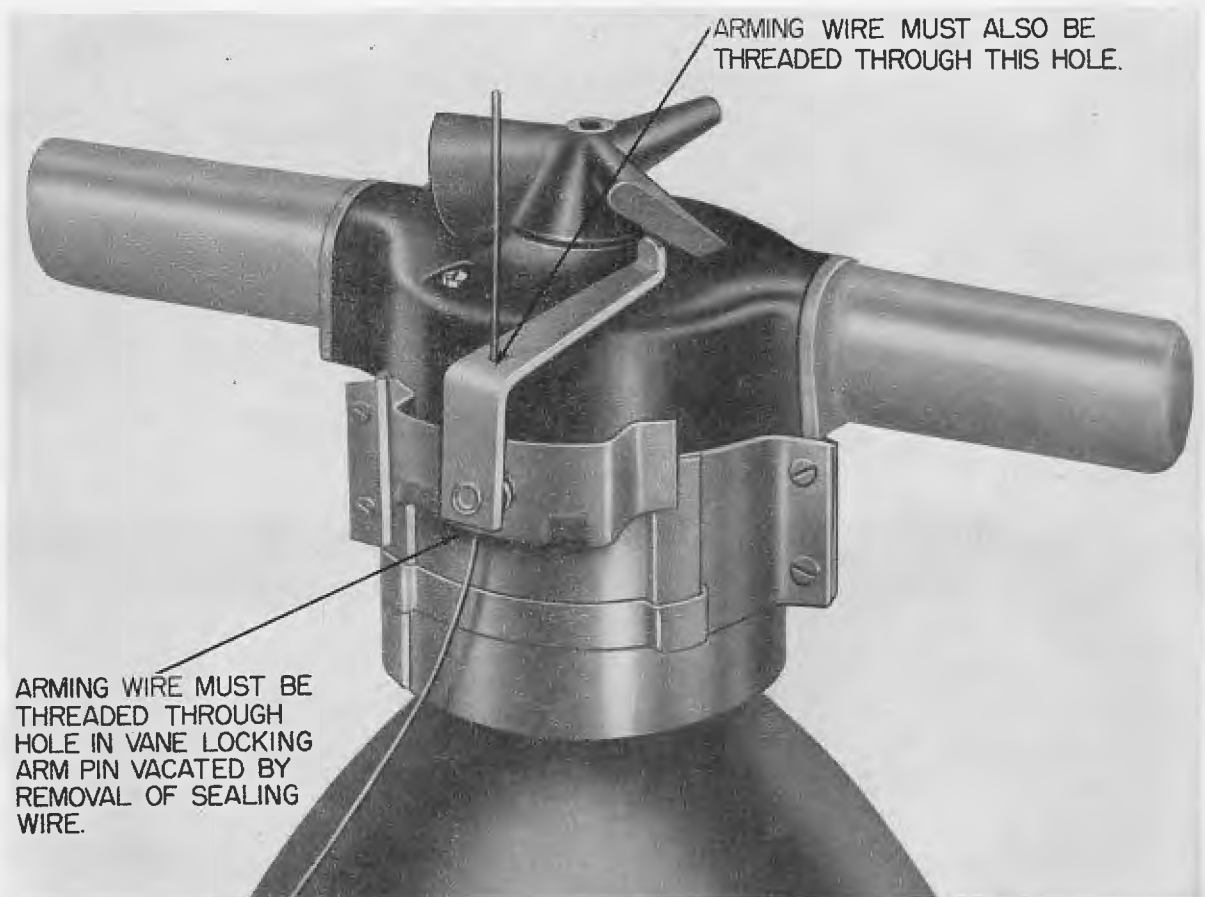


Figure 16—Bar Type Fuze on Bomb.

the arming vane lock pin (or arm) is undamaged. IF THE SEALING WIRE IS BROKEN OR MISSING, CONSIDER THE FUZE DAMAGED AND DO NOT USE IT. HANDLE CAREFULLY AND INSPECT TO SEE WHETHER THE SAFETY PIN IS PRESENT (see paragraph 10, Safety Provisions). DAMAGED FUZES SHOULD BE DESTROYED (see par. 24, Destruction).

Assembly Procedure, Figure 17

- A. Check the sealing wire.
- B. Remove the safety pin (if fuze is so equipped) from the booster cup.
- C. See that the lock washer, figures 2 and 3, is in place, and then screw the fuze into the fuze well of the bomb, by hand.

