LIST OF ABBREVIATIONS USED IN CIVIL DEFENCE AND/OR IN THIS PRECIS

In Full	Abbreviation
Accommodation	accn
Acknowledge, acknowledged or acknowledgement	ack
Administration or administrative	adm
Ambulance	A.P.
Armour Placing	bn
Battalion	bty
Battery	BW
Biological warfare	B.D. Units
Bomb Disposal/Units	br.
Bridge, bridging	bdg.(s)
Building(s)	bds
Brigade	cas
Casualty(ies)	CW
Chemical Warfare	CD
Civil Defence	colm
Column	comd
Command, commanded or commander	comm(s)
Communication(s)	coy
Company	CEV
Company Equipment Vehicle	con
Control or controller	Xrds
Cross Roads	Dr
Despatch rider	diag
Diagram	elec
Electricity	eqpt
Equipment.	est
Estimate(d)	ETA
Estimated time or arrival	ETC
Estimated time of completion	ETD
Estimated time of departure,	evac
Evacuate, evacuated or evacuation	flg
Figure	Frag
Fragmentation	ft.
General purpose/bomb	G.P./Bomb
Ground Zero	GZ
Headquarters	HQ
Heavy capacity	H.C.
High Explosive	HE
Homeless	hmls
Hospital	hosp
Hour (s)	hr (s)
Incendiary Bomb	IB
Inches	In.
Include(s), included, including or inclusive	Inc.(s)
Inform, informed, information or for information of	info

Injured (but see seriously injured)	inj
Intelligence Officer	IO
Junction	June
Kilogram's	kg. kgm/s
Leader	K.T.
Liaison Officer.	ldr
Light capacity	LO
Local Authority	L.C.
Location, locate, locality, located or locating	LA
Medical	loc
Medical Officer	med
Medical Officer of Health	MO
Medium Capacity	MOH
Megaton	M.C
Message or messenger	MT(normally with a preceding number)
Meteorological or meteorology	Msg.
Mobile or mobilisation	met
Movement	mob
Officer	mov
Operate, operated, operation, operational or operator.	offr
Party	op
Personal Carrying Vehicle	oz./s
Platoon	pty
Point	PCV
pounds	pl
Radio telephony	pt
Railway	lbs
Reconnaissance or reconnoitre	RT
Region	rly
Regional Commissioner	recee
Rendezvous	reg
Required	RC
Rescue	RV
Restricted	reqd
Second Section or sector	rsc
Sami Armour Piecing	RESTD
Seriously injured	sec
Situation.	S.A.P.
Stuff Officer	SI
Stretcher Bearer	sit
Temporary	SITREP
Time of despatch	SO
Time of Receipt	tele
Transport	temp
Unclassified	TOD
Unexploded	tpt
Vehicle	veh
With effect from	wef

CHAPTER NO. 1

OBDUCTION TO BOMB DISPOSAL AND ITS ORGANISATION

1. Aim

The aim of this precis is to give an introduction to the problem of bomb disposal and a historical account of the organisation.

2. Historical

By the end of the 1st World War bombing squadrons has become one of the major offensive weapons. Since then development took place in both aircrafts and bombs. This meant that in any future war bombing will take place on an unprecedented scale, which proved to be true during the 2nd World War. To face the above menace comprehensive plans for Air Raid precautions were made during the war so that the civil life of the community survives and the war effort is maintained. These measures did cater for the widespread damage and disorganisation which would follow the use of High explosive, Incendiary, Chemical bombs etc, but that many of the missiles would fail to explode and would also constitute a serious problem was never foreseen.

3. During the German attack on Poland and Spain in 1939 reports about the disrupting effects of unexploded bombs (UXB's) were received and only some precautionary measures were taken. There was nothing like Bomb Disposal Units. In Great Britain, cases of any such UXB's were considered to be the responsibility of the Home Office who very a domestically and naively planned that they should be collected by the air raid wardens and police and then delivered to convenient dumps which will be later on detonated by the members of the armed forces. The Home Office proposed to train some of its Civil Defence personnel for elementary demolition, since it was expected that the bombs would be easily accessible on or only just below the surface. In Nov,1939 as a temporary measure the War Office accepted the responsibility till sufficient number of civilians were trained. The bomb disposal parties provided by the war office were each to consist of three men from Royal Engineers, a Junior N.C.O. and two sappers and were equipped with a vehicle, 75 pounds of explosive, 2 shovels, 2 picks and 500 sandbags. The only technical instruction given to them was in the method of building a sandbag wall around an UXB and then explode it where it lays. They were to instruct ARP volunteers in the necessary technique for this work while actually engaged in it. The civilian volunteers however never materialised and thus the idea of training ARP volunteers in bomb disposal was dropped.

4. During Dec,1939 1st air raids took place over Britain (Shetland) and a number of bombs remained unexploded. The bombs were recovered and fuses examined. It was discovered then that many UXB's remain dangerous, also some had timed fuses. This necessitated a properly organised force in the event of a heavy air attack. Thus on Feb. 2nd 1940 the war office assumed full responsibility for planning Bomb Disposal Squads and the Royal Engineers were entrusted with the job.

5. The first formation order authorised the formation of twenty-five sections and simultaneously the Germans began bombing U.K. in right earnest. New types and large sizes of bombs were dropped, many with delayed action fuses, anti-handling devices and booby traps. UXBS were found to penetrate deep and take unpredictable courses inside the ground. Many got lodged within or in close proximity of factories, power houses, railway yards etc. Thus, each

UXB had to be treated individually as a potential source of danger. While dealing with them the newly formed sections suffered heavy casual- ties, firstly because they lacked technical information and then worked only with petty and improvised tools and some explosives for detonation.

6. When France fell in early 1940, the air raids on Britain became more frequent another 109 sections were ordered to be formed by the war office. The situation became so tense that the Prime Minister Churchill ordered special priorities to be allotted and most modern equipment to be provided to the bomb disposal squads. In August, 1940, the overall responsibility of Bomb Disposal was passed on to G.H.Q. Home forces and a Bomb Disposal Directorate was formed. By the end of September 1940 there were about 4,000 officers and men on roll in the bomb disposal units. Since then with ever increasing manpower, higher efficiency and improvements in equipment and methods, the problem was gradually mastered. By early 1941 there were 25 companies, many formed into groups commanded by Lt. Col's, each company consisted of a H.Q. and about 12 operating sections. By May 1941 the organisation was functioning well. Full liaison with Civil Defence Corps and the Police had been established and an efficient reporting procedure introduced. The Navy and Air Force planned their specialist units to meet their own requirements. Civilian firms also formed their B. D. Units who were later incorporated in Home Guards and did much good work.

7. The greatest deficiency in the early days of war was the inefficient system of reporting and recording of incidents, which resulted in many false and ambiguous reports leading to harassment to the B.D. Units. This necessitated correct reconnaissance, identification and re- porting of UXB's, By 1942 most of the civil defence wardens had some training in bomb reconnaissance and used to examine every incident before it was reported to the B.D. Units, Thus the majority of obvious false reports (which were very large in the early stages) were eliminated. The reports were now being sent only after thorough reconnaissance and confirmation of the UXB. This resulted in correct assessment of the situation, allotment of correct priorities in disposal and thus allowed the over- worked B.D. Squads to deal with bomb in a planned manner.

Extent of Work Involved

8. It was Aug, 29th, 1940 that London faced the first storm of bombing and 48 hours later 2500 UXB's were there to be dealt by B.D. Squads. By Sept. 20th the number leapt to 3759 and only 4000 men on the job. In the Western deserts the B.D. Squads faced and mastered the Italian fuses. In the small island of Malta 584 UXB's were recorded in the worst week of bombing. Many bombs were dealt with in the Far East. The Americans and Australians also shared the responsibility. In Burma also, many bombs were dealt with, mostly demolished in situ. The 2nd World War resulted in very high casualties amongst the B. D. Units. Lessons were learnt and techniques mastered at great cost of lives. Those who survived the war continued the work of disposal of thousands of UXB's and mines still left over.

The Organisation in India

9. During the 2nd World War simultaneous with the war preparations, the ARP was organised which was responsible for recce and reporting of UXB's and the bomb disposal was the responsibility of the military for all civilian areas. The bomb disposal regulations were published in 1943 which contained instructions regarding recce, reporting and disposal of bombs. The whole country was divided into areas and sub-areas for purposes of disposal of UXB's. The division was according to the convenience of working of bomb disposal organisations. The

authorities responsible for deciding the priority of disposal was also designated. The B.D. Companies were to operate in more than one area.

10. The organisational set-up planned was:

(a) Bomb Disposal Training Centre.
(b) Bomb Disposal Groups.
(c) Bomb Disposal Platoons.
(d) Bomb Disposal Sections.

11. The B. D. Training centre was responsible for training, maintenance of spare sets of B.D. special technical equipment, research, issue of B.D. technical information and instructions and liaison. The present B.D. training is given in the Bomb Disposal School of the Faculty of combat Engineering at the College of Military Engineering, Kirkee, Poona. A Bomb Disposal Group will usually have up to 16 B.D. Sections. The Platoon Commanders are usually responsible for maintaining liaison with civil, railway, and port authorities and receive information from them regarding UXB's, allocation of work and movement of B.D. Sections in accordance with the priority laid down, submitting reports on new types of bombs and fuses to the B.D. Training Centre with copy to E. in C's branch GHQ.

12. The bomb disposal sections are responsible for disposal of bombs in accordance with the priority allotted by the B.D. Platoon H.Q. They also maintain a close liaison with Civil Authorities regarding maintenance or re- laxation of any restrictions regarding essential services, movement of traffic etc. Send returns of disposal, and report on new weapons to Platoon H.Q. or direct to B.D. Training Centres and to E. in C's Branch GHQ. After the 2nd World War was over, the B.D. Organisation existed in the form of the bomb disposal training centre at CME and only few B.D. Platoons which had the responsibility of dealing with all the UXB's during the Chinese and Pakistani aggression. The history of disposal of Pakistani bombs is quite interesting as many of them were found incorrectly fused or with even safety caps on. Some of the bombs dealt with are kept at CME Kirkee for training purposes.

13. At present bomb disposal units exist in all the three services, but the bulk of B.D. Units however exist in the Army and they are located at suitable parts in the country.

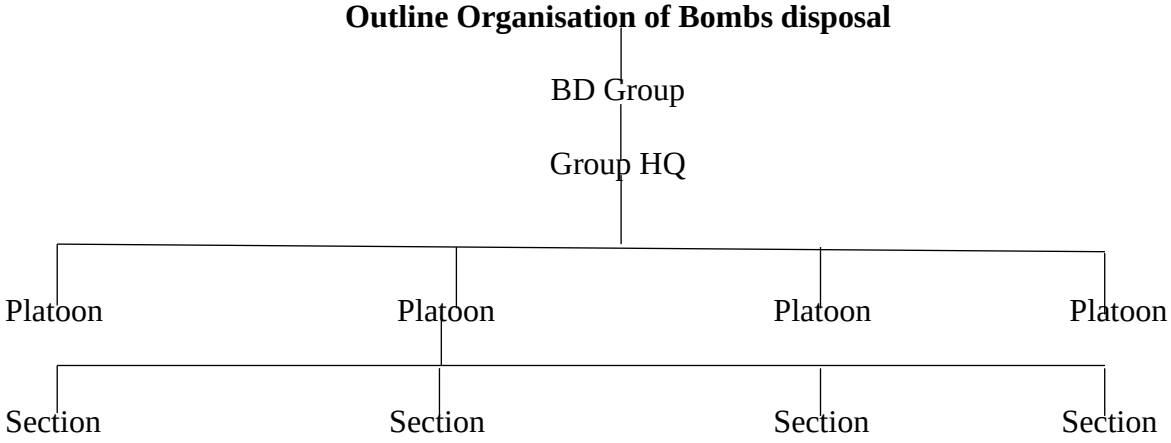
14. The latest set-up of a B.D. platoon and the equipment used by it is given in the appendix.

Conclusion

15. The work of bomb disposal is a difficult and dangerous one. The B.D. units' available will always be fewer than required and therefore to conserve the efforts of B.D. Units on priority bombs, a thorough reconnaissance is a must before an UXB is reported for disposal. This is the main responsibility of civil defence organisation regarding bomb disposal.

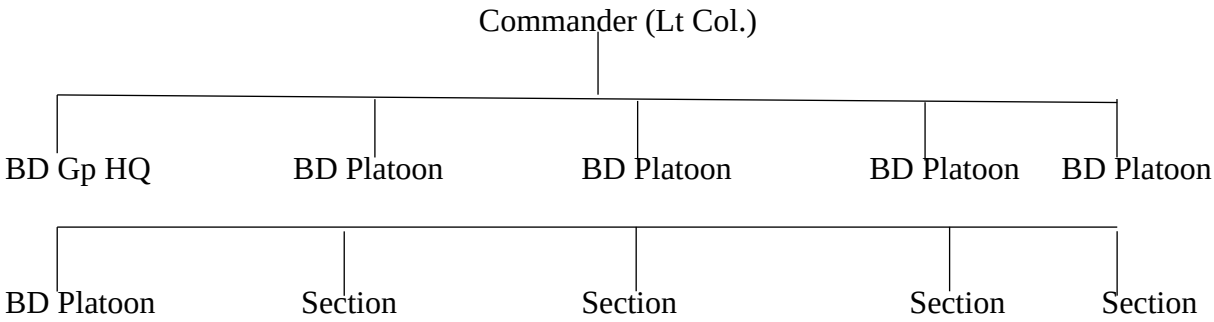
Appendix to UXB/11

Outline Organisation of Bombs disposal

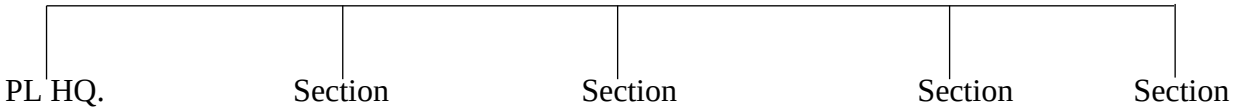


Outline Organisation of Bombs disposal Group

(Refer to Sec 4, Para 2)



Organisation of Bombs disposal Platoon



Maj	1 OC			JCO-1
Capt.	1 2 i/c			HAV-1
Capt/ Sublt	1 BRO			NK-2
Sublt	1 PL JCO			Spr-13
Hav	2 QM & DPMT		**Total**	**17**
NK	4	Officers-3		
Spr	52	JCOs -5		
		CRs 122		
Total	**62**	**Total-130**		

Engineer Plant

1. Earth Boring machine type 3 cc	-	1
2. compressor air ftr mounted	-	2
3. Generator Steam	-	1
4. Crawler tractor size II with A./O and winch		1

Transport

Motor Cycle Solo 350 cc	-	2
Cars 5 cwt 4 x 4 GS	-	2
Truck 1 ton Wels	-	5
Lorry 3-ton 4 x 4 GS with winch		11
Lorry 3-ton 6 x 4 Turn Table		1

CHAPTER NO. 2

RESPONSIBILITIES OF DEFENCE SERVICES & CIVIL DEFENCE IN REGARD TO U.X.B.'s

1. **Aim**

The aim of this precis is to clearly understand the specific responsibilities of the Civil Defence Organisation and of defence ser- vices in regard to U.X.B.'s with a view to ensure that Civil Defence Personnel perform the role assigned to them. While it is important that Civil Defence Services should promptly and courageously discharge their role and responsibilities, it is also important that they do not over-step their role into spheres which are reserved for Defence Services of the country and for which Civil Defence Services are neither equipped nor tramped.

The Policy

Civil Defence Responsibilities

2. Civil Defence Organisation is responsible for the reporting of unexploded bombs, shells and mines except those which are found in Ser- vice areas e.g. Cantonments, Ordnance factories where it is the responsibility of the concerned Defence Service. Thus Civil Defence Personnel have the following roles to perform:

1. Reconnaissance of the U.X.B.'s.

2. Reporting of the U.X.B.'s.

3. Recommending "PRIORITY" for the disposal of an U.X.B.'s.

4. Evacuation in the vicinity of U.X.B.

5. Institution of elementary protective measures for the protection of civil population and property.

6. Assisting the bomb disposal party.

The detailed problems which will be encounter- ed in performing each of the above roles have been discussed separately in subsequent precis.

Defence Services Responsibilities

3. The policy regarding division of responsibility between the three-armed services are defined as follows: -

(i) The Navy is responsible for bomb reconnaissance & disposal on all ships, on Naval property and of all missiles below high-water mark, Mines usually will be made safe by the Navy and disposed of by Bomb Disposal Units.

(ii) The Air Force is responsible for the reconnaissance and disposal of bombs on all their property, of jettisoned air force bombs and of bombs in or near crashed aircraft,

(iii) The Army is responsible for Bomb Disposal over the rest of the country. Units of all arms will be responsible for:-

(a) reconnaissance of unexploded bombs.

(b) ensuring that adequate safety precautions are taken within the vicinity of unexploded bombs.

(c) assisting Corps of Engineers units by providing working parties when necessary.

Digging down to bombs will be undertaken only with Corps of Engineers assistance or under their supervision.

(iv) **Bomb Disposal Units**-These units will be responsible for all removal of un- exploded bombs, where that removal or destruction is the responsibility of the Army. If no Bomb Disposal Units are available the provision of the succeeding paragraphs will apply.

(v) All Corps of Engineers Units (less Survey and Transportation) other than Bomb Disposal. These units will be responsible for:

(a) reconnaissance of unexploded bombs,

(b) ensuring that adequate safety precautions are taken within the vicinity of unexploded bombs, and removal, or

(c) destroying 'in situ' any bombs in areas where their removal or destruction is operationally necessary by the local commander. (This will normally be applicable to only those units which hold demolition equipment).

No special bombs disposal equipment will be issued to these units. If it is operationally necessary to remove a bomb, the bomb must be removed without defusing and the risk accepted. Bomb Disposal Platoon like any other units of the Army may be used to assist in accordance with the over-all Civil Defence Plan. The Bomb Disposal Platoon will be kept concentrated and squads despatched to deal with unexploded bombs in accordance with priorities laid down.

Thus, within the Army, bomb disposal is primarily the responsibility of the Bomb Disposal Unit of the Corps of Engineers. When operationally necessary and when Bomb Disposal Unit is not available any Engineer Unit (other than a Survey or Transportation Unit) may be called upon to destroy an UXB in situ and on rare occasions to gain access to a buried UXB or to remove an UXB which cannot be blown up.

All Arms Responsibilities

4. **All arms are required to**:

(i) recognise indications of unexploded air warfare missiles which are buried and identify dangerous ones which are exposed.

(ii) know the procedure for reporting the presence of unexploded air-warfare missiles.

(iii) know what safety precautions to adopt pending the arrival of a Bomb Disposal Party.

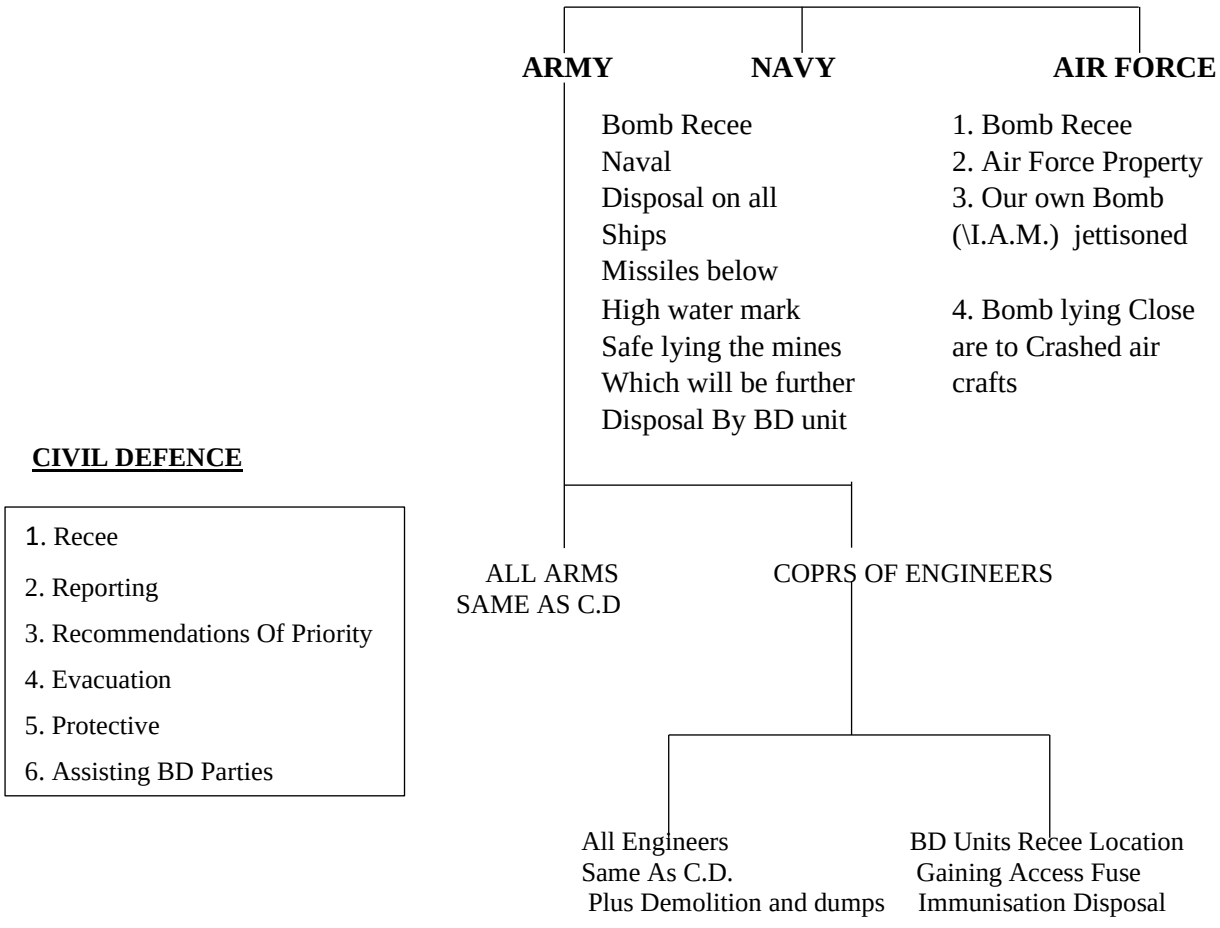
(iv) know how to remove certain of the safer unexploded missiles from the area occupied or controlled by the unit to some suitable place to await demolition by Engineers. The designation of these missiles, which will probably include some Incendiary bombs. AA shells, and aircraft cannon shells will be published soon after the start of a war as sufficient experience and data have been obtained.

Conclusion

5. The respective responsibilities of the Civil Defence Organisation vis-a-vis Defence Services can be seen at a glance in the chart appended to this precise. It may be emphasised that Civil Defence is mainly responsible for reconnoitring, reconnaissance and reporting of the U.X.B. (Three R's) together with instituting protective measures such as evacuation, erection of sand-bag walls etc., whereas Defence Services are responsible for the actual disposal of the U.X.B.

Responsibilities

CIVIL DEFENCE SERVICE



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CHAPTER NO. 3

HIGH EXPLOSIVE BOMBS CONSTRUCTIONS TYPES, EFFECTS AND MARKING ON BOMBS

(Addendum to H. E/I for UXB Reconnaissance and reporting Course only)

1. **Aim**

The aim of this addendum is to give detail- ed information regarding construction, design, markings and types of H.E. Bombs to Bomb Reconnaissance Parties, who will have to visit the sites of UXB's and report on likely type of bomb. This will lessen/make easy the work of the Bomb Disposal Units and also give them some idea about the method of making the bomb safe, means of disposal, the equipment needed for disposal etc.

2. **Construction**

(For simple construction refer to para 3 of Precis No. HE/1).

(i) The Bomb Case-It is just a container to hold the charge, but its secondary requirements are:

(a) It should not give way till the whole of the main filling has ignited i.e. the case should be strong enough to withstand this pressure which is usually 500 tons/square inch.

(b) In case of fragmentation bombs, it is shaped suitably to provide as many splinters as possible.

(c) It should have suitable arrangements to be suspended or held the bomb in bomb bay of the bomber.

(ii) The casing which is usually made of one piece forged steel varies in thickness from ¼ " to several inches. Even in the same casing usually the nose side is thicker than the central and tail part. The casing of a G.P. Bomb, 250 lbs. is about 5/16" and a 1,000 lbs. about 7/16". Some typical fragmentation bombs may have two coaxial thin casings, the annular space being filled with lead shots or other objects to act as splinters.

(iii) The main filling. These should be powerful explosives but at the same time should be insensitive to shock and fire. TNT and RDX (Trinitrotoluene and Re- search Department Explosive) or a mixture of both are the most common. Explosives, Halite and Cyclonite when mixed with other explosives give main fillings like Ednatol, Pentolite, Amatol and Pieratol. The details about these will be found in a subsequent para. The various types of main fillings are:

(a) Cast filling
(b) Powder filling
(c) Cast powder mixture
(d) Filling with hollow shaped charges or space filled.

(e) Liquid filling.

(a) **Cast filling**-The explosive is melted and filled inside the casing through the filling plug 19. The liquid solidifies and takes the inside shape of the bomb. The disadvantages are that firstly they are not of high degree of purity and secondly the layers formed not being uniform, speed of detonation is affected and the transmission of detonating wave is not uniform resulting at times in partial detonation of the main fil- ling. The advantages are long storage life and no deterioration in properties. The dis- advantages are usually countered by putting auxiliary booster charge laced through- out the main filling, making cast filling most common.

(b) **Powder Filling**-Ammonal, Amatol and Baratol are some- times used as powder fillings Disadvantages are short life because of the air pockets in the powder. The filling tends to flow or move bodily within the bomb causing stress on the casing or distorting any interior transverse structure like fuse pockets while in motion or impact. It does not stick to the casing because of which casing might break on impact. Advantages are the uniform transmission of detonating wave in the filling and from disposal point of view unless badly affected, can usually be removed more easily than cast fil- lings. Also, from manufacture point of view powder filling is quicker and simpler.

(c) **Cost plus powder**-There have been examples of H.E. Bombs filled partly with cast explosives and partly powder. These are usually done for special effects. Typical examples are pellets embedder in a matrix of cast explosive or wax. In anti- personnel bombs sometimes nails and bullets are filled in powder layer, one layer of cast, then a coating of wax, then delaying layers it necessary, then a layer of powder filed with miss les. The wax acts as a protective coating.

(d) **Hollow charge or space filled**- For special effects like greater damage in a particular direction, a suitably shaped hollow space is left on that side to- wards which maximum damage is intended. A hollow charge in the nose of the bomb is usually provided in the Armour piercing bombs. The hollow charge can also be provided parallel to the axis of the bomb to make the omni- directional flow of energy of blast, directional. This principle of shaped charge has been applied to rifle grenades, rockets, artillery projectiles, charges and fuse detonators also.

(e**) Liquid Filling**-The liquid ex- plosive is filled inside the casing through the filling plug. The liquid explosives have not so far been used to any extent because of the difficulty and danger in handling them. Moreover, the liquid explosives frequently create a pressure within their containers; and if they come in contact with organic matter can cause spontaneous detonation.

3. **The Exploder System**

The High Explosives which are used as main filling in bombs and shells in huge quantities have got to be insensitive to initiation by mechanical shock, flame or spark so that the large-scale handling of such stores are not hazardous. Also if the extremely sensitive ex- plosives used as initiators were handled in large quantities, their use would be hazardous. The basic requirements are thus the use of sensitive initiators in very small quantities and insensitive main filling in larger quantities.

This basic requirement creates a problem for the ammunition designer, because a small quantity of initiator will not detonate a large quantity of insensitive high explosive. The connecting link between these two is called an explosive train. This is achieved with the help of the exploder system. It consists of a series of elements arranged according to decreasing sensitivity and increasing power or brisance.

The first element called the initiator or primer contains a small quantity of very sensitive and powerful initiating material. In an electrically operated fuse it is usually a pellet or explosive powder which is ignited when a thin wire running through it is sufficiently heated by an electric current. In mechanically operated fuses the explosive is contained within a cap on which a striker hits and it is ignited. The cap may be either "percussion" or "friction". The percussion caps are fired by the impact of a blunt nosed striker, friction caps are fired by a sharp pointed striker penetrating into the explosive. The most commonly used explosive are ASA mixture (Lead azide, lead styphnate and Aluminium powder) and mercury fulminate.

The second element in the explosive train contains a larger quantity of somewhat less sensitive but more powerful explosive and is known as a detonator. The common explosives used for this purpose are an ounce or two of Tetryl, Lead Oxide or PETN (pentaerythritol tetra Nitrate) wax. Some however contain ASA mixture or fulminate of mercury.

At times the primer and detonator are combined into one component. In case a definite time delay in the train is desired, it is achieved by adding a small black powder pellet between the primer and detonator. An additional element called a relay may be required to provide continuity of the explosive train by picking up the weak flash from the delay element then in turn properly initiating the detonator.

The third element in the train contains an even larger quantity of even less sensitive but even more powerful explosive called a booster. It transmits the impulse of the initiator to the bursting (main) charge so that high order detonation takes place. It is called a booster because it boosts or amplifies the initiator impulse. The size, shape and type of booster depends upon the size and type of bomb. When forming a part of the main filling it is known as the auxiliary booster. The most commonly used explosive is tetryl, a fine crystalline yellow powder almost as sensitive as azide and more bris ant than TNT. Because of high sensitivity it is not used as main filling, but its high stability, ease of pelleting and high brisance combined with high sensitivity make it an ideal booster explosive in bombs. The busters of chemical and smoke shells and boosters of bombs were formerly loaded with tetryl pellets, but for mass production an explosive that could be cast was required, thus Tetrytol (TNT 35% + tetryl 65%) was found to be more satisfactory for mass production. It has got the same sensitivity and brisance as tetryl and replaced it in shell and bomb busters. Granular TNT has also been used as a booster charge.

Thus the three elements of the exploder system besides the fuse are covered. But the fourth element of the explosive train is the main filling or the bursting charge. The types of main fillings have already been covered earlier. It should be obvious at this stage that each element is initiated by one ahead of it and initiates the one following it, except the first which is initiated by firing pin stop action, crushing action, heat, flame etc. and the last which is culmination of the train accomplishing detonation.

4. **Some Typical Main Fillings**

Special types of main fillings are used for special effects and, therefore, if the type of bomb could be identified, the explosive in it could be guessed. Special fillings being used in A.P., Anti-personnel and hollow charge bombs, the extent of danger can also be anticipated.

TNT (Tri-nitro-toluene) is the most widely used and best-known explosive. It appears like brown sugar, sufficiently insensitive to be safely loaded, manufactured or shipped in wooden boxes or freight cases. It is non-hydroscopic, stable and withstands surveillance very satisfactorily. It can be mixed with other explosives to form a variety of compounds having a variety of desirable properties. It is also used in demolition devices.

Explosive-D is Ammonium Picrate. Although its brisance is less than TNT, it is used in Armour piercing bombs because of its comparative insensitivity to shock and friction. It is slightly hygroscopic. However, a shell containing it can penetrate thick armour plate without detonation until the plate has been negotiated, thus the detonation takes place inside a tank, ship or fortification.

Halite or EDNA (Ethylene Dinitramide) is being used recently because of its excellent properties as high explosive for main filling and a better manufacturing process. It has the highest brisance of all the explosives and of comparable sensitivity. It has a higher rate of detonation than TNT but cannot be cast, it is used as a powder filling.

Cyclonite or CTMTN (Cyclo-tri-methylene- trimipramine). RDX is the common name for various compounds of Cyclonite. It has got high sensitivity and brisance, being about as sensitive as azide and more bris ant than TNT and Tetryl but less than PETN. It cannot be Cast and, therefore, is used primarily with other explosives to form mixtures, principally RDX's some of which can be cast.

