ADVANCED FUZE & EXPLOSIVE ORDNANCE BULLETIN No. 2

1 MARCH, 1944

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This Bulletin has been compiled by the Staff of the U.S. Navy Bomb Disposal School primarily for the graduates of the Advanced Fuze & Explosive Ordnance School. While it is believed to be accurate, it is not to be considered an official publication.

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

AIRCRAFT ROCKETS

FORWARD FIRING AIRCRAFT ROCKETS

BRIEF HISTORY

In the last two years considerable interest in rockets has developed in the United States, and our armed forces are now using several types of rocket weapons. Artillery rockets had been in production in England, Russia, and Germany as early as 1940. American interest in rocket weapons was stimulated mainly by the British antiaircraft rocket, the UP 3. The performance of this high-velocity rocket, while not too successful in antiaircraft work, indicated that rockets designed along similar lines would have numerous applications. During the past year the British modified the UP 3 for use from aircraft and conducted extensive tests. The weapon has now been in tactical use since June 1943.

The possibility of obtaining an aircraft rocket for American use by placing the British rocket in production in this country has been considered. However, the British propellant, cordite, is not being manufactured in large quantities here. Also, there is some advantage in using a faster burning propellant than cordite. A slow-burning rocket requires a larger sighting correction; furthermore, when used against short-range targets the slow-burning projectile may not be completely burnt. A rocket similar to the British weapon but using American ballistite was developed by the California Institute of Technology in cooperation with the Bureau of Ordnance of the U.S. Navy. Another high-performance rocket is being developed by the U.S. Army.

The first forward-firing rockets for the U.S. Navy were fired from a TBF-1 at Goldstone Lake, July 14, 1943. Because the U.S. ammunition was not yet standardized, the British aircraft rocket was used. U.S. ammunition was first fired August 20, 1943. Launchers have been developed to fit on PV-1, TBF-1, TBM-1, and TBF-1C aircraft, and installations for the F6F-3, PBY-5, and SBD are being designed.

ADVANTAGE OF ROCKETS OVER GUNS FOR AIRCRAFT USE

The limiting factor in the firing of heavy caliber guns from aircraft is the inability of the aircraft structure to withstand the recoil forces. For instance, the recoil force from a 40 mm cannon firing a 3-lb shot is about 6000 lb. This force acts on the aircraft structure, which therefore must be stressed to withstand it. It becomes impracticable to strengthen the structure to withstand much greater forces and so the caliber of aircraft guns is limited.

Rocket projectiles do not present a recoil problem because the rocket recoil is taken up by the high-velocity gases ejected by the rocket itself. These gases blow past the wing surfaces and do not impart recoil to the airplane as long as no parts of it lie in the blast. Thus there is no noticeable effect on the flight of the airplane, and it maintains a steady course during the firing of successive rounds.

Though rockets are somewhat inaccurate when fired from the ground they are much more accurate when fired from aircraft moving at speeds of 300 to 500 ft/sec. For example, the U.S. 3"5 AR (with the 20-lb shot) when fired at these speeds has a mean deviation in dispersion of about 5 mils. When fired from the ground the dispersion is 26 mils. This difference between ground and aircraft behavior arises from the fact that when a rocket is launched from an airplane the velocity is already great enough for the fins to exert a restoring force.

SHIPPING & STOWAGE

For the present, this ammunition will be shipped in wooden shipping boxes as follows:

Quantity	Item	Box Size	Weight
4	3"5 solid bodies	13" x 9" x 9"	89 lbs.
4	3"5 H.E. bodies	15" x 9" x 9"	90 lbs.
4	3"25 motors & fins	54" x15" x15"	185 lbs.
2	5" H.E. bodies	23" x13" x 7"	100 lbs.
24	Mark 148 fuzes	23" x15" x15"	45 lbs.

The aircraft rocket should not be fired at temperatures above 120°F or below -10°F. It is therefore important that the rocket motors be stowed at temperatures below this value.

Rocket motors should not be needlessly exposed to the direct rays of the sun or to any temperature in excess of that printed on the motor tube as a safe firing limit. Storage of loaded motors at a constant temperature of 110°F. for one hundred hours results in no malfunction of the propellant provided the propellant is allowed to return to the safe firing temperature before use. Safe firing temperature limitations have been determined for this ammunition, and these limitations are plainly printed or stamped on the motor tube of each round. Under no circumstances are rockets to be fired when they have been subjected to a temperature outside the safe firing limitations until they have been allowed to return to a temperature within the safe firing limits. Ammunition which has been exposed to excessive temperatures (temperatures in excess of the upper limit or less than the lower limit printed on the tube) should be maintained within the safe firing limits for at least six hours before use. It should be remembered that the critical upper temperature limit for safe firing applies to the propellant grain and not to the motor tube. Since the grain is partially insulated from the motor wall it takes a considerably longer time to cool off than does the tube. In general, for purposes of stowage, the entire motor may be classified as smokeless powder. The H.E. rocket bodies and fuzes may be classified with existing fuzes and shells.

THE ROCKET BODIES

(1) The 3"5 Mark 2 is a 20 lb. solid steel body containing no explosive or fuze and forms a semi-armor-piercing projectile for forward firing from aircraft against submarines or tanks. The projectile is capable of penetrating up to 3 inches of mild steel armor at normal incidence and is especially designed to perforate the pressure hull of a submarine. The shape of the complete round gives a relatively long under-water travel at shallow depth for entry angles of about 20°.

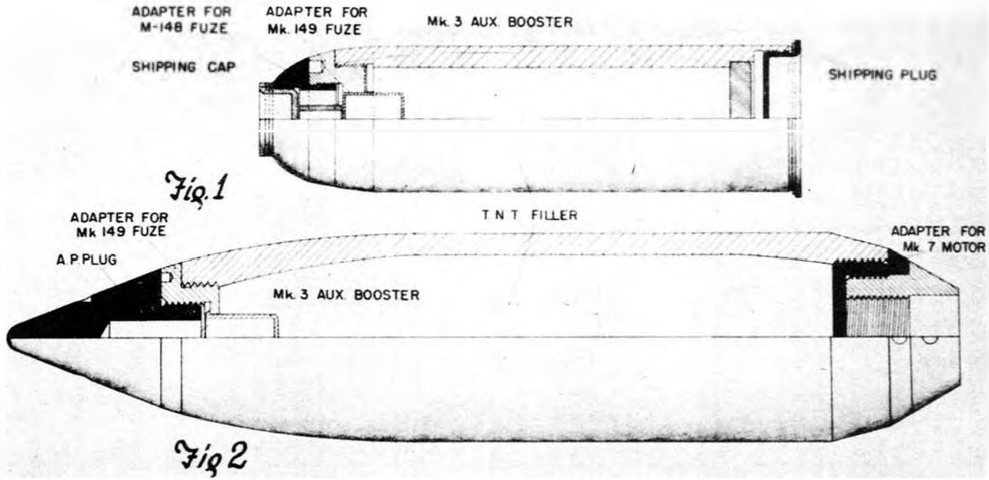
(2) The 3"5 Mark 5 high explosive body weighs 18.5 lbs. loaded without the fuze. The explosive filler consists of 2.2 lbs. of cast T.N.T. This body, when fitted with an adapter in the nose, provides a fuze cavity 1"701 and will receive the Mark 149 fuze. With a second adapter, the diameter is reduced to 1"500 and will then take the Mark 148 fuze.

(3) The 5" Mark 1 body is a high explosive shell weighing a total of 46.5 lbs. when loaded with 8.6 lbs. of T.N.T. and fitted with the Mark 148 point-detonating fuze. It is a modification of the 5" - 38 A.A. common shell and should have the penetration and fragmentation characteristics of this shell. This body uses the same adapter rings as the 3"5 Mark 5.

THE 3"5 MARK 7 MOTOR

At the present time there is only one type of motor and tail assembly, the 3"25 Mark 7, being shipped out for service use. Both the 3.5" and 5" bodies (heads) can be screwed on to this motor. The motor (see drawing) consists of a piece of seamless tubing threaded at both ends to receive the body (head) and the tail locking ring. Nearer the forward end, and consuming the largest portion of space is the single grain of Ballistite.