D. Tighten the fuze as much as possible with a Fuze Wrench, type T4, figure 18, applied to the wrench lugs. If no T4 fuze wrench is available, use the most suitable fuze wrench on hand. Do NOT HAMMER EITHER THE FUZE OR THE WRENCH HANDLE. Do NOT USE THE BARS OF BAR TYPE FUZE M166 AS LEVERS OR HANDLES; Do NOT STRIKE OR TWIST THE BARS IN ANY WAY.

NOTE: It is permissible to use the bars of Bar Type Fuze M166E1 as handles, but the use of these bars to tighten the fuze is not recommended. Experience has shown that it is difficult to tighten the fuze sufficiently by means of the

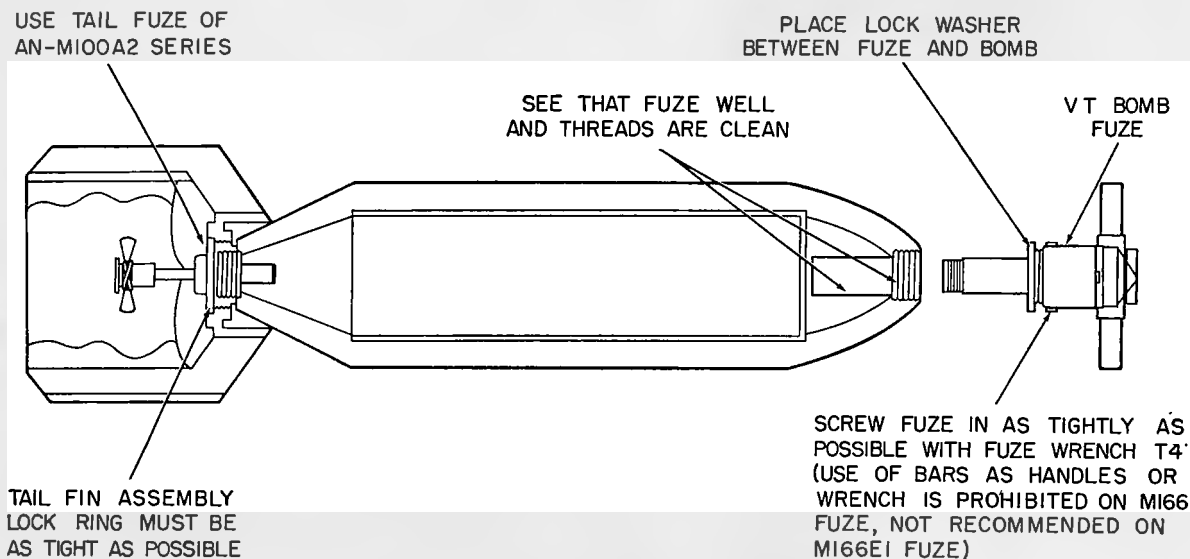


Figure 17—Assembly of Fuzes with Bomb.

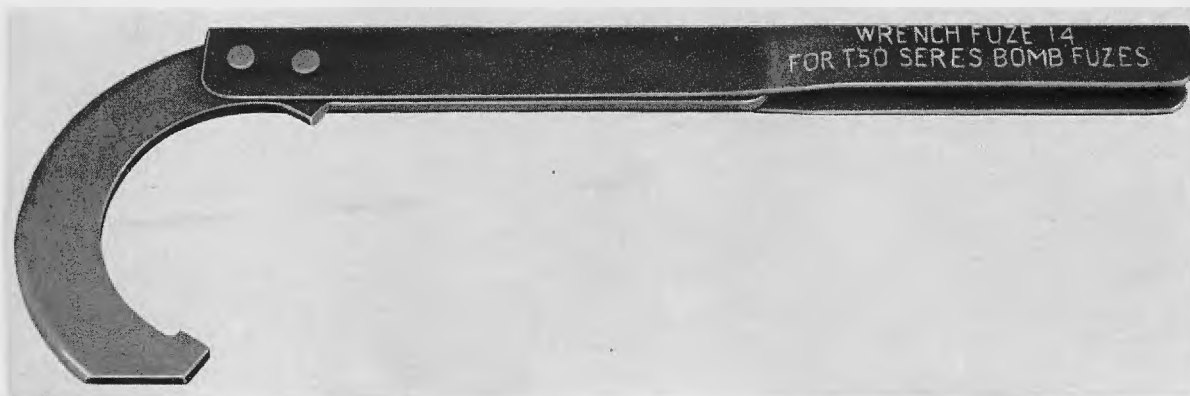


Figure 18—Fuze Wrench, Model T4.

bars alone, and that undue strain on the bars may loosen or spring them, thus altering their electrical characteristics.