RDX Compositions (Research Department Explosive)-When Cyclonite is mixed with other chemicals to suit special requirements, they are known as RDX compositions. When mixed with a small percentage of wax it is known as RDX-A. This is more bris ant than TNT. It is loaded by pressing into Armour Piercing Shells which are required to withstand shock before detonation. RDX-B is a mixture of Cyclonite, TNT and wax. B-2 when wax is not added. It can be cast and forms an ideal filling for bombs, specially fragment at on bombs, where we need insensitive explosive with high blast effect. It is a little more sensitive than TNT but the brisance is between Ednatol and Cyclonite. At present most bombs are loaded with either TNT or RDX-B, the latter having replaced Amatol which has got only half the blast effect.

RDX-C is a plastic explosive formed by mixing 88 percent Cyclonite and 12 percent Plasticizer. It is more bris ant than TNT and about as insensitive, and can be formed on the spot into all shapes as well as tamped into components. It is generally used for demolition work and has been tried in bombs where it is desired to spread explosive over an area at impact as upon concrete fortifications. Other plastic explosives of Cyclonite are RDX-C 2 and RDX-C 3.

Explosives for shaped charges: They need fairly high sensitivity for ease of initiation: Combined with high rate of detonation to form the most effective jet. Ednatol, Pentolite and a mixture of 50% TNT and 50% PETN wax are most common. Cyclotol has also been considered for shaped charges,

Aluminized explosives for under-water demolition work e.g. torpedoes and depth bombs Aluminised explosives are used. Tritonal (TNT +Aluminium); Minol (A mixture of Ammonium

Nitrate + TNT + Aluminium) and MINEX (Ammonium Carbonate + TNT + Aluminium +Cyclonite) and DBX (Ammonium Nitrate + TNT + Aluminium + Cyclonite) are the most common.

Amatol (Ammonium Nitrate + TNT) in proportions of 80/20, 60/40, 50/50 has been used as main filling when Toluene for making TNT was not available in large quantities. But

now it has been replaced by TNT and RDX-B. 5. The detailed information about fuses will be covered in a separate precis,

6**. Types of Bombs**

Bombs can be classified according to their service, use, tactical use, filler and capacity.

(i) Classification according to Service Use:

(a) **Service Bombs**-For use against the enemy to damage men and material regardless of the filler.

(b) **Practice Bombs**-Have the same flight characteristics as the service bombs but loaded with a spotting charge only and while bursting can cause serious or even fatal injury to personnel in the vicinity. Hence it is essential to deal with these as fused live bombs for all disposal work. The common types are 8 lb. flame break up, 10lb. Smoke 8 lb. break up, 52 lb. smoke and 10 lb. flash and smoke.

(c) **Drill bombs**-To train ground crew, in assembling, fusing, defusing and other handling of bombs.

(ii) Classification according to tactical use:

(a) Blast Bombs cause damage primarily to material by blast alone."

(b) Armour piercing and semi-armour piercing. For use against resistant targets, where for a given size bomb demolition effect is sacrificed for greater penetration, although demolition effect is still the objective.

(c) Fragmentation Bombs-For use against personnel and light ground targets, because of their fragments rather than demolition effect is still the objective.

(d) Depth Bombs. For use against under water targets, primarily by blast effect.

(e) General Purpose Bomb-For use primarily against men and structures. Cause damage by blast, mining and general demolition after penetration.

(f) Chemical Bombs-Where proper dispersion of chemicals, smoke or incendiaries is desired against personnel and inflammable targets.

(iii) Classification according to actual filler:

(a) H. E. Bombs filled with high explosives.

(b) Chemical bombs filled with chemicals, smoke mixtures, incendiary mixtures etc.

(c) Practice bomb, filled with spotting charge of black powder or smoke mixture.

(d) Miscellaneous bombs filled with special fillers for a particular purpose e.g. target indicator bomb.

(iv) Classification according to capacity:

(a) Low capacity (less than 50%) e.g. A.P.-5 to 15% S.A.-about 30% and fragmentation-about 15%.

(b) Medium capacity (about 50%) e.g. G.P.

(c) High capacity (usually light cased) about 80% i.e. blast bombs like block busters, dam busters and other depth bombs. (Please see chart on explosive capacity, types and sizes of bombs).

(v) **Special types of bombs**-There are certain types of high explosive bombs which are designed for specific purposes but used less extensively than the other type of H.E. bombs.

(a) Anti-tank bombs.

(b) Nickel bombs for distributing leaflets.

(c) Anti-submarine bombs.

(d) Chemical bombs.

7**. Nomenclature of Bombs**

The standard series of bombs developed by the Army is designated by M numbers. The 500 lbs. G.P. Bomb is known as M 64. Any modifications are denoted by suffixes like M 64 A1. If used both by Army and Navy, the M number is prefixed by AN-e.g. AN-M 64 Al.

Bombs developed by Navy are designated by MK number followed by model no suffix if necessary e.g. the 325 lbs. depth bomb MK 17, if modified might be called MK-17 Mod. 1. If used by both Army and Navy, the AN is prefix- ed e.g. AN-MK 17 Mod 1.

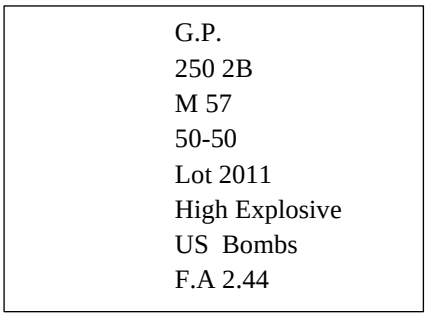
8. After the first world war Army developed a series of stream lined G.P. or demolition bombs, known as MK I series. The same series with thinner and thicker cases were designated MK III and MK II respectively. The sizes were 100, 300, 600 and 1,000 lbs. After 1930) first set of cylindrical bombs of the same size were developed but called M 30 series. Later the sizes were standardized as 100, 250, 500, 1,000 and 2,000 lbs. This series was denoted by larger M number. It is this series, with certain improvements which forms the standard AN series of G.P. bombs. The experimental bombs are denoted by T numbers and E suffixes.

9. **Colour and Markings on Bombs**

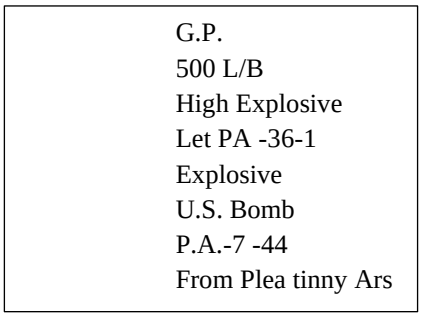
The usual pattern followed is that bomb body if painted olive drab or yellow, they are live service bombs. Bombs of American and British origin are Green (i.e. olive or dirty olive

green) where as those of Russian origin are usually grey or dirty yellow. The coloured bands on the body usually indicate the type of filling and the climatic factor i.e. a red ring at the nose indicates TNT filling for any climate, Red broken ring shows limited life in tropical climate, Red bar-cross-bar indicates explosive filling for use in temperate climate only.

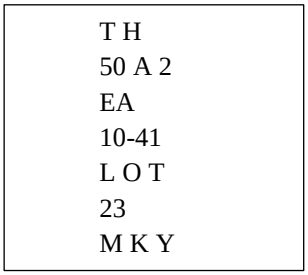
10. On every bomb, the type, size, design number, date of filling, weight, lot number monogram of the filling station etc., are usually printed or stencilled. They give complete information about the bomb. A few typical markings are shown in the attached chart.



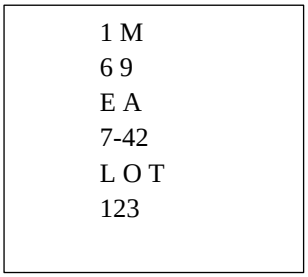
Markings on a 250 lbs. G.P.U.S Bomb.



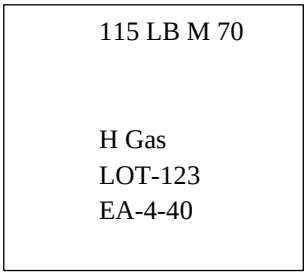
Markings on a 500 lbs. G.P.U.S Bomb.



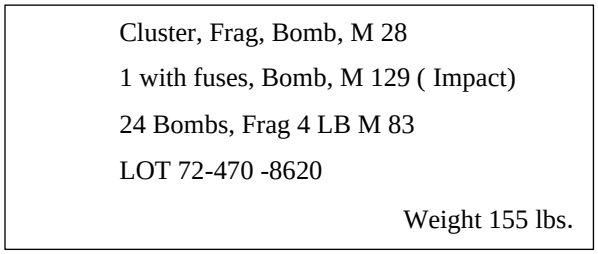
Markings on a M50A-4



Markings on a M 69.6 lbs



Markings on a M -70 Chemical



Markings on as Clyster of twenty-four
4 lb, butter fly bombs.

Table on Explosive Capacity

Type of Bomb	Capacity percentage of Total Weight
AP (M Series)	2-6
AP (M k Series)	14-16
Fragmentation	13-15
SAP	25-30
G.P.	50-55
Depth	70-75
L.C.	75-80
Chemical (Gas or Smoke)	80-80

Table on sizes and Types

(Weight given in Lbs)

G.P.	A.P.		S.A.P.	L.C.	Depth.	Fragmentation	Chemical			Practice
	M. Series	MK Series					Gas	Smoke	Incendiary	
100	600	1,000	5,000	4,000	325	4	100	10	4	3
250	800	1,600	1,000		350	20	115	100	6	4
500	1,000				650	23	500		10	5
1,000	1,400				700	90	1,000		100	20
2,000	-				--	260			---	100

Printing and Marking Colours of Bombs

Type of Bomb	Body Colour	Colour Band on Body	Marking (Letters and Figures)
High Explosive:			
(G.P. Demo, AP, SAP, Frag*) filled with TNT or Amatol	Olive drab	Nose: One 1 in yellow Tail: One 1 in yellow	Black
Filled with Comp. B	Olive drab	Nose: Two 1 in yellow Tail: Two1 in yellow	Black "Comp. B" stencilled on one nose band and one tail band.
Practice	Light blue	Nose	White
Drill	Olive drab	Nose: One 1 in Black Tail: One 1 in Black	Black Drill (inert)
Chemical			
Non – Persistent Gas	Blue-grey	1 Green, nose, tail and centre	Green
Persistent Gas	Blue-grey	2 Green, nose, tail and centre	Green
Irritant smoke (vomiting gas)	Blue-grey	1 Red, nose, tail and centre	Red
Screening smoke	Blue-grey	2 Green, nose, tail and centre	Yellow
Incendiary	Olive drab	1 Purple, nose, tail and centre	Purple

* Small fragmentation bombs: nose and tail painted yellow (no bands) body, olive drab.

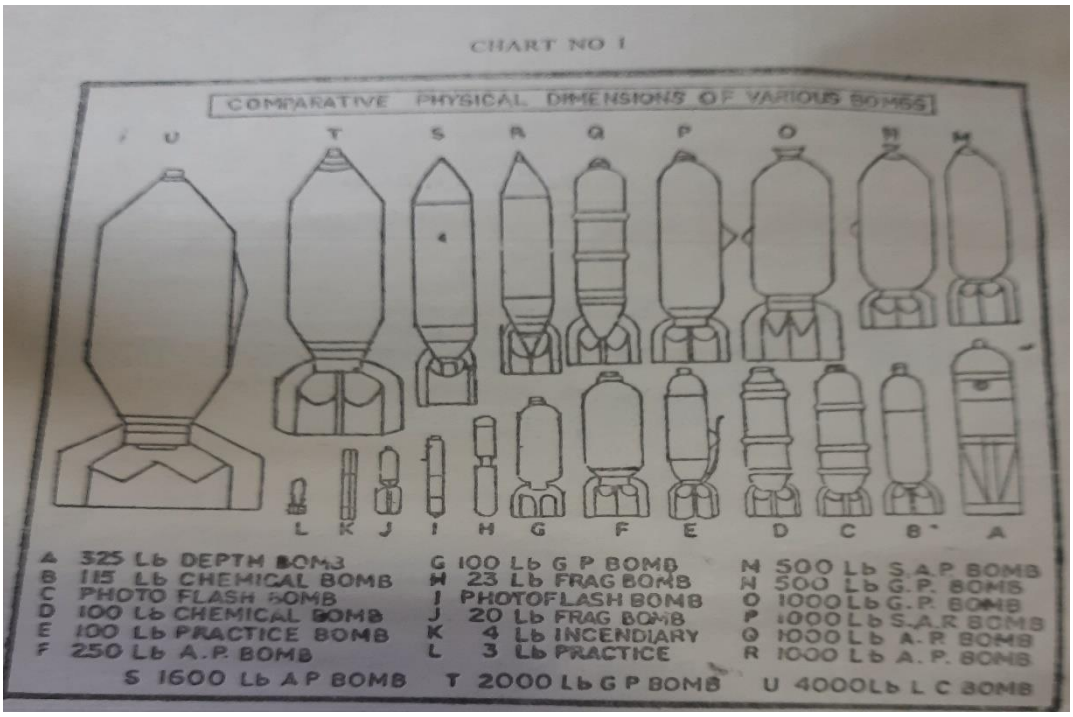
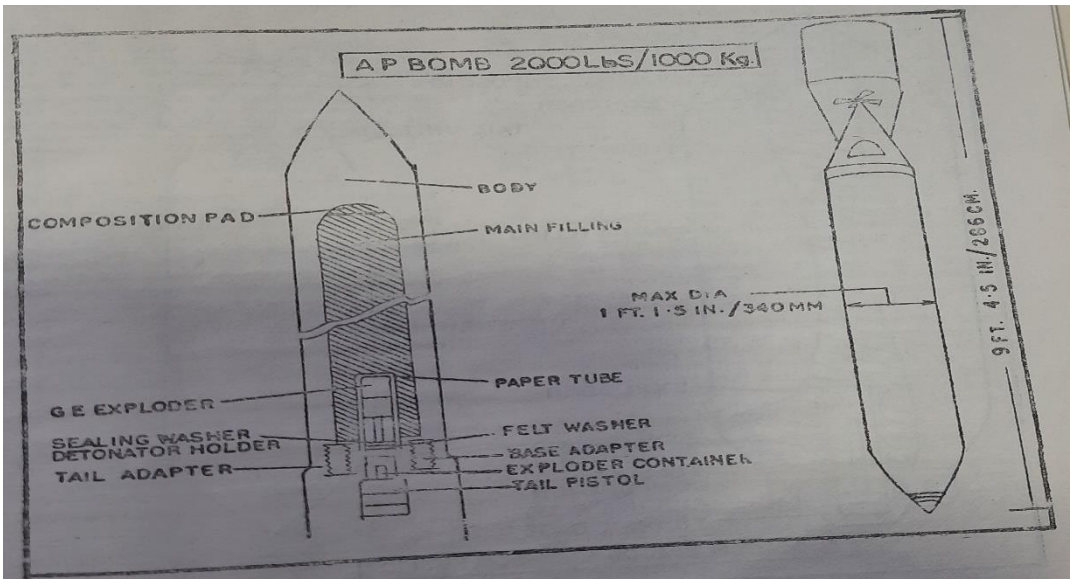
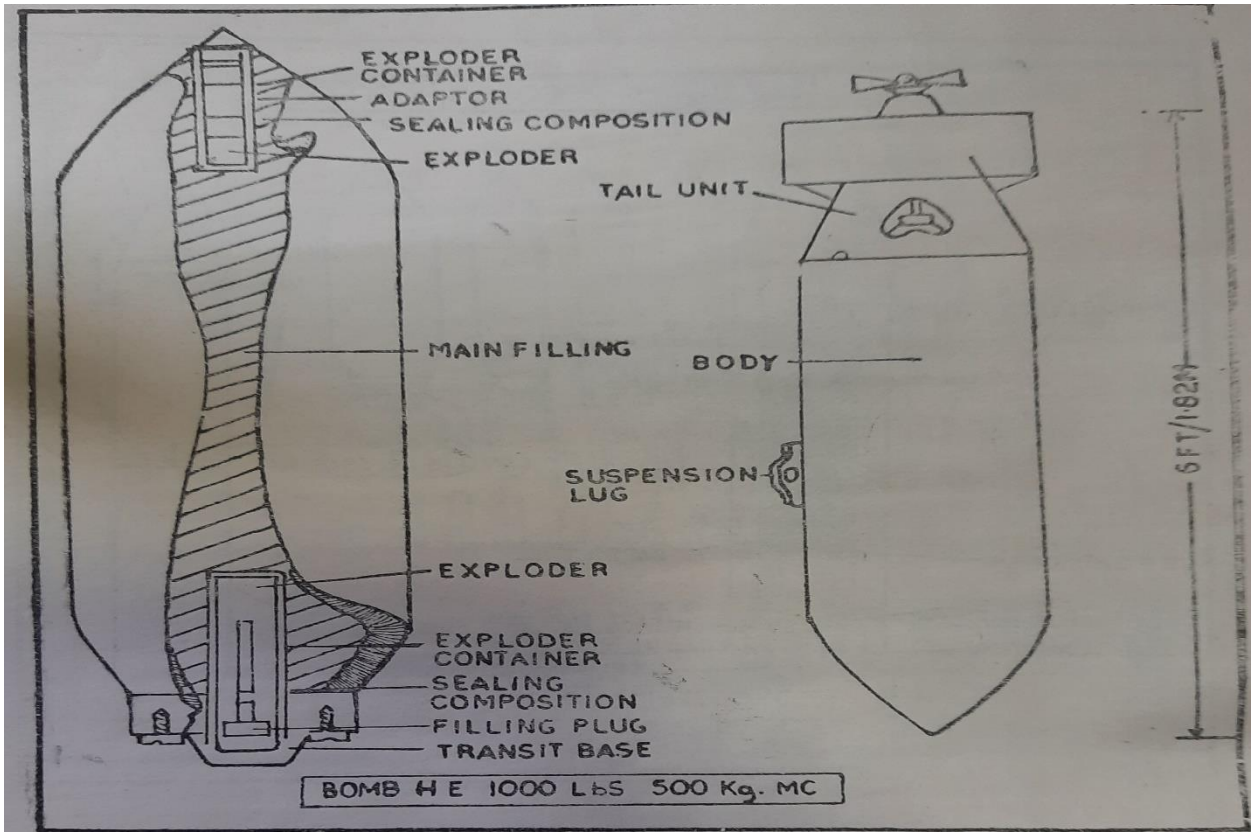


CHART NO 1
COMPARATIVE PHYSICAL DIMENSIONS OF VARIOUS BOMBS
U T S R Q P O N M
L K J I H G F E D C B A
A 325 Lb DEPTH BOMB
B 115 Lb CHEMICAL BOMB
C PHOTO FLASH BOMB
D 100 Lb CHEMICAL BOMB
E 100 Lb PRACTICE BOMB
F 250 Lb A.P. BOMB
G 100 Lb G P BOMB
H 23 Lb FRAG BOMB
J PHOTOFLASH BOMB
J 20 Lb FRAG BOMB
K 4 Lb INCENDIARY
L 3 Lb PRACTICE
M 500 Lb S.A.P BOMB
N 500 Lb G.P. BOMB
O 1000 Lb G.P. BOMB
P 1000 Lb S.A.P. BOMB
Q 1000 Lb A.P. BOMB
R 1000 Lb A.P. BOMB
S 1600 Lb A P BOMB
T 2000 Lb G P BOMB
U 4000Lb L C BOMB


A P BOMB 2000LbS/1000 Kg
BODY
COMPOSITION PAD
MAIN FILLING
MAX DIA
1 FT. 1·5 IN./340MM
9FT. 4·5 IN./286CM.
PAPER TUBE
G E EXPLODER
FELT WASHER
SEALING WASHER
DETONATOR HOLDER
BASE ADAPTER
EXPLODER CONTAINER
TAIL ADAPTER
TAIL PISTOL


EXPLODER CONTAINER
ADAPTOR
SEALING COMPOSITION
EXPLODER
TAIL UNIT
MAIN FILLING
BODY
SUSPENSION LUG
EXPLODER
EXPLODER CONTAINER
SEALING COMPOSITION
FILLING PLUG
TRANSIT BASE
6FT/1.82M
BOMB H E 1000 LbS 500 Kg. MC

****

CHAPTER NO. 4

TAIL UNITS, CARRYING DEVICES AND OTHER SPECIAL, ATTACHMENT TO BOMBS

1. **Aim**

The aim of this precis is to give detailed information about the tail units, parachute assembly, arming wire assembly, carrying devices and other special attachments to bombs.

2. **Introduction**

For the identification and confirmation of presence of UXB's at times a Racee Officer has to depend on the auxiliary parts of a bomb which might have got detached or might be the only visible parts in case of buried or hidden bombs. The presence of the above parts, their conditions, marking on them will have to be carefully observed and, therefore, a detailed study is a must.

3. **The Tail Unit**

The tail unit comprises the fin assembly and the parachute assembly. The main function of the tail unit is to stabilize the bomb during flight but at times the tail units have also got to arm the tail fuses. The shape, size and type of tail unit depends upon the ballistics of the bomb i.e. whether correct aiming is essential or not, whether the descent is required to be fast or slow, whether the towing space is to be economised etc.

The most common types are the fin type and the drum type. Fin types are usually provided to smaller bombs and may not form a separate unit, whereas most of drum types are separate units. They are usually welded, clipped, rivet- ted, bolted or screwed to the tail end of the bomb. Some of the bombs have a conical rear end to provide more space for main filling and also to suitably fit the tail unit on it. Some of the latest bombs have collapsible fin type tail assembly to economise stowage space in the bomber. They spring into position once the bomb is out of its bay.

Some typical variations are the fins at an angle to produce spin for greater stability, permanently attached arming vanes at the centre of the tail assembly with or without arming fork, a drag plate at the end of the tail unit to decrease the rate of descent, parachutes instead. of tail units, small ones to save stowage space and big ones for bigger bombs, mines etc. and for slow rate of descent long lengths of ribbons for smaller bombs.

All the above generally being fragile usually get detached or broken from the bomb and forms one of the commonest clues to identification.

4. Types of Tail Units

(i) Long tail units;
(ii) Short tail units; and
(iii) Special types.

Besides these, which are fitted into the bomb only prior to its operational use, the smaller types of bombs like the 20 lbs. fragmentation bomb have the tail unit permanently fitted on to them by a maker. As a general rule, bombs up to 1.000 lbs. in weight are fitted with tail units by

means of clips to the bomb body and are commonly known as "Clip ON" tail units. Bombs of weight greater than 1,000 lbs. are fitted with tail units by means of wing bolts to the bomb body and are commonly known as "bolt on" tail units,

(i) **Long tail units-**There is a certain standard length for each tail unit which is consistent with the maximum ballistic efficiency of the bomb for which it is designed. These are known as long tail units. These are used with bombs carried in heavy bomber aircraft as internal stowage only as when carried externally, due to the design of the tail unit, there is a possibility of tail units being sheared off during flight. The main points of construction can be seen in Fig. 1.

(ii) **Short tail units**-When the bombs are supposed to be carried by fighter bomber externally, the tail unit should be able to withstand the stress produced during flight because of external carriage. Tail units for such use are usually short and are of strengthened construction. (Please see figure No. 2).

(iii) **Special types-**The above types usually incorporate arming devices, but there are special types designed for specific bombs. One such type is the one used with 4,000 lbs. H.E. Bomb made of light gauge metal cylinder; one end of which is closed by a plate and is screwed to the bomb by twelve screws.

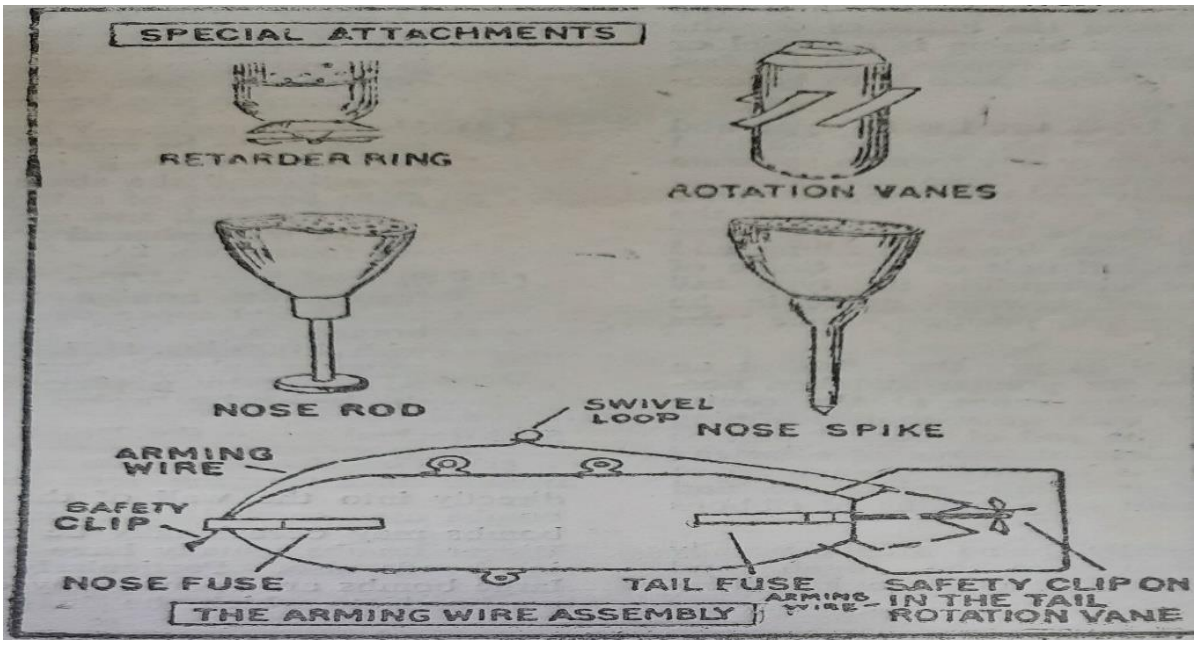
5. **Attachments to the Bomb Casing**

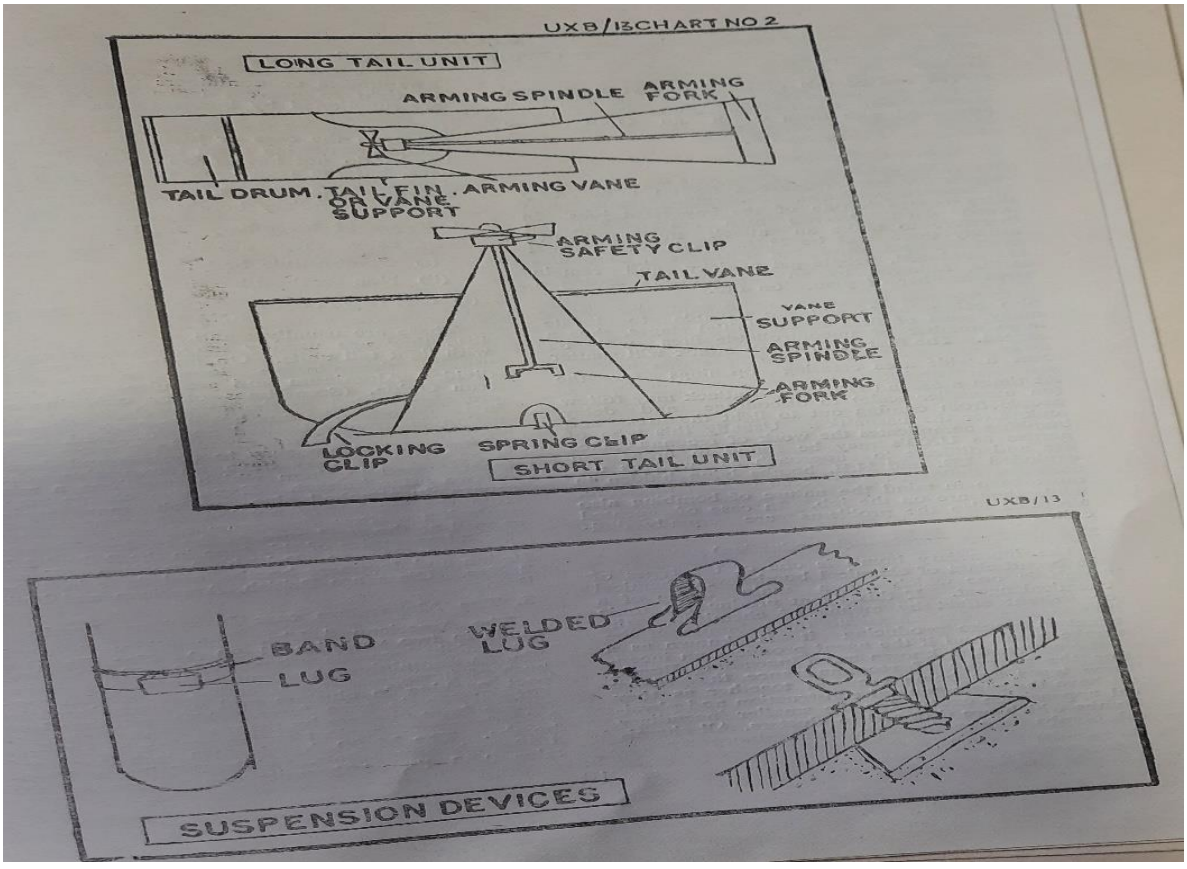
(i) **The Carrying device**- Smaller bombs usually have carrying lugs or eye bolts fitted directly into the wall of the bomb. Normally bombs are carried horizontally, but smaller bombs may occasionally be suspended by nose. Bigger bombs usually have two lugs and carrying bands also. Particularly the thin walled large bombs are spanned by one or more carrying bands to which the lugs or eye bolts are fitted (Please see Fig. 3 on suspension devices). The suspension lugs for G.P. bombs weighing 1,000 lbs. and less are 14 in. apart and for bomb weighing 2,000 lbs. or more are 30 inch apart. They are spaced equidistant from the centre of gravity and tested at ten times the bomb load. When a plane banks and turns the lugs are subjected to other types and magnitudes of forces and the lugs are tested in a centrifugal device at a force equal to several times the bomb weight. In dive bombers, the bombs are provided with only one lug.

The lugs bolts and bands, being external and comparatively fragile things, frequently get detached from bombs and may be found near the surface when an UXB is buried and are of assistance of establish identity.

(ii) **The special attachments**-They are not very common but for special effects, retarder plates or rings, nose rod, nose spike rotation vanes or screamers are used. (Please see Fig. 4 on special attachments). The retarder rings are used at the nose to decrease penetration or prevent ricochet (particularly from water). The retarder rings often break off on or near the surface. A nose rod usually with a thick disc at the tip is used to transmit the shock of impact to the fudge and cause it to detonate at the ground level. Nose spike is another attachment to prevent ricochet. For certain types of fuses which are armed by rotation, the rotation is achieved by fitting rotation vanes to the body of the bomb to produce the spin. The rotation, vanes also help to scatter the contents of a bomb or a cluster. To produce screaming sound, to terrorise the people special paper whistles are also attached to the body. Sometimes small Incendiary bombs are also attached to the body of big bombs to set the knocked down buildings on fire.

(iii) **Attachments to the fuse assembly, the arming wire assembly, the safety cap etc**.- Usually all the fuses are supposed to remain unarmed till they are dropped over the enemy territory. For this purpose, the smaller bombs have safety cap, which remains in position with the help of a split pin and can be pulled out by an arming wire when the bomb is out of the bay. In bigger bombs there may not be a safety cap, but the arming devices do not function till these wires are pulled out. For every fuse there will be an arming wire which are permanently attached to the bomb shackle. When the bombs move out of the bay, the wires get automatically pulled out and the fuse is ready to take up the process of arming.





CHAPTER NO. 5

INCENDIARY BOMBS

1. Aim

The aim of this precis is to give a general idea about the various incendiary bombs, their identification, construction and the dangers associated with them which an UXB recee officer must know while carrying out recon- naissance of such bombs.

2**. Method of Attack**

Incendiary bombs are weapons used for setting objects on fire. There can be an attack only by incendiary bombs. Controlling small incendiary bombs is one of the important jobs in which Civil Defence men are trained, and therefore to make an attack more effective usually there will be H.E. bomb attack first so that people move out to shelters, casualties are produced, people get panicky and remain inside, followed by an L.B. attack, setting a large number of places on fire.