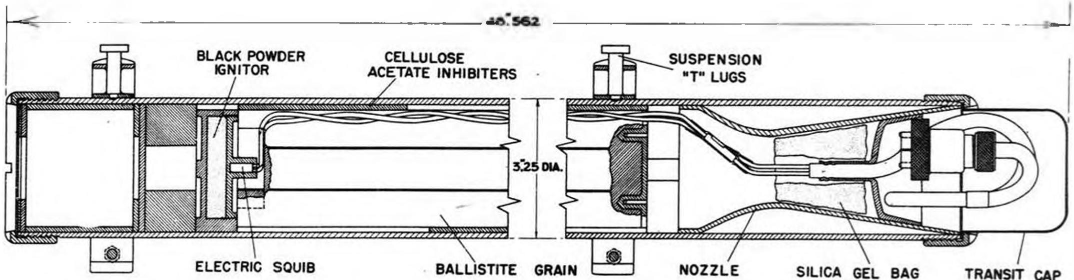
At the forward end of the motor there is a black powder igniter and an electric squib (ignites black powder). From the electric squib two electric leads extend through the motor and



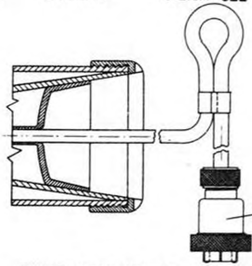
ROCKET BODIES

FIGURE 1 3.50 ROCKET BODY MK. 5

FIGURE 2 5" ROCKET BODY MK. 1



U.S. 3.25 IN. ROCKET MOTOR MK 7



END OF MOTOR WITH CAP REMOVED

out the aft end to a cable and plug connection. At the aft end of the motor there is a Venturi tube which acts as a nozzle, and a bag of silica gel which is a dehydrating agent and assists in keeping moisture from the ballistite. Two lug bands to which are welded 2 T-lugs are secured to the forward and aft ends of the motor. The T-lugs are the means by which the rocket is suspended and directed from the Mark 4 launcher.

THE TAIL

The tail consists of 4 sheet metal fins set 90° apart and welded to a central cylinder. The tail is slipped over the aft end of the motor and is secured by a tail locking ring which screws on. Care must be taken to insure that the aft T-lug is located 45° from each of the nearest fins i.e., looking along the longitudinal axis of the motor the T-lug will appear in the exact center of the arc formed by the two top fins . This must be done so that the tail fins will not get fouled in the launcher.

THE PROPELLANT

The propellant employed in rocket type ammunition is a double-base (nitro-glycerine, nitro-cellulose) smokeless powder known as ballistite. It is used in all Navy type rockets in the form of a single grain, located inside the motor, shaped in cross section like a cross 1" thick. This ballistite grain is 33" long, 2"75 in diameter, and weighs 8.5 lbs. Burning time of the ballistite varies from .62 seconds to 1.46 seconds, depending on temperature conditions. The longer burning time occurs at 0°F, and the shorter burning time at 110°F. Motor pressure (pressure of gases) will vary inversely with the burning time, but will remain constant throughout the burning, i.e., at an initial temperature of 0°F the motor pressure will remain constant at 500 lbs. per sq. in. and at 110°F, the pressure will remain constant at 1250 lbs. per sq. in.

A rocket motor attached to a rocket projectile is essentially a loaded gun. If an assembled round for any reason be ignited, it may take off and fly in a normal fashion, and the blast from the nozzle will be at a high temperature and quite intense. On the other hand, a rocket motor equipped with only the front and rear closure discs and with no body attached will burn either quietly or not at all.

Since, at present, the propellant is sealed into the motor tube by means of closure discs and glyptal paint, it is not possible to conduct visual or surveillance tests of any kind. Under no circumstance is the propellant to be removed from the motor. Any rocket motors on hand in which the closure disc or discs have become loosened must not be fired. They must be disposed of either by turning in to an ammunition depot, or, if this is not practicable, by dumping into deep water.

ASSEMBLY OF ROCKET ROUND

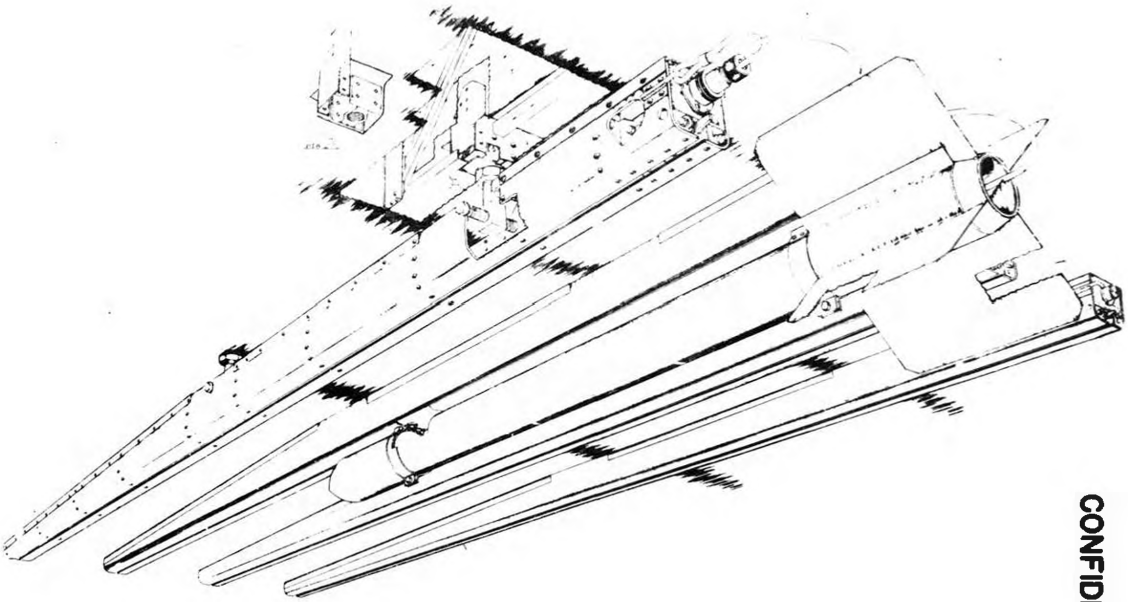
Each round is made up of three parts, the head, the motor and the tail fins. The ammunition is to be assembled just prior to loading on the launchers. To assemble a round of ammunition unscrew the thread protection cap from the front end of the motor and screw on the rocket body until it seats solidly. This requires about ten turns. The rear end of the motor contains the igniter cable. The tail ring is then unscrewed from the rear or nozzle end and the shipping cap is removed. The tail is then pushed onto the rear end of the motor with the lug band button half way between two of the fins and until the tail is up against the lug band. Next the tail ring is replaced and tightened up with the wrench provided in the shipping box. In assembling the rocket, care must be taken not to damage the firing cable or bend the fins. The former may result in a misfire and the latter in erratic flight. If the fins become bent they should be straightened before the rocket is fired. Next, unscrew the shipping plug nose from the body (when assembling H.E. rockets) and insert the Mark 148 fuze, which is supplied with an adapter already installed. When installing the fuze, care must be taken that the auxiliary TNT booster which is supplied with the body does not fall out. Assembled rounds must not be stood on end as this may damage the igniter cable. They should be placed horizontally on the deck or in racks. Fuze caps must not be removed until the rounds are loaded on the launcher.

The Mark 146 fuze is shipped installed in the base of the 5"0 body. No preparations are required to ready the fuze for use. The shipping plug in the base adapter protects the exposed end of the fuze. This plug should be kept in place until the round is assembled and should promptly be replaced if the round is disassembled. Before assembling the rocket motor into the 5"0 body see that the fuze is in place in the base adapter.

AIRCRAFT ROCKET LAUNCHER MK. 4

RAIL

The Aircraft Rocket Launcher Mk. 4 is a single non-jettisonable dural rail. The rail is 90 in. long overall, 3½ in. wide, 3-5/8 in. deep at the center, and 1-3/4 in. deep at the forward end. The launcher rail is drilled at two points so that it can be attached to the wing studs. A lengthwise slot in the underside of the rail supports the round, which has two button-type lug bands. At the breech end of the rail is a spring stop which allows the round to be breech loaded, and prevents it from falling out rearwards after loading. Forward of the backstop is a trigger arm which is rotated so that



DRAWING OF LAUNCHER MK 4, SHOWING METHOD OF MOUNTING AND HARMONIZATION ADJUSTMENT.

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one end is in front of the rear lug band after the round is loaded. The other end of the trigger arm, located on the top breech end of the rail, is drilled to take a 12-ga. copper shear wire. When wired in place the trigger arm will hold a round until a force of a little over 300 lbs. is exerted. This force is dependent on the strength of the shear wire used.

A two-prong socket, of the type used in the standard British launcher, is located at the breech end of the rail. The igniter cable from the round to be fired is looped and then fastened to a catch at the breech end before the plug is inserted into the socket. The catch takes up the strain which arises when the cable is shot out through the rear of the projectile. The launcher socket is connected to another socket set in the wing of the airplane by a short lead.