E. Cut the sealing wire and remove it.

F. Carefully remove the cotter pin and move the vane locking pin or arm, if necessary, to the hole in the ring or strap bracket most nearly in line with the bomb suspension lugs. **DO NOT ALLOW THE ARMING VANE TO BE TURNED MORE THAN TWO OR THREE TURNS DURING THIS OPERATION.**

G. Replace the cotter pin.

Attachment of Arming Wire to Fuzed Bombs

A. Thread the end of the arming wire through the front bomb suspension lug and the hole in the vane locking pin (or arm) through which the sealing wire was inserted. On bar type fuzes, the arming wire also must be threaded through the cotter pin hole in the branch of the vane locking arm which prevents rotation of the vane, figure 16.

B. When the bomb has been placed in the bomb rack of the aircraft, and the arming wire swivel has been engaged in the bomb shackle, pull the arming wire through the fuze to remove any excess slack between the fuze and swivel. The wire end should protrude not more than 3 inches in front of the fuze nose. Any excess should be cut off and burrs should be removed from the end of the wire.

NOTE: Under normal operating conditions, the force of the vane locking pin (or arm) spring, after the cotter pin is removed, is sufficient to hold the arming wire firmly in place during flight. However, if the arming wire will be exposed to the slip stream at high speeds (see par. 16, Precautions To Be Observed When Using VT Fuzed Bombs), additional precautions are required. **ON BAR TYPE FUZES ONLY**, a safety (fahnestock) clip must be placed on the wire, forward of the vane locking arm (see paragraph 18, Exterior Suspension of Bar Type VT Fuzed Bombs). For extra safety when ring-type fuzes

are used, see paragraph 17, Installation of Auxiliary Safety Device.

C. Remove the cotter pin.

14. Assembly of Arming Delay With Fuze

Preliminary Adjustment of Arming Delay

ARMING DELAY, AIR TRAVEL, TYPE M1:

A. Place the arming delay on a flat surface, vane down, dial to the right.

B. Free the dial by pressing down and outward on the short stud projecting from the left side. Hold down the bar across the top of the device and turn the dial until the slot is in line with the bar. Release the stud and bar carefully, to avoid injury from spring action.

ARMING DELAY, AIR TRAVEL, TYPE M1A1:

A. Place the arming delay on a flat surface, vane down, dial to the right.

B. Press the release bar to disengage the dial shaft, and then turn the dial to zero. Carefully release the bar.

Assembly Procedure, Figures 19 and 20

A. Thread the short end of the arming wire through the front bomb suspension lug, the small hole in the strap bracket on the vane end of the arming delay, and the hole in the vane locking pin (or arm) from which the sealing wire was removed. On bar type fuzes, the arming wire also must be threaded through the cotter pin hole in the branch of the vane locking arm which prevents rotation of the vane.

B. Place the arming delay, with its vane toward the bomb tail, so that the channel is over the vane locking pin or arm and the hooks of the delay engage the bottom of the fuze ring or strap bracket.

C. Turn the bar back into place through the slot in the dial, engaging the movable hook over the upper edge of the ring or strap bracket.

D. Press the stud (on type M1) or the release bar (on type M1A1) and turn the dial to the desired setting. Release the stud or release bar.

E. When the bomb has been placed in the bomb rack of the aircraft, and the arming wire swivel loop has been engaged in the bomb shackle, pull the arming wire through the fuze to remove excess slack between the fuze and

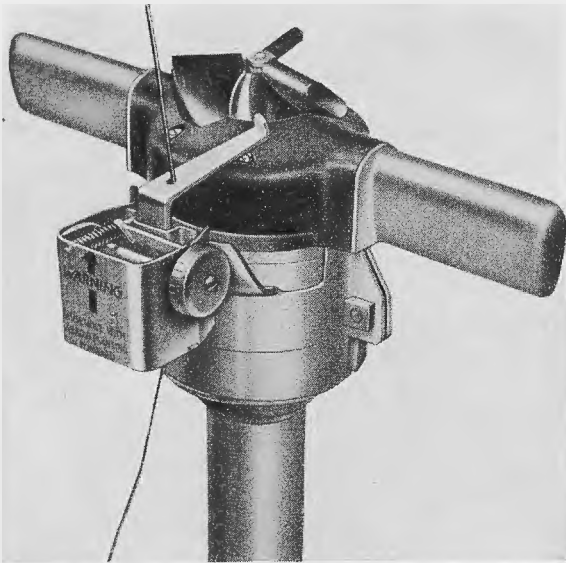


Figure 19—Arming Delay M1 on Bar Type Fuze.