People will not come out to fight, these fires, also being inside will not be able to locate many seats of fires in the initial stages, thus a large number of uncontrollable fires will be caused. The first H.E. bomb attack will shatter doors and windows of buildings due to blast over a wide area creating openings for the incendiary bombs to get inside buildings easily. At times a second H.E. bomb attack may follow (on a smaller scale) to discourage and delay people from coming out to fight the fires and look after the casualties. Usually this type of bombing complicates the work of reconnaissance parties as UXB's may be found in areas on fire and difficult to approach as well as un- exploded LB. and H.E. bombs lying hidden in damaged buildings. The recee officers therefore, must keep in mind the nature of bombing also while they are on the job. In case of repeated air raids also the problems are equally difficult.

3**. Incendiary Bombs-(Introduction)**

The incendiary bomb is one of the types of the broad class of chemical bombs. A chemical bomb is one which has a main filling of a chemical agent. If this agent produces a toxic or irritant effect by means of chemicals, the bomb is a true chemical (gas) bomb; if the agent is smoke producing it is known as a smoke bomb and if the agent produces an incendiary action it is known as an Incendiary Bomb. For the purpose of reconnaissance, the above three types are being grouped together as they all have the same general construction and physical appearance except for the smaller incendiary bombs which are dropped in clusters. All chemical bombs must function instantaneously on reaching the ground and splash their contents. The bodies or containers of such bombs must be tight to prevent leakage. All these bombs are functioned by busters (except for small incendiaries), the bursting charge is adjusted to the nature of the contents, so that it may just lay open the case or just pulverise the contents without scattering them too far. Some chemical bombs do not have drop safety e.g. thin cased ones, but the recent ones like type M 70 are similar to GP bombs, and have the same degree of drop safety. The big fire bombs are a special type of incendiary bombs.

4**. Types of Incendiary Bombs.**

Basically, they are divided into two types:

(i) Combustible body.

(ii) Non-combustible body.

(i) **COMBUSTIBLE CASE INCENDIARY BOMBS**

These are usually small, weighing only a few lbs., they are usually long, narrow and fitted with light tail units. On impact the main filling usually thermite, a loose mixture of finely divided Aluminium and granules of magnetic Iron Oxide, (Sometimes other oxidising agents are also added to the mixture), is ignited and in turn ignites the combustible case. Since their action is usually limited and localised, they are dropped in large numbers in clusters or containers. They are easy to control and therefore some of them may have an explosive charge incorporated in them which functions a minute or two after impact. Explosive charge may be separately attached also which may separate from the incendiary portion after impact. The explosion scatters fragments of burning material as well as the steel case of the explosive portion. Typical examples of this type in the 2 lbs./ 1 Kg. Class are German, British, American, French, Italian and Japanese bombs, and those in 4 lbs./ 2 Kgs. Class are British, American and Italian Bombs.

5**. The Magnesium case Incendiary Bombs**

The American 4 Lbs. incendiary bomb is made in two varieties M 50 A_2 (See Fig. 1) of the straight incendiary type and M 50 XA_3 (See Fig. 2) containing the antipersonnel explosive both of hexagonal cross section to provide com- pact packing in clusters and are functioned by integral inertia type fuses, which get armed on release from clusters by means of safety plungers held depressed against spring action by adjacent bombs. The M 50 A_2 is 21.3-inch-long and 1.69 inch across flats, weighs 3.7 lbs. and contains 0.63 lb. of thermite composition in the body made of Magnesium known as Electron metal consisting of Magnesium. Aluminium and Zinc which weights 1.25 lbs. The thermite burns at 300000 for about 1 Minute igniting the case, which burns for 10115 mts. at 1300°C after it becomes ignited.

6. The M 50 X A_3 (X denotes presence of anti-personnel feature) is a variation of M 50 A_2 and incorporates a delay fuse of a few seconds, to several minutes, a detonator, and a tetryl explosive charge in a steal housing at the end of the bomb. The bomb fuse burns for about 1 Mt. and then the delay fuse is ignited. At the expiration of the delay the bomb detonates projecting fragments of steel shell and burning magnesium. The actual delay before detonation varies depending upon the position the bomb takes after it lands, and the variable delay combined with the explosive feature is an important aspect of this bomb.

7. **The German B2.2 E 1-Z Antipersonnel Incendiary Bombs**

This 5 lb. German incendiary bomb was used during 2nd World War. It is in the form of an ordinary 1 Kg. bomb to which a 34 oz. of H.E. charge has been fitted in an extension to the nose. The charge is powerful one. The total weight is about 5 lbs. which causes the bomb to penetrate further into buildings than the ordinary type. The overall length is 20.7 inch. A still wire, 13 inches. long, with metal disc about 1 inch. in diameter at the upper end is passed through the ring at the end of the tail vanes, down the side of the bomb and through a hole in a safety pin projecting from the fuse body. This acts as an arming wire. On release from the air-craft air pressure with- draws the wire which falls separately and may be found on the ground near the bomb. The safety pin is then ejected by an internal spring leaving the striker free. On impact the fuse functions, ignites the incendiary body immediately and lighting a slow match fuse in the nose extending the delay before the detonation of the explosive charge up to a maximum of seven minutes. The explosive extension may also break off on impact and detonate separately, some distance from the incendiary body (See fig. 3.).

8**. Large Size Electron Bombs**

The normal sizes of Electron bombs are 1 Kg. or 2 Kgs. which are usually most effective against general residential and industrial targets, but for fire resistant type of structures even 12 and 25 Kg. sizes have been developed. They are totally identical to the 2 Kgs, bomb but will usually have more penetration and will burn for much longer period.

9. **Multiple Unit Electron Bomb**

This bomb usually weighs 12 Kgs. (26 Lbs.) and consists of a casing containing a number of separate incendiary units. This casing is provided with a steel nose to enable it to penetrate a strongly constructed roof. After penetration the bomb burns and expels the incendiary units over a relatively wide area, each unit functioning as a separate small incendiary bomb and initiates a fire wherever it falls. This special multi-unit type of bomb is more effective against targets like store-houses, large factory. buildings and ammunition storage yards,

(II) **INCENDIARY BOMBS WITH NON- COMBUSTIBLE BODY**

10. **Steel Cased Incendiary Oil Bombs**

There are two 6 Lbs. incendiary oil bombs the M 69 without any antipersonnel feature and M 69 X containing the detonating element. The M 69 (Fig. 5) is 19.5 inch. length and 2.9 inch. across the flats, it has a charge of 2.8 Lbs. of gelled gasoline in a cheese cloth sock and an ejector ignitor charge of 0.4 oz. of black powder and magnesium. The case is of sheet steel, and the incendiary oil composition is ejected from it. The incendiary oil composition or gelled gasoline, as it sometimes is called is formed by adding a powder to gasoline. The M 69 bomb is stabilized by a group of muslin streamers contained in a tail cup. The fuse has a 3 to 5 sec. delay, after which the gel is ignited and ejected and then burns for 8 to 20 minutes depending upon the size of the individual fragments.

11. The M 69 X is similar except that a high explosive charge is added at the nose and is ignited by a detonator after a delay of 1 to 6 minutes. Each bomb has a fixed delay and the various delays are obtained by using different length of use which is ignited by a flash from the ejection charge.

12. There are two 10 Lbs. bombs similar to the above known as M 74 and M 74 X (See fig. 6). They are improved versions of M 69 wherein the muslin streamers have been re- placed by a six bladed fixed shroud fin at the tail end of the tube which is spring ejected when the bomb is released from the cluster, giving more positive stabilization. The filling is a mixture of gelled gasoline, magnesium and an oxidizing agent, which gives more intense burning. This is a typical flame-thrower type of bomb and throws burning get in one direction up to 50 feets. A container of white phosphorus (WP) smoke has been added to hinder firefighting further, the smoke makes the bomb more difficult to locate and extinguish. The M 74 X contains a comparatively large quantity of intense burning material combined with a delay explosive, antipersonnel feature, and obscuring smoke.

13. **Smoke Bombs**

Just like the M 74, a 10 Lbs. smoke bomb known as M 77 has been developed with hexagonal cross section for dropping in clusters and about the same size. It is 19.5 inch. long 2.9 inch. in diameter and weighs 13 lbs. It is functioned with an all ways fuse which blows off the end of the case and the H.C. (H.C. is a mixture of zinc dust. Hexachloroethanes, Ammonium perchlorate, and ammonium chloride) smoke burns from one end for 12 to 15 minutes, although a single bomb does not produce a very dense smoke cloud, a large number of them can screen a

large area, and they have the advantage over a single large smoke bomb that the smoke is spread over a larger area and "Pillaring" is eliminated.

LARGE SIZE INCENDIARY BOMBS WITH NON-COM- BUSTIBLE BODY AND RELEASED INDIVIDUALLY

14. **Japanese Incendiary (Phosphorus) Bomb**

This is similar in appearance to a High Ex- plosive Bomb of similar weight, but it may be marked with a white band situated immediately in front of the slinging band and with a red band at the nose. Weight 50 Kgs. length excluding tail is approximately 2' 9" and with tail 3' 4" Diameter 7". Civil Defence Personnel will not touch these bombs. Phosphorus filled bombs which have failed to function but have been damaged by impact may exude a liquid that fumes and is liable to catch fire spontaneously (See Fig. 4).

15. Normally chemical bombs are bigger than 100 Lbs. in weight. They are not clustered and are released individually like other G.P. Bombs. Of course, two or more 100 Lbs. Chemical bombs may be clustered in the same way as small G.P. bombs. (Please refer to precis in cluster and containers). Such bombs may have thin or thick cases both.

16. The individually dropped bombs need the streamlined shape and tail units as for G.P. bombs. The tail fins like G.P. bombs is permanently attached to the body for small bombs and is carried separately for larger ones. These bombs function by nose fuse for small ones and nose and tail both for larger ones and a central buster running the length of the bomb. (Please Kee the 115 Lbs. M 70 chemical Bombs. (Fig. 7).

17. **The 100 Lbs. M47 A, Bombs**

This is a conventional thin case chemical bomb with a variety of fillers like persistent gas, white phosphorus (WP) or any incendiary com- position (Please see Fig. 8-M 47 Chemical Bombs). It is 49 inch. long and 84 inch. in diameter. It is made of sheet steel coated on the inside with oil and is functioned by fuse along with an appropriate buster. This bomb has different weights and percentage capacities depending on filler. When the bomb is loaded with 68.5 Lbs. mustard gas (H), the total weight is 98 Lbs. with 100 Lbs. W P. it weighs 127 Lbs and with 40 Lbs. of gelled gaoling the total weight is 69 Lbs.

18. **The 115 Lbs. M 70 Chemical Bombs (See Fig. 7)**

It is made from tubing, has an ogival nose and a separate fin assembly. It is 48.7 inch. long and 11 inch. across the fins and weighs 116 Lbs. when filled with 51 Lbs. of persistent gas (H) (.) it is fused with vane arming type of impact fuse.

19. There are two more large size chemical bombs, the 500 Lbs. M 78 and 1000 Lbs. M 79. These are basically used for gas warfare only. The M 78 is filled with 170 Lbs. of CK (Cyanogen Chloride) for a total of 450 Lbs. of 205 Lbs. of Phorsene giving a total weight of 485 Lbs. The M 79 if filled with 200 Lbs, of AC (Hydrocyanic Acid) will have a total weight of 860 Lbs.

20. **Bombs with GPHE Bomb Casing**

The larger incendiary bombs were originally designed from GPHE tombs by modifying them for field assembly of buster and igniter. They have a gasoline gel magnesium mixture and they take the standard nose and tail fuses of G.P. Bombs, set instantaneous and non-delay respectively. With an adapter booster they may also have an air burst nose fuse. M 76 is a typical

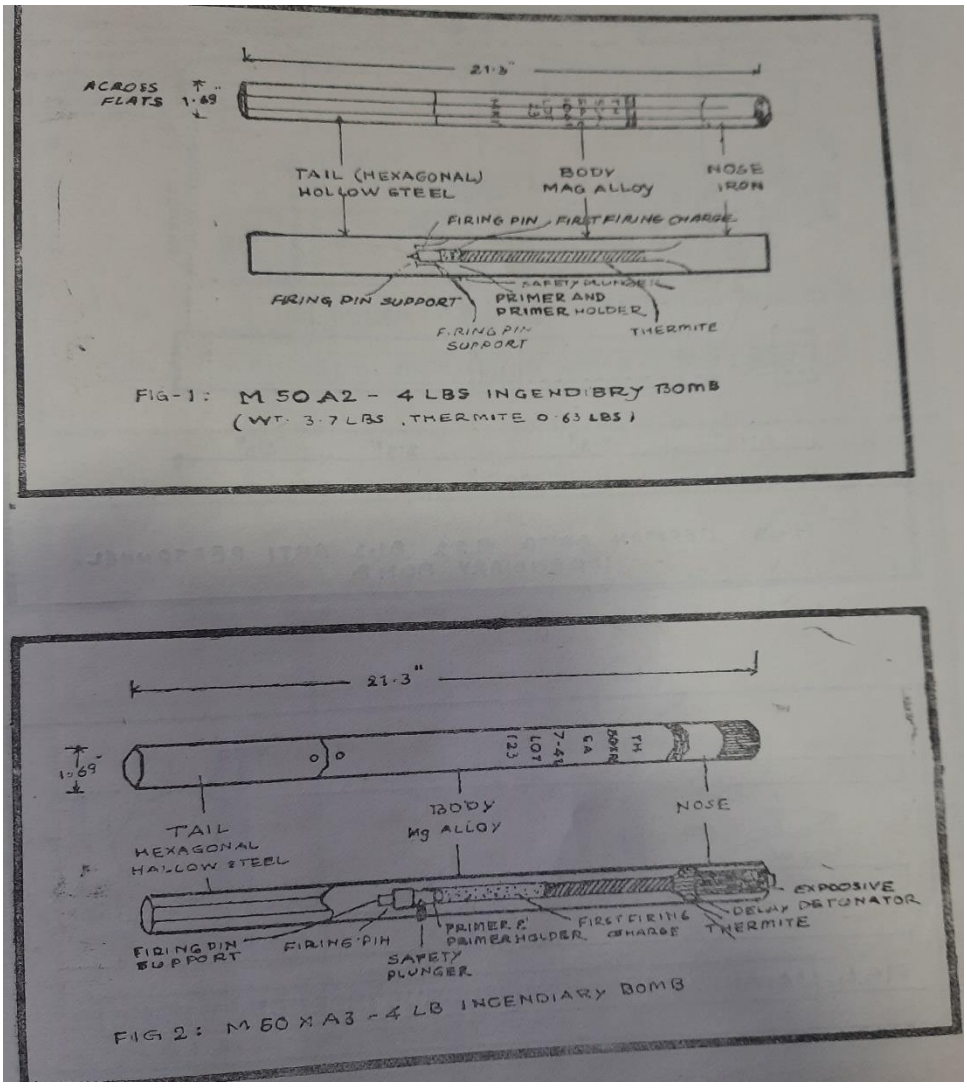
500 Lbs. incendiary bomb of the above type, containing 180 Lbs. of the above mixture weighing 475 Lbs.

21**. Fire Bombs**

The 75- and 300-gallon auxiliary fuel tanks of fighter aircrafts have been used for incendiary bombs. For low level bombing, no tail fins are provided but for medium altitude bombing, modified GP bomb tail units are added for stabilization. They usually have an all ways fuse with an anemometer vane which arms the fuse within about 100 Ft. of air travel attached to the tank with an adapter, and an igniter, WP grenade body ignites the composition. The Igniter is filled with W.P. for land use and Magnesium for water use. The filling is gelled gasoline like M 69 bomb. The most popular size is 165-gallon fire bomb which has a modified 200 Lbs. G.P. bomb tail unit. They spread fire over large areas and are very effective against common Residential targets.

22, **The Napalm Bomb**

(Please see precis no. UXB/38 on Napalm Bomb-Effects and protection).



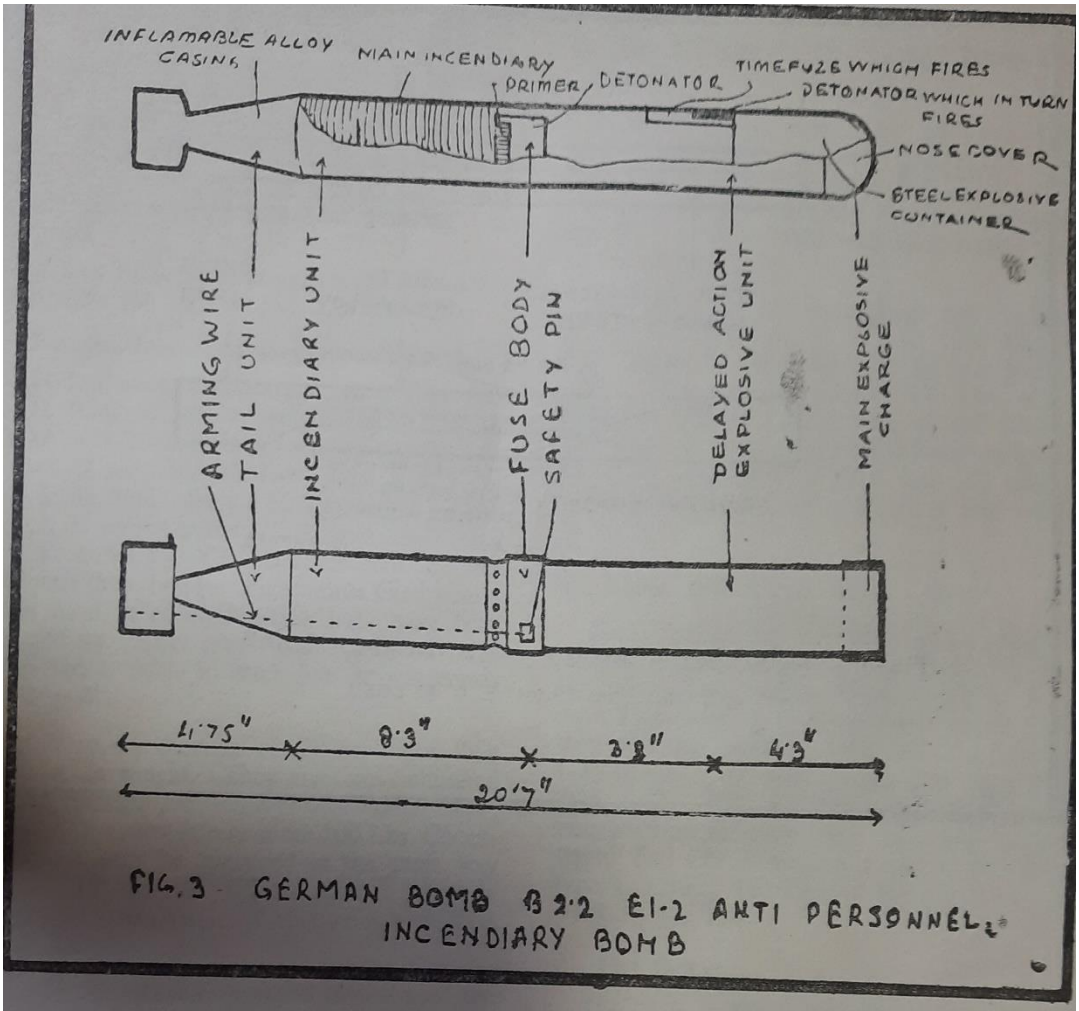


FIG. 3 GERMAN BOMB B 2·2 EI-2 ANTI PERSONNEL INCENDIARY BOMB

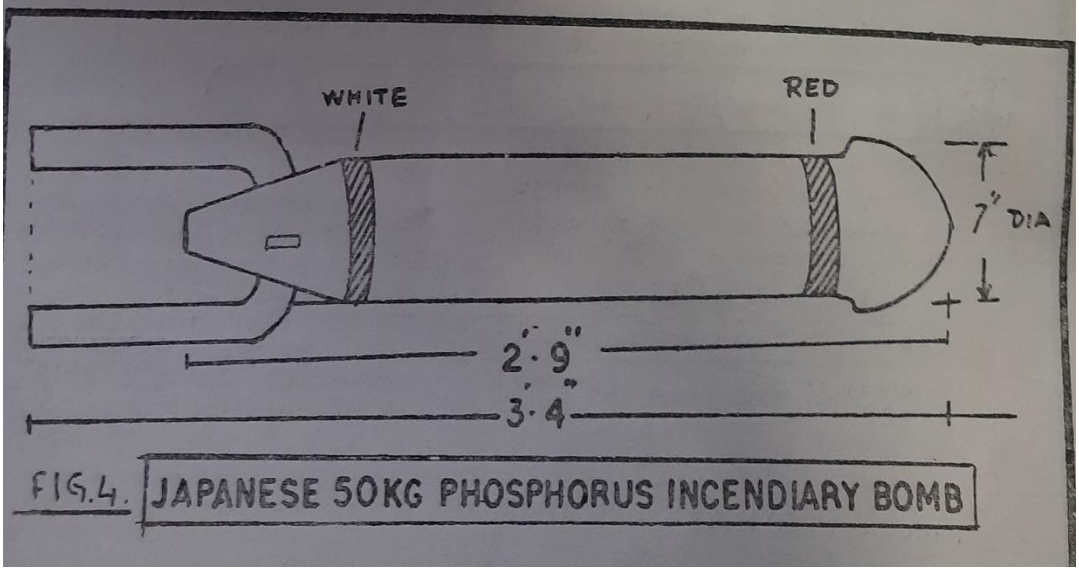


FIG. 4. JAPANESE 50KG PHOSPHORUS INCENDIARY BOMB

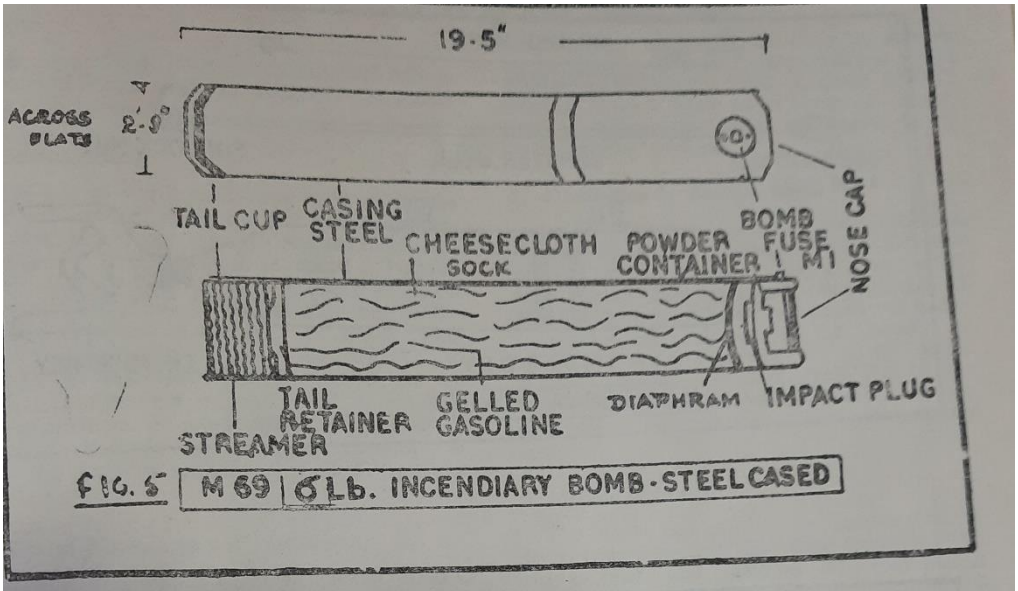


FIG. 5 M 69 6 LB. INCENDIARY BOMB - STEEL CASED

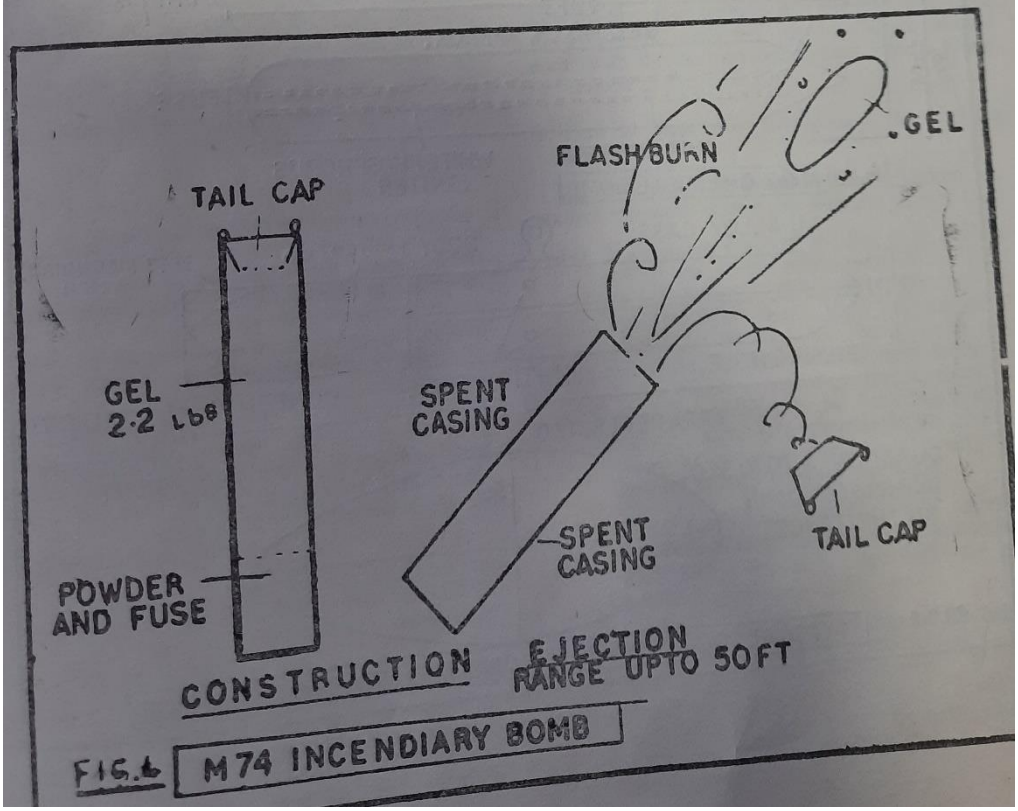


FIG. 6 M 74 INCENDIARY BOMB

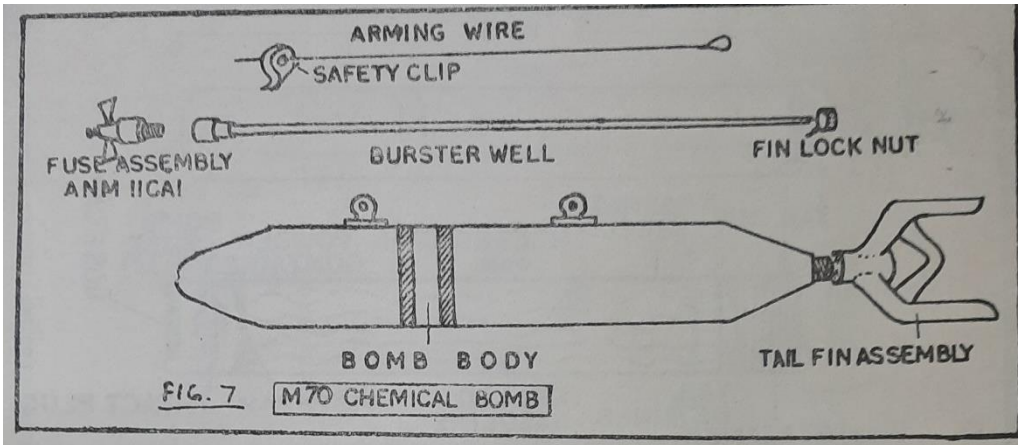


FIG. 7 M70 CHEMICAL BOMB

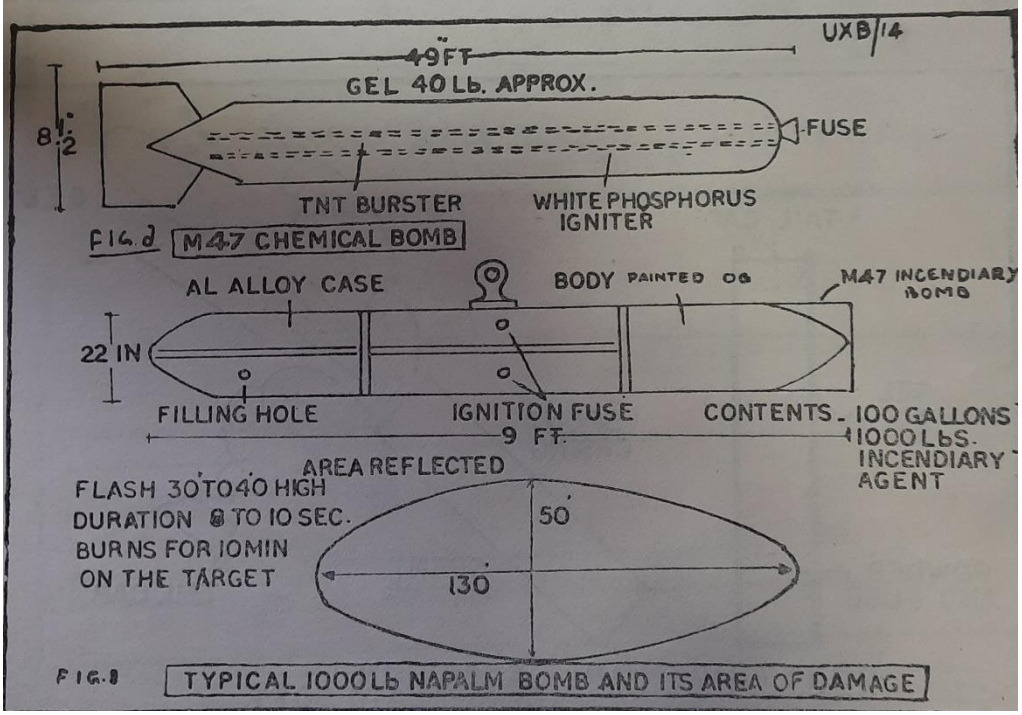


FIG. 8 TYPICAL 1000Lb NAPALM BOMB AND ITS AREA OF DAMAGE

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CHAPTER NO. 6

NAPALM BOMB -EFFECT AND PROTECTION

1. **Aim**

The aim of this precis is to study the effects of Napalm Bomb and the protective measures against the same.

2. **Construction**

It is one of the typical large sized oil bombs filled with gelled gas in: The gelling agents are also, soaps, particularly Naphthenate and Palmitate. This why it is called a Napalm Bomb. The gelling powder is added to petrol between 5 and 12% by weight according to the required thickness of the gel. It has a long life. It remains fluid between minus 35°C. to plus 65 so that while being carried in an aircraft, it does not become brittle or too thin due to extremes of temperatures. The body of the bomb is made of aluminium alloy. A 1000 lbs. Napalm consists of about 100 gallons of filling.

3. **Use of Napalm as a Flamethrower**

Napalm burns at a heat of about 2060°C and produces high concentration of carbon monoxide which is lethal in confined places like air raid shelters. It sticks to the body like coal tar and keeps burning. It is also used in flame throwers and it gives a continuous rope of blazing gel at a target 150 yards away, whereas earlier flame throwers could rarely get beyond 30 yards.

4. **Effects**

Usually Napalm is ignited with white phosphorus. Fine phosphorus particles are driven in to the Napalm gel by an explosive charge and these particles ignite when exposed to oxygen. Many time these deadly phosphorus particles will also be lodged deep in the tissues of the victims of Napalm attack; and may continue to smoulder there; often the enormous heat given off by the weapon alone will be enough to ham- per both attempts at escape and rescue. In fact, the fear of fire on such a vast scale has been found to produce even among hard boiled soldiers, what has been called "irrational flight or immobilization".

The Napalm Bomb removes oxygen from air in the vicinity of the fire, but a man can live for some time in atmosphere containing an considerably less oxygen.

The flame from a Napalm bomb shoots up in 8-10 seconds of the explosion and the burning contents are spread all round. The area affected is elliptical in shape and is about 130' long and 50 across. The flash rises 30 to 40 high and lasts for about 8-10 seconds. The contents keep on burning for about 10 minutes on the targets. The temperature reached in the fire caused by Napalm bomb is about 1500°C. Napalm bomb is likely to set ablaze all combustible or inflammable objects which may be hit by its burning contents.