AIRCRAFT LOADING

First, test launcher for short circuits and malfunctioning.

Before commencing loading operations the plane should be placed in such a position that the launchers are not pointed toward any structures that would be damaged by accidental firing of a rocket during the loading operations. Having determined that the launchers are in proper operating condition, it is recommended that a safety officer, with the safety plug in sight, ascertain that the master armament switch and the firing switch are in the "off" position. He then authorizes the loading to begin. The rockets should be loaded from inboard out, first one wing and then the other. No one should at any time stand directly in front of or directly in back of a rocket while loading of the launchers is proceeding or after loading is completed. Any person or object in the paths of the rocket or the flame is in great danger of suffering a fatal casualty.

Normally, the completely assembled round, with one man holding the body and another man the tail, is raised to the launcher breech with the round parallel to and to the rear of the rail. The front "T" on the lug band is then engaged into the breech of the launcher rail and the round is slid forward. The rear stop will spring out of the way and the trigger arm will rise to allow passage of the "T". The round is pushed forward and the rear lug band is engaged in the same manner as the front lug band. The round is pushed slightly forward so that the rear lug band passes the trigger arm and then the round is moved backwards until it seats firmly on the backstop. However, for folded wing installations, it is usual to load the round from the front, or discharge end, of the launcher. With the trigger arm down and the hole in the upper end in line with the holes on the trigger arm lock, insert the proper shear wire, furnished with the round. Then ensure that the round is firmly held in place by trying to push it both rearward and forward. Hook the igniter cable loop onto the catch on the rear of the launcher. Do not plug in the igniter cable at this time, but let it hang loose. The above operations are repeated for each of the launcher rails. When high explosive bodies are used the next operation is to prepare the fuze for functioning. Insert the arming wire plate in the rocket arming control mechanism on the launcher. Remove the sealing tape from the Mk.148 fuze and take off the brass protecting cap on the fuze. Then the fuze safety wire is removed. The end of the arming wire is then fed through the one of the four arming wire guides which is in the most convenient position to receive it. Next the metal tube is placed over the arming wire and pushed back between two of the propellor blades until it rests against the lug through which the arming wire has been inserted. The tube is held secure by placing the two Fahnestock clips, supplied with the arming wire and tube, over the arming wire and pushing them up snugly against the tube. The arming wire is clipped off about two inches beyond the Fahnestock clip and dressed for burrs. When the rockets have been loaded they should be inspected by the safety officer to ensure that they are properly in place on the launcher, that the igniter cables are not plugged in and that the safety plug is in plain sight. He may then instruct the loader to plug in the igniter cables. If practicable, plugging in should be delayed until just prior to taxying to the take-of* position. Plugging in should be done from inboard out and special precaution should be taken to see to it that the loader stands to one side of the round he is plugging in, and to one side of any rails that have been plugged in. The safety officer should then signal the pilot that loading is complete. After take-off the pilot places the station distributor switch on "1", the master armament switch and the firing switch to "on" and inserts the safety plug.

UNLOADING PROCEDURE

If, upon return of the aircraft, there are any unfired rounds on the launchers they are to be unloaded by two men as follows:

The safety officer checks to see that the master armament switch and the firing switch are on "off" and obtains the safety plug from the pilot. With the safety plug in plain sight he instructs the loader to remove the plugs of the igniter cables from the launcher outlets. This should be done from outboard in on each wing, care being taken that no one is standing in line with the launchers either fore or aft. The arming wire is then removed from the fuze and the fuze safety wire and cap are replaced on the fuze. The shear wires are then removed from the trigger arms of all the launchers. By raising the rear stop the rocket may be pulled back out of the launcher. Before the front lug band will clear the breech the trigger arm must be pushed up and the rear stop held raised up. After all rounds are unloaded from the launchers they are to be disassembled if they are not going to be reloaded presently. The fuze is first removed and the body nose plug is replaced. Since four of the motors with fins installed will not fit into the original shipping box provisions must be made to store the loaded motors in magazines or ready service lockers. It is assumed that in most cases the rounds will be fired.

MALFUNCTIONING

Should a round for any cause fail to leave the rails when the firing button is pressed it should be removed after landing and after at least fifteen minutes have lapsed since the last attempt to fire. After removal from the rails the fuze should be removed from the body, the motor being then removed and disposed of by dumping into deep water. Since a hang-fire may be present, every care and precaution should be taken in handling a round that has failed to fire. If it is the judgment of the safety officer that the entire round should be thrown overboard, this action is authorized.

SAFETY PRECAUTIONS

The subject of forward firing aircraft rockets is new and no background of experience is available. Relatively little information has been sent to the field. In view of these circumstances the extreme danger of mishandling or failure to observe proper safety precautions cannot be stressed too strongly upon all hands. The instructions contained herein should be followed implicitly. In summary, the main points to bear in mind are as follows:

1. Test all firing circuits.

2. The safety plug should remain in the hands of the Safety Officer.

3. Do not permit loaders to stand either directly in front of, or behind a round while loading. The plane should be headed in the direction of some void area to prevent damage in case of accidental firing.

4. The ammunition should never be assembled and fuzed inside a magazine.

5. Naked lights, matches or other flame producing apparatus should never be allowed in the vicinity where this ammunition is present.

GENERAL INFORMATION

There are so many new developments taking place in conjunction with forward firing aircraft rockets at the present time, that even some of the information contained in this bulletin will be obsolete by the time it is received by the addressee.

Although the Mark 4 T-slot launcher is the only one being shipped to the field at present, another experimental launcher is being tested for use on the F6F. This is known as the Zero-length Launcher -- actually a 1" T slot. Use of the Zero-length Launcher is practical only when the airplane is traveling at high speeds (approximately 300 m.p.h.) since this launcher provides no continuing guide in the rocket's initial trajectory as does the Mark 4 launcher which is 7½ feet long. The Zero-length Launcher is simpler in design and produces much less drag on the airplane than does the Mark 4 launcher. Experiments are also being conducted so that the Mark 4 launcher can be jettisoned after the rockets are fired.

The School is making every effort to keep up on the latest developments and subsequent bulletins will keep the men in the field posted.

BIBLIOGRAPHY

1. "Forward Firing of 3"5 and 5"0 Aircraft Rockets from TBF-1, PV-1, SBD-5 and F6F-3 Aircraft", published by United States Pacific Fleet Air Force, N.A.S., San Diego, dated 31 December 1943.

2. Bureau of Ordnance letter S-78-1(119)(Re2d).

3. Bureau of Ordnance drawings and blueprints.

ROCKET FUZES

MARK 148 FUZE

GENERAL DESCRIPTION

The Mark 148 fuze is designated A.I.R. for air arming, impact firing, rocket fuze. As can be seen from the drawing it operates on the same basic principle as the Mark 137 used in the barrage rocket. The essential working parts are (1) the fuze body, (2) the firing pin, (3) the detonator shutter, (4) the propeller assembly, and (5) the set-back pellet. The pointed end of the firing pin holds the detonator shutter to one side in the safe position, the middle portion being threaded to correspond to the threads in the fuze body, and the front end is made to engage the propeller assembly. The propeller locking pin attached to the set-back pellet serves to prevent rotation of the propeller assembly except when set-back forces are operative, or when the propeller assembly and firing pin have been turned far enough out to clear the locking pin.

USE

The Mark 148 fuze is used with two adapters, in the nose of the 3".5 Mark 5 and 5" Mark 1 H.E. aircraft rocket bodies. In both cases the Mark 3 auxiliary booster (granular TNT) must be inserted before screwing in the fuze.

The Mark 148 will fire on either land targets or water, and will do so consistently at impact angles as low as 5° to 10° for targets into which the round penetrates some distance before it ricochets. On hard targets (steel plate) from which the round ricochets without penetrating, the fuze will probably not fire consistently at impact angles less than 20° to 25°.