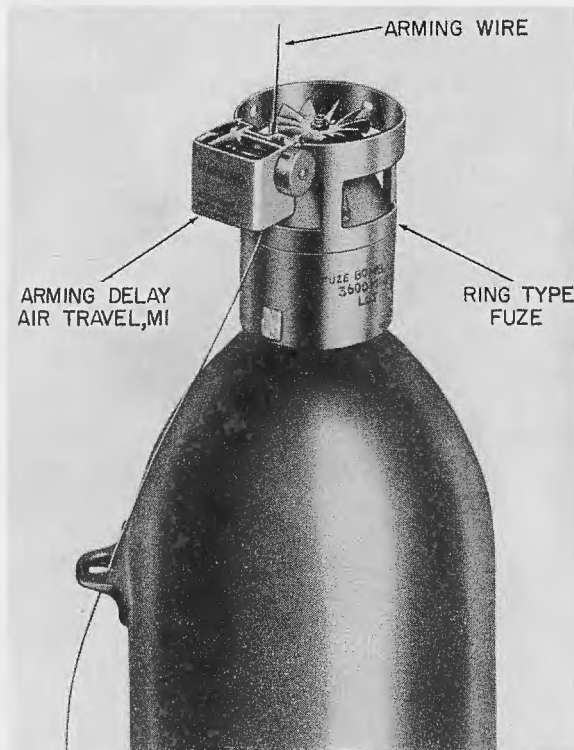


Figure 20—Arming Delay M1 on Ring Type Fuze.

swivel. If necessary, trim the wire protruding in front of the fuze to a length of about 3 or 4 inches. Remove any burrs from the end of the wire. **DO NOT USE A SAFETY (FAHNESTOCK) CLIP**, except as instructed by para-

graphs 17 and 18; the force of the vane locking pin (or arm) spring is sufficient to hold the arming wire firmly in place after the cotter pin is removed.

F. Remove the cotter pin from the fuze.

15. Use of Tail Fuze To Ensure Bomb Detonation

An instantaneous tail fuze of the AN-M100A2 series should be used as insurance that the bomb will detonate on ground impact in the event that the VT fuze does not function. Testing, assembly, and attachment of the arming wire should follow the normal procedure for the tail fuze employed.

16. Precautions To Be Observed When Using VT Fuzed Bombs

Clustering. The clustering of VT fuzed bombs is not encouraged. If the increased loads made possible by clustering are required when VT fuzes are being used, only the bomb attached directly to the shackle should be VT fuzed. Bombs suspended by the hook and cable assemblies of cluster adapters should not be VT fuzed, but should contain some other type of fuze. When bombs are VT fuzed under such conditions, the cables loosely attached to the bombs will nearly always cause early functioning of the VT fuzes.

Inspection of Arming Wires Before Take-Off.

The accidental withdrawal of the arming wire from a VT fuzed bomb during flight, which could conceivably occur with the bomb carried in an external rack or in a position of appreciable turbulence in the bomb bay, would cause the fuze arming vane to rotate and thereby result in the arming of the fuze. In this case, the bomb would almost certainly detonate in the bomb rack. Accidental withdrawal of the arming wire will not occur if the installation is properly made. **IT IS, THEREFORE, ESSENTIAL THAT VT FUZED BOMBS IN SUSPENSIONS OF THIS KIND BE CAREFULLY INSPECTED BEFORE FLIGHT, TO MAKE SURE THAT THE ARMING WIRE IS PROPERLY INSTALLED.**

Bombs Carried Externally at Speeds Greater Than 260 Knots. Tests of properly installed arming wires on externally mounted bombs have shown that the arming wires can be de-

pended on to remain in place without accidental withdrawal, at all speeds up to 260 knots (300 miles per hour). In the interest of safety, VT fuzed bombs should not be loaded where they will be subjected to air speeds greater than 260 knots unless an auxiliary safety device is provided to prevent accidental pulling out of the arming wire (see pars. 17 and 18).

17. Installation of Auxiliary Safety Device, Figure 21

Several instances have been reported in which a VT fuzed bomb exploded on the pylon wing mounts of an aircraft while in flight. The only known way in which this could have happened, with the bomb and fuze correctly assembled and properly installed in the aircraft, was for the arming wire to have been withdrawn during flight. In extensive tests to determine the cause, the only way in which accidental arming wire withdrawal could be made to occur was for the arming wire loop to come out of the arming control mechanism and then, by whipping in the slip stream, work the wire out of the fuze arming vane locking pin (or arm). The auxiliary safety device was designed to prevent this.