5. **Destruction by Napalm Bomb**

A U.S. Defence department report released reveals that on an average of about 1500 tons of Napalm bombs were dropped every month in Vietnam. This represents employment of Napalm the weapon in use to-day on a scale unprecedented in the history of warfare. Napalm bombs caused more deaths in Japan towards the end of World War II than the Hiroshima and Nagasaki bombs. It was also used in North Korea to slow down enemy advance.

6. **Method of use**

The bombs are usually Jettison able on target from about 100'-200' from ground without risk of blast and splinters of conventional bombs. When the bomb hits the ground, it burst open along the seams throwing the fuel forward and also igniting it. Burning fuel from the bomb is scattered over a "Cigar shaped area" with the burning being most intense along the central of the cigar.

7. **How to deal with fires caused by Napalm Bomb**

The following action should be taken to control the fires caused by Napalm bombs:-

(a) If the main body of the fire is at a place where no combustible material is likely to be set alight, either directly or by the radiated heat from the burning gel it should be allowed to burn itself out, However, if the radiated heat from the fire is likely to endanger the surrounding property which may be of combustible nature; such property should be cooled down by spraying water over it with the help of stirrup pump or by hand.

(b) If the main body of fire has already involved a large quantity of combustible material; it is safer to call the fire brigade.

(c) Small fires due to scatterings of the bomb should be tackled immediately with the help of sand or dry loose earth. If dry powder extinguishers are readily available, several small fires could be extinguished with spectacular rapidity by a single extinguisher.

(d) If the burning gel hits any person, an attempt should be made to dislodge the burning gel from the body with the help of a stick. Simultaneously, an attempt should be made to extinguish the burning gel by throwing sand or dry loose earth on it. The burning clothing should not be extinguished with water. The affected person Shouldice down on the floor and roll, He should also be wrapped in a blanket or any thick sheet.

(e) Slit trenches, ditches and folds in the ground give considerable protection as they form a barrier against the rush of burning fuels.

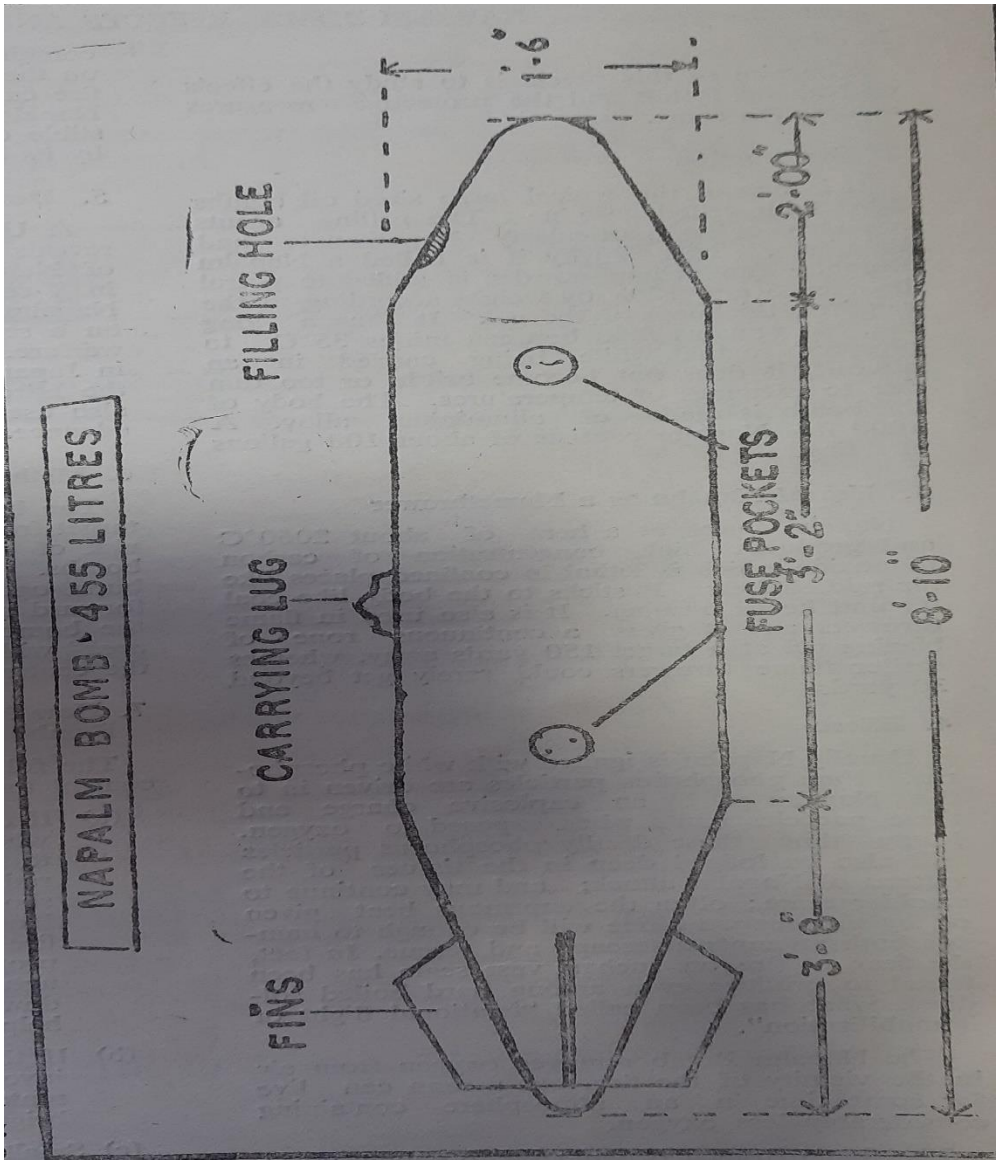
(f) Not to panic even though there is fire all around and a feeling of suffocation as it will get extinguished soon and the feeling of suffocation does not last long.

7. **First Aid**

Burns caused by burning gel from a Napalm bomb causes severe third-degree burns. Suitable burn dressing should therefore be kept handy for immediate first aid and the affected persons removed to hospitals immediately.

8**. Conclusion**

Napalm is probably the cheapest as well as one of the most effective weapons invented in modern times. The Americans have improved upon the Napalm and a second-generation weapon known as Napalm Bomb with polystyrene, petrol, and gel and benzene in 2:1:1 proportion is being produced at the rate of about 22,000 tons a month.


NAPALM BOMB - 455 LITRES
FILLING HOLE
CARRYING LUG
FINS
FUSE POCKETS
1'-6"
2'-0"
3'-2"
3'-8"
8'-10"

****

CHAPTER NO. 7

FRAGMENTATION BOMBS

1. **Aim**

Fragmentation bomb is a weapon which is used principally against personnel. Hence these. are often referred to as anti-personnel bombs. The destructive effect by one of these to property will be comparatively negligible. Nevertheless, used against personnel it can be very effective for disrupting the morale, particularly of the civilians.

2. **General**

The construction of these in general is of a thick body which is capable of breaking up into many small fragments upon detonation. The body can be either of heavy steel material or spiral steel strips. The explosive content itself is comparatively small (12-14%). The detonation is brought about by fusing components which are so fused that fragmentation will take place above the earth's surface. They can either be dropped singly or in clusters. Normally they are dropped in clusters. The size of each bomb varies from to 500 lbs. (0.25 to 250 kg). To prevent the burying of the bomb in the ground before exploding, these are sometimes attached with parachutes, but it is not an essential part of the bomb. The following fragmentation bombs are known to be in current uses: -

(i) 20 lb./10 kg. fragmentation bomb (British).

(ii) 6 lb./3 kg. fragmentation bomb (British).

(iii) 4 lb./2 kg. fragmentation bomb (Ameri- can).

(iv) 20 lb./10 kg. fragmentation bomb (American).

3. **20 lbs. (10 Kgs.) Fragmentation Bomb**

(i) **Description**- It consists of a bomb body and a tail unit and is fused at the nose only. The bomb body is of thick-walled construction and is filled with H.F. The tail unit is of cone and cylindrical type and is supplied secured to the bomb body.

(ii) **Use**-Used for attack against personnel and can be dropped either singly or in clusters. When dropped in clusters it will be either:-

(a) in a bomb container consisting of 8 such bombs, or

(b) in a bomb container consisting of 12 such bombs.

4. **8 lb. (4 kg.) Fragmentation Bomb**

(i) **General**- This bomb was developed towards the end of the 2nd World War and is believed to have replaced the 20 lb./10 kg. F. bomb.

(ii) **Description**-The bomb body consists of a post shaped cast steel cylinder open at the top. It is fused at the centre and has a para- chute assembly. The explosive content is about 2 lb./(1 kg.) of TNT.

(iii) **Use**-Probably used in clusters. Details are not known. When used in clusters may consist of 20 to 40 such bombs in one cluster.

(iv) **Functioning**-It has a delay fusing system which is designed for a normal delay of 0 to 6 hours.

5. **4lb. (2 kg.) Fragmentation Bimb (Butterfly Bomb)**

(i) **General**- This is a versatile bomb which is an adaptation of the German SD 2 butterfly bomb. It is believed that these were being used in KOREA with remarkable success.

(ii) **Description**-The bomb body cylindrical in shape and the vane assembly consists of four pieces hinged together, two semi-cylindrical surfaces (wings) and two discs (propeller blades). Before the bomb is dropped the vane, assembly is folded round the bomb to form a cylindrical casing which can be closed against the pressure of the vane springs by means of safety clips, the arming spindle projecting through the bomb casing. The German 4 lb. "Butterfly Bomb" presented more problems than any other type of anti-personnel bomb used in the 2nd World War and is considered here as representing the "worst case". Some butterfly bombs were designed to explode on or before impact, some were fitted with long delay and some with anti-disturbance fuses. So sensitive were the latter that a bomb exploding could detonate another 25 yards away. The explosive content weighed half a pound. The splinters were lethal at 50 yards, would wound up to 150 yards, just penetrate 3-inch plank two feet away but not a ½ inch steel plate one foot away. The bombs were dropped in large numbers from containers which opened in mid-air. One modern bomber could carry 10,000 bombs of the butterfly type and size.

(iii) **Use**-Used against residential areas, air-fields, roads and troops movements. Never dropped singly and always dropped in clusters. Two types of clusters are used:-

(a) M 28 cluster holding 24 bombs.

(b) M 29 cluster holding 90 bombs.

(iv) **Functioning**-When the cluster opens, the individual bombs scatter and the vane assembly on each spread open-air resistance causing it to raise up the arming spindle. The two wings reduce the velocity of the descent of the bomb and the two propellers turning it in an anti- clockwise direction and thereby arming the fuse. different types of fuses can be used with this bomb: -

(a) M 129 which is Air or ground burst.

(b) M 130 which is delay fuse (30 minutes).

(c) M 131 which is an anti-disturbance fuse.

6. **9 lb. Fragmentation Bomb**

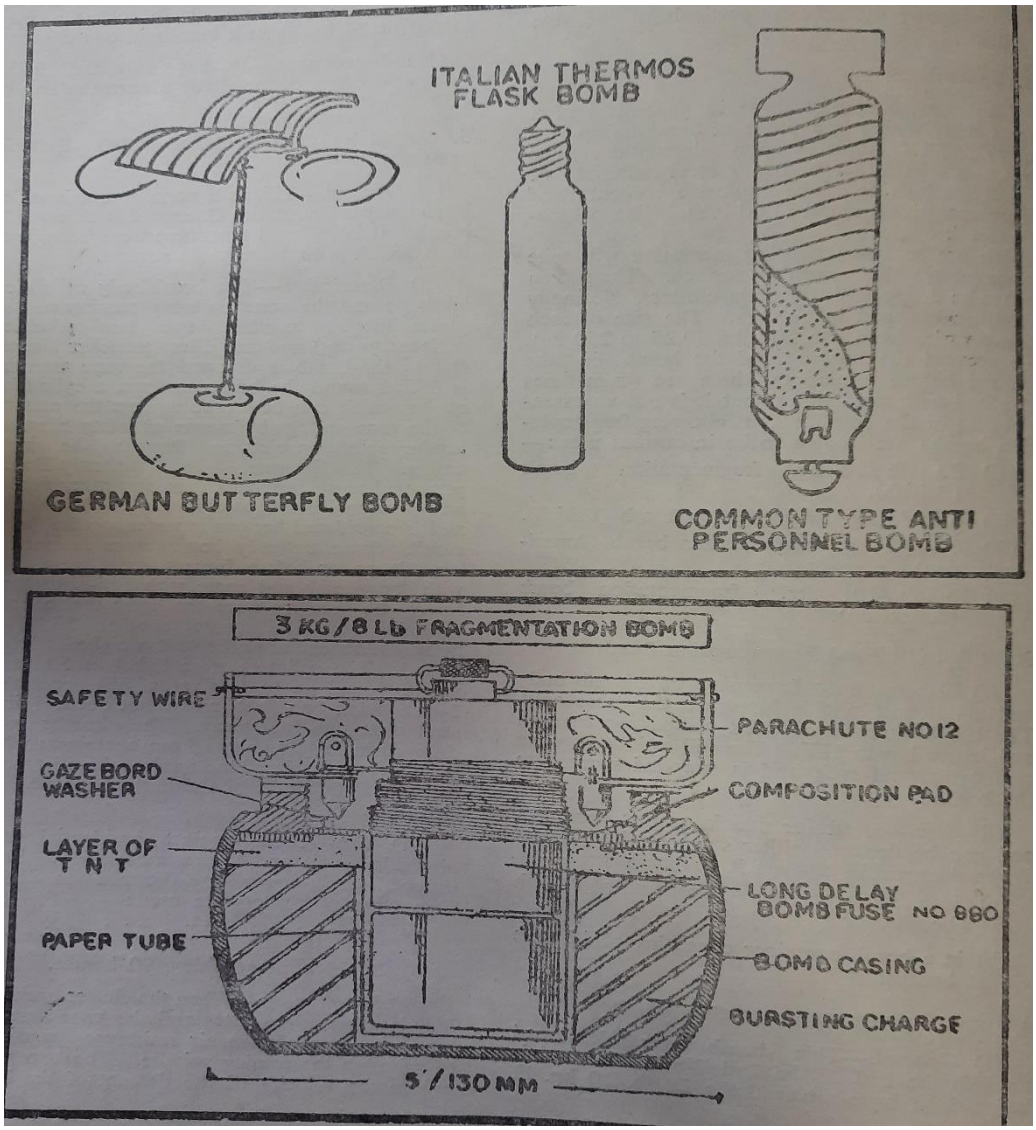
(i) **Description**-This has a body of cast steel nose and tail pieces with a seamless steel inner over which is wrapped helically drawn steel wire. It has an explosive content of approximately 3 lbs. (14 kg.). The bombs are fitted with parachutes.

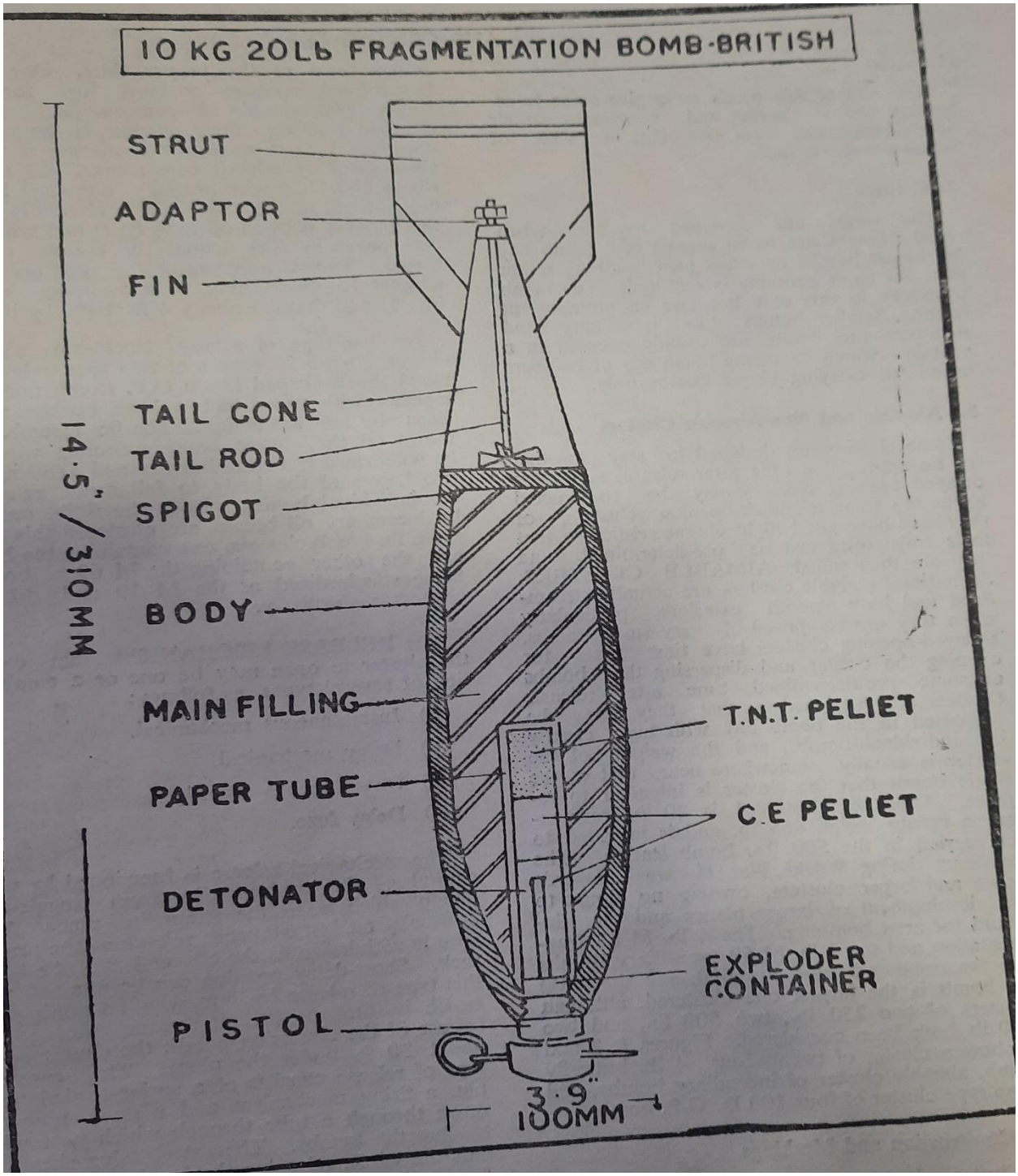
(ii) **Use**-Dropped in clusters of two types.

(a) 300 lbs./150 kg. cluster holding bombs.

(b) 600 lbs./300 kg. cluster holding 24 bombs.

(iii) **Functioning**-It function on impact after disintegration of the cluster faggot. Details of fuse used are not known. It is reasonable to assume that a normal nose fuse is used which functions on impact with ground.




10 KG 20Lb FRAGMENTATION BOMB-BRITISH
STRUT
ADAPTOR
FIN
TAIL CONE
TAIL ROD
SPIGOT
BODY
MAIN FILLING
PAPER TUBE
DETONATOR
PISTOL
T.N.T. PELIET
C.E PELIET
EXPLODER CONTAINER
14.5" / 310MM
3.9" 100MM

****

CHAPTER NO. 8

CLUSTERS AND CONTAINER

1. **Aim**

The aim of this precis is to give information about clusters and containers, their identification etc. from the point of view of bomb reconnaissance.

2. **General**

The bombs are clustered together when smaller bombs are to be carried in a bomb bay for bigger bombs or when area bombing rather than pin point bombing is required. The bomb trajectory in this case becomes an unimportant factor. Smaller bombs like Incendiary and Anti-personnel bombs are usually encased in a container which fits in the bomb bay of bombers meant for carrying bigger bombs only.

3. **Aimable and Non-Aimable Clusters**

Some clusters are designed to stay together for an appreciable time after release, and these delayed opening clusters may be constructed about the same as quick-opening clusters, or they may have good flight characteristics so that their trajectories can be pre-determined, and they are then called AIMABLE CLUSTERS. Some-times aimable clusters are actually stream-lined and have smooth exteriors, particularly when they are composed of very small bombs. Delayed-opening clusters have time fuses for opening the cluster and dispersing the bombs at some pre-determined time after release. Clusters are designed so that they may be supported in the bomb bay with lugs exactly like individual bombs, and the weight of the cluster is usually somewhere near that of the single bomb that the cluster is intended to replace. Thus, the cluster of six 20 lb. fragmentation bombs weigh 465 lb. and is intended to be carried in the 500 lbs. bomb station. The tendency during World War II was towards more and larger clusters, owning no doubt to the development of larger planes and the de- mand for area bombing. The 4 lb. M 83 frag- mentation and the 4 lb. M 50 Incendiary Bombs are the smallest bombs clustered, and the 100 lb. bomb is the largest one clustered, although clusters of two 250 lb., two 500 lb., and two 260 lb. have been considered. Figures 1, 2 and 3 show a cluster of twenty-four 4 lb. butterfly bomb, aimable cluster of incendiary bombs, and strap type cluster of four 100 lb. G.P. bombs.

4. **Construction and Markings**

Cluster adapters usually consist of two or more longitudinal members for strength and rigidity, plus two or more cross members to hold the bombs in position, plus various straps or wires to fasten the bombs in the cluster and release them at the proper time. One of the longitudinal members contains lugs for both single and double suspension. An entirely different type of cluster adapter is the totally enclosing type, a container consisting of a thin sheet-metal cylindrical case shaped like a G.P. Bomb and fitted with hinges. Individual bombs are packed in the case, which obviously is of the aimable delayed-opening type, and when the case opens by fuse actions the bombs are released. Typical adapters of this type are the adapter for twenty-four 4 lb. butterfly bombs (fig. 1) and that for ninety 4 lb. butterfly bombs.

Another type of totally Enclosing aimable cluster, Figure 2 consists of two semi-cylindrical metal sheets shaped like a G.P. Bomb and held together with straps and release buckles which open by tail-fuse action. The fin assembly is blown off the cluster, causing arming wires to be withdrawn from the buckles and allowing the two halves of the body to fall away, releasing the individual bombs. Both the 6 lb. and 10 lb. incendiary oil bombs are clustered this

way, the 6 lb. bomb clusters, one containing the M 69 and the other containing the M 69 x bombs, being standardized as the M 19 and M 21 clusters, respectively.

The RELEASE MECHANISM that causes the cluster to open may be one or a combination of several types, as follows:

(i) Instantaneous mechanical.

(ii) Delay mechanical.

(iii) Instantaneous cartridge.

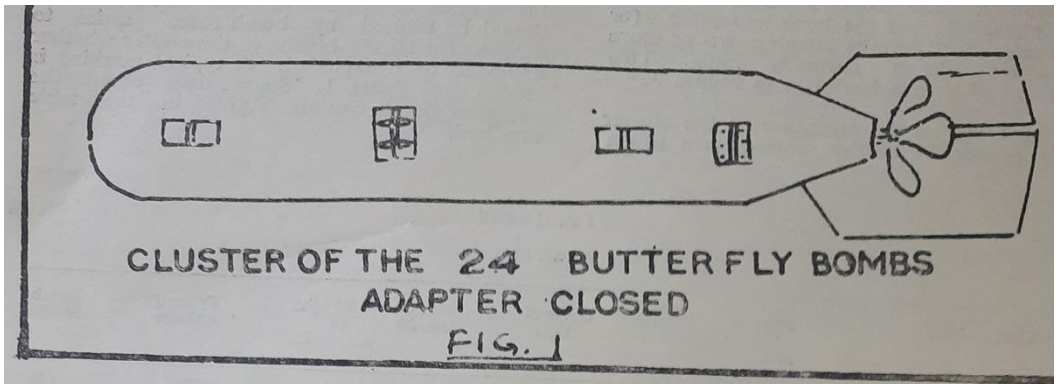
(iv) Delay fuse.

The mechanical release is functioned by withdrawal of the arming wire from toggle-type clamp which holds the straps in place. This is usually an instantaneous release as the arming wire is withdrawn as the cluster leaves the bomb rack. Short-delay opening can be attained with this type of release by employing an arming flap which is lifted by the air stream, causing full release of the clustering bands; the cluster opens about 30 ft. under the plane. The cartridge type of release consists of a spring-loaded firing pin, a firing mechanism and a steel plug to move through a tube through which pass wires holding the bombs. The steel slug shears or cuts the wires, releasing the bombs. Release by fuse action is obtained by the firing of the fuse after the cluster has fallen a pre-determined distance. The hook-and-cable cluster adapter is really a means of attaching two or more bombs to the same set of bomb shackles so that, instead of one bomb, several are released simultaneously. The individual bombs are not actually clustered, and the hook-and-cable (or strap) arrangement permits hanging two or more bombs where one is normally hung. This arrangement of bombs is shown in Figure 3. The markings on the container or the cluster casing is practically of the same pattern as on G.P. Bombs, but they specifically also indicate the number of bombs in the cluster, which should be utilised by bomb recce parties to account for all the bombs of the cluster whether exploded or unexploded. A typical marking is shown in figure 1. Some data about the common bomb clusters is given in the table attached.

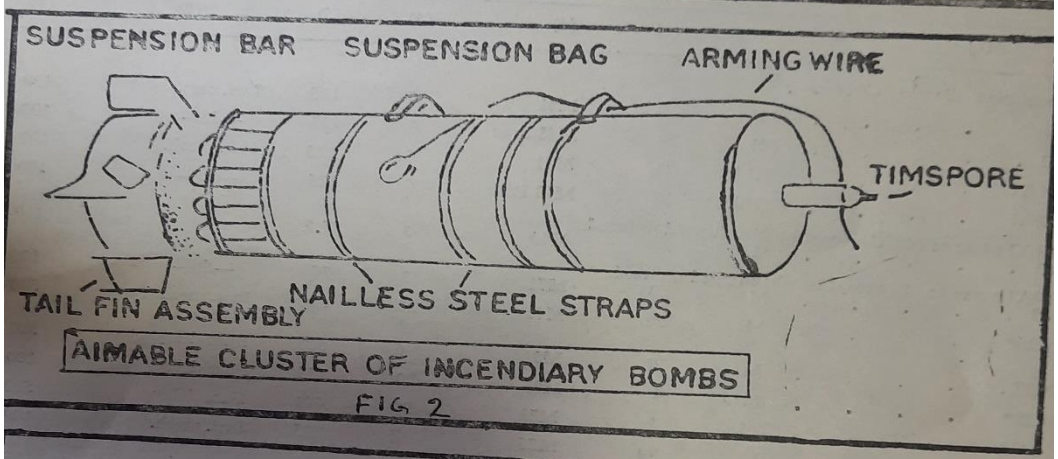
TABLE I To UXB/16
Data on Bomb. Clusters

Cluster No.	Cluster adapter No.	Bombs size lb.	Designs size lb.	No. of Bombs	Weight of cluster lb.	Type of Release	Bomb Station
1	2	3	4	5	6	7	8
Fragmentation Bombs Clusters:							
M1	M1	20	M 41	6	125	Inst. cart,	100
M2	M1	20	M 48 Prac	6	125	-do-	100
M1 A1	M1A2	20	M 41	6	125	Inst. , mech.	100
M2A1	M1A2	20	M48 Prac	6	125	-do-	100
M1A2 same as M1A1 except bombs shipped unfused.							
M4	M3	23	M40	3	87.2	-do-	100
M4A1 same as M1 except bombs shipped unfused.							
M5	M3	20	M71	3	76	-do-	100
M26*	M13	20	M41	20	500	Insp. mech. Fuse delay	500
M27	M14	90	M82	6	585	Fuse delay	500
M28*	M15	4	M83	20	155	Fuse delay	100
M29*	M16	4	M83	90	441	Fuse delay	500
		90	M86	2	225	Inst. mech.	100
Incendiary Bomb Clusters:							
ANM6	M5	4 4	M 50A2 M50 x A3	28 6	145	Inst. mech.	100
M17	M6	4 4	M50A2 M50 xA3	102 26	540	Inst. mech.	500
AN-M12	M4	6	AN M69	14	105		100
AN-M13	M7	6	AN M69	60	417		500
M17A1*	M10A1	4 4	M50 A2 M50 x A2	88 22	500+	Fuse delay	500
M14	M10A1	4	M50A2	110	500+	Fuse delay	500
M19*	M23	6	ANM 69	38	400+	Fuse delay	500
M21	M23	6	M69X	38	400+	Fuse delay	500
G. P. Bomb Clusters:							
M12	Cable & Hook Strap	100	M30	2	200+	Inst. by release	100
		100	M30	4	400+	Inst. by release from shackle	500

* Aimable Cluster.



CLUSTER OF THE 24 BUTTERFLY BOMBS
ADAPTER CLOSED
FIG. 1



AIMABLE CLUSTER OF INCENDIARY BOMBS
FIG 2

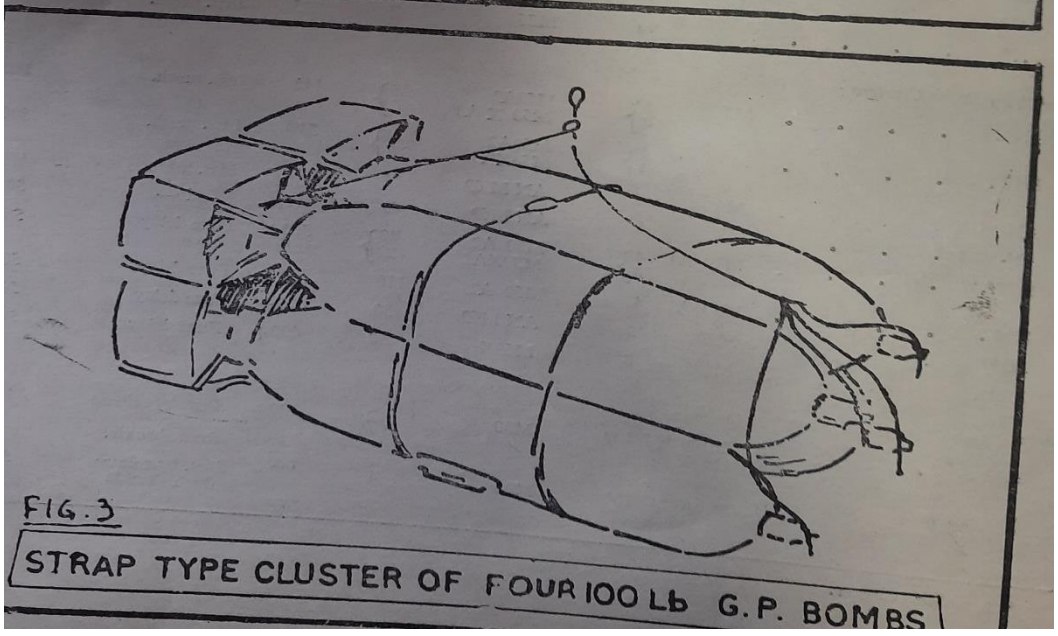


FIG. 3
STRAP TYPE CLUSTER OF FOUR 100 Lb G.P. BOMBS

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CHAPTER NO. 9

PYROTECHNICS IDENTIFICATION COLOUR AND MARKING

1. **Aim**

The aim of this precis is to give general information about Pyrotechnics used during a war from the ground as well as from the air. Since they contain explosives and have dangerous chemicals, they are likely to be dangerous. The Recce Officers should be able to identify them assess the associated dangers and take precautionary and protective measures.

2. **General**

Pyrotechnics are devices based on fire, smoke and noise as against those based primarily on explosion and detonations. Basically, they are of two types:

(i) **Military Pyrotechnics**: for signalling or illumination. Signals are for signalling between aircraft and ground troops, bet- ween ground troops themselves, from air-craft to air-craft and in general bet- ween sea, air and land. Furthermore, these signals must exist in such variety that enough of different signals are avail- able to transmit a variety of information and can be changed often enough to confuse the enemy and make their duplication difficult.

(ii) **Illuminates**: are for the illumination of some object or some area and are re- quired for reconnaissance, observation, bombardment, photographing, landing of air craft and Para troops, disclosure of enemy movement and a variety of special purposes.