INSTALLATION

Remove shipping plug. Inspect the adapter threads in the nose of the rocket body to make sure they are free of burrs and dirt. See that the Mark 3 auxiliary booster is installed. Screw fuze in and tighten with a wrench. After the rocket assembly is installed on the launcher, remove the shipping cap from the nose of the fuze and remove the safety wire. Insert arming wire through the arming wire guides and through the propeller. Place

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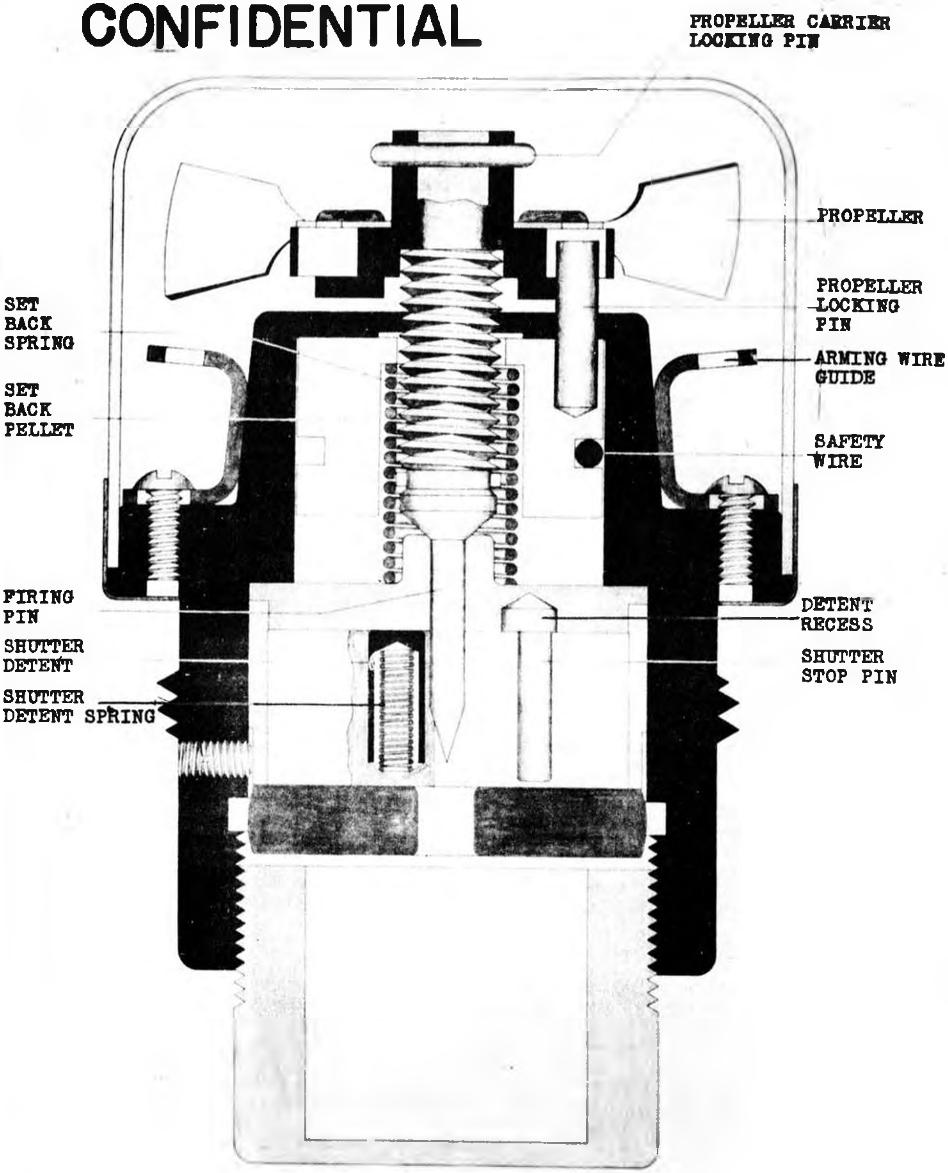


MARK 148 A.I.R. FUZE

the metal tube over the end of the arming wire through two of the blades of the propeller and flush against the arming wire guide on the fuze. Place two Fahnestock clips over the end of the arming wire so that they are against the metal tube. Cut the arming wire two inches beyond the Fahnestock clips and dress with fine sandpaper for burrs. Fuzing and unfuzing of rocket ammunition should be done in an isolated place away from planes and buildings. This work should never be done in a magazine.

OPERATION

When the rocket is fired the arming wire is withdrawn and the set-back pellet is retracted until the propeller locking pin is flush with or slightly below the front face of the fuze body. Thus the propeller assembly is free to turn in a clockwise direction and screw the firing pin upwards with it. The propeller must make from 3 to 4 turns during acceleration to unscrew the firing pin sufficiently to prevent re-engagement of the propeller locking pin. After 8 to 10 turns, the firing pin has moved far enough to free the detonator shutter. The latter is then rotated by the shutter spring into the armed position (detonator in line with the firing pin and lead-in), and is held in place by the shutter detent which engages the detent recess. After one or two additional turns the end of the firing pin thread is reached, and the firing pin stops turning. On impact the fuze is fired when the firing pin shears the threads in the nose of the fuze body and is driven into the lead azide detonator.

FIRING SAFE

The fuze may be fired safe if the arming wire is released from the launcher so that it stays with the fuze and thus prevents the propeller from turning.

REMARKS

In order to reduce the speed of arming, the propeller pitch has been set at 85°, only 5° from being in line with no pitch at all. This feature decreases the certainty of arming and in addition does not provide a sufficient amount of air travel for arming to fully meet the requirements for naval use. Compared to the Mark 149, which was designed specifically for airplane use, it has further disadvantages. Once the arming wire has been inserted, the propeller and firing pin assembly is exposed. The fuze is thus subject to icing and corrosion and must not be considered wholly reliable after exposure for any length of time.

MARK 149 FUZE

GENERAL DESCRIPTION

The Mark 149 fuze, like the Mark 148, is designated A.I.R. The essential changes are the addition of a second set-back block, shutter locking pin, a nose cap and clamp, smaller but less sharply pitched propeller blades and a sturdier more streamlined construction. The principle parts of the fuze are as follows: Nose cap and spring, propeller and propeller hub, firing pin, upper set-back block and propeller locking pin, lower set-back block and shutter locking pin, set-back spring, (which acts for both set-back blocks), and shutter and shutter spring.

USE

The Mark 149 fuze is designed specifically for use as a nose fuze in the 3"5 and 5"0 aircraft rocket bodies. This fuze is point-detonating and will fire on ground or water impact in A.R. projectiles, even at very low angles of impact.

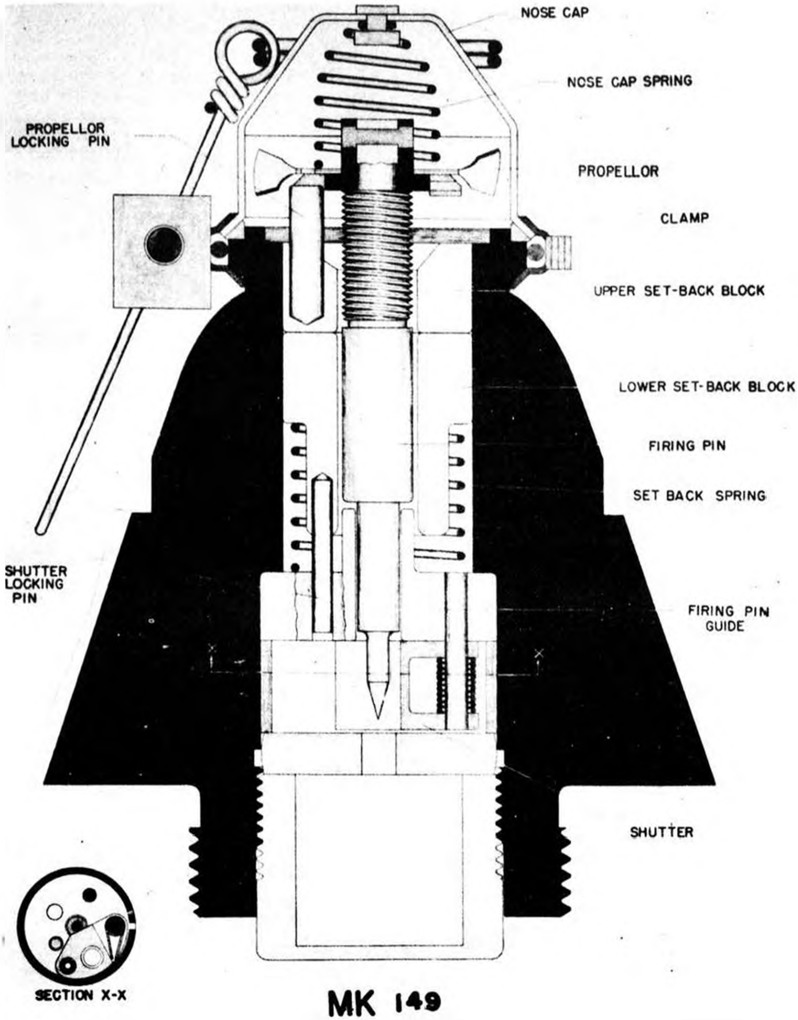
INSTALLATION

No official instructions on installation have been issued as yet by the Bureau of Ordnance since none of these fuzes has been shipped to the service. However, the following procedure has unofficial approval:

Remove the small adapter ring from the nose of the rocket body (leave the large adapter in). Note that fuze seat liner is clean and auxiliary booster is in place. Screw the fuze in and tighten with a wrench. After installing the rocket assembly in the launcher, insert the arming wire into one of the holes in the clamp bushing which secures the nose cap. Place one Fahnestock clip over the arming wire so that it is flush against the clamp. Cut the arming wire two inches from the Fahnestock clip and dress the end of the arming wire with fine sandpaper for burrs. Remove the safety pin from the second hole in the clamp bushing.