The auxiliary safety device uses a perforated

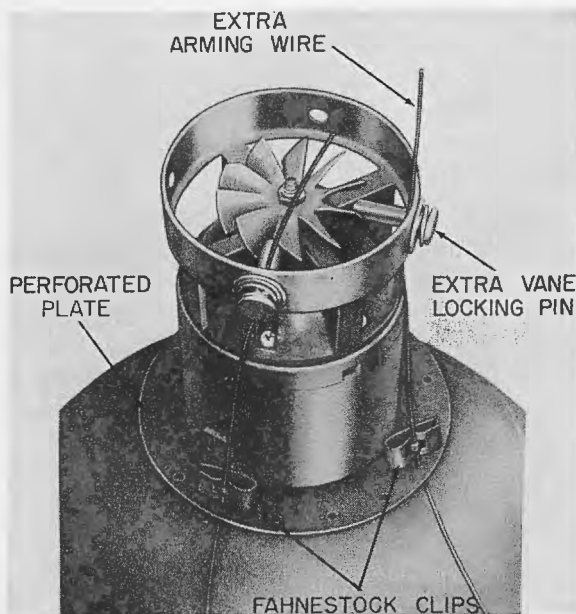


Figure 21—Auxiliary Safety Device for Externally Carried Ring Type VT Fuzed Bombs.

plate and safety (Fahnestock) clip to increase the force necessary to withdraw the arming wire. Additional safety is provided by means of a second arming wire secured directly to the structure of the aircraft. The device is designed for and should be used only with ring type VT bomb nose fuzes which have metal arming vanes.

Installation Procedure:

A. Install the perforated plate as shown in figure 21, preferably between the lock washer and ring type fuze.

B. Install one Arming Wire Assembly Mk 1 (0.064" dia., OCL AV 25-44) from the arming control mechanism to the fuze, taking care to pass the wire through the forward front bomb suspension lug.

NOTE: In certain F4U type aircraft, the arming control mechanism is mounted forward of the lugs. In this case, the wire should not pass through the suspension lug.

C. Install an additional arming wire assembly by attaching the loop end permanently to the aircraft structure.

D. Assemble an extra vane locking pin and spring in preparation for installing them on the fuze with the extra arming wire.

E. Pass the two arming wires through separate holes in the perforated plate, taking care to align them with the locking pin holes in the fuze antenna ring.

F. Install one Fahnestock clip on each arming wire, and then pass the wires through the holes in the vane locking pins (the pin held by cotter pin, and the extra pin prepared for installation in step D), as shown in figure 21.

G. When required by operating conditions, one Arming Delay, Air Travel, type M1 or M1A1, may be used. When making the installation, the arming wire attached to the arming control mechanism should be assembled with the arming delay.

H. Three (3) Fahnestock clips must be used on each arming wire when ring type VT fuzed bombs are carried in F9F Bomb Racks Mk 55 which have arming wire controls modified in accordance with Bureau of Aeronautics Restricted dispatch 062125Z July 1950.

WARNING

All three (3) clips must be placed between the perforated safety plate and the vane locking pins.

Safety Features. The auxiliary safety device adds to the safety of the aircraft in the following ways:

A. The Fahnstock clips increase the force required to withdraw the arming wires.

B. The second vane locking pin increases the safety of the fuze.

C. When the arming control mechanism is set on SAFE, making it possible for the arming wire loop to come out, protection is maintained by the second arming wire.

D. The bomb may still be dropped safe.

Safety Device for F6F Catapulted Aircraft. Fuze Protector Mk 2 (BuOrd Dwg. 563004) is designed for use with VT fuzed bombs on F6F catapulted aircraft. This protector will fit wing type fuzes only. The perforated plate of the auxiliary safety device is used as a means of support for the fuze protector. When using the fuze protector:

A. Install Arming Wire Assembly Mk 1 from the arming control through the perforated plate, attach Fahnstock clip, and pass the wire through the vane locking pin (see steps B, E, and F, Installation Procedure, Installation of Auxiliary Safety Device, par. 17). The fuze protector replaces the extra vane locking pin required for the auxiliary safety device.

B. Secure the two fuze protector sections in place, with the additional arming wire of the auxiliary safety device which is permanently attached to the aircraft structure (see step C, Installation Procedure, Installation of Auxiliary Safety Device, par. 17). Pass the arming wire through the perforated plate. Arming Delays M1 and M1A1 cannot be used with Fuze Protector Mk 2.

18. Exterior Suspension of Bar Type VT Fuzed Bombs

The design of the bar type fuze permits use of a Fahnstock clip on the arming wire forward of the vane locking arm, without danger of the clip becoming jammed in the arming vane when

the bomb is released armed. For this reason, it is not necessary to use the perforated plate of the auxiliary safety device for bar type fuzes. Both arming wires of the auxiliary safety device arrangement are therefore installed directly into the vane locking arms of bar type fuzes. To do this:

A. Thread the wire through the hole in the vane locking arm pin made available by removal of the sealing wire.

B. Remove the cotter pin, press down on the vane locking arm to compress the throw-out spring, and push the arming wire through the cotter pin hole in the branch of the vane locking arm which prevents rotation of the vane.