3. **Classification of Pyrotechnics**

(i) According to practical use, depending upon whether pyrotechnics are for ground forces or the air forces. They are called ground pyrotechnics or aircraft pyrotechnics. Some are specially used for providing signalling to ground or air forces or to each other.

(ii) According to type of functioning, ground and aircraft pyrotechnics may be further divided as signals which provide light or smoke of various colours and arrangements, and illuminates which provide light for an appreciable time, usually longer then signals or for a very short time for photographic purposes-markers or slicks marking a spot on the surface of water.

(ii) According to type of component, signals and illuminates can be further classified according to the actual type of component. Thus, we have pyrotechnics in the form of flairs, signals, cartridges, bombs, mortar shells, artillery shells, grenades, mines etc. as well as many special sizes and shapes peculiar to pyrotechnics. Fig. 1 shows variety of Military Pyrotechnics.

(iv) According to methods of projection, Pyrotechnics devices are projected in a number of ways and can be classified accordingly. Projector types are fired through projectors which is a small smooth bore mortar type device used primarily by ground troops or through discharger a similar device used by an air-craft. Pyrotechnic pistol which may be muzzle or breach loaded, or either of the short barrel pistol or the long barrel signalling pistol type. Others are fired from service rifle by means of grenade launcher, thus obtaining direction and altitude. Still others such as signalling shell are fired

through a standard mortar and others dropped as bombs or thrown as grenades, and some are even held in the hand.

(v) According to the type of descent, flairs, signals, and other pyrotechnic devices may be of the freely falling variety or of a parachute variety, depending whether or not they have the parachute attached to them to retard their rate of fall. In general, all the devices could fall to the ground while still burning, though if desired some reasons keep in the air.

4**. Pyrotechnic composition**

These are combustible physical mixtures, and have characteristic intermediate between those of a mixture like thermite and explosive com- pounds. Pyrotechnic mixtures contain Oxygen, for supporting their own combustion, burning progressively and are usually pressed into cylinders. The proportion of these compounds are adjusted so as to produce a range of effects. from dark fires, an element of blinker signals to brilliant flash of photo-flash bombs. They contain four types of ingredients.

(i) **Fuel**- Magnesium or Aluminium powder.
(ii) **Oxidiser**-Salts like Chlorates, Perchlorates.
(iii) **Colour Intensifier**-Salts of Barium, Copper, Strontium, Sodium, Organic Dyes etc.
(iv) **Miscellaneous Agents**- Retarding, binding and water proofing agents such as asphalt, sulphur and paraffin, blending and water proofing agent such as castor oil and linseed oil.

5. Ground Pyrotechnics Ground pyrotechnics are functioned from the ground or air force units or to illuminate objects or an area. Thus, we have ground signals and ground illuminates.

(i) **Ground Signals**- These are fired from a projector or a rifle. They are of three different types.

(a) The M. 17 to M. 22 projector series of star signals;

(b) The M. 17 A1 to M. 22 Al rifle grenade launcher series of star signals; and

(c) The T. 38 to T. 42 rifle grenade launcher series of coloured smoke signals. In both projector and the launcher, there are two types of stars in three colours, the stars being of either of single variety with parachute or a five-star cluster without parachute. The colours are white, green and amber. In addition, the launcher series contains red stars. Most ground signals are for both day and night use.

(ii) **Projector Signals**- M.17 to M.22. These signals are assembled in a cylindrical case 6" long and 1.6" in diameter to which a finned tail assembly is attached. The signal slides down the projector bore of the M1A1, M3 or M4 projectors. The closing cap in the end is embossed with the signal identification mark. These signals weigh about a pound and burn for 20 to 30 seconds with a candle power of 4 to 20,000 depending upon the colour.

(iii) **Launcher Signals**-M. 17 Al to M 22 A1, M51 A1, M 52 A1. These cartridges are of the same size as the projector signals, but the tail fin assembly is replaced by a stabilizer tube and round fins similar to rifle grenades. They are ignited by the powder of special blank cartridges fired in the rifle or carbine and propelled by a combination of this power

and the supplementary expelling charge. These are about 10.4" long. The parachute types also weigh about 1 lb., burn for about 20 to 30 seconds, with a candle power of 4 to 20,000 depending upon the colour. The cluster types also weigh one pound but burn for 5 to 7 seconds only with a candle power of 2,000 to 35,000 depending on the colour. The launcher series has the same colours as the projector series i.e. white, green and amber plus red.

(iv) **Coloured smoke launcher signals**-These are similar to M 17 A1, launcher series but the signals contain the coloured smoke composition instead of an illuminate composition. The smoke colour being red, orange, yellow, green and violet. They have the same appearance of M 17 A1 series but are 10.2" long and 1.88" in diameter, detonate with the sharp noise caused by E.C. blank pew- der. Coloured smoke launcher signals are used primarily by artillery observers to signal or lay in a line of fire.

(v) **High burst ranging signal M27**-This was developed to simulate the air burst of an artillery shell by producing a smoke puff and a flash at the top of its trajectory to give artillery crew ranging practice.

(vi) **Flash and sound signal M74** - This is 3" long and 1½ " in diameter filled with 1 oz. of flash powder (black powder plus aluminium) and fitted with a 2 to 3 seconds delay. It is intended to give a flash and short report but no fragments used for training troops.

(vii) **Ground Illuminate**- Ground Pyrotechnics which are illuminates consist of 60- and 81-millimetres illuminating projectile, the airport flair, 2 types of trip flairs, and various types of ground flairs.

(viii) **Illuminating Projectiles**-These are fired from 60 and 81 millimetre trench mortars to illuminate the enemy at sight, dis- closing movements and making them vulnerable to fire. The 60 mm. shell M 83 is 14.2" long and 2.3" in diameter weighs 3.7 lbs. It burns for 25 seconds and emits 1,45,000 candle power. The 81 mm. M301 burns for 60 seconds at 2,75,000 candle power.

(ix) **Trip Flairs** -There are two most common M 48 and M 49, it is like an anti-personnel mine, the fragmentation projectile being replaced by a flair and is projected upward. It is buried in flush with the ground or just below the surface or hidden upwards, by camouflage. It is intended to give warning to enemy marauders or infiltration by hostile troops. It produces flairs and rises up to 300 to 500 ft., with power of 1,10,000 illuminating circle of 300 yards radius.

(x) **Air Port Flairs**-These are used to illuminate the Air Fields for emergency landing The M. 13 type is 23" long and 1.76" in diameter which produces about 4,000 candle power for three minutes. Other high-power flairs are also in recent use.

(xi) **Hand Illumination Flairs**-They are 4-3/8" long and 2-3/8" in diameter weighing 1.3 lbs. They are thrown by hand like grenades or can be launched through a rifle also. These are used to find out the suspicious movement of the troops.

(xii) **Tree suspended Flairs**-These are modified parachute fairs about 24" long and 4½" in diameter weighing about 18 lbs. and emit 8,00,000 candle power. These are suspended

over the free to investigate suspicious noise at night near the front lines and are laid when the site is accessible during lull in enemy activity.

(xiii) **Aircraft Pyrotechnics**-These are similar to ground signals except that they are fired through pyrotechnic pistols. The aircraft flairs can be dropped like bombs with or without delay. The most common ones are photo flash bombs for aerial photography and certain target indication pyrotechnics used in connection with bombing.

(xiv) **Aircraft Signals**-These serve a variety of purposes like signalling distress from grounded planes, or regular or emergency identification of aircraft, for making a reference point on the surface of water (flame floats), for obtaining information in the drift of the plane or the wind direction and for illuminating the surface of water before landing.

(xv) **Aircraft illuminates**-The aircraft bombardment flairs are designed to provide illumination for bombing and better accuracy and visibility during the day time. The aircraft bombardment flair AN-M26 is the largest bombardment flair dropped from a plane weighing 52.5 lbs. and looks like a bomb. It is 50" long 8" in diameter and the tail diameter is 13.5" across the fins. It has a parachute also. It burns for 3 to 31 minutes with yellowish light at 80,000 candle power. Some are especially designed for reconnaissance and landing. They just illuminate the area at night to assist landing of the reconnaissance parties.

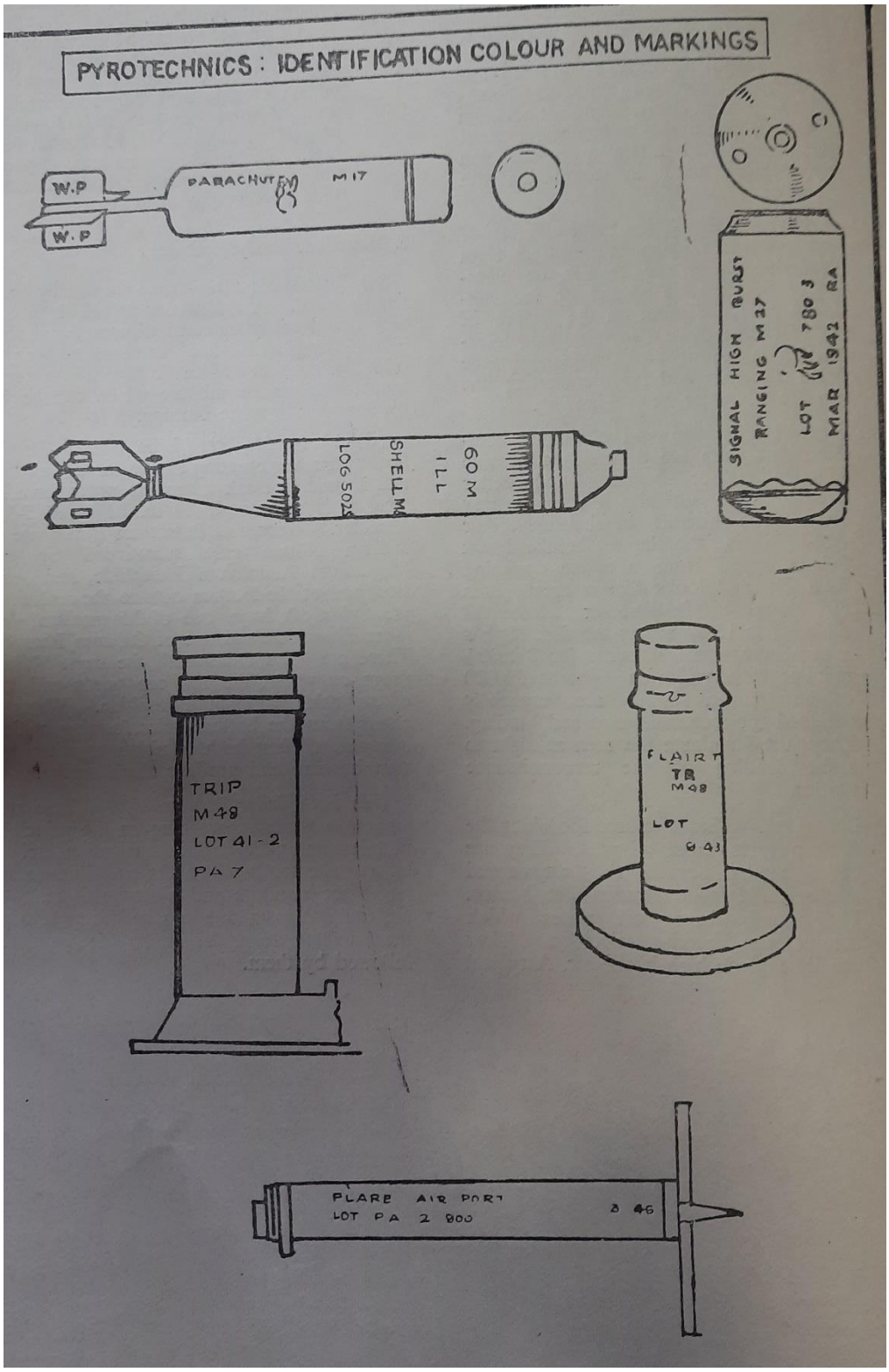
(xvi) **Photoflash**-These are used for taking the flash pictures from aircraft. They are called bombs because they are carried and released from aircrafts like bombs. They usually have tail plates which control the bomb trajectory. They usually explode high in the air. A typical photoflash bomb is M 46. It looks like 100 lbs. G.P. Bomb. It is 48.4" long 8" in diameter weighs 51.9 lbs. contains 25 lbs. of Photoflash powder, emits peak candle power of 800 million with 500 million average over 0.2 seconds and is dropped from 7,500 to 25,000 feet by properly setting the 5 to 93 seconds delay fuse. There are some smaller photoflash bombs and cartridges for low altitude photography also.

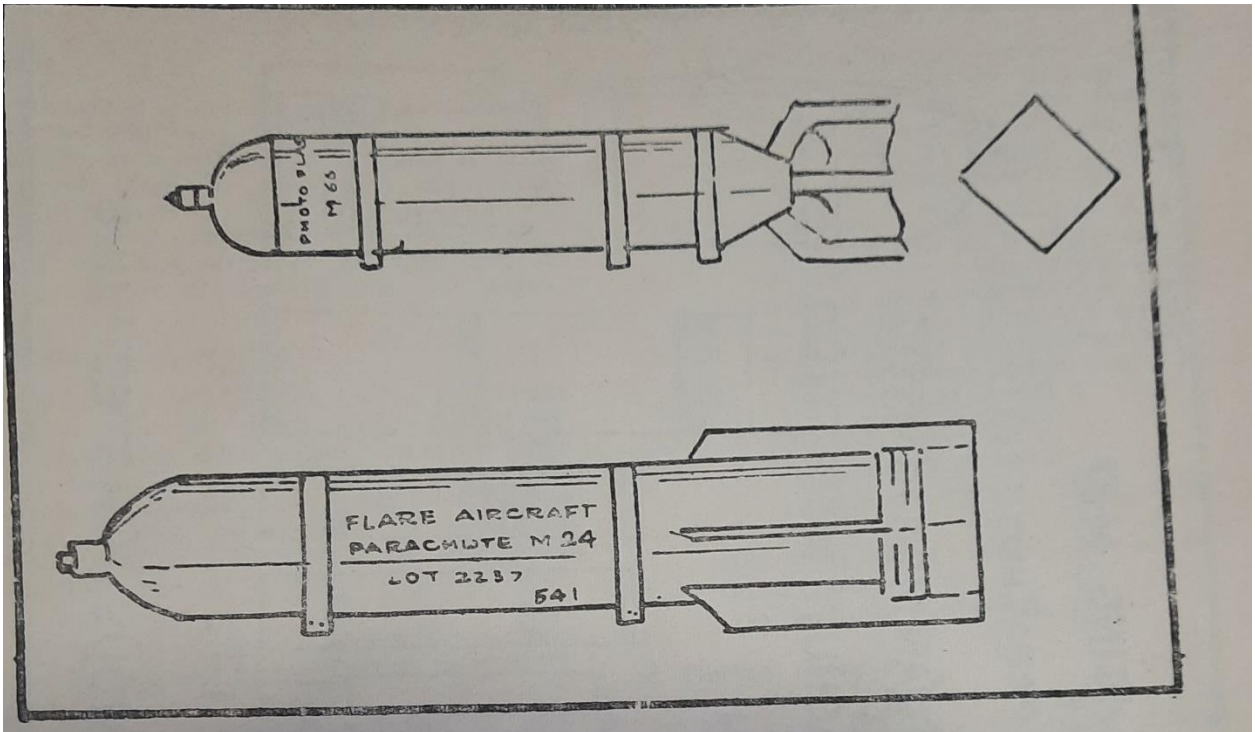
6. **Miscellaneous Pyrotechnics**.

(i) **Distress Signals**-These are usually opera- ted by hand. A typical one is Mk 1 mod 0, very useful easily operated distress signal about 3-7/8" long and 1-5/8" in diameter weighing 0.37 lbs. consists of a high visibility orange pyrotechnic smoke mixture which can be held by bare hands while burning.

(ii) **Marine Markers (flame floats)**-This is a floating marker emitting smoke for 2 ½ to 5 hours and is used to mark a spot on water for a long time. It is cylindrical, 29 in. long and 5-3/4" diameter. It contains Potassium Bisulphate and Sodium Nitrate core surrounded by course Magnesium Aluminium Phosphide, and excelsior, and at the bottom outside the central tube are two cloth bags, one of Magnesium aluminium Phosphide and one of Calcium Phosphide. There are holes underneath the bags. When it drops on water, the top cap opens and water enters inside forming Phosphide. Water also enters from the bottom holes forming oxides of nitrogen. When both combine together, they start burning and produce thick smoke.

(iii) **Path finder Pyrotechnics**-These are of numerous varieties, working on the principle of illumination, radio, radar navigation etc. The target indicator bomb marks and illuminates the target for accurate and night bombing. Radio and radar transmitters can be dropped to guide the bombers to a target or the path to be followed by them.

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PARACHUTE M 24
LOT 2257
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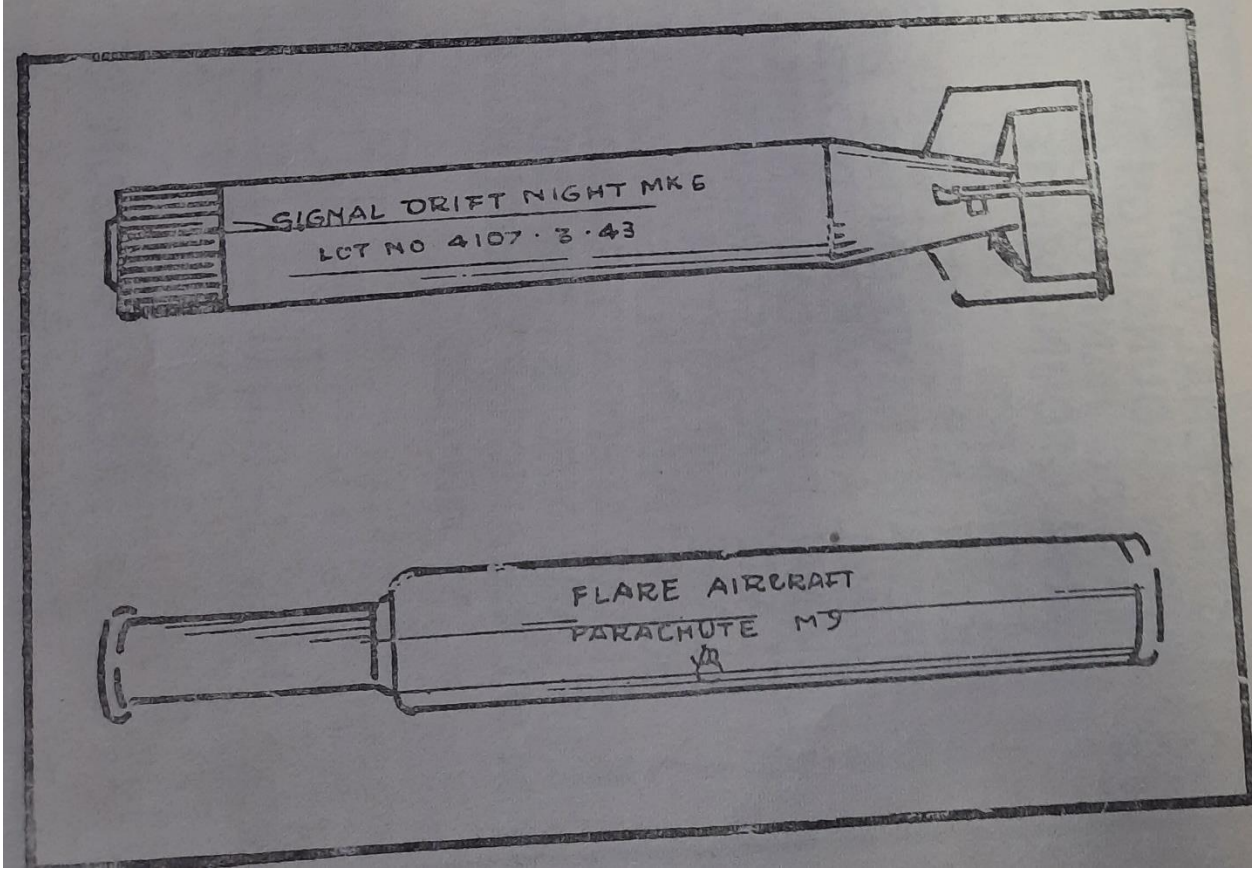
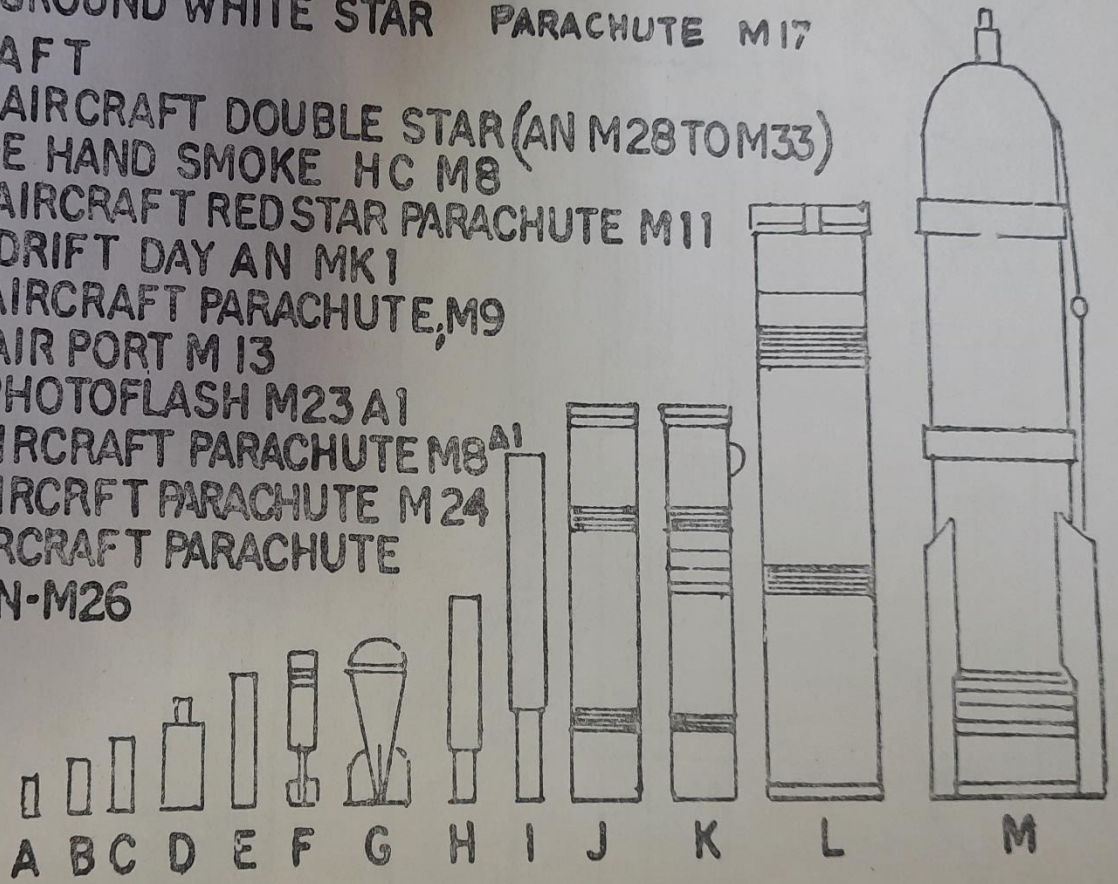

SIGNAL DRIFT NIGHT MK 6
LOT NO 4107 · 3 · 43
FLARE AIRCRAFT
PARACHUTE M9

A LIGHT SIGNAL VERY MK II
C SIGNAL GROUND HIGH BURST RANGING M27
D GRANADE HAND SMOKE Hc M8
F SIGNAL GROUND WHITE STAR PARACHUTE M17

AIRCRAFT

B SIGNAL AIRCRAFT DOUBLE STAR (AN M28 TO M33)
D GRENADE HAND SMOKE HC M8
E SIGNAL AIRCRAFT RED STAR PARACHUTE M11
G SIGNAL DRIFT DAY AN MK 1
H FLARE AIRCRAFT PARACHUTE, M9
I FLARE AIR PORT M 13
J BOMB PHOTOFLASH M23 A1
K FLARE AIRCRAFT PARACHUTE M8 A1
L FLARE AIRCRFT PARACHUTE M 24
M FLARE AIRCRAFT PARACHUTE AN-M26



COMPARISON OF VARIOUS PYROTECHNICS

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CHAPTER NO. 10

DESIGN AND TYPES OF FUSES, FUSE IMMUNISATION

1. **Aim**:

Although it is not necessary for everybody concerned with recce reporting and instituting protective measures from H.E. Bombs to know all details about the construction and mechanism of fuses of bombs, yet the knowledge will be of great use in appreciating the dangers associated with unexploded bombs and the effects of the explosion of various types of H.E. Bombs.

2. **Requirements of a Fuse**:

The basic requirement of the fuse is its ability to initiate, at the right time, the sensitive explosive which will eventually cause the bomb to function. The construction of a fuse should have been, therefore, very simple but because certain additional requirements, as mentioned below, are also to be fulfilled, the construction sometimes appears complex. The additional requirements are:

(i) The bomb must be absolutely safe during storage and during its carriage in an air- craft.

(ii) The bomb must be incapable of functioning (when released) until it has covered a safe distance from the air craft from which it is released.

(iii) The bomb must be further capable of being rendered safe, incapable of functioning at all so that it can be safely dropped on a friendly territory, as may have to be done in case of a forced landing of the plane.

3. **Types of fuses for operational use**:

Fuses are made of different types to suit operational requirements. The main types of considering their uses are given below:

(i) **Airburst**-These work at a predetermined time before the bomb reaches the target.

(ii) **Proximity**-These are a variety of air- burst type but these operate within a pre-set distance from the target.

(iii) **Impact**-These are designed to operate immediately upon impact with the target. This type of fuse is commonly used in blast, G.P. or fragmentation and even in chemical and incendiary bombs.

(iv) **Short delay**-In this type, the fuse operates a few seconds after the impact. It is used in bombs which give maximum effect after gaining some penetration e.g. in buildings etc. Its special value lies in low level attacks to allow the air craft to fly clear of the danger zone.

(v) **Long delay**-This fuse operates at a pre- determined time (which may be in minutes, hours, days or even weeks) after coming to rest. These fuses are commonly used in general purpose bombs for demoralising the civilians.

(vi) **Anti-disturbance-** The fuse gets com- missioned only after the bomb has come to rest and operates when a particular type of influence is received. This type of fuse is usually

used in conjunction with a long delay fuse to prevent easy disposal of bomb by enemy. These fuses may be set into operation because of:

(a) vibration of the earth.
(b) movement of the bomb.
(c) carriage of magnetic metals near the bomb.
(d) disturbances caused by sound waves; and
(e) variation in the light.

4. **Practical Grouping:**

Almost all fuses used can be divided into two groups from the constructional point of view viz., the mechanically operated and the electrically operated ones. The groups are not very water tight as some fuses contain both moving parts and electrical circuits but for practical purposes the following basis may be accepted for grouping:

(i) **Mechanical fuses** -Mechanically operated fuses are those in which the final ex- plosive or delay train is initiated by a striker impinging upon a sensitive cap.

(ii) **Electrical fuses** - Electrically operated fuses are those in which the final explosive or delay train is initiated by heat which gets generated electrically.

5. **Examples of Mechanical Fuses**:

(1) **Impact or short delay type fuses**-The mechanism used to bring the striker into contact with the cap depend either on the pressure or on inertia:

(a) **Pressure type** :-These are usually located in the nose of the bomb. In its simplest type (see diagram A) the pressure plate is held clear of the cap by a "creep" On impact, pressure on the plate becomes sufficient to overcome the spring and the striker is driven into the cap.

(b**) Inertia type** -These are usually fitted in the tail or side fuse pocket. In one of the common types (see diagram B) the heavy striker is retained by a thin metal disc. On impact, the inertia of the heavy striker bends the disc and drives the point on to the cap.

(ii) **Long delay fuses** -There are two common types:

(a) **Clock-work**-The arrangement is some- what like the setting of an alarm in a clock at a pre-determined time. Instead of relating the alarm mechanism, this type of fuse releases a spring-loaded striker. A very accurate time-setting of the delay can be arranged.

(b) **Chemical**-In this type, a spring-loaded striker is held back by a soluble plug (see diagram C). During descent of the bomb from the plane or upon its impact on the target, the glass-phial containing a chemical solvent of the plug is broken and softening of the plug starts. The period of delay varies with the strength of solvent, the composition or size of the plug and the temperature. Due to these factors, an appreciable margin of error is to expected in the timing set in this type of fuse.

(iii) **Air-burst fuses**- Some of the types of fuses are:

(a) **Barometric**-In this type of fuse vacuum bellows are contracted by the increasing atmospheric pressure as the bomb descends. The movement obtained from this is used to arm and fire the fuse.

(b) **Clock-work-** This type is similar to that used for long delay fuses, except that the clock is started as soon as the bomb leaves the plane.

(c) **Direct action** -A cord attached to the Air-craft or the container of the bomb palls out a safety device from the bomb as it falls. This frees the spring-loaded striker which hits on the cap.

(iv) **Hydrostatic fuse**- These fuses are used in underwater Missiles and are pressed to function when they descend to a depth where the water pressure is equivalent to that at which the fuse has been set to function. The varying water pressure causes movement of rubber bellows. The movement of the rubber bellows frees a striker which hits percussion cap and initiates the train of explosives.

6. **Examples of Electrical Fuses**:

Each type of electrical fuse, consists of three basic components, viz., a source of electrical energy such as a condenser or battery, an electric igniter in the form of a fusible wire which becomes heated and fires the powder, and a switch which closes the circuit at the required moment. Certain common types of electrically operated fuses are described below:

(i) **Switch-operation fuse**

(a) **Vibratory type**- In this type, on impact or any other deliberate movement, a flexible metal contact which is supported within a metal ring allows the contact to touch the ring and complete the firing circuit (see diagram D).

(b) **Nose-switch**-The switch is fitted at the nose of the bomb at the end of a rod. It consists of two plates held a little apart. On impact they are forced together to complete the circuit (see diagram E).

(ii) **Battery**-operated fuses. When used in bombs, these fuses are of the anti-disturbance variety. The firing circuit consists merely of the battery, a switch and an igniter. The battery is connected to the fuse through a switch which operates in either of the ways described in para 6 (i) above.

(iii) **Generator-operated fuses**- In its simplest form the current is generated by the rotation of a permanent magnet around another. One of the two components is attached to the vanes which rotate in air-stream as the bomb falls.

(iv) **Radio-operated fuses**-This is a "remote control" fuse which can be operated from a distance. This fuse contains a radio receiver which causes the igniter to fire on receipt of pre-arranged signal from the operator.

7. **Fuse Immunisation:**

General. Although not a direct responsibility of the bomb reconnaissance parties, some know- ledge about the process involved in fuse immunisation will be of interest. The basic principles on which methods of making fuses safe are worked out are simple and straight forward. The source of power, be it mechanical or electrical, or a combination of both, must first be neutralized and then killed. The method by which this is done must be largely automatic, so that it can be operated by remote control and easily applied so that not more than one or two men are exposed to danger and then only for a short time. The practical requirements demand also that the methods should be suitable for application under field and operational conditions and be simple to teach and that the equipment involved should be both easy and inexpensive to produce.

8**. Injection of Liquids**:

Most fuses, mechanical and electrical, can be made safe by the injection of a suitable liquid. Although every fuse would be made safe if the explosive or pyrotechnic components were sufficiently wetted or if the flash passage were block- ed. these aims are difficult to achieve with certainty. Liquids which will penetrate the usual wax or paper covering and then thoroughly wet the explosive or powder reasonably quickly are rare. Most of those suitable in this respect are inflammable and deposit extremely sensitive chemicals from the solutions they make with the original explosive. The flash passages are usually small and are often sealed oil, and, even with the most efficient vacuum or pressure pumps, it is rarely possible to guarantee that a small air-clock will not remain. Given however a liquid of suitable properties and the means of injecting it at the right place it is possible to clog and stop the movement in mechanical fuses or to accelerate the rate of discharge of condenser resistance electrical fuses,

9. **Methods of Injection**

The liquid may be injected into the vital section of the fuse either through gaps in the fuse case or through prepared holes. If the inner portion of the fuse is to be attacked and access cannot be achieved from the surface, it may be necessary to gain entry to the fuse pocket and pass the liquid into the fuse via the pocket. The means used for gaining entry will frequently be dictated by booby traps and by the sensitivity of the fuses in the bomb. The liquid may be injected in its natural state or as a gas (e.g. steam). To get quick positive results and to ensure that the more inaccessible parts of the fuse are reached, it is usually necessary to inject under pressure.