OPERATION

When the round is fired the arming wire pulls free, releasing the clamp assembly which falls apart. The strong cap spring throws off the cap, exposing the propeller. At the same time acceleration effects set-back which forces both set-back blocks down againstthe compression of the set-back spring. This accomplishes two things: First, the propeller locking pin is freed from the propeller hub and the propeller is free to turn (in a clockwise direction) and screw the firing pin upward. Second, the lower set-back block forces the shutter locking pin down into the shutter cavity. This pin will prevent the shutter


NOSE CAP
NOSE CAP SPRING
PROPELLOR LOCKING PIN
PROPELLOR
CLAMP
UPPER SET-BACK BLOCK
LOWER SET-BACK BLOCK
FIRING PIN
SET BACK SPRING
SHUTTER LOCKING PIN
FIRING PIN GUIDE
SHUTTER
SECTION X-X

MK 149

from moving over and lining up under the firing pin as long as the rocket is accelerating (i.e. set-back will continue to operate as long as the rocket motor is burning). About 8 turns are necessary for the point of the firing pin to free the shutter. After 400-900 feet the rocket motor will cease burning and both set-back blocks will be forced up again by the set-back spring. The shutter can then move over in the normal manner and be locked directly under the firing pin by a spring loaded detent. On impact the firing pin is driven down bending the nose plate in and breaking the thread connection with the fuze body and is driven into the lead azide detonator.

FIRING SAFE

The fuze may be fired safe if the arming wire is released so that it stays with the fuze, retaining the cap. In the 5" Mark 1 body, which also has a base fuze, Mark 146, it may be desirable to have a delay in detonation upon impact, such a delay being incorporated in the base fuze. In this case the nose fuze would be fired "safe".

ADVANTAGES

The advantages of the Mark 149 over the Mark 148 fuze are:

1. The waterproof cap assembly covering the propeller protects the working parts of the fuze from weather and icing until the round is actually fired.

2. The body, of steel, is designed to fit directly into the fuze liner ring of the 3"5 and 5" bodies and is more streamlined.

3. A positive delay in arming, until the end of acceleration is effected by the locking pin attached to the lower set-back block. The minimum arming distance will be slightly greater than the burning distance of the rocket.

4. The firing pin is stronger and better guided so that there is a higher probability of firing on glancing incidence.

REMARKS

While production has not yet started on this fuze, there should be no great difficulties since its basic principles have been thoroughly tested on previous fuzes.

MARK 146 BASE FUZE

GENERAL

The Mark 146 fuze is classified P.I.R. which means it is pressure arming, impact firing, and used in rocket ammunition. This fuze operates on a basically new principle and differs greatly from any other bomb or rocket fuze. The fuze is of sturdy construction, the body being of steel. It is well protected from damage on impact since it is threaded into the base of the rocket body. At present the fuze is designed for instantaneous action only but since it is so well protected it could incorporate a delayed functioning time and still work reliably. It is anticipated that some time in the future, this fuze will be shipped out with varying delays. Tactically, a delayed functioning time would be useful against reinforced pill-boxes, gun emplacements, or other armored targets.

The fuze head screws into an adapter fixed in the base of the rocket body and the gasket and luting on the threads make a gas tight seal. The rear end of the fuze (the exterior surface of the diaphragm cup) is exposed to the front end of the rocket motor.

USE

The Mark 146 fuze is used in the base of the 5"0 H.E. aircraft rocket body only. This fuze may be used alone with an AP cap over the nose fuze cavity, or it can be used in conjunction with the Mark 148 or Mark 149 nose fuzes.

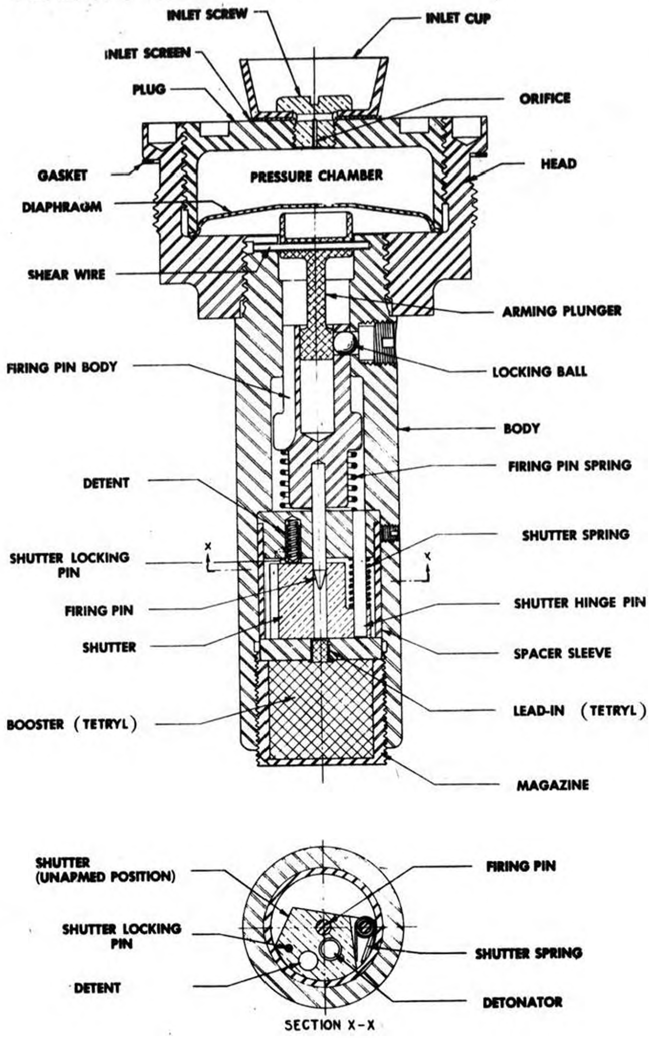
INSTALLATION

The Mark 146 fuze comes already installed in the 5"0 H.E. aircraft rocket body.

OPERATION

When the rocket is fired, gas under considerable pressure from the rocket motor passes through the inlet screen underneath the inlet screw and enters the pressure chamber. As the gas pressure builds up, the diaphragm bears against the arming plunger breaking the phosphor bronze shear wire and forcing the arming plunger down. The locking ball, which is preventing the upward movement of the firing pin body, moves over into the narrow portion of the arming plunger. Then the firing pin body moves up carrying the firing pin out of the shutter cavity. At this point the shutter would normally move over as it does in other fuzes employing a shutter. However, at the moment the rocket is fired, the force of set-back will thrust the shutter up (not down since this is a base fuze) and the shutter locking

CONFIDENTIAL



MK. 146, P.I.R., ROCKET FUZE

pin will mate with the hole in the bottom of the firing pin guide. This will prevent the shutter from moving over despite the fact that the firing pin will have moved up by that time. As long as the rocket is accelerating (i.e. as long as the rocket motor is burning) set-back will keep the shutter locked in this position. After 400-900 feet of air travel, the motor will burn out and the shutter will be forced down again by its spring. This will disengage the shutter locking pin from the hole in the bottom of the firing pin guide and the shutter can then move over in the normal manner, the detonator being in line with the firing pin and lead-in where it is locked by the detent. The fuze fires on impact when the inertia of the firing pin body drives the firing pin forward into the detonator.

It is to be noted that the shutter spring performs two functions: (1) It keeps the shutter down against the booster disc (except as stated above) and (2), it swings the shutter in into firing alignment. Detail sketch, Section X-X shows the shutter in the unarmed position.

ARMING DISTANCE

Because of the delay in admission of gas, via the small orifice in the inlet screw from the rocket motor to the pressure chamber, the first stage of arming does not occur until approximately half the burning is over. Thus, if the rocket motor blows up before it leaves the launcher, the fuze should not arm because of this delay. Arming is not completed until after the end of acceleration. The burning distance and therefore the arming distance will vary with the temperature. On the average, arming is completed about 0.1 second after the end of burning. Approximate arming distances in the 5"0 A.R. are given below.