C. Pull the arming wire through the fuze to remove any excess slack.

D. Attach a Fahnstock clip to the wire and slide it up to the vane locking arm. The wire end should protrude about 3 or 4 inches in front of the fuze. Any excess should be cut off and burrs should be removed from the end of the wire.

One vane locking arm is attached to each fuze as furnished. One additional vane locking arm must be assembled to these fuzes when they are used with bombs carried on exterior suspension. The vane locking arm is identified by Piece Mark 73-11-204C. It is available for issue. If not issued as part of the ship's or organization's allowance, it should be drawn in amounts corresponding to the number of bar type fuzes available.

How to Obtain Auxiliary Safety Devices. The additional material required for auxiliary safety devices (perforated plates, extra arming wires, etc.) is available for issue. If not issued as part of the ship's or organization's allowance, it should be drawn in amounts corresponding to the number of ring type, metal-vaned fuzes available.

19. Conditions Causing Malfunctions of VT Bomb Fuzes

Personnel handling VT fuzed bombs should be careful to prevent possible causes of malfunctioning. In most cases, improper function-

ing of VT fuzed bombs will be due to one or more of the following faults:

A. Improper inspection (see "Inspection of Bomb and Fuze Before Assembly", par. 13).

(1) Bomb fin assembly not tight.

(2) Bomb fins bent, damaged, or poorly made.

(3) Fuze damaged.

B. Improper assembly of fuze with bomb (see "Assembly Procedure", par. 13).

(1) Fuze not tight.

(2) No lock washer inserted between fuze and bomb.

(3) Bars on bar type fuze damaged by too much pressure while tightening fuze.

C. Wrong bomb type used (see table 1).

D. Cable clustering device used (see "Clustering", par. 16).

E. Insufficient intervalometer spacing (see "Train Spacing", par. 4).

F. Rain (see "Effect of Rain and Other Weather Conditions", par. 4).

G. Release altitude incorrect.

(1) Too high (see "Effect of Altitude and Speed at Release", par. 4).

(2) Too low (see "Performance", par. 8).

20. Removal of VT Fuzes From Bombs

When aircraft return with VT fuzed bombs, examine fuzes for damage. Replace undamaged fuzes in their original packaging containers and reseal the containers with friction tape. Dispose of damaged fuzes (see paragraph 11, Handling of Damaged VT Fuzes). Use the following procedure when removing fuzes from bombs:

A. Replace the cotter pin in the vane locking pin or arm.

B. If an arming delay is mounted, remove it by pressing the stud (on type M1) or bar (on type M1A1) toward the fuze and, holding the bar across the open end, turn the dial until the dial slot is in line with the bar. Release the arming delay and slide it back along the arming wire.

C. Pull the arming wire from the vane locking pin or arm.

D. Insert a sealing wire through the hole vacated by the arming wire, twisting the ends

around the ring (on ring type fuzes) or strap bracket (on bar type fuzes).

E. Loosen the fuze with Fuze Wrench T4 until it can be unscrewed by hand. If the fuze has not been assembled too tightly, its removal may be facilitated by tightening it further to flatten the lock washer before loosening it for removal.

F. Remove the fuze from the fuze well.

NOTE: If the lock washer is in serviceable condition, keep it with the fuze for further use. If the lock washer is unserviceable, and spare lock washers are available, throw it away. If necessary, unserviceable lock washers may be reconditioned for further use by twisting the teeth with hand pliers.

G. If the fuze was received with a rear safety pin, reinsert the safety pin through the groove in the side of the booster cup.

H. Replace the fuze in its shipping container and reseal the container as tightly as possible.

21. Disassembly of Fuzes Prohibited

WARNING

VT BOMB FUZES MUST NOT, UNDER ANY CIRCUMSTANCES, BE DISASSEMBLED BY (USING) PERSONNEL.

22. Storage and Handling of VT Bomb Fuzes

Storage of Packaged Fuzes. VT bomb fuzes may be stored for extended periods, sealed in their original shipping containers, at any temperatures within the range, -65 to +165 degrees F. These containers are hermetically sealed and moisture-proof, and, hence, are impervious to high humidity.

Storage of Unpackaged Fuzes. Unpacked fuzes are likely to deteriorate if exposed to warm, humid conditions for periods of more than a day or so. Fuzes should therefore be unpacked only when they are required for use. Fuzes which are returned to storage must be stored in a cool, dry place, or otherwise pro-

ected from dampness. It is recommended that they be repacked in their original containers, and that the containers be sealed with tape. Additional moisture proof packing or moisture-absorbing material may be added, if available, either internally or externally, as further protection. Repacked fuzes should always be used before opening additional sealed fuze containers.