The pressure may be applied direct from a hand operated pump, or hydraulically via a transfer cylinder and piston, by atmospheric pressure after exhausting the air from the fuse with a vacuum pump, or from a boiler, the liquid being vaporized prior to condensing in the fuse.

10. **Liquids for Mechanical Fuses**

The liquid must be mobile enough to enter the fuse but viscous enough to prevent the fuse from functioning. If electrical components are also contained in the fuse, the conductivity of the liquid must be such that it will not cause a short circuit. For very sensitive fuses the liquid may have to be injected in vapour form and if the liquid is too "thin" to prevent the mechanism from operating it may be solidified when inside by freezing. Less sensitive fuses are usually jammed with a quick setting substance. A salt or sugar and water solution is a useful substitute, as these solutions are more viscous than water alone and are particularly useful for holding stopped long delay clock-work fuses when the main filling is subsequently to be removed by heating. As the water evaporates the sugar or salt deposited encrusts the works of the clock and prevents its starting.

11. **Liquids for Condenser-Resistance Electrical Fuses**

The conductivity of the liquid injected must fall between certain definite limits. The higher limit is controlled by the necessity that the liquid shall not be sufficiently conductive to the firing circuit and actuate the fuse. It must also have sufficient resistance not to close the circuit when a trembler of the switch is permanently displaced and the gap is consequently very small. The lower limit is mainly controlled by the necessity for the condensers to be dis- charged within a reasonable space of time. The conductivity of the liquid being so vital, special apparatus is issued for testing the liquid in the field. If the condensers themselves are accessible to the liquid it is an advantage if the liquid will cause their physical break down as well as discharge them. The liquid should also have good wetting properties so that it adheres to the surfaces if touched and forms continuous conductive paths. It is necessary to know, for every type of fuse, the minimum quantity of liquid which must be injected (this also may vary with the angle at which the fuse is lying), the minimum time of discharge (allowing for a reasonable safety factor. German fuses were left for between 5 and 20 minutes after injection was complete), and if booby trapped plungers are fitted, the maximum pressure which may be applied.

12. **Other Methods Applicable to Mechanical Fuses:**

(i) **Safety pin**- Many fuses are armed by removing a safety pin, fork or collar and may sometimes be made safe if these are replaced by similar devices. For other fuses it may be possible to make a hole in the casing and insert some device which will prevent movement. Precautions must be taken to prevent the pin falling out.

(ii) **Pressure**- The application of pressure at a given point will prevent certain fuses from functioning. The method is most commonly used for clock work or chemical fuses. The equipment required is usually quite simple and may often be made up in unit workshops. The fuse gas used to depress the spring-loaded balance wheel stop pin of a German 89 clock- work airburst fuse, is inserted through the safety pin hole in the fuse head and retained in position with a simple domed leaf spring. The Metzler tool was designed to make safe the Japanese Cl (a) Chemical long delay fuse by releasing the pressure on the striker spring. The collect is screwed into the arming spindle of the fuse and is thereafter held still with a spanner. The outer collar is screwed down on the collet until a decent shears, releasing the pressure on the rear end of the striker springs. By elaboration, devices such as those described can be adapted for remote control. The Metzler tool has in fact been modified to operate by pressure from an oil pump. Most tools of this type, however, must remain in position while the bomb is finally disposed off and must therefore be expendable.

(iii) **Magnetic**-This method has been developed for stopping and hold ng stopped a clock work long delay fuse. The equipment consists essentially of an air-cooled electro magnet and a bank of batteries, connected by a long cable allowing remote control. The magnet is positioned directly over the fuse head and operates by magnetizing the steel spindles and bearings of the clock movement, the increased friction thus caused stopping the clock. The balance wheel comes to rest in the neutral position so that if the current is switched off, the clock remains stopped until moved or vibrated. The great advantages of the method are that the fuse need not be interfered with and that operation is by remote control. It is only applicable, however, if some of the spindles and bearings in the clock are of magnetic materials and then only if a sufficient field can be concentrated in the area of the clock. The German 17 series fuses had a number of steel pivots and bearings and the steel fuse pocket helped to concentrate the magnetic field

around the clock. Nevertheless, even with a magnet weighing 90 pounds and a supply of 52 volts, fuses could only be stopped in thin-walled (less than inch) bombs up to 500 kilogrammes and in thick-walled (over inch) bombs up to 50 kilogrammes, the metal in the cases of larger bombs causing too much dispersion of the magnetic field.

(iv) **Dearing**-The dearer is a remotely controlled device for bending, removing, or dis-placing some vital portion of a fuse which stands proud of the bomb by firing a steel slug at it from close range. It is useful when a mechanical fuse is too fragile or too sensitive to allow drilling of the case. The action of the dearer is so fast that the fuse does not have time to function before it is rendered harmless.

13. **Other Methods Applicable to Condenser Resistance Fuses**

After a period of time all condenser-resistance fuses lose their charge and cease to be dangerous and all the techniques designed specifically for making condenser-resistance fuses safe rely upon accelerating the rate of discharge.

(i) **External short circuiting**-The simplest means of discharging the condensers is to short circuit the conductors by which the charge was introduced. For instance, German condenser-resistance fazes were armed by depressing a plunger and could be made safe by depressing plunger again and leading the current to earth. In practice the contacts should be made and broken a number of times, for initially the charge is only being taken from the reservoir condenser and a time lag occurs before any charge starts to flow from the firing condenser. The method is useless however if the contacts are broken behind the plungers after the fuse has been charged, and it may lead to disaster if the plungers are booby trapped.

(ii) **Thermal dischargers**-If condensers of the type used in German fuses are heated, sufficient change in the dielectric constant of the insulating material occurs for the discharge rate to be considerably increased. It was, however, found that if German fuses were heated above 70 degrees Centigrade there was a risk of the fuse becoming warped and the trembler switch being made to contact. In other fuses the limitations may be the sensitivity to heat of the explosive components. The particular advantages of the thermal method are remote control; suitability to fuses damaged or covered with caps, fuses into which liquid cannot easily be injected or may not be injected for fear of closing a sensitive trembler switch, and to fuses which have booby trapped plungers or are in an inaccessible position.

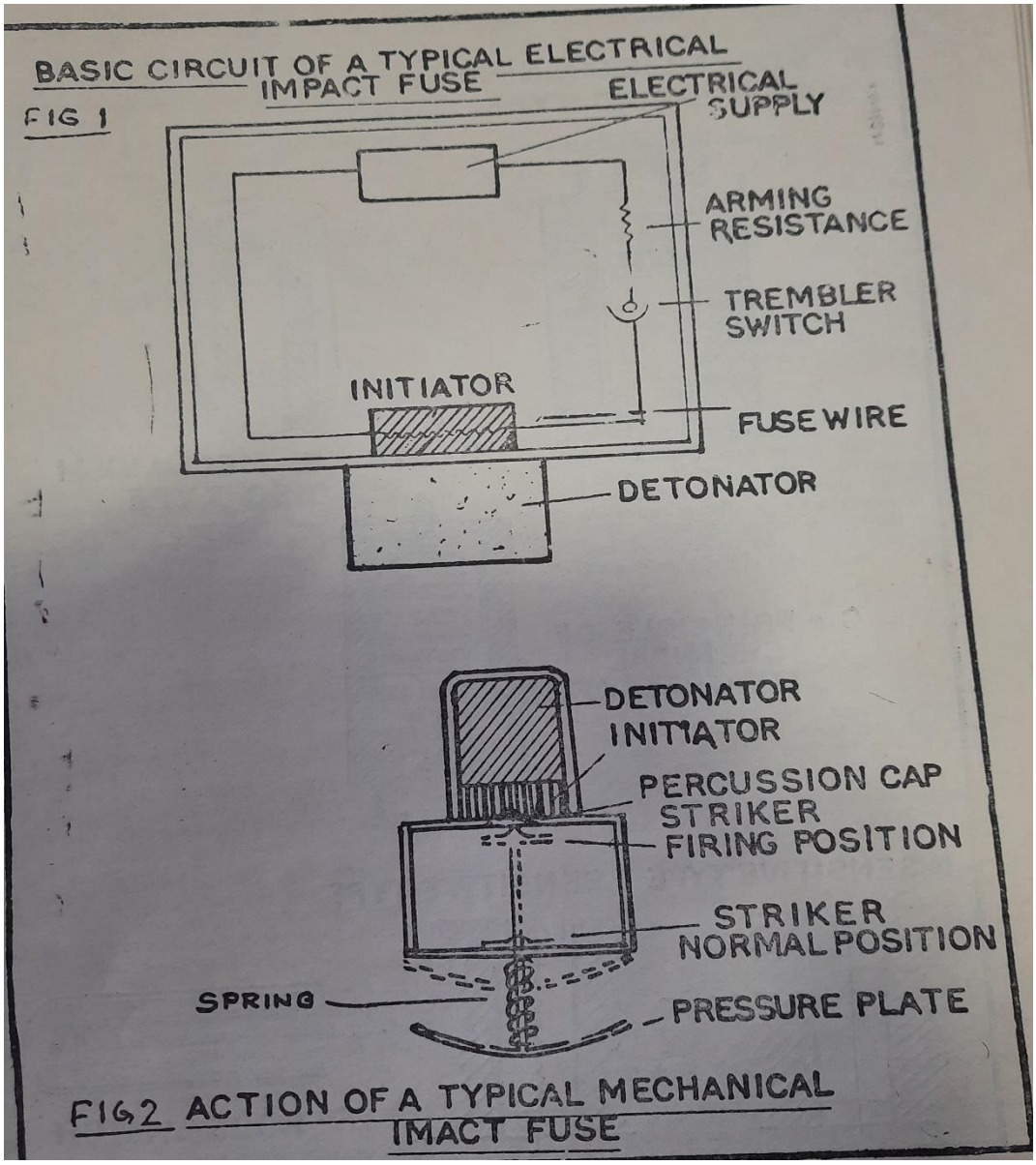
14. **Techniques Applicable to Battery Operated Fuses**

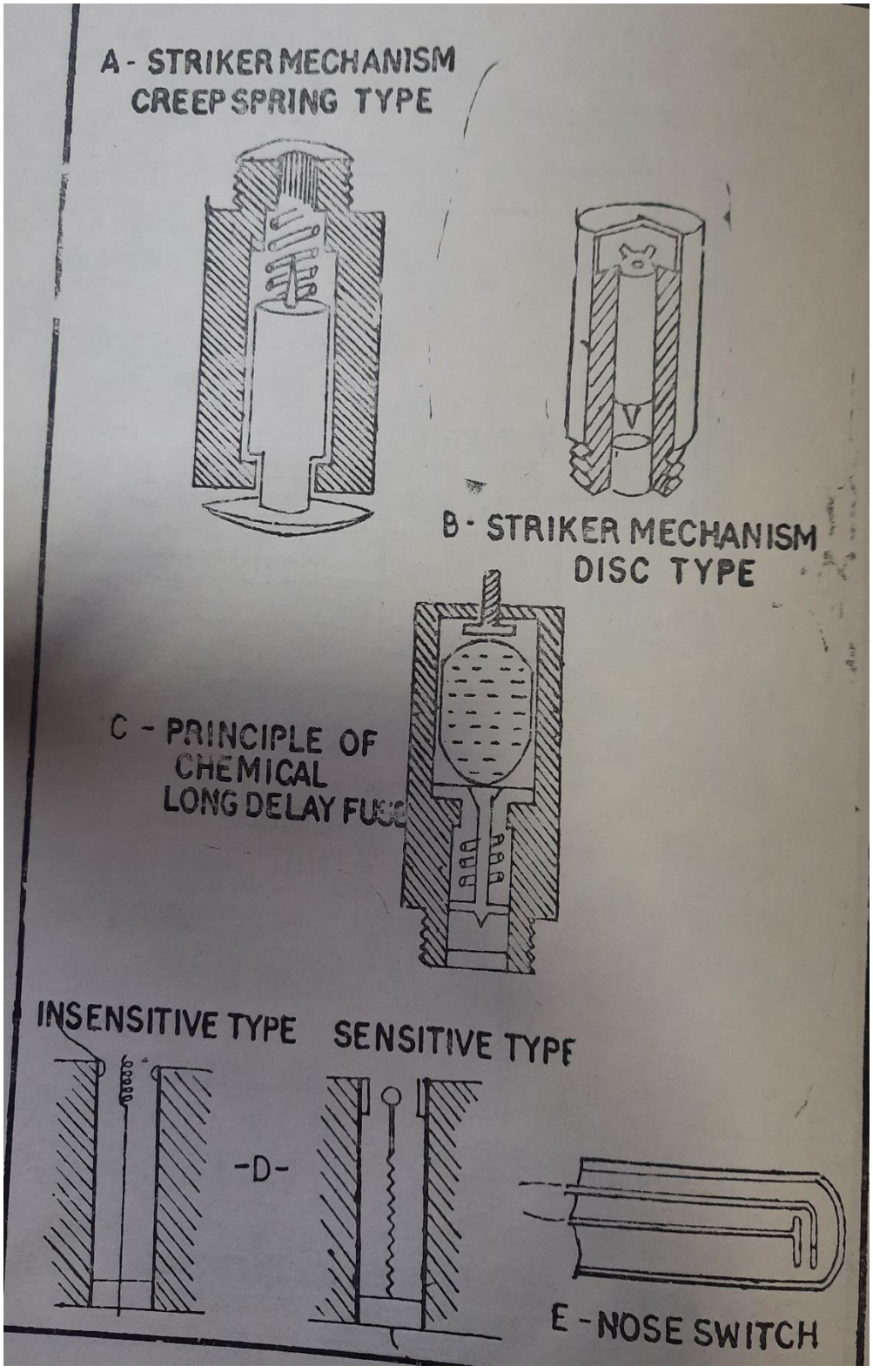
(i) **Breaking electrical contacts**-Certain battery-operated fuses may be made safe by cutting wires forming part of the firing circuit. If this method is applicable each wire must be cut separately and the severed ends insulated before the next is touched. The severed ends must also not be allowed to touch any metal portion of the fuse or missile until insulated. If multicore cables are used and the strands can- not be separated, they must not be cut. A disastrous short circuit through the cutting tool might result.

(ii) **Freezing**-Fuses containing primary cells may be made temporarily safe by freezing. The internal resistance of the cells rise as the temperature falls and the fuse is safe as soon as the output from the cells has been lowered be- yond the minimum necessary to fire the igniter. If the electrolyte within the cells is completely frozen, no current will flow.

When the fuse is cold enough the bomb may be moved but the freezing process must be maintained until the bomb has been made safe by some other method. Cooling agents used are solid carbon dioxide (Powdered) mixed with methylated spirits, liquid oxygen, liquid nitrogen.

(iii) **Heating**- The process aims at drying off the liquid in the electrolyte. It is normally lengthy but should be shortened if the boiling point of the electrolyte can be lowered by first creating a vacuum in the fuse and pocket.




A - STRIKER MECHANISM
CREEP SPRING TYPE
B - STRIKER MECHANISM
DISC TYPE
C - PRINCIPLE OF
CHEMICAL
LONG DELAY FUSE
INSENSITIVE TYPE
SENSITIVE TYPE
-D-
E - NOSE SWITCH

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CHAPTER NO. 11

DETECTION OF UXB-CRATERS AND CAMOUFLETS AND ACTION AT VARIOUS LEVELS

1. **Aim**

The aim of this precis is to understand the importance of detection of UXB-study of the various signs of explosion particularly the formation of craters and camouflets and then if the presence of an UXB is confirmed, action to be taken at various levels,

2. **Introduction**

The purpose of bomb reconnaissance is to decide if a UXB is present, and if it is, its type and size. An estimate of the type and size is required to determine:

(i) whether long delay or anti-disturbance fuse are likely to be fitted.

(ii) the probable depth of penetration.

(iii) the extent of evacuation and the protective works and safety precaution to be applied.

An air attack, even by a single plane usually produces not a single bomb but a number, the majority of which will explode. For the efficient and rapid reconnaissance for the bombs which have not exploded it is essential for the recon- naissance party to have not only a thorough knowledge of indications of the presence of a UXB but also of the effects of bomb explosion. The following are the reasons:-

(i) The damage caused by a small bomb which has exploded may be confused with that caused by the passage of a large bomb which has failed to explode or with that caused by flying debris.

(ii) An examination of the effects produced by a bomb which has exploded often makes it possible to estimate the type and size and hence the danger associated with another bomb, dropped at the same time, which has failed to explode.

(iii) It is impossible to apply the rules for enforcing evacuation and safety precautions and for constructing protective works intelligently without such know- ledge.

The next few sections of this precis are there- fore devoted to an examination of what happens when an HE bomb explodes and to the resulting effect on neighbouring ground and buildings in various circumstances.

3. **General Signs of an Explosion**

The damage caused by explosion of bomb falls into three main categories: -

(i) Blast effects	}	If bomb explodes in air
(ii) Effects of flying splinters		or on impact
(iii) Effects of earth shock		If bomb explodes as a buried bomb.

4. **Detailed Proofs of Explosion**

(i) **Blast**

(a) Window panes and even frames are blown or cracked over a wide area surrounding the point of explosion.

(b) Roofs of houses suffer quite commonly.

(c) Telegraph poles may not be affected to a great extent by blast alone, but trees are stripped of leaves and smaller branches. Trees having thick foliage offer greater resistance to the blast and may get uprooted.

(d) Small, unattached objects may be thrown away for some distance,

(e) Unprotected human beings and animals, persons or animals very near the explosion may be lifted in the air and thrown away but usually at some distance there is little damage to the body, but clothes may be stripped off. Some may suffer from blast injury to the lungs.

(ii) **Splinters**

(a) Pock-marking of walls or surfaces facing site of explosion.

(b) Presence of massive splinters from the case of the bomb. These splinters are undistorted, rough and have "fractured" edges. (The small splinters would have travelled very far and are not of much use in this matter).

(c) If the bomb has exploded in an open, grassy land, furrow-marks may be seen in the grass radiating from the point of explosion.

(iii**) Earth-Shock**

(a) Displacement of earth and resulting damage to structures on the surface which cannot be explained by any other way. Thus, cracks may result in walls of buildings located near the point where the buried bomb explodes. The roofs and floors of buildings may also show cracks. Smaller buildings may be displaced bodily.

(b) Damage may occur to underground structures e.g. water-pipes, sewage-system pipes and electric cables, which is not explainable in any other way. These effects are not easily visible and extensive enquiries will have to be made from the people living there, the Warden of the area and men belonging to the utility services in this matter.

5. **Additional Proofs of Explosion**

these act more as corroborative evidence than the actual proofs:-

(i) Sound of explosion (by eye-witnesses).

(ii) Flash of explosion (at night, by eye-witnesses).

(iii) Smoke and dust (during day-time by witnesses).

(iv) **The smell of explosion**-Near the site of explosion, a peculiar smell lingers for some time while earth and other substances which have been contaminated by the gases 3.0 remains of explosion may retain this smell for days together.

(v) **Black deposit**-Most explosives leave a deck deposit in the immediate neighbourhood especially upon some pieces of rubber and on primary splinters.

(vi) **Pitting on tail units-**if a tail unit is found separately, it has no value as proof of explosion, unless it is obviously pitted with pock-marks by primary splinters.

6. **Positive Signs of Presence of UXB**

(i) Bombs lying on the surface, in the open, present very little faculty.

(a) **Part of whole of a bomb**- Sometimes, pieces of the bomb may get detached and then they must be located to prevent their giving rise to further reports of UXB.

(b) **The splash-crater**-The impact alone may cause some disturbance in surface of earth giving rise to a "splash" crater to be distinguished from a crater caused after explosion. (See para 7 below).

(ii) Bombs which have entered a building.

(a) The entry hole is seen, through a wall or roof.

(b) Damage due to impact and penetration due to a very large UXB may sometimes be mistaken for damage: due to explosion of a much smaller bomb. In these cases, the absence of a corroborative signs of explosion became of some importance.

(iii) **Buried bombs** -These need a careful examination, but the C.D. personnel responsible for examination should not take unnecessary risks in carrying out these examinations.

(a) **Hele of entry**-The entry hole is normally roughly circular, Bomb under 500 lbs. cause clear-cut holes varying from 8 inches to 18 inches in diameter, Holes with less than 6-inch diameters are not made by bombs, li they are regular in shape they may have been made by anti- aircraft shells etc. Bombs of more than 500 lbs. may form crater due to the shock of impact and it may be necessary to scrap away the earth at the bottom of the crater so as to disclose, the true hole of entry.

(b) **Depth to which a bomb may penetrate**- This depends upon many factors e.g. type of bomb height from which it is dropped, size, and weight of the bomb and the nature of the soil. In high altitude bombing, bombs may penetrate as deep as 20 it. in dry clay soil and deeper in the wet soil. On a concrete floor or road it may not penetrate beyond 4 or 5 ft.

(c**) The path of a buries bomb in the ground**- The hole generally starts slanting slightly away from the vertical and continues so for about 6 to 12 ft. It then sinks sideways so that the bomb may come to rest at a distance of 10 ft. or to away from a vertical line drawn at the entry hole. The tail fins of the bomb are usually wrenches off during its pass- age through the earth, usually at the point where the entry hole bends to one side. Thus, a probing rod pushed down the hole will probably be stopped by the fail-fins and therefore, cannot be relied on to give the accurate depth of the bomb.

7. **Craters and Camouflets**

A Crater is the "inverted cone-like" excavation of the ground caused by the explosion of a bomb on or near the surface of the ground. Bigger the bomb, the larger is the crater formed. A rough estimate of the probable size of different types of craters formed due to explosion of different weights of bombs is given at Appendix “1”.

A Camouflet- Is a cavity created by the ex- plosion of H.E. bomb well below the surface of a soft ground.

The knowledge of different types of craters and camouflets is necessary as an aid towards distinguishing unexploded from exploded bombs. Craters and camouflets result from explosions of bombs on surface and deep underground, respectively.

(i) **Craters**-Formation of a crater is one of the proofs that explosion has taken place (but there are some exceptions e.g. splash-crater). A crater is formed when the bomb penetrates slightly in the ground before exploding. A conical mass of earth is loosened up and thrown into the air in pieces. The resulting depression is called a crater. These are three types of craters and from the type and dimensions of the crater it is possible to deduce the type and size of the bomb that caused it. This is an important help in investigations carried on in connection of a UXB especially if the bombs are from the same "stick".

(a) **Type "A" Crater**- It is a shallow, smooth sided crater with a little spoil in the bottom and around the lips but most of the displaced earth is broken up in small particles and is widely scattered.

(b) **Type "B" Crater**- This crater is formed when the bomb explodes at a deeper point than that of "A" type which bursts just on the surface. This type of crater is characterised by raised-lips and 45° platform. The crater is almost filled with the spoil and apparently the crater appears to be very shallow.

(c) **Type "C" Craters**-This is caused by a bomb that has penetrated deeply. The crater walls at the mouth are almost vertical and the crater is almost filled with large-sized spoil. An indirect proof of a "C" type crater is the absence of much damage due to blast or splintering as against "A" type crater where damage due to blast and splintering would be very much noticeable.

(ii) **Camouflets**- When a bomb penetrates to such a depth that the force of explosion is insufficient to expel the earth above it, the rapidly expanding gases form a spherical chamber of compression which re- mains practically or totally, sealed below the ground in the form of a camouflet.

(a) **Shallow Camouflet**-When a bomb explodes at a depth only just exceed- ing that at which a type "C" crater (described above) would have been formed the earth on top of the camouflet is disturbed to some ex- tent and some of the gases may escape. If the surface of the ground above is very hard only some circular cracks may be visible around an area which gets slightly raised.

(b) **Deep Camouflets**-When explosion occurs at greater depth or below very strong surface layer, there is no disturbance visible at the ground level.

8. **Distinguishing signs of Entry Holes of UXB and Exploded Bomb**

(i) The entry hole left by UXB can be easily probed to certain length, while the entry hole of a camouflet is usually jammed with loose earth.

(ii) In case of a camouflet entry hole, its sides and mouth are blackened by the gases which escape before the blockage took place.

(iii) Unexplained damage to nearby under ground structures and utility services points to a camouflet.

(iv) In a camouflet, the gases caused by explosion may persist for some time and these can be tested for with special apparatus. But this is a dangerous process as these gases include carbon monoxide etc. and great care must be taken in carrying out these investigations.

9. **Action by Local Authorities**

The members of the public should be instructed that when an UXB comes to their notice or where they suspect that a UXB has been found in a locality, they should inform the nearest War- dens Post. On receiving this information, the Civil Defence Warden/Local Police Authorities should search for its exact location and ascertain whether the UXB does or does not exist. The Local authorities should further proceed as follows:

(i) The suspected area should immediately be concorded off and precautions taken to safe guard the public from the danger.

(ii) A flag indicating the presence of UXB should be planted. A number of warning boards in regional languages indicating the presence of UXB should be placed near the site.

(iii) Submit a preliminary report to the Control/Sub-Control Centre, indicating the exact location and State of the UXB (whether buried or unburied).

10. **Action by the Officer-in-Charge, Control/ Sub-Control Centre**

(i) The information will then be passed on by the Officer-in-Charge to:-

(a) Local Police Headquarters.

(b) Heads of Public Utility Service.

(c) The District Magistrate or Head of Local Government; and

(d) Recce Party will be sent to confirm the presence of the bomb.

(ii) The Police will take suitable steps to clear the affected area and divert traffic where necessary. Inform the District Magistrate or local head of the Government, action taken by them and the attendant extent of dislocation of public life.

(iii) Police should ensure that Civil Defence Rescue Parties or other services engaged in their work are not unduly disturbed but duly warned of the existence of UXB. (iv) The recee report is then sent to the CD Controller.

11. **Action by C.D. Controller**

After receipt of a preliminary report, the Civil Defence Controller will send immediately a reconnaissance party, who will ascertain the existence of the UXB. They will report their findings back to the C. D. Controller as early as possible. This report will be in the form shown at Appendix "A" to UXB-24 precis. The C. D Controller, in the case, where the UXB does not exist will send in his report to the District Magistrate or his representative and send a copy of this report to the local police Headquarters also. In case the reconnaissance party reports that the UXB does not exist or has since been exploded, the same information should be passed on to the C. D. Controller or the District Magistrate or his representative and also the police authorities in order to enable them to. bring the public life back to normalcy.

12. Action by District Magistrate

On receiving the information about a UXB. from the Civil Defence Controller/Sub-Divisional Officer, the District Magistrate will communicate the matter to the State Government through the quickest means of communication. His message will give as much information as possible about the UXB and will contain his reasons for the priority recommended.

13. **Action by the Civil Authorities in Smaller Towns**-

The District Magistrate's representative will pass on the report received from the C. D. Controller, to the District Magistrate with as much of information as is available and his suggested priority of disposal of UXB.

14. **Action by the District Magistrate when Report is received direct from areas where there is no C. D. Controller**

It is possible that UXBS may be reported as present in areas where there is no C. D. Organisation. In such cases the Police may spot the bomb and report the matter to the District Magistrate who will at once arrange to contact the neighbouring District having C.D. Organisation. The District Magistrate of this district will be responsible for getting confirmation and further action in the matter.

15. **Action by the State Government**

The State Government after studying the re- port and the District Magistrate's recommendations on the disposal priority will suggest to the nearest Military Divisions/Area Commander and give the following information’s so that military authorities can take immediate and appropriate action to dispose of the UXB:-

(i) Exact location of the UXB.

(ii) Location of the Civil Defence Control Centre of the town, name and designation of the Officer to whom the Bomb Disposal unit should report on their arrival.

APPENDIX-1

Dimensions of Craters Formed by Explosion

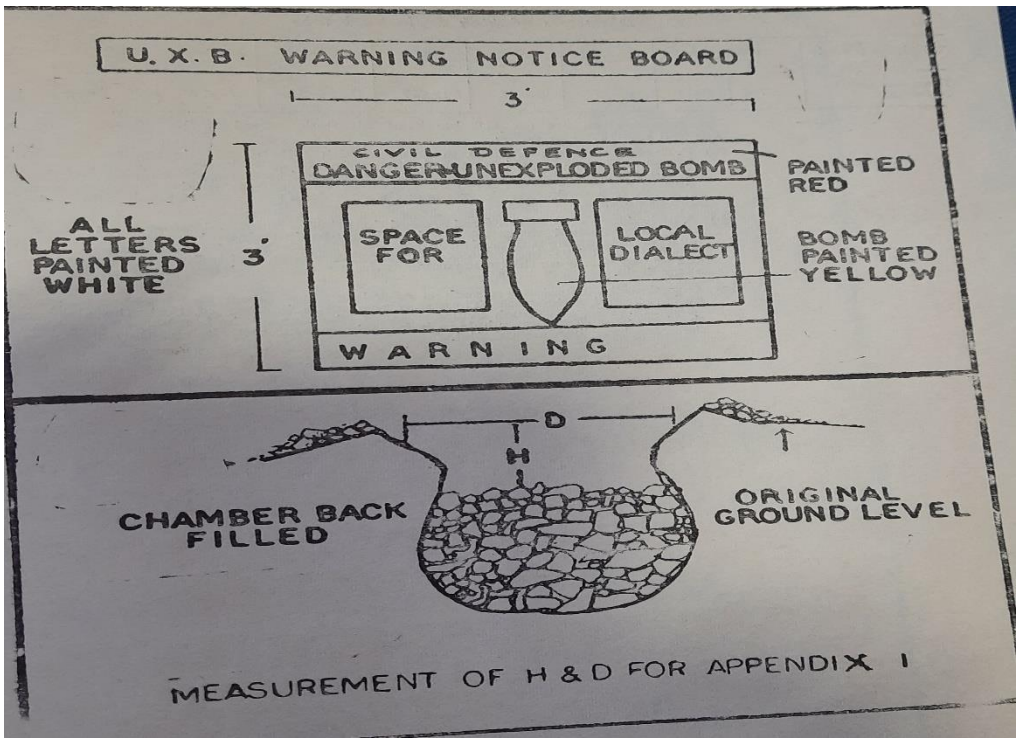
Total weight of bomb in pounds							
Type of crater	100	500	1,000	2,000	4,000	12,000	22,000
a	**b**	**c**	**d**	**e**	**f**	**g**	**h**
	ft.	ft.	ft.	ft.	ft.	ft.	ft.
A	9X3	15x5	18x6	26x8	33x10	-	-
B	20x6	33x10	45x12	56x16	74x21	103x31	124x37
C	15x4	27x7	31x8	43x10	55x12	-	-

NOTES :-

1. The first dimension given in each case is the diameter D and is measured at original ground level.

2. The second dimension is the apparent depth H. i.e. to the surface of the runnel at the lowest point and is measured from original ground level.