ARMING DISTANCES OF MARK 146 FUZE IN 5"0 A.R.

0°F.	70°F.	135°F.
575 Ft.	350 Ft.	250 Ft.

MISCELLANEOUS

EFFECT OF BOMBS ON STRUCTURES

The following compilation of data on the effect of bombs on structures of various types is issued as reference material which may be of value to Advanced Fuze & Explosive Ordnance School graduates.

Three types of problems are discussed:

1. The effect of bombs on buildings and fixtures.
2. Graphs of armor penetration by AN Series Service Bombs.
3. Effects of bombs on reinforced concrete bomb-proof structures.

THE EFFECT OF BOMBS ON BUILDINGS AND FIXTURES

The amount of damage caused by any one H.E. bomb varies with a number of factors the most important of which are (a) the nature of the structure involved, (b) its distance from the bomb, and (c) whether the bomb fell in a confined space or in the open.

The type of buildings damaged should be noted, i.e. whether dwelling house, factory, shop, etc., and as much information as possible of such details as the number of stories, type of construction, etc.

Damage to dwelling houses is classified as follows:

<u>Class A.</u> Houses completely demolished, i.e., 75-100 per cent external brickwork destroyed.

<u>Class B.</u> Houses beyond repair and to be demolished, i.e., 50-75 per cent external brickwork destroyed; if less than 50 per cent, remaining walls with gaping cracks making the house unsafe.

<u>Class C.</u> Houses seriously damaged, uninhabitable but capable of repair, i.e., damage to roof structure (rafters, purlins, hips etc.) and/or partial demolition of one external wall or two adjacent external walls.

<u>Class D.</u> Houses inhabitable but requiring repairs to remedy serious inconveniences, i.e., damage to ceilings and/or minor splinter damage to walls and/or glass of windows, excluding cases where less than 10 per cent glass of windows is damaged.

The following information is issued to enable AF & EO Officers to advise authorities as to the damage which might be expected should an unexploded bomb explode, in order that the classification of bombs may be facilitated.

Table I shows the effect of buried bombs on houses with 9" brick walls. It has been found that the degree of damage is practically independent of the depth of the bomb. (No figures can be given for heavier construction). The figures give upper limits, and are only attained in the absence of screening between houses and bomb.

1. DWELLING HOUSES

Table I - Buried Bombs

Maximum distances in feet at which houses with 9" brick walls will sustain varying degrees of damage.

Bomb	Class A Damage	Class B Damage	Class C Damage
50 kg.	12'	23'	50'
250 kg.	22'	44'	70'
500 kg.	35'	70'	100'
1000 kg.	60'	120'	200'
1800 kg.	70'	140'	250'

Table II - Unburied Bombs

Maximum distances in feet at which houses with 9" brick walls will sustain varying degrees of damage, (building not screened).

Bomb or Mine	Charge Weight	Class A Damage	Class B Damage	Class C Damage	Class D Damage
50 kg.	24 kg.	10'	20'	40'	200'
250 kg.	130 kg.	30'	60'	120'	600'
500 kg.	250 kg.	45'	95'	190'	950'
1000 kg.	450 kg.	70'	140'	280'	1400'
1800 kg.	800 kg.	145'	290'	580'	2900'

2. STEEL FRAMED STRUCTURES

(a) As regards the steel framing it can be taken that destruction of steelwork would only occur in the actual crater area or just beyond it. For this purpose, the figures shown in Table II, (which allow a margin for the offset of the bomb) may be taken.

Table III
Radius within which steel framework may be destroyed.

Bomb	Average Crater Radius	Maximum Recorded Offset	Maximum Distance to Edge of Crater	REMARKS
50 kg.	8'	15'	23'	The offset normally increases as the depth of penetration increases. The figures given in Col. 4 are maximum and can be reduced if it is seen from the hole of entry that the bomb was travelling away from the building, or in cases where a shallower penetration than normal can be diagnosed.
250 kg.	18'	20'	38'	
500 kg.	23'	20'	43'	
1000 kg.	32'	22'	54'	
1800 kg.	40'	40'	80'	

(b) As regards brick or reinforced concrete panel walls in steel framed structures, Table IV shows the minimum distance in feet at which not more than slight damage will be done to an unshielded wall panel. Note screening or deflecting blast will reduce the distance.

(c) It has been concluded by the British that the damage done to a machine shop (provided the bomb explodes in the interior of the shop) by bombs of charge/weight ration 50% is greater than that done by A.P. or S.A.P bombs of the same total weight but smaller charge; and, therefore, blast damage to the machines is greater than fragment damage.

Table IV

Bomb	Cement Mortar Wall				Reinforced Concrete Wall			
	4½"	9"	13½"	18"	6"	12"	18"	24"
50 kg.	51'	26'	17'	13'	8'	5'	3'	2½'
250 kg.	155'	78'	52'	39'	26'	13'	9'	6'
500 kg.	240'	120'	80'	60'	40'	20'	13'	10'
1000 kg.	360'	180'	120'	90'	60'	30'	20'	16'
1800 kg.	750'	375'	250'	185'	125'	62'	41'	29'

3. DAMAGE TO GLASS

The distance up to which glass will be broken or splintered depends on the size of the pane. Table V refers to average panes (not shop windows).

Table V

Bomb	Distance up to which all glass may be expected to be broken.	Distance up to which a considerable amount of damage may be expected to occur.	Distance beyond which all average sized panes may be expected to be safe.
50 kg.	85'	170'	340'
250 kg.	200'	400'	800'
500 kg.	280'	560'	1120'
1000 kg.	375'	750'	1500'
1800 kg.	670'	1340'	2680'

4. DAMAGE TO UNDERGROUND SERVICES.

Table VI gives the horizontal distance in feet beyond which damage to underground services should not occur. The figures given are for pipes etc. in clay.

For made ground they should be multiplied by 1.3.
For chalk " " " " " " 0.9.
For sand and gravel " " " " 0.8.

Table VI - Clay Soil - Distances in Feet

Bomb	Cast Iron or Concrete Pipes	Steel pipes or Cables	Earthenware, Stone or brick drains & sewers
50 kg.	20'	15'	30'
250 kg.	30'	24'	50'
500 kg.	35'	27'	60'
1000 kg.	45'	34'	70'
1800 kg.	50'	38'	90'

Note: The distance from the bomb at which damage takes place may be increased under the following circumstances.

(a) When the pipe enters a rigid structure such as a man-hole or foundation, which prevents it yielding to the earth movement, damage is likely to occur at the point at which the pipe enters the structure.
(b) When the earth movement is confined in one direction only by the presence of a large and rigid structure, the radius of damage in other directions is likely to be increased.
(c) When the ground is waterlogged, the same effect may be produced.

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

ARMOR PENETRATION BY SERVICE BOMBS
(BuOrd Sketch No. 124400)

Altitude of Release/1000 feet.

Notes:

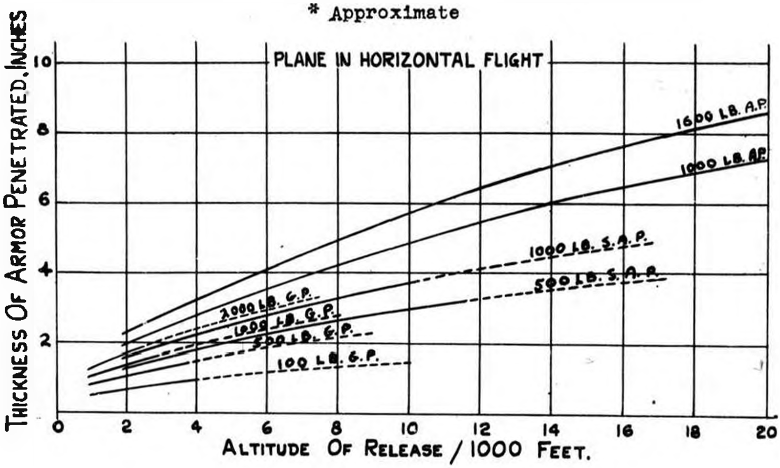
1. The curves on the accompanying graphs show computed penetration of horizontal Class B armor, assuming no appreciable deformation of the bomb. Dotted sections indicate the region where the bomb will probably break up.