Handling of VT Bomb Fuzes. VT bomb fuzes packed in shipping containers may be subjected to the same handling as any other bomb fuzes, provided that the proper security measures are taken. Rough and abusive handling of unpacked VT bomb fuzes will not make the fuzes any less safe. However, such handling may render them unserviceable and should therefore be prohibited.

23. Packaging and Marking of VT Bomb Fuzes

Special precautions are taken to make sure that VT bomb fuzes are received in good operating condition by the using organizations. Each fuze is held in a shock resistant mounting inside a hermetically sealed container. A lock washer is shipped in its place on each fuze. In addition to fuzes, each shipping box (except those containing M166E1 fuzes) contains a Fuze Wrench, Model T4.

Packaging Ring Type Fuzes, Figure 22. Ring type fuzes are packed individually in sealed metal containers. Each metal container contains an arming delay as well as a fuze. Nine fuze containers are packed in each shipping box, together with a Fuze Wrench T4 and instruction sheets. Each box has a shipping weight of 68 lbs. and requires 2.5 cu. ft. of storage space.

When the fuzes are unpacked for use, the rubber, plastic, and metal mounting material should be removed before assembling the fuzes with bombs.

Packaging Bar Type Fuzes. Bar type fuzes produced during World War II are packed in hermetically sealed boxes of four, rather than individually. Instruction sheets and arming delays are included in each box. This packaging arrangement has now been replaced by a

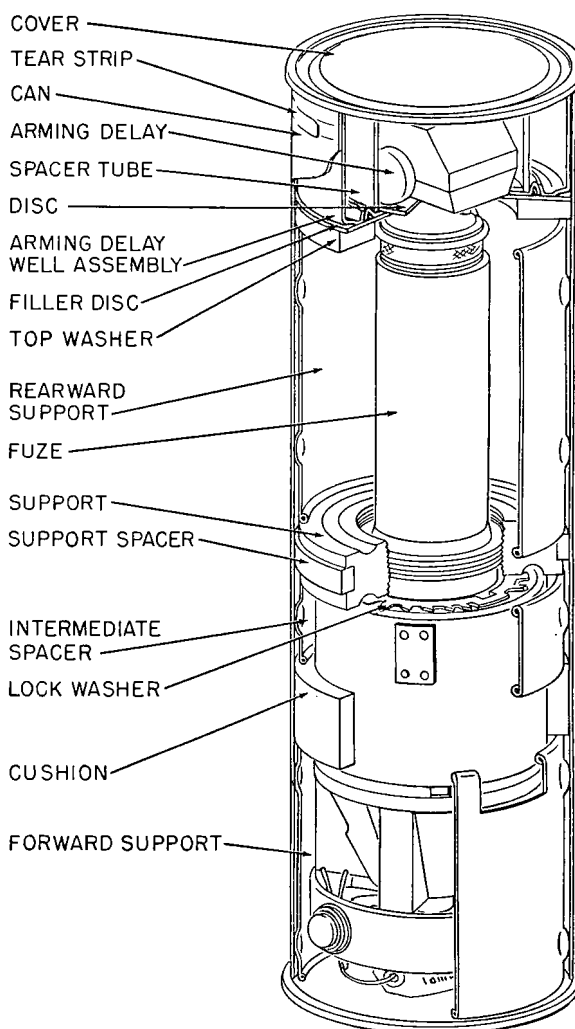


Figure 22—Shipping Container for Ring Type VT Bomb Nose Fuze.

metal can, 16" high by 20" diameter, containing four fuzes. Each can has a shipping weight of 55 lbs. and requires 3.5 cu. ft. of storage space.

When the fuzes are unpacked for use, the rubber, plastic, and metal packing material should be removed before assembling the fuzes with bombs.

Packaging Arming Delays. One arming delay is furnished with each fuze with which it may be used. For ring type fuzes, an arming delay is packed in a compartment in the top of each individual fuze shipping container. Four arming delays are packed in each box of four bar type fuzes. Retain and store unused