3. The dimensions given relate to clay soil and should be multiplied by 3/5 for chalk, sand or gravel.



APPENDIX-2

Diameter of high explosive bombs

Weight in Pounds	100	250	500	1,000	2,000	4,000	8,000	12,000	23,000
Diameter bombs in inches	7-8	9-11	12-15	16-18	19-24	26-32	37-38	38	46

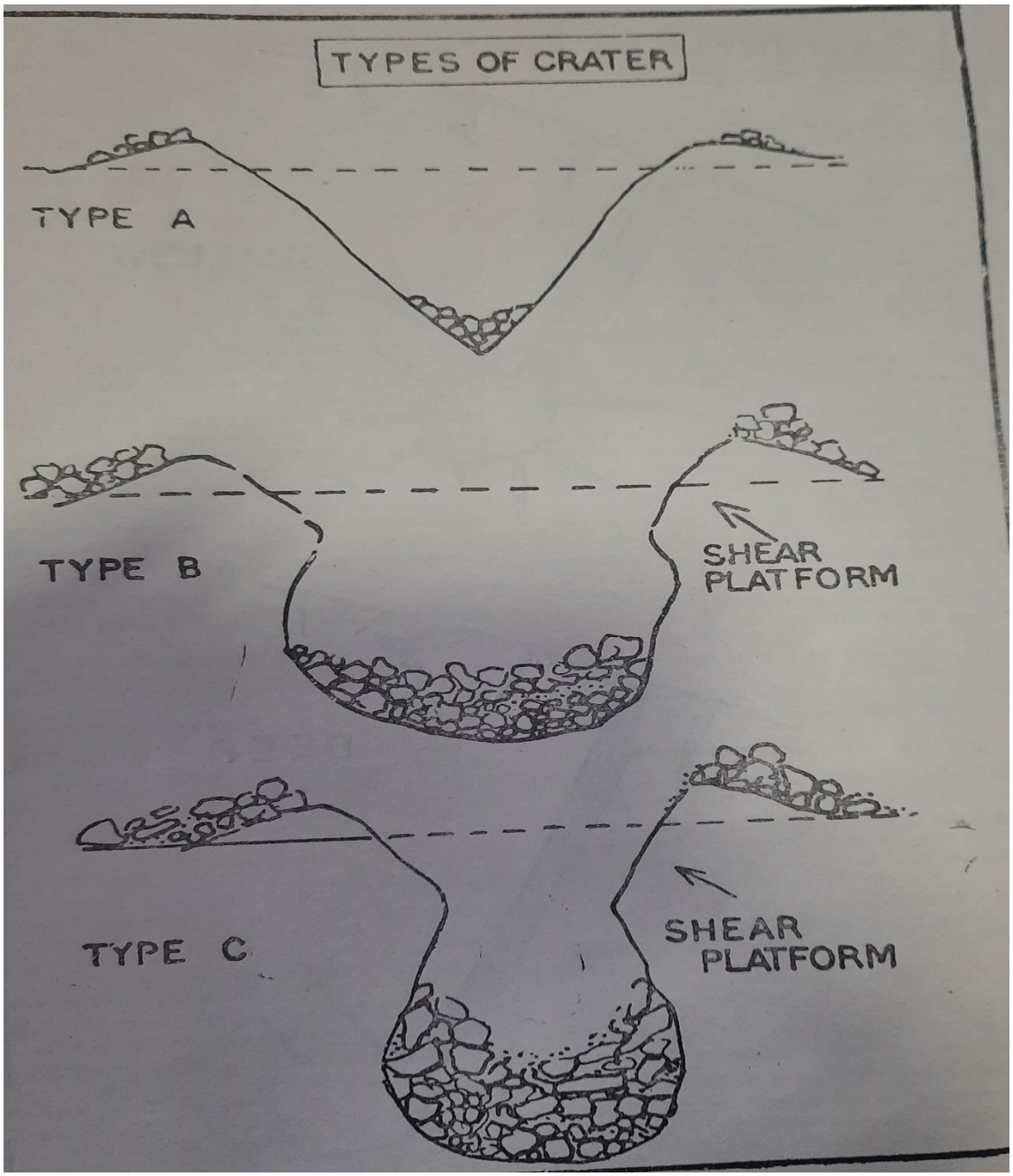
Note-

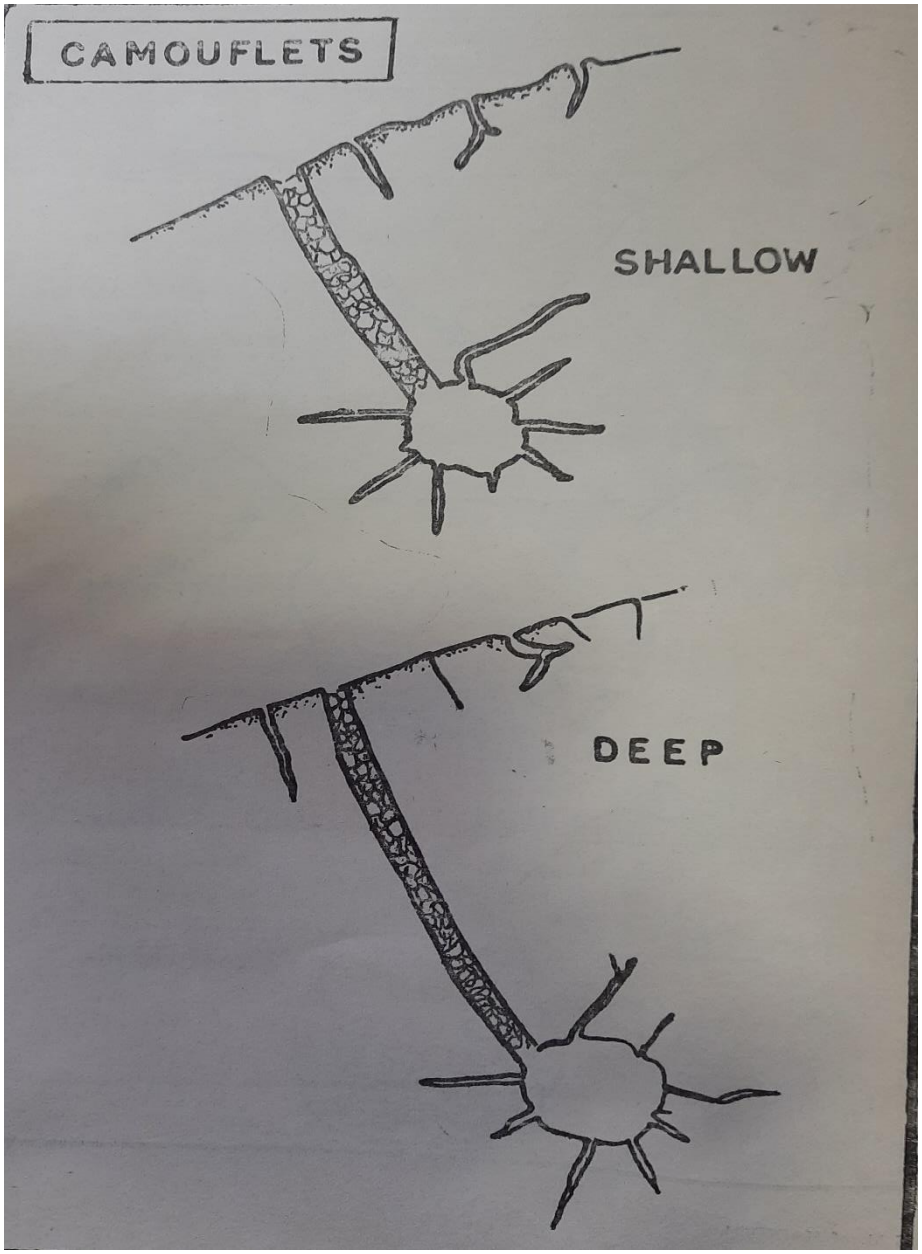
The figures given are for HE bombs of all nations used in the 1939-45 war. Armour piercing bombs are excluded.

(a) A bomb weighing 1,000 lb or more which fails to explode usually forms a crater on impact. This is called a splash crater and may be large enough to be confused with a collapsed camouflet or a true crater formed by the explosion of a small bomb. The dimensions of the splash crater of 2,000lb UXB in soft ground are approximately nine feet x three feet, that is, the same as those of the Type A crater produced by an exploded 100 lb bomb.

(b) A little debris may be scattered around the splash crater and some earth shock damage may be expected nearby. It should not be difficult to determine the cause of crater however, for no signs of explosion will be evident, the sides will not be consolidated as they would be in a crater formed by explosion, and it should be possible, by probing or by removing the loose rubble at the bottom, to detect the continuation of the entry hole.

(c) Occasionally, attachments such as retarding rings or carrying lugs break off on impact and are found in the crater. These may give an indication of both the size and type of bomb. Where no such evidence exists, the size of the bomb can be estimated from the dimension of the entry hole as before, the measurement being taken at a point where the sides have become parallel.


TYPES OF CRATER
TYPE A
TYPE B
SHEAR PLATFORM
TYPE C
SHEAR PLATFORM


CAMOUFLETS
SHALLOW
DEEP

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CHAPTER NO. 12

ANTI-PERSONNEL, BOMBS -METHOD OF SEARCH

1. **Aim**

Small anti-personnel bombs may be dropped in very large numbers. They usually remain on or near the surface and if unexploded may still be It is important for Civil Defence Personnel to be able to recognise dangerous types of enemy and allied ant-personnel. The aim of this precis is to study the searching and disposal of these bombs.

2. **The Butterfly Bomb**

The German 4 lb. "Butterfly bomb", presented more problems than any other type of anti-personnel bomb used in the 2nd World War and is considered here as representing the "Worst case". Some butterfly bombs were designed to explode on or before impact, some with long delay and some with anti-disturbance were fitted fuses. So sensitive were the latter that a bomb exploding could detonate another 25 yards away. The explosive content weighed half a pound. The splinters were lethal at 50 yards, would up to 150 yards, just penetrate 3-inch plank two feet away but not a 1/2 inch steel plate one foot away. The bombs were dropped in large numbers from containers which open- ed in mid-air. One modern bomber could carry 10,000 bombs of the butterfly type and size.

3. **Responsibilities**

(i) **Searching**- Search of butterfly bombs will be done by Civil Defence Personnel in accordance with para 4.

(ii) **Protective works**-are home times required and may have to be erected by Civil Defence Personnel.

(iii) Disposal will normally be undertaken by Bombs Disposal Units when available but may have to be carried out by other Engineer Unit or any unit provided with demolition equipment.

4. **Searching**

(i) Searching should not normally begin until the maximum delay period of the time fuses is known to have expired. In vital centres or where operations are affected, bombs may have to be blown up, removed, or surrounded by protective works immediately.

(ii) The whole area affected will be divided into sectors and priorities allotted for searching.

(iii) Working parties will be allocated to each sector. They must be competently led. In built-up areas they should consist of only one commander and three or four men, but in the open where control, is easier the party will consists of 1 commander and 10 men.

(iv) Parties should work 150 yards apart, or whatever the effective range of the missiles may be.

(v) Each party will sub-divide its sector blocks or lanes and must ensure that every possible resting place is searched.

(vi) Complete concentration is essential. Unnecessary talking must be forbidden. Each party should be rested every 45 minutes.

(vii) The position of each unexploded bomb found will be distinctively marked on the ground. Furthermore, the position of all bombs, containers, and sites of exploded bombs should be recorded in a report. Appendix shows a specimen improvised report form.

(viii) The idea is to calculate the total number of bombs dropped from the number of containers found and then to account for every bomb. If different sizes of containers are used in one raid a record of the capacity, or if not known, the measurement or a copy of the markings on each container would also be required. By consolidating the reports from search parties at the control centre it should be possible to determine if at least certain areas are completely cleared. The report for itself is useful to the protective works and demolition parties which follow.

(ix) As each sector and the one on each side of it is cleared, the protective works parties and then the demolition parties can start work. In some situations it may be possible to erect protective works immediately the bombs are found, a lorry containing filled sand-bags following a safe distance behind each search party.

5. **Safety precautions while searching**

(i) Every man must know exactly what he is looking for and the dangers involved.

(ii) When searching buildings do not open doors and trap-doors wider than necessary. Whenever possible open them by remote control or from behind cover.

(iii) There must be no unnecessary vibration. If pickets are used for marking the position of bombs, press them in-do not hammer them into the ground.

6. Where to look

The following are typical of the places where small anti-personnel bomb may be found:

(i) Lying on the surface in the open in vegetation, in ditches.

(ii) Partially buried in soft ground-usually with the drogue or parachute showing.

(iii) Completely buried in soft ground-when the drogue or parachute had become detached in flight.

(iv) Hanging by drogue or parachute in trees, hedges or vegetation.

(v) Hanging from telephone wires, electric overhead cables, wire fences and proof guttering.

(vi) On the roofs of buildings.

(vii) Hanging inside building from the underside of the roof or from ceiling.

(viii) Lying anywhere inside buildings having entered through the roof or windows.

7**. Tail Units or Drogues**

Tail units or drogues pitted by splinters indicate an explosion, possibly in mid-air. If un-pitted and found separately they indicate the presence of either an exploded or unexploded bomb nearby.

8. **Protection Against Exploding Butterfly Bombs**

The effects of explosion can be reduced by building protective surrounds, Great care must be taken not to cause vibration by dropping sand-bags. For bombs in buildings protective works are usually unnecessary if all adjacent rooms can be cleared. A 4 inches brick wall provides complete protection against a butterfly bomb but breeze walls, thin sheets of metal doors and wooden or plaster partitions are not effective.

9**. Warning Notices**

Any areas not searched and any groups of bombs or single ones, whether surrounded with sand-bags or not, must be marked.

10. **Disposal by Demolition**

Disposal of these bombs will be done by the Bomb Disposal Units where there is no reliable and simple method of distinguishing bombs fit- ted with potentially dangerous fuses from those which are "duds", the standard method of disposal must be by demolition in situ. A 1-lb. slab of gun cotton, a 75 grenade or an equivalent cutting charge, should be placed in line contact with each bomb. If the charge is not in contact or only touches at a point, the bomb will probably be blown intact to one side. All bombs within 25 yards of each other should be blown simultaneously. If possible, an observer should be posted at safe distance to watch the effect of the explosions and the consequent behaviour of the bombs. If it is observed that a bomb has not been affected or has merely been blown to one side, if any doubt exists as to the success of a demolition, or if there is another bomb within 25 yards of a demolition, no approach must be made to the site until the maxi- mum delay period of a long delay fuse has again elapsed.

11. **Disposal by Other Means**

Where no demolition equipment is available and bomb must be disposed of it should be dragged into a deep slit trench or some other safe position by means of a long cord. The cord must not be tied to the bomb for fear of disturbing it, but the end should be formed into a loop and so placed that when pulled it will engage with some part of the bomb. The cord may be pulled by hand from behind cover or from a safe distance or by an adequately armoured vehicle. A bomb which has been moved and has not exploded, cannot be assumed to be safe. It must not be approached again until a time fuse has had an opportunity to run its full course, and even then, must not be touched or vibrated.

APPENDIX

A Report to control centre from search party

	Location	Incident	Remarks
1.	12, Park Road, Black garden hanging oak tree	3 UXBs	Two obvious one at top only seen from garden No.14
2.	14, Park Road	Empty	Size 36”x 12’ dia, Marking BOMB 50
3.	10, Park Road, Black garden	4 Craters 2 UXBs	
4.	16, Park Road, hanging from side gutter.	1 UXB	

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CHAPTER NO. 13

SAFETY PRECAUTIONS

1. **Aim**

The aim of this precis is to give the details of safety precautions to be taken on detection of an UXB.

2. **General**

The following general points must be remembered when doing bomb reconnaissance work:-

(i) Only the minimum number of men quired for the work should be allowed near the bomb.

(ii) Safety distances must always be observed by all concerned not detailed for work near the bomb and on completion of a task. Men are safe against bomb up to 1,000 lbs. (500 Kgs).

(a) in a trench 80 feet (25 m) from the bomb.

(b) behind a 14 ins. (350 mm) brick wall or 2 ft. 6 ins. (770 mm.) sand bag wall. 80 ft. (25 m) from the bomb.

These distances must be doubled for bombs over 1,000 lbs. (500 Kgs.).

(iii) Bomb splinters may travel up to 1,200 yds. (1000 m). Therefore, always keep under cover if possible. If you must be in the open, lie down. When lying down, men are reasonably safe against a buried bomb at 100 yds. (95 m) and against a bomb on the surface at 300 yds. (275 m).

(iv) All equipment likely to be required for the reconnaissance of a bomb must be on the site before the bomb is approach- ed.

(v) As the bomb is approached, care must be taken not to: -

(a) cause unnecessary vibration.

(b) hit the bomb with tools or timbers.

(c) jump near the ground.

(vi) It must be constantly borne in mind that no bomb can be considered safe until it is finally disposed of.

3. **Eventualities**

(i) **General**-During reconnaissance operations, safety precautions must be taken against the following eventualities: -

(a) Explosion of bomb whilst work is in progress.
(b) Explosion of bomb during intervals bet- ween work.

(c) Camouflet chamber in ground.
(d) Other hazards like electric mains, sewers, water mains etc.

(ii) **Explosion of bomb whilst work in progress**- This may be caused by: Time expired long delay fuses. To counteract this, the following safety precautions to be taken:-

Start work only after having ascertained that all safety precautions have been taken.

(iii) **Clock-work restarted by vibration**- Observe the following safety precautions: -

(a) never jump on the ground.
(b) work gently when near the bomb.

(iv) Explosion of bomb during intervals.
This can be caused by: -

(a) time expired long delay fuses.
(b) Detonation due to ground movement.

In both cases the safety precautions to be taken are: -

(a) Notice boards to be erected.
(b) Normal evacuation to be enforced.

(v) Camouflet chamber in ground: -

(a) A life line secured to the waist of the explorer should always be used. Reconnaissance Officers must always work in pairs.

(b) Probe in-front of excavation.

(c) Watch for signs of camouflet.

(d) Hole of entry peters out.

(e) Whistling of escaping gas.

(f) Blackening of earth.

(g) Probe becomes loose.

(h) It is to be remembered that the service respirator gives no protection from carbon monoxide and carbon dioxide.

(vi) **Other hazards**:-

(a) **Electric Mains**-All possible information regarding the underground electric lines must be obtained well in advance and borne in mind whilst digging.

(b) Sewer gas can suffocate people to death. All informal on regarding sewer lines also must be obtained and borne in mind whilst digging.

(c) Collapse of Shaft: -

(i) High safety factor must always be observed.
(ii) Timbering must always be done properly.

(iii) Voids must never be allowed to appear behind timber.

(d) **Exhaust Fumes-**Engines which are used down the shaft must have a gas tight exhaust pipe discharging above ground level. Any leak in the pipe will be dangerous to people working in the shaft.

(e) **T. N. T. Poisoning**- No part of the bomb filling should be allowed to come in con- tact with the person otherwise serious in- juries may result. Locking rings must not be uncovered and fuses must not be extracted without direct orders from the officer-in-charge of site.

4**. Carbon monoxide poisoning**

All bomb reconnaissance personnel must be conversant with the symptoms of carbon monoxide poisoning and the first-aid to be given in such an eventuality: -

(i) **Symptoms**-First signs of poisoning are giddiness, vomiting and indistinct vision followed by breathlessness, palpitation and collapse. Loss of muscular power often prevents a man from withdrawing from danger. The face may be leaden. pale, moist with perspiration or pink with vivid carmine lips. Loss of consciousness may be very rapid and death follows unless a man is removed quickly.

(ii) **First-aid**- Open the collar, keep warm, give hot sweet tea but no alcohol and keep very quiet. If the patient is unconscious artificial respiration should be commenced at once. In all cases send for a doctor and keep the patient warm and still until he arrives.

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CHAPTER NO. 14

EVACUATION AND SAFETY DISTANCES

1. **Aim**

It is not possible to determine the type of fuse of a buried UXB till such time the UXR is reached by digging down by the bomb disposal personnel. Therefore, all UXBs must be treated as though they contain a long delay fuse. To reduce casualties, should the UXB explode, it is necessary to impose evacuation on the population in the vicinity of the UXB. It should be realised and always remembered that evacuation distances are not the same as safety distances and both must be learned and applied wisely. The aim of this precis is to give the details of the same.

2. **General**

The sequence of evacuation falls broadly into four:-

(i) Evacuation by the Civil authority.

(ii) Function of bomb disposal officer during race.

(iii) Special considerations affecting railways.

(iv) Evacuation during bomb disposal operations.

Evacuation by Civil Authority

3. **General**

The civil authorities, usually the police, are responsible for evacuation. The problem which faces them is to combine mini- mum evacuation and disturbance with needs of safety. Evacuation distances will vary depending on whether the UXB is a buried one or not.

4. **Unburied bombs**

An unburied bomb can be defined as one whose nearest portion is not deeper than twice its body length. Therefore, UXBS even though they are partially buried but do not exceed twice its length in depth will be considered as unburied bombs. Evacuation will be enforced using the following figures as a guide.

5. **Buried Bombs**

A buried bomb is one whose nearest part to the ground surface is buried at a depth of more than twice its body length. The radii of evacuation distances required for all buried bombs up to 4,000 lbs. (2,000 kg.) total weight are: -

(i) Complete evacuation 50 yds. (50 m.)
(ii) Partial evacuation 100 yds. (100 m.)

6. Over 4,000 lb. (2.000 kg) no figures are available from experience, but it is suggested that the above figures are doubled.

7. **Danger periods**- The length of time for which evacuation must remain in force will be determined by the designed maximum long delay of enemy fuses. Germans, had long delay fuses up to 96 hours. The British long delay pistols have a delay time up to 144 hours.

8. The term "danger period" will be used to represent the period of time which must elapse to ensure that long delay fuses have the opportunity to function.

9. **Evacuation rules**-Evacuation ordered in according to the above figures will remain full force until the following conditions are satisfied:-

(i) The danger period has elapsed.

(ii) The bomb disposal officer may revise civil arrangements.

(iii) If a railway (including an underground railway) passes within 50 yds. (50 m.) of the bomb, evacuation will remain in force, until the bomb has been finally disposed off.

Functions of Bomb Disposal Officers

10. **General**

During recce the bomb disposal officer should advise the civil authority on the following evacuation questions:

TABLE -I

H.E missiles except blast bombs and sea mines		**Blast bo bs and sea mines**		**Unburied**				**Windows opened**	
				complete Evacuation		**Partial Evacuation**			
				Radius					
lb.	kg	lb.	kg.	yds.	meter	yds.	meter	yds.	meter
1		**2**		**3**		**4**		**5**	
100-500	50-250	100-500	50-250	50	50	150	150	150	150
500-3000	250-500	500-1000	250-500	160	150	300	275	300	275
3000-4000	1000-1500	1000-3000	500-1500	200	190	400	375	800	750
4000-8000	2000-4000	3000-4000	1500-2000	300	275	600	575	800	750
8000-22000	4000-11000	4000-8000	2000-4000	400	3375	800	750	800	750

(i) **Minimum Evacuation**-Is it the minimum consistent with public safety?

(ii) **Funnelling of blast**-Does the evacuation system allow for this?

(iii) **Screening**-Can evacuation be reduced as a result of a building screening the UXB? Can any additional form of screening be introduced evacuation? to reduce

(iv) **Traffic Arrangements**-Are these satisfactory?

(v) **Railways**- Have the effect of nearby railways been taken into account?

(vi) **Windows**-Has the danger from glass been given full consideration?

11. The Bomb Disposal Officer can authorise reduction in evacuation depending upon the nature of the UXB i.e. buried or unburied.

12. **Buried Bomb**

If the size of the hole of the entry is that of a bomb which does not carry a dangerous fuse, total evacuation can be reduced.

13. **Unburied Bombs**

If the B.D. Officer can identify the fuse as one which is safe if the bomb is not disturbed e.g. an impact fuse, full evacuation will have to be reimpose while the bomb is being dealt with.

Special condition affecting Railway

14. Because railways are vital in war time delay imposed on them by an UXB must be kept to the minimum. UXBS in the vicinity of railway property will be reported to the railway authorities, applying the following restrictions:"

(i) Passenger traffic may not run within 200 yds. (185 m.) of an unburied UXB, un- less it is screened from the bomb. Then no traffic may run within 50 yds. (45 m.) and is restricted to 5 mph (8 km.) within 200 yds. (185 m.).

(ii) Passenger traffic may not run within 30 yds. (30 m.) of buried UXB, and restricted to 5 mph (8 km.) within 70 yds. (65 m.).

(iii) Goods traffic may not run within 30 yds. (30 m.) of any UXB, and is restricted to 5 mph (8 km.) within 70 yds. (65 m.)

(iv) The railway authorities may permit important traffic to run at 5 mph (8 km.) within 10 yds. (10 m.) of a screened bomb, pending recce by B.D.O.

(v) The railway engineer may require special consideration to be given to tunnels and bridges.

(vi) Parachute mines and blast bombs may be fitted with extra sensitive fuses. No train should run within 400 yds. (375 m.) of such bombs.

Evacuation during Bomb Disposal Operations

15. With the exception of category 'A' bombs, bomb disposal operations will take place after the danger period has elapsed. The following evacuations rules will then apply:

(i) Evacuation will be for the hours of day light only and it will be kept to a minimum.

(ii) Where bombs have been in site for more than 3 months, there will be no evacuation while digging down to the bomb.

(iii) Contact must be maintained with the police and an emergency evacuation plan arranged before any work commences.

(iv) Should a dangerous fuse be found active, a prearranged evacuation plan will be put into operation.

16. **Safety distances**

The figures given for evacuation are the minimum distance for evacuation, The Table below shows the true distances from an exploding bomb in the open. These should be applied whenever possible when demolishing bombs.

Maximum safety distance for unprotected persons

Total Weight of bomb		Buried-Bombs		Unburied- Bombs	
lb.	**kg.**	**yds.**	**metres**	**yds.**	**metres**
20	10	40	40	700	650
40	20	50	50	790	750
250	100	100	100	1050	1000
500	250	200	190	1200	1100
1000	500	220	200	1350	1250
2000	1000	300	275	1500	1375
4000	2000	390	360	1700	1560
8000	4000	550	500	1900	1750
12000	5500	630	600	2000	1850
22000	10000	675	420	2300	2100

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CHAPTER NO. 15

PROTECTIVE WORKS

1. **Aim**

Unexploded Bombs may fall in places where their explosion would cause great damage to important buildings, fortifications or installations. Certain precautionary measures can often be taken immediately the bomb falls with a view to minimising the damage should explosion take place before it has been rendered safe by the bomb disposal party. The aim of this precis is to study the protective works required for the same.

2. Although unexploded bombs may include both "duds" and time bombs it must be assumed that every buried bomb may be fitted with a time fuse.

3. The following protective measures can be undertaken:

(i) Preventive trenching to minimise damage to foundations buried pipes etc.

(ii) Packing basements with sand-bags.

(iii) Sand-bag walling.

(iv) Digging down to the bomb to form a vent.

(v) Covering the probable crater with sandbags.

4. It is to be borne in mind that any such work done should not hinder the work of the ultimate disposal of the bomb.

Protective Trenches

5. The following table 1 shows the distances at which pipes, cables, foundations etc, are liable to be damaged from explosion of a buried bomb.

TABLE I

Size of bomb	**Cast iron mains or concrete pipes**		**Earthen ware or brick sewers**		**Electrical cables steel pipes**		**Foundations**	
lb/kg.	**unburied ft/m.**	**buried ft/m.**	**unburied ft/m.**	**buried ft/m.**	**unburied ft/m.**	**buried ft/m.**	**unburied ft/m.**	**buried ft/m.**
100/50	20/7	28/8	30/10	40/13	15/5	20/7	35/12	50/16
500/250	30/10	10/13	50/16	65/20	24/8	30/10	75/23	100/25
1000/500	35/12	50/16	62/91	80/25	27/9	35/12	120/40	150/45
2000/1000 and above	50/16	65/20	90/28	120/40	38/12	50/16	165/51	250/80

6. If a buried bomb is within the above distances of vulnerable objects, damage can be minimised by digging a trench about 2 ft. (600 mm.) wide; 2 ft. (600 mm.) deeper than and is near as possible to the object to be protected. Thus, a cast iron pipe buried 4 ft. (1.20 m.) below surface, 30 ft. (9.14 m) from a 500 lbs. (250) kg.) bomb buried 15 ft. (4.57 m.) would be protected by a trench 6 ft. (1.80 m.) deep. Such trenches need only be of minimum width required for excavation about 2 ft. (600 mm.) and should on no account be strutted. Trenches should not be dug in ground which will not remain in repose unriveted as while digging proceeds.

7. Owing to the size of the crater made by the explosion of the bomb, no protection could be given by a trench within 10 ft. (3 m.) of a 100 lb. (50 kg.) bomb, 20 ft. (6 m.) of a 500 lb. (250 kg.) bomb and 30 ft. (9.10 m.) of a 1,000 lb. 500 kg. bomb.

Sandbag Abutments

8. **Purposes**

This method is used when bomb is so near the or the foundations so deep that the depth of the protective trench would be prohibitive.

9. **Construction**

It consists of packing sand- bags into the internal space against the outer wall so as to support it against the explosion. The tighter the bags are packed and the deeper it is, the more effective will be the support.

10. A depth of about 10 ft. (3 m.) will be found to be effective. Sandbags should not extend as far as an internal weight carrying wall or bear against an internal column for fear of damage by transmitted force.

Sandbag Walling

11. **Purpose**

Used for unburied bombs on surface outside a building to minimise damage from splinters blast etc. It may also be used to isolate the effects of a bomb inside a building.

12 **Construction**

The basic principle is that the wall must be built just outside the crater which would be formed if the burred bomb exploded. For practical purposes suitable radii from the hole of entry are shown in Table II.

TABLE-II

Size of bombs	Radius of actual crater in ft./m.	Maximum distance of crater edge from entry hole allowing for off set in ft./m.	Remarks
100/50	10/3	28-9	(i) Bombs at over 15ft. depth camouflet probable and wall useless. (ii) Crater radii are for clay soil Dimensions in chalk sand and gravel may be only 3/5 of the figures given.
500/250	17/5	37/12	
1000/500	23/7	43/13	
2000/1000	28/9	54/16	
4000/2000	37/12	73/22	
12000/5500	52/16	100/35	
22000/10000	62/19	120/40	

13. The following points should be noted in the construction of sandbag walls:

(i) Walls should invariably be 2 ft. 6 ins. (76 cm.) thick at the top and not more than 10 ft. high. Open faces should be sloped at 1/6. This involves a base wider than 2 ft. 6 ins. (i.e. 4 ft. 2 ins.) (76 m. day 1.37 m.).

(ii) Bonded walling gives maximum strength.

(iii) For curved walling constructed of a series of straight lengths, ensure that the bend is unbroken at intersection. 14. In the case of an unburied bomb, sand- bag walling will ensure that the damage is limited to windows and roofs of buildings only.

Sandbag Mound

15. This is done by covering the possible crater area with sandbags. Very seldom used owing to the excessive weight of sand and labour required to achieve the desired effect.

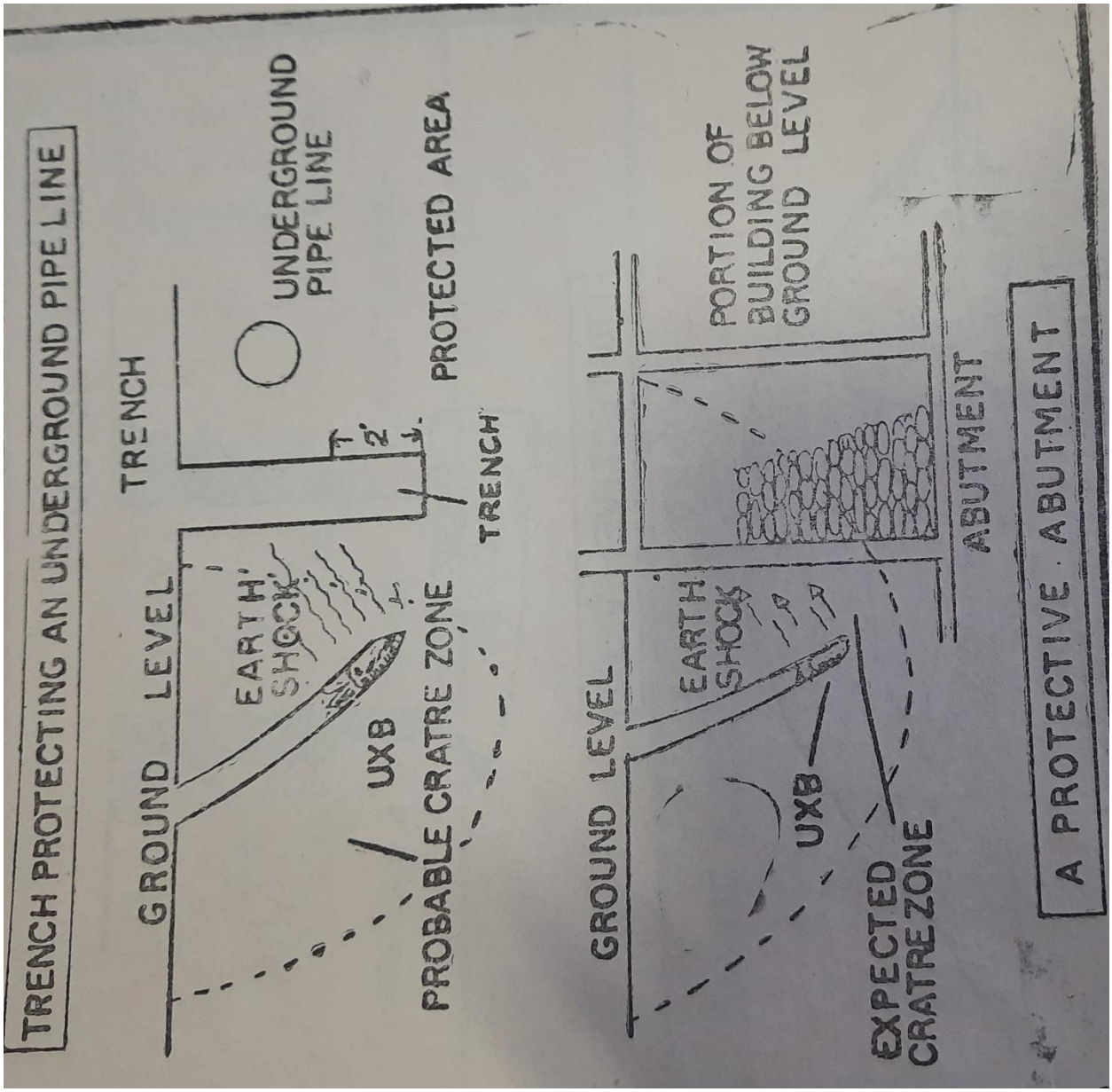
16. The principle underlying is to drive the force of the explosion underground and thus reducing damage above ground. Also, in the case of buried bombs to mask the effect of splinters.