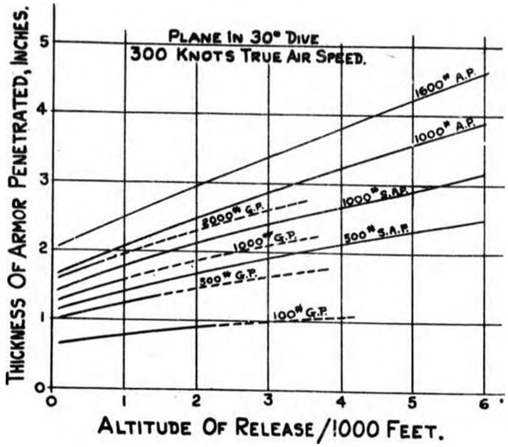
2. The curves for release from plane in horizontal flight are computed for 180 knots true air speed. They may be used for any plane speed, however, since any change in striking velocity is offset by a corresponding change in angle of fall.

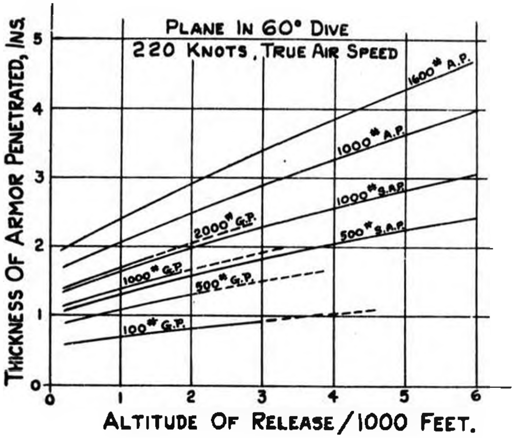
3. Values used in calculations for the various bombs are as follows:

Designation	Type	Weight *	Diameter *
100 lb. AN-M30 & Mk. 4	G.P.	117 lbs.	8".0
500 lb. Mk. 12 & AN-M43 or 64	G.P.	500 lbs.	14".0
1000 lb. Mk. 13 & AN-M44 or 65	G.P.	1000 lbs.	14".7
2000 lb. AN-M34 & 66	G.P.	2050 lbs.	23".1
500 lb. AN-M58A1	S.A.P.	500 lbs.	11".75
1000 lb. AN-M59	S.A.P.	1000 lbs.	15".0
1000 lb. AN-Mk. 33	A.P.	1000 lbs.	12".0
1600 lb. AN-Mk.1	A.P.	1600 lbs.	14".0

* Approximate




PLANE IN 30° DIVE
300 KNOTS TRUE AIR SPEED.
THICKNESS OF ARMOR PENETRATED, INCHES.
ALTITUDE OF RELEASE/1000 FEET.
1600# A.P.
1000# A.P.
1000# S.A.P.
500# S.A.P.
2000# G.P.
1000# G.P.
500# G.P.
100# G.P.
0
1
2
3
4
5
6


PLANE IN 60° DIVE
220 KNOTS, TRUE AIR SPEED
THICKNESS OF ARMOR PENETRATED, INS.
ALTITUDE OF RELEASE/1000 FEET.
1600# A.P.
1000# A.P.
1000# S.A.P.
500# S.A.P.
2000# G.P.
1000# G.P.
500# G.P.
100# G.P.
0
1
2
3
4
5
6

EFFECT OF BOMBS ON REINFORCED CONCRETE STRUCTURE

1. The results obtained by statically detonating 500 lb. (142 lbs. TNT) bombs at known distances from certain test materials are as follows:

A. Unburied Bombs - To resist the maximum splinter effect and blast pressure produced by the detonation of unburied bombs, the thickness of these materials should be as indicated in the following table. A uniform distance of 50 feet between the bomb and the test material was maintained in obtaining the following results.

Material	Thickness Necessary
Mild Steel	1.5"
Bricks in cement	13.5"
Unreinforced concrete	15.0"
Ordinarily reinforced concrete	12.0"
Specially reinforced concrete	10.0"
Sand or earth revetments	30.0"

B. Buried Bombs

(a) Chalk soil, 22.5 inch thick brick wall.

Distance Away	Pressure Exerted
33'	10 lb./sq.in.; wall intact.
17'	30 lb./sq.in.; wall failed; earth movement 1-3/8" to 4-3/4".

(b) Sandy loam, reinforced concrete wall.

Distance Away	Pressure Exerted
45'	Negligible; wall intact.
20'	45 lb./sq.in.; wall intact.
13.5'	180 lb./sq.in.; wall intact.

It will be noted that unlike the uniform distance employed in the tabulation under unburied bombs, the distances employed in the buried bomb table are variable. The thickness of wall represents the constant factor in the buried bomb table. Inspection of the tables reveals that reinforced concrete walls will resist pressures many times as great as will brick walls. The fact that reinforced concrete structures can withstand enormous underground pressures was well illustrated during the recent actions in the Gilbert Islands.

2. The following conclusions are drawn from tests performed to determine the penetration, scabbing and perforation effects of 2000 lb. A.P. bombs (hypothetical) at 1000 F/S on ordinarily reinforced oncrete slabs and shelters.

(a) The maximum diameter of impact craters was approximately six (6) times the diameter of the bomb, while the diameter where perforation occurred was one and one-half times the diameter of the bomb.

(b) Scabbing craters were two and one-half to three times larger than the spalling craters on the front faces and were longer in the direction of the transverse steel next to the surface of the slabs.

(c) Reinforcing: The bars were bent outward on both faces. Special reinforcing attaching transverse and longitudinal reinforcing at the faces securely to the shear reinforcing (see description and diagram of ideal reinforcements for concrete slabs following) limits the damage and will be preferable.

(d) Anti-scabbing plates are steel plates placed on the inside face of the reinforced slab. It is possible that anti-scabbing plates would be desirable under certain conditions, but approximately equivalent resistance can be obtained more easily and economically by an additional foot thickness of concrete.

(e) The general effect of oblique impact was to reduce penetration. The bombs pursued a curved path through the target material with deflection along path of bomb, hole elliptical, and plane tilted back.

(f) As one slab thickness was reduced, penetration increased. Resistance to penetration is constant only when the slab is three and one-quarter to three and one-half times as thick as the depth of penetration (in slabs of great thickness). Example: a 100 lb. projectile of 1000 F/S penetrated 15 inches into a 31 inch reinforced concrete slab, while it only penetrated 11-3/4 inches into a 40 inch slab.

An Armor Piercing bomb or projectile of constant size will always penetrate a constant distance into a concrete slab of infinite thickness; however, if the slab be reduced in thickness enough so that the bomb or projectile will go completely through the slab, the following difference in penetration will be observed. The thickness of the slab which the bomb or projectile went completely through will be found to represent a greater distance than the distance which the same projectile or bomb had penetrated into the slab of infinite thickness.

(g) Effects of TNT charges placed on slab and detonated:

(1) Scabbing was less when specially reinforced concrete was used.

(2) Anti-scabbing plates appeared not to have reduced damage to slabs. Actually, the process of removing the plates to repair slabs is a long tedious job, so that adding one foot thickness of concrete is preferable.

3. The Ideal Shelter

A. General Observations

It was found that an A.P. bomb does more damage to a reinforced concrete shelter than a G.P. bomb of the same weight regardless of the higher percentage loading factor of the G.P. bomb. Projectiles and bombs produced very little concussion effect inside the shelters, but TNT charges statically detonated on the shelter roofs produced great concussion effects. Therefore it is recommended that the shelter roof be constructed in two layers with an air space between the upper slab and shelter ceiling. The upper slab should be perforation proof to prevent detonation of the bomb or projectile against the ceiling (which would cause concussion effect in the shelter). It was found that an earth fill between the upper slab and shelter ceiling served no useful purpose, and that an air space was more effective.

B. Specifications of an Ideal Shelter

The following specifications are for a shelter designed to resist the perforation and concussion effects of a 2000 lb. A.P. bomb with a 22% loading factor traveling at 1000 F/S at 20% obliquity.

(a) Upper slab specially reinforced, 6 feet thick (4500-5000 lbs/sq.in. concrete), overhang 6 - 8 feet.

(b) Air space with 5 foot vents between upper slab and ceiling.

(c) Lower slab specially reinforced concrete 4 feet thick.

(d) Bulkheads specially reinforced concrete 4 feet thick above ground (if exposed to sea, 6 feet thick) and 6 feet thick below ground.

(e) Deck specially reinforced concrete 4 feet thick.