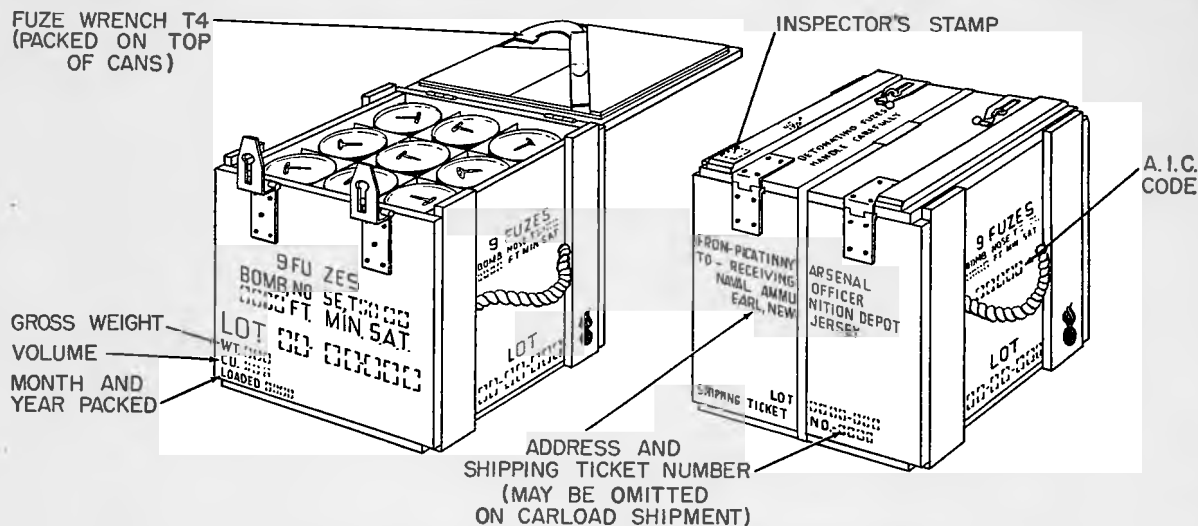


Figure 23—Packing Box for Ring Type VT Bomb Nose Fuzes.

arming delays in available empty VT bomb fuze cans. Remove fuze packaging material and fill cans to capacity with arming delays. Reseal cans with friction tape. When the quantity of excess arming delays on hand is sufficient for shipping purposes, request disposition instructions from the Bureau of Ordnance.

Marking VT Bomb Fuzes. Each VT bomb fuze is stamped with complete nomenclature, minimum SAT, lot number, and date of loading. Instruction tags are attached to the vane locking cotter pin, sealing wire, and safety pin.

Marking VT Fuze Shipping Containers. Each fuze shipping container is stamped with complete nomenclature, minimum SAT, the number of fuzes it contains, the lot number, the date of loading, and the number and nomenclature of the arming delays it contains.

Marking VT Fuze Packing Box, Figure 23. Each box of fuzes is marked with complete nomenclature, minimum SAT, the number of fuzes and arming delays it contains, the lot number, date loaded, weight, cubage, and ship ping date.

24. Destruction

In the event that the destruction of VT bomb fuzes or literature pertaining to them becomes necessary, the following methods are recommended:

Fuzes. The following methods of destroying

VT fuzes are preferred in the order indicated:

A. Disposal in deep water (see Bureau of Ordnance Circular Letter NAVORD OCL A4-46, dated 6 February 1946).

B. Destruction by explosives.

NOTE: Damage to the arming vane will make the fuze inoperable, but security requirements will not be satisfied unless the nose section is completely destroyed.

Literature. Literature pertaining to VT fuzes should be destroyed by burning.

25. Disposal of Dud Fuzes

In handling and disposing of dud VT fuzes, it must always be borne in mind that the fuze may be armed and ready to fire. In such condition, the fuze may detonate in response to any shock or jar. A dud fuze may be sensitive to the approach of personnel only if the vane is still turning at high speed (equivalent to air speeds greater than 80 knots). Sufficient time (usually 24 hours) must be allowed for the firing charge to dissipate. After 24 hours, duds may be handled with comparative safety, provided that the vane is locked, since they contain no impact firing elements. However, it should be kept in mind that a complete explosive train is present which may function on external violence, especially if the fuze has been deformed.

REFERENCE PUBLICATIONS

NAVORD OCL A9-48 of 27 July 1948—VT Fuzes and all Ammunition Assembled with VT Fuzes, Security of. (CONFIDENTIAL)

NAVORD OCL A4-46 of 6 February 1946—Dumping of Explosives, Ammunition and Chemicals, Instructions for. (UNCLASSIFIED)

NAVORD OCL AV25-44 of 30 October 1944—Standard Navy Aircraft Bomb Arming Wire Assemblies, Description and Use of. (UNCLASSIFIED)

BuOrd Dwg. No. 563004—Fuze Protector Mk 2 Mod 0. General Arrangement.

Department of the Army Film Bulletin No. 197 (Navy No. 6294), VT Bomb and Rocket Fuzes. (RESTRICTED) (Copies of this film may be requested, on a loan basis, from Training Film Libraries in Naval Districts).

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