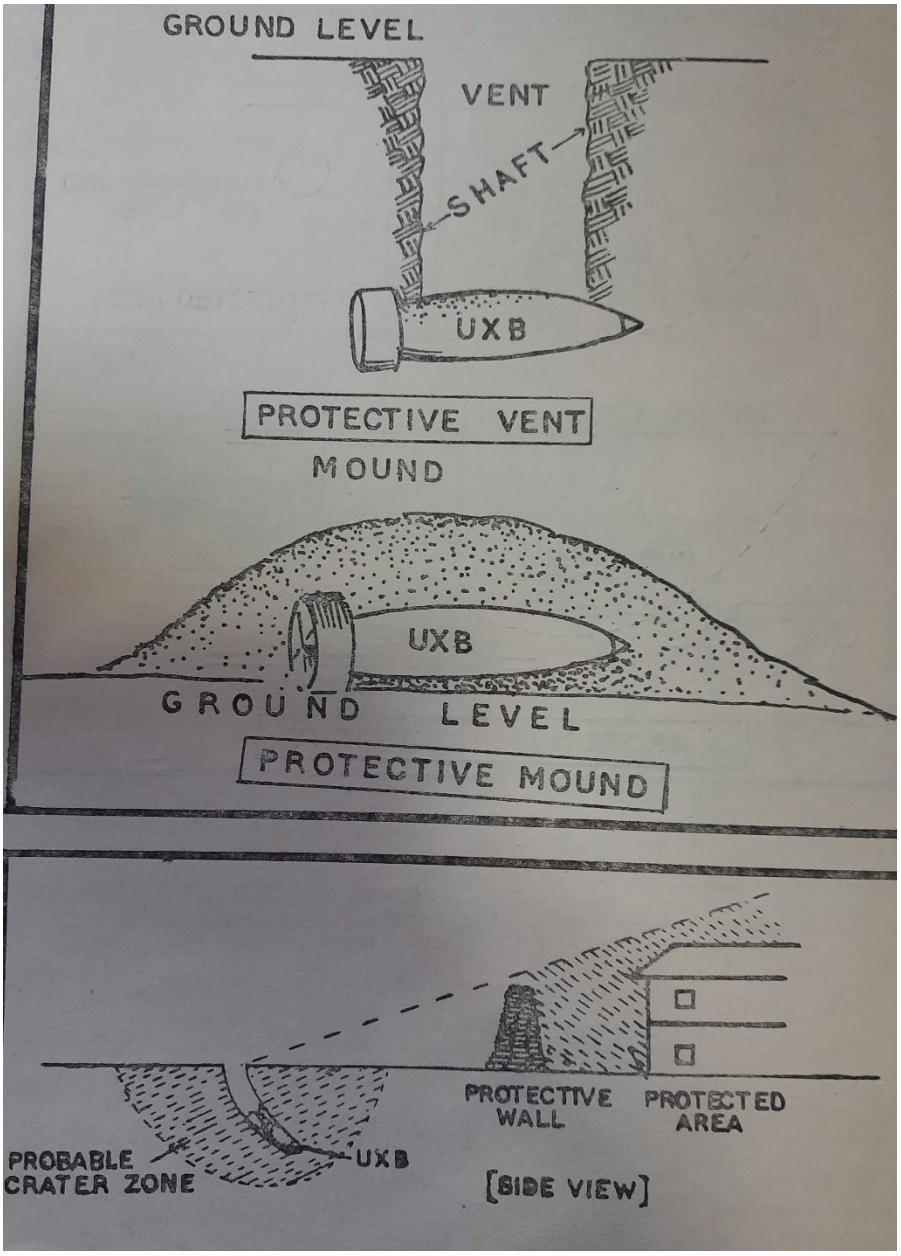
Vents

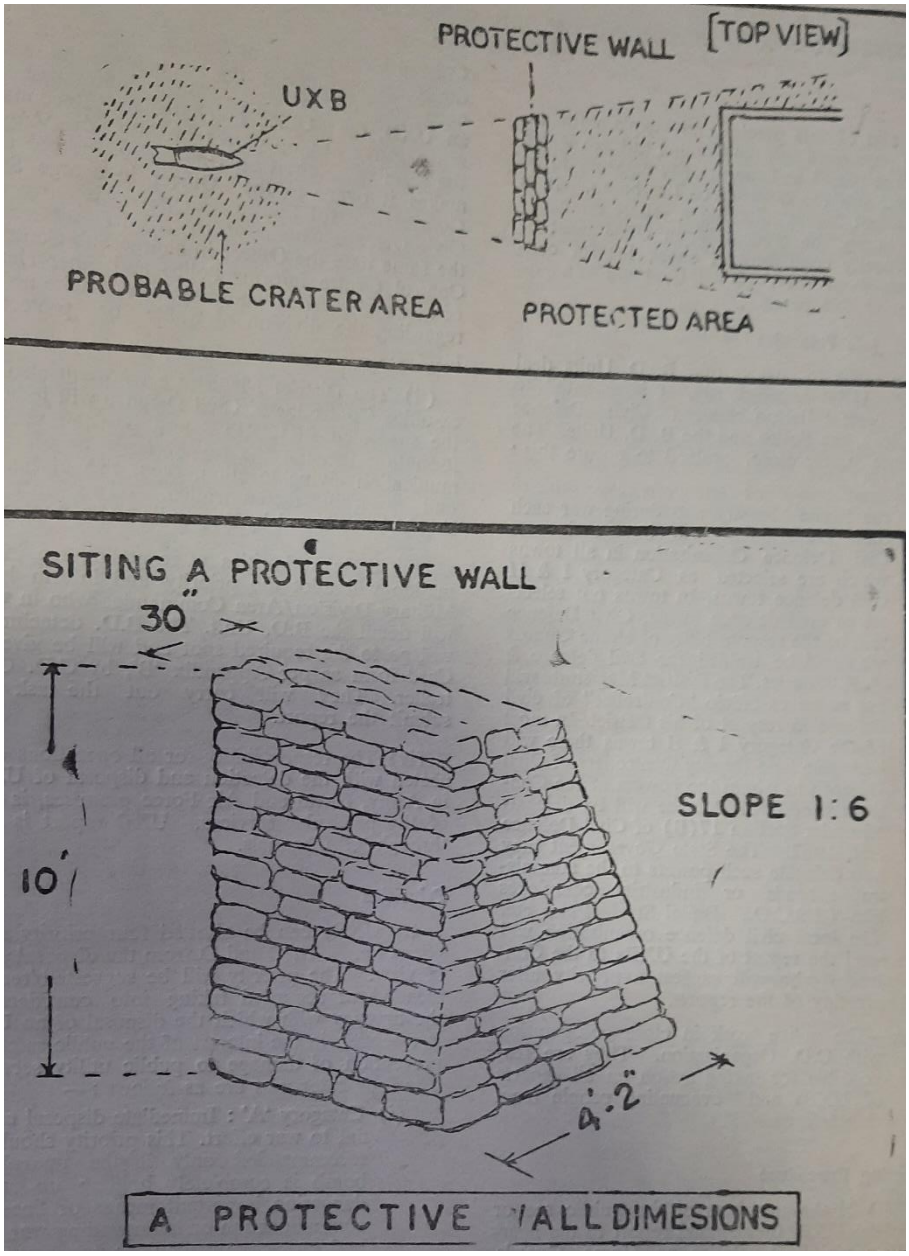
17. Construction of vents to reduce and direct the force of explosion of a buried bomb upwards is resorted to in cases where it is vitally important to diminish earth shock and move- and fundament (e.g. railways lines, bridges, dams, important gas and water main and foundations).

18. When a shaft is excavated to gain access to a bomb and the bomb is exploded at the bottom of the shaft, there is appreciably less earth shock and earth movement than if the same bomb had exploded before the excavation was made. Further a small crater would result. On the other hand damage by blast will probably be greater in this case.

19. The normal size of shaft constructed for this purpose is 8 ft. by 4 ft. (2.40 m. by 1.21 m.). However, in deciding to use this method, the damage likely to done by blast chiefly to windows and roofs must be balanced against that likely to be done to foundations and basements.




GROUND LEVEL
VENT
SHAFT
UXB
PROTECTIVE VENT
MOUND
UXB
GROUND LEVEL
PROTECTIVE MOUND
PROTECTIVE WALL
PROTECTED AREA
PROBABLE CRATER ZONE
UXB
[SIDE VIEW]


PROTECTIVE WALL
[TOP VIEW]
UXB
PROBABLE CRATER AREA
PROTECTED AREA
SITING A PROTECTIVE WALL
30"
10'
SLOPE 1:6
4'-2"
A PROTECTIVE WALL DIMESIONS

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CHAPTER NO. 16

CONFIRMATION AND REPORTING OF UXB, REPORTING CHANNELS, ALLOTMENTS OF PRIORITIES

1. Aim

The aim of this precis is to explain the re- porting procedure and the channel through which the report passes and the priority category to be suggested for the disposal of the bomb. It is obvious that before initiating a report on unexploded bomb, the process of an UXB must be unequivocally confirmed. A check list for confirmation about the UXB will be found as a supplement to this precis.

2. Reporting & Priorities

In order to ensure that B. D. Units deal with the UXB expeditiously, it is essential to have a perfect liaison between Civil Defence Authorities, the Police and the B. D. Units. The procedure is, therefore, evolved to ensure this.

Civil Defence-Civil Defence is responsible to the Home Ministry and during war each State Government will have their own Civil Defence Organisation in all towns which are selected as Category I & II civil defence towns. In towns not select- ed as civil defence towns, Civil Defence will be the responsibility of Home Guards who will be trained for civil defence & A.R.P. duties. The District Magistrate will act as an ex-officio "Controller" of civil defence in respect of his district. In most of the Category & II towns there will be whole time Deputy Controllers of Civil Defence to whom the powers of the Controllers of Civil Defence will be delegated under Section 17(B) of Civil Defence Act, 1962. The State Government may also delegate such powers to the administrative heads industrial complexes or like T.L.S.C.O., Bhilai Steel Plant etc. The local civil defence organisation will send the report of the UXBS to the Controller who will suggest a priority after scrutiny of the reports.

Police- The police work in close co-operation with CD. Organisation. They are responsible for taking action on all reports of UXBS and evacuating people from danger area.

Reporting Procedure

3. (i) If the members of the public see or suspect an UXB, they should report to the nearest Warden's Post, Police or Home Guards. Otherwise it is the duty of a Warden to recce the area after an air raid and report about the UXBS if any. The Warden reports to the Sub-Control/ Control Centre. The Officer in charge Sub Control Centre/Control Centre may then send the Reconnaissance party to confirm the existence of the UXBS, On confirmation of an UXB, the Office in charge of Reconnaissance Party fills up part I of Appendix 'A' to the form of "Report on Unexploded Bomb" and makes it over to the Officer in charge Sub- Control/Control Centre who passes it on to the Civil Defence Controller/District Magistrate. At the same time the Officer in charge Sub-Control/ Control Centre informs Police and other Heads of essential services who may have to take action regarding the division of traffic or protective measures.

(ii) The District Magistrate who will also be ex-office Controller of Civil Defence will indicate the suggested PRIORITY and pass on the in- formation through the quickest means of communication giving location, type, size of bombs and priority recommended. This message should be followed by Appendix 'A' of the form.

(iii) State authorities after getting the information will allot the priority and inform local Military Division/Area Commander who in turn will detail the B.D. Unit. The B.D. detachment will go to the required spot and will be given a Card form as per Appendix 'B', by C.D. Controller. They will carry out the task and submit the report.

(iv) The responsibility for all operations connected with the detection and disposal of UXBS in Army, Naval and Air Force premises, is that of the particular services. UXB report is sent through 'G' Channels.

Priorities

4. UXBS can be allotted four priority categories i.e. A, B, C and D from the disposal point of view. The priority will be suggested/recommended or accorded taking into consideration the urgency with which the disposal of an UXB is essential, in the interest of the public safety or prevention of damage to public utility services. The four categories are as follows:-

(i) Category 'A': Immediate disposal essential to war effort. This priority should be recommended only if the unexploded bomb is completely holding up or endangering important means or lines of communication or is impending war work and protective work does not lessen dangers.

(ii) Category 'B': Disposal important to war efforts, but not so urgent as to justify immediate action e.g. unexploded bombs at important production centres contributing to war effort.

(iii) Category 'C': Disposal necessary from the point of view of maintenance of public morale e.g. unexploded bombs affecting essential services, busy centres etc.

(iv) Category 'D': These unexploded bombs will be disposed of after all unexploded bombs of the other three categories have been dealt with and if time can be spared by the personnel of the Bomb Disposal Unit i.e., unexploded bombs in open fields' area on the out skirts of the town. etc.

UXBS in Vital Places

(i) **Railways-** Reconnaissance and reporting of the UXBS on Railways Premises (including station, workshop, yards etc., having their own C.D. Organisation), will be done by the Railway C.D. Authorities. The Railway authorities will inform the State Governments direct indicating the priority recommended by them and at the same time endorse a copy of the report to the Local District Magistrate. In case of small stations which do not have full-fledged C.D. Organisation, this action will be taken by the District Magistrate who while communicating the UXB report to the State Government, will also endorse a copy to the concerned Railway Divisional Head- quarters for information.

(ii) **Factories and Industrial Installations**- If it is known that an UXB has fallen in factory premises, the factory authorities should immediately report the matter to the nearest Warden's Post who will arrange to obtain the services of the Bomb Disposal Unit in the normal channel. Where, however, such factories etc. have then own Control Post, the report on UXB may be sent by the authorities in charge of such posts direct to the Town's Civil Defence

Controller who will arrange to obtain the services of the Bomb Disposal Unit through the District Magistrate.

(iii) **Port Harbour**- Aerodrome and such other vital installations which have their own C.D. Organisation. Report on UXBS found in the premises of Ports, Harbours, Aerodromes etc. will be communicated by the C.D. Controller of the Posts etc., concerned direct to the State Government A copy of the report should also be endorsed to the District Magistrate so that the latter may arrange to inform the Heads of Public Utility Services that may be affected.

SUPPLEMENT ON CONFIRMATION OF AN UXB

As soon as a report of an UXB is received and a Recce Party is despatched to confirm the presence or otherwise of an UXB, the Recce Party- has to determine whether the incident under re- port has actually been caused by an unexploded bomb or the incident pertains to some other occurrence. In such cases an incident can be :-

(i) High explosive bomb unexploded.

(ii) High explosive bomb exploded.

(iii) High explosive bomb camouflet.

(iv) Miscellaneous pyrotechnics.

(v) False report,

The Recce Party must, therefore take into con- sideration the various factors in order ruled out the possibility of incidents referred to at (ii) to (v) above, before making a report about the presence of an UXB. A check list for eliminating the possibilities and confirming an UXB is given in subsequent paras.

H. E. Bomb Exploded

2. The following indications of explosion can be observed:

(i) Formation of crater throwing loose soil in all directions.

(ii) Presence of steel splinters.

(iii) Breakage of windows in locality around.

(iv) Evidence of earth shock, like cracked walls.

(v) Blackening of earth in crater on entry hole.

(vi) Cracking of ground due to camouflet,

High Explosive Bomb Camouflet

3. When a bomb explodes so much deep under the ground that the force of explosion is insufficient to expel surface plug, a Camouflet is formed. The signs of formation of a Camouflet may or may not be visible on the surface depending upon whether it is a shallow or a deep one and also on type of the surface. There- fore, in case the entry hole is to be taken as a proof of the presence of UXB, it should not be associated with a Camouflet.

Indication of Mines

4. Parachute mines are normally found on surface. These are often dropped in pair. These should not be touched. Non-parachute mines have hole of entry similar to heavy bombs.

False Reports

5. A false report may be due to one of the following reasons: -

(i) High flung debris.

(ii) Exploded anti-aircraft shells.

(iii) Exploded incendiaries.

(iv) Skid marks of low altitude bombs.

(v) Natural causes like rabbit holes, old wells.

Confirmation of an UXB

6. Positive indications of an UXB will be as follows:-

(i) **General**

Two situations may arise. Either the bomb may be buried or may be unburied. A bomb is considered buried when the upper surface of the bomb is at least twice the length of the bomb body below the ground level. The penetration of buried bombs will be affected by:

(a) Height of release.

(b) Weight and shape of bomb.

(c) Nature of ground soil (concrete or soft soil).

(d) Nature of soil and sub-soil. Ascending order is rock, gravel, sand, chalk, shingle, dry clay, wet, and wet clay and silt.

(ii) **High level bombing**

Bomb may penetrate ground to great depth. May change direction when losing speed. Tail fins may be wrenched off on surface or somewhere in ground.

(iii) **Low level bombing**

The offset will be greater in comparison. May be deflect- ed upwards to surface or above surface. May skid off a ground causing a groove. Always trace path of bomb to point of impact to discredit false report occasion- ed by bomb in its travel.

(iv) **UXBs in buildings**

Considerable structural damage will often be caused. Should not be confused with exploded bomb damage. Path of bomb will be clearly visible through upper storeys. Debris and damage will be maximum on the ground floor. There will be no sign of splintering or blast damage.

(v) **UXB in open ground**

Small bombs usually make a clean hole of entry. Fin marks and paint may be visible. Larger bombs may cause a "splash crater" with firm/sides. Hole of entry may be bleak- ed by loose soil.

(vi) **Unburied Bombs**

These may be ricochets from low altitude bombing or bombs which are intended to stop on sur- face e.g. anti-personnel bombs and incendiaries. May also be spent containers. If exploded incendiaries small craters will show signs of burring and twisted metal. If containers have opened look for con- tents.

APPENDIX-A

Report on unexploded Bombs

To…….(The State Government concerned).
Copy to..... (The nearest Bomb Disposal unit if whereabouts known for advance information)

1. Exact location.....
   B.D. Division/Area Number……
   Nearest Warden's Post……

2. Date and hour of falling……..
   (if not known, the time of discovery)

3. Say if in
   (i) Open ground, fields etc.....
   (ii) Built up area……
   (ii) Building..... ……..(State type)
   (iv) Naval, Army or Air Force Lands or Railway Port……
   ……..

4. What is the effect of the unexploded bomb on
   (i) Civil population
   (ii) General industry
   (iii) Communication, Railway etc.
   (iv) Industrial war effort
   If nothing affected, say so……

5. State
   (i) Can Bomb be seen?
   (ii) Diameter of entry hole.
   (iii) Estimated size and depth.
   (iv) Type of ground.
   (v) Can water be seen in bottom of hole? Or give the depth of water below ground in nearby wells
   (vi) Can the bomb disposal lorries approach the spot ?
   (vii) If not, how near can they come ?

6. Give distance of the bomb from.
   (i) Buildings (state type).
   (ii) Water Mains.
   (iii) Sewers.
   (iv) Telephone or electricity mains.

7. If near Railway, give distance from

   A (i) Running tracks
   (ii) Bridges
   (iii) Railway Buildings and their nature.

   B. Have trains been stopped?

8. Describe:
   (i) Type of bomb (if possible)
   (ii) Any part or parts of bomb found
   (iii) Colours and markings or any part of parts visible.

9. Any special remarks, give full details such as: Difficulties of reaching site, roads flooded, state of road if out of way place etc.
……
……..

10. Give sketch if possible (showing distance from buildings)

Signature of the Offer Charge
Recommissions Party or other Officer
marking report.
Rank……..
Date……

(To be filled in by Districts Magistrate or other authorised Authorities)

Suggested category.
Officer to Bomb Disposal Unit should report with full address in English and local script etc.

Date Time Signature of District Magistrate

(To be filled in by Authority for deciding priority of disposal)

Bomb Category allocated.....
Passed for action to Commander, B. D. Division/Area etc…….
……..

Time
Date For State Government

APPENDIX- B

Form of Card to be handed over to Officer in Charge, Bomb Disposal Unit his arrival.

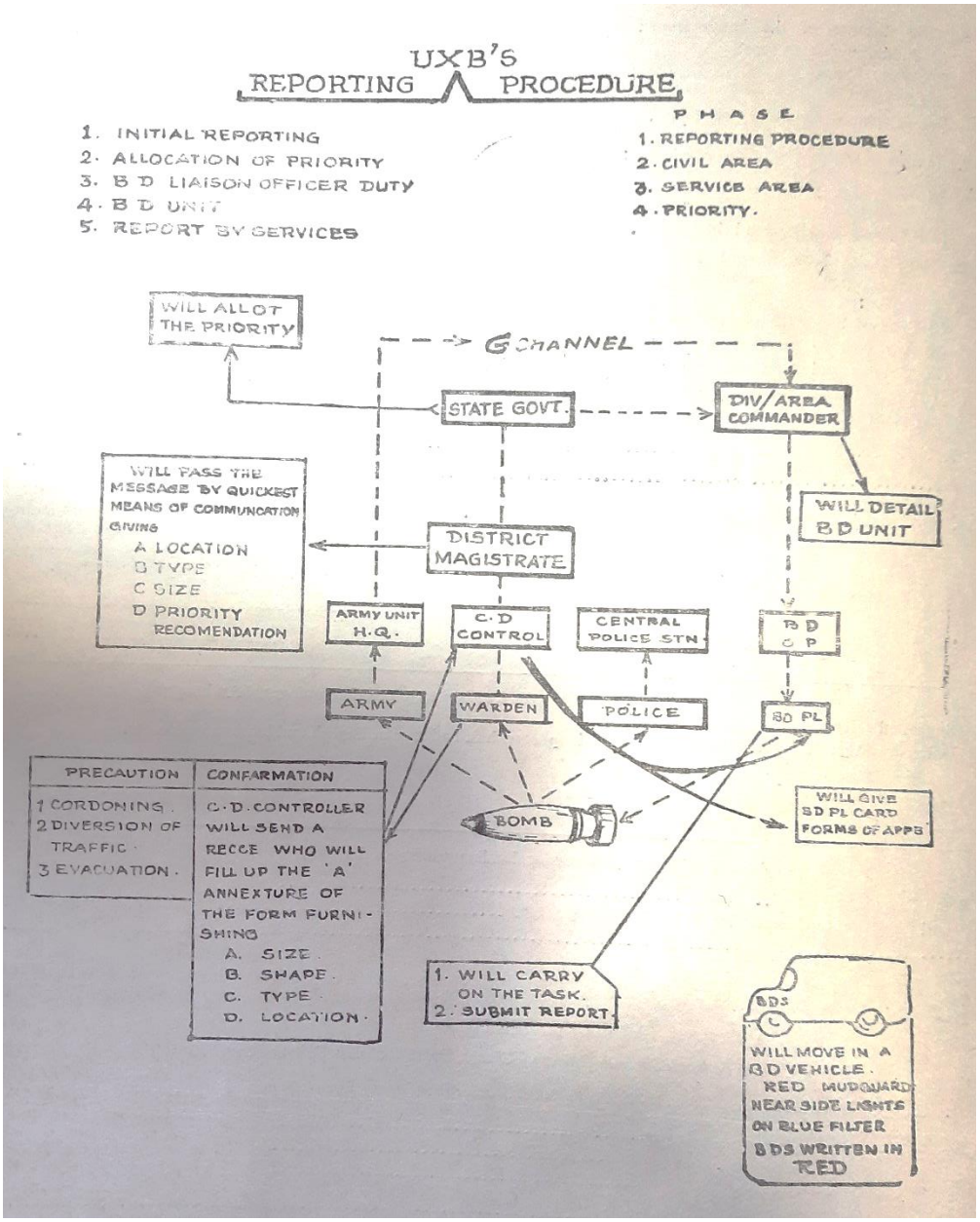
1. C.D. Controller……Telephone Number……..

2. Easy place at which UXB lies……....
……
……

3. Report of the Bomb Disposal Unit…….....
……
……..
……

Date.....
O. C. No.....

Signature……
B.D Unit…….


UXB'S
REPORTING PROCEDURE
1. INITIAL REPORTING
2. ALLOCATION OF PRIORITY
3. B D LIAISON OFFICER DUTY
4. B D UNIT
5. REPORT BY SERVICES
PHASE
1. REPORTING PROCEDURE
2. CIVIL AREA
3. SERVICE AREA
4. PRIORITY.
WILL ALLOT THE PRIORITY
G CHANNEL
STATE GOVT.
DIV/AREA COMMANDER
WILL PASS THE MESSAGE BY QUICKEST MEANS OF COMMUNICATION GIVING
A LOCATION
B TYPE
C SIZE
D PRIORITY RECOMENDATION
DISTRICT MAGISTRATE
WILL DETAIL B D UNIT
ARMY UNIT H.Q.
C.D CONTROL
CENTRAL POLICE STN.
B D C P
ARMY
WARDEN
POLICE
BD PL
PRECAUTION
1 CORDONING.
2 DIVERSION OF TRAFFIC.
3 EVACUATION.
CONFARMATION
C.D. CONTROLLER WILL SEND A RECCE WHO WILL FILL UP THE 'A' ANNEXTURE OF THE FORM FURNISHING
A. SIZE.
B. SHAPE.
C. TYPE.
D. LOCATION.
BOMB
WILL GIVE BD PL CARD FORMS OF APPS
1. WILL CARRY ON THE TASK.
2. SUBMIT REPORT.
BDS
WILL MOVE IN A B D VEHICLE.
RED MUDGUARD
NEAR SIDE LIGHTS ON BLUE FILTER
B DS WRITTEN IN RED

****

CHAPTER NO. 17

PHASES IN UXB OPERATIONS

1. **Aim**

The aim of this precis is to give a general idea about the bomb disposal problems.

2. **Operations involved**

Any bomb disposal job has these basic operations:

(i) Bomb Reconnaissance and location

(a) Position of the bomb.
(b) Depth of the bomb
(c) Lie of the bomb

(ii) Gaining access

(a) Excavation
(b) Lining
(c) Pumping out water

(iii) Fuse immunisation

(iv) Disposal

(a) Fuse extraction
(b) Trepanning
(c) Steaming out explosive:
(d) Bomb demolition in situ
(e) Or in bomb cemetery
(f) Back filling

(i) **Bomb Reconnaissance and location**-For the correct location of the bomb a Bomb locator is used, but this need be done by B.D. Squads only. For reconnaissance purposes only, approximate location and depth by weight/penetration chart is enough. With the Bomb locater correct location within a feet, depth within 6 inches and the lie of the bomb in the correct posture can be determined. To determine whether the fuse is still working or not an electronic stethoscope, remove controlled is used. For all this the suspected area near the entry hole is marked in the form of a graph, then the readings taken along the (intersections of the lines) grids are plotted on a graph paper and position, depth and lie determined. For bombs below 30 feet a shaft has got to be dug and bomb locator used from within 30 feet of vertical depth. At times transverse cut is essential in the shaft to achieve this (Heading).

(ii) **Gaining Access**-Once the location has been correctly ascertained the bomb has got to be reached by excavating manually to the required depth. All this is done at great personnel risk and the minimum number of men necessary are put on the job. As the digging goes on the shaft is lined with wooden plank and beams. No nails are to be used. Folding wedges and cleats are used. In case of sandy soil aluminium sheets and planks are used. in case of sub- soil water pumping it out is essential to gain access.

(iii) **Fuse Immunisation**-Once access has been gained the first problem would be to know if the fuse is still working if it is a time bomb. This is done by an electrical stethoscope. If still working it has got to be stopped by a magnetic clock stopper. The bomb is usually taken out along with this, taken to a cemetery, stopper removed, bomb covered with explosive and disposed off. If the delayed fuse has gone bad or it is some other type of fuse the fuse is immunised by other methods (viz. by S-set, steam fuse discharger, F-process or D-process). The process of fuse immunisation most dangerous of all the jobs in B.D. usually it is the O.C. of the B.D. Unit who does it.

(iv) **Disposal**- Once the fuse has been immunised and it is possible to take the bomb out, the fuse is extracted outside otherwise it is usually done inside the shaft. To know what is the likely type of fuse and whether it is safe to extract or has got an anti-extraction device the colour/markings and batch number on the bomb should be seen. If the marking is underneath, plastic in or some other such material is used to get an impression of the markings. The knowledge about batch number, markings etc. is of great help to know the bomb in case they have been used earlier. Then the exploder system is extracted with a fuse extractor remotely. Once the exploder system is out, the casing with main filling is safe to handle and is disposed off. In case of smaller bombs they all are carried to the bomb cemetery and dispose ed off. In case of bigger ones the casing has got to be cut either at the tail side or 4" noels are cut on the body with the help of a trepanning machine, a little of the man filling is taken out to identify it with the Field-testing set. The main filing is steamed out with a Portable Steam Generator (for explosive other than Amatol and Baratol) or is scrapped or scooped out with due precautions. These can be done inside the shaft itself, the casing can then be removed. The shaft can then be filled back.

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CHAPTER NO. 18

BOMB LOCATION

1. **Aim**

In order to estimate the damage a buried bomb can do it is essential to know its exact position and depth. Bomb Disposal Squads are issued with specialised equipment called "Bomb Locators" but these will not be available with the C.D. Bomb Reconnaissance Parties. The aim of this precis is to give what other methods could be adopted to know the approximate location of the bomb.

2. **The path of a bomb through the ground**

Chart at the end illustrates typical bomb trace. The general direction of the trace continuous along the line of flight of the air- craft. Marked lateral movement from this line is uncommon and is only likely to occur if the bomb is deflected by an underground obstacle. In almost every instance, however, the trace turns up towards the surface shortly before the bomb comes to rest. Long thin missiles have less tendency to turn than short stumpy ones.

3**. Depth**

Table 1 gives the average depths at which bombs are likely to be found when dropped from a high level. Bombs penetrate less if they are dropped in low level attacks, pass through buildings or hard surfaces, or are fitted with parachutes or other retarding devices. Armour piercing and rocket assisted bombs may penetrate further.

4**. Off-set**

The horizontal distance between the entry hole at the surface and the centre of the bomb is known as the offset. (See chart). The average offset when a bomb is dropped from a high level is about 1/3 of the depth (Table 1). Larger offsets can sometimes be anticipated. They are likely to occur when the bomb has entered the ground at a slight angle to the horizontal as a result of a low level attack or a ricochet from an intervening structure, or where hard under- ground surfaces exist which may cause deflection. as large as the figures given for the average depth in Table 1 may occur. (From a high level attack a bomb usually enters the ground at about 10 to 15 degrees to the vertical. From a low attack, the angle may be 45 degrees or more).

5. **Procedures for estimating position**

(i) Estimate the weight of bomb from the diameter of the entry hole which is usually 2" more than