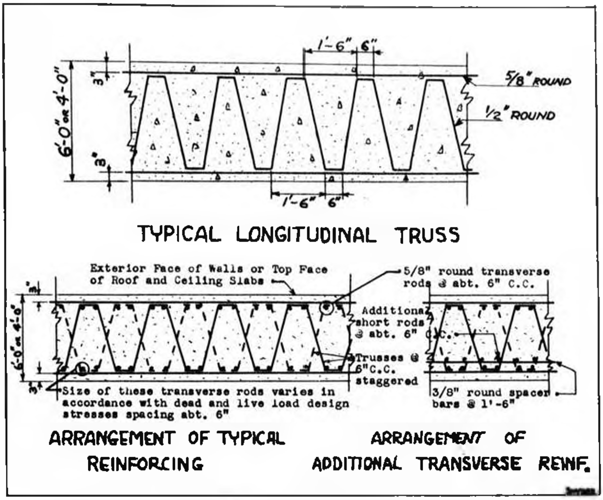
(f) Apron 3½ feet thick and 20 feet wide around base of shelter.

(g) For a 3000 lb. A.P. bomb (hypothetical) with a 1300 F/S velocity, the upper slab must be specially reinforced concrete 96 inches thick.

(h) The doors into the shelters must be strong and out of alignment with the sheltered interior.

Bibiliography

1. BuOrd sketch No. 124400.
2. Australian Military Forces Intelligence.
3. Bomb Proof Structures, 1940, BuShips.



REINFORCING FOR BOMBPROOF STRUCTURES

EXPLOSIVES

NEW EXPLOSIVE - DBX

The name DBX is an abbreviation for "depth bomb explosive". It signifies that the explosive was originally intended for depth bombs, but actually it is suitable for replacing Torpex in other munitions as well. The composition of DBX is 21%

RDX, 21% Ammonium Nitrate, 40% TNT, 20% Aluminum. Actually, in some of its characteristics DBX is intermediate between Torpex and Minol; but, as far as underwater damage power is concerned, the tests conducted by the Bureau of Ordnance so far seem to indicate that DBX is slightly superior even to Torpex on equal weight basis.

TORPEX

Because of the increasing importance of Torpex, the following information, which first appeared in U.S.N. Bomb Disposal Intelligence Bulletin No. 31, is being reprinted.

Torpex, a new explosive, is being loaded into certain types of U.S.N. war heads, mines, bombs, and other munitions. The British have been using Torpex for over a year in similar weapons.

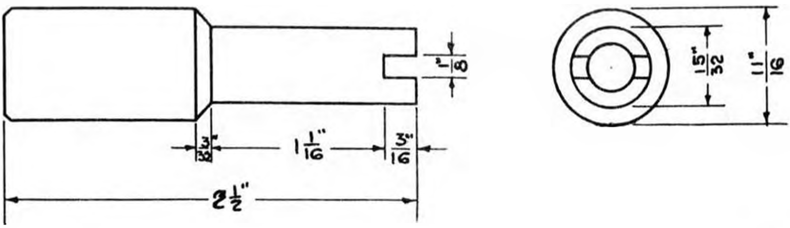
Torpex is a mixture of three substances: TNT, RDX and Aluminum Powder. The explosive, R.D.X., has been known for a long time under the name Cyclonite, but until recently it was only a laboratory product. Although its excellent explosive qualities were recognized, its great sensitivity barred its use as a military explosive. However, it has been found that mixing with some beeswax, or with certain plasticizing oils, or even with TNT, reduced the sensitivity of RDX to such an extent that these mixtures could be used readily as explosive fillers.

Torpex is a much more potent explosive than TNT. On a weight basis, 100 lbs. of Torpex produce as much underwater damage as 150 lbs. of TNT; on a volume basis, 100 volumes of Torpex produce as much underwater damage as 170 volumes of TNT. (The density of Torpex is 1.73; that of cast TNT is 1.54.) Torpex for underwater performance, according to reports of comparative tests, is superior to explosives recovered from captured German, Italian and Japanese munitions.

Torpex is non-hygroscopic and non-corrosive. Surveillance tests proved it to be chemically stable when exposed to temperatures as high as 150°F. for prolonged periods. The impact sensitivity of Torpex is slightly greater than that of TNT, consequently it must be handled with greater care. When struck by bullets, or projectile fragments, a low-order detonation occurs; therefore, it is important to protect Torpex-loaded munitions from projectile or fragment impacts, as far as possible.

TOOL FOR REARMING AIRCRAFT DEPTH BOMBS
(Bulletin of Ordnance Information 4-43)

Considerable difficulty has been encountered in the fleet in rearming aircraft depth bombs. The AN-Mark 224 Mod. 2 and the AN-Mark 234 Mod. 2 plastic head fuzes have only one hole for the arming wire and cotter pin. The insertions of the arming wire must be done against the action of the jump-out spring. A tool to accomplish this has been designed by Gunner A. J. Crowley. Pressure on the tool depresses the pin and washer allowing the arming wire to be inserted through the cut-away sections of the tool. These tools may easily be made up locally.



RESTRICTION OF USE FOR AN-M103 AND M103 FUZES

(BuOrd Circular Letter AV125-43)

Service reports indicate that the subject fuzes do not function satisfactorily when set for delay. All reports of malfunctionings further indicate that all these were due to delay trains and detonators not being sealed.

All issues of fuzes of lots listed in Section I below have been stopped, and all future issues will be made with fuzes listed in Section II. All Naval activities with stocks of subject fuzes listed in Section I will turn them in to the nearest ammunition depot and replace them with fuzes listed in Section II. As stocks of defective fuzes are accumulated, they are to be turned in to the Naval Ammunition Depots at Crane, Indiana or Hawthorne, Nevada, for ultimate replacement by the War Department.

If replacement fuzes are not available, the fuzes listed in Section I may be satisfactorily used with the instantaneous setting.

Section I

LOT NUMBERS OF NOSE BOMB FUZES M103 AND AN-M103, NOT SEALED

M103 Fuzes - Not Sealed

Section I

Lot Numbers	Date Loaded
P.A. 2717-1 to -6 incl.	10/40 to 7/41
P.A. 5189-1 to -2 incl.	7/41
P.A. 6284-1 to -2 incl.	7/41 to 8/41
P.A. 3-6285-1 to -22 incl.	10/41 to 6/42
P.A. 1-6286-1 to -24 incl.	12/41 to 4/42
P.A. 7348-1	7/41
P.A. 8135-1 to -5 incl.	11/41 to 12/41
P.A. 8-15534-1 to -29 incl.	4/42 to 6/42
P.A. 24-22205-1 to -10 incl.	6/42 to 7/42
A.O.P. 2-23202-1	7/42
A.O.P. 2-23202-7 to -13 incl.	7/42 to 8/42
A.O.P. 2-23202-40 to -41 incl.	9/42 to 10/42
E.O.P. 7-23204-1 to -2 incl.	8/42
R.O.P. 4-23214-1 to -3 incl.	6/42
R.O.P. 4-23214-22	9/42
A.O.P. 2-23202-68	10/42

AN-M103 Fuzes - Not Sealed

A.O.P. 2-23202-56 to -67 incl.	10/42
A.O.P. 2-23202-69 to -99 incl.	10/42 to 12/42
A.O.P. -11-100 to -109 incl.	12/42
A.O.P. -110 to -226 incl.	12/42 to 6/43
P.A. 9-15534-1 to -14 incl.	5/42 to 6/42
P.A. 23-22205-1 to -21 incl.	6/42 to 8/42
A.O.P. 2-23202-3 to -6 incl.	7/42
A.O.P. 2-23202-14 -39 incl.	8/42 to 9/42
A.O.P. 2-23202-42 to -55 incl.	10/42
E.O.P. 2-23204-1 to -30 incl.	6/42 to 10/42
I.O.P. 17-23207-1 to -5 incl.	8/42
R.O.P. 4-23214-4 to -10 incl.	6/42 to 8/42
P.A. 52882-1	7/42

Section II

AN-M103 Fuzes - Sealed

P.A. 23-23205-22 to -48 incl.	8/42 to 12/42
E.O.P. 2-23204-31 to -48 incl.	10/42 to 12/42
I.O.P. 17-23207-8 to -28 incl.	9/42 to 11/42
R.O.P. 4-23214-11 to -57 incl.	8/42 to 12/42
E.O.P. 4-1 to -3 incl.	12/42
I.O.P. 4-1 to -17 incl.	12/42 to 1/43
P.A. 13-1 to -19 incl.	12/42 to 5/43
R.O.P. 5-1 to -2 incl.	1/43
SC-2-1 to -54 incl.	12/42 to 8/43
S.O.P. 3-2 to -83 incl.	1/43 to 9/43

Section II

M-103 Fuzes - Sealed

Lot Numbers	Date Loaded
P.A. 24-22205-11 A to -30 incl.	8/42 to 12/42
R.O.P. 7-23214-1 to -2 incl.	10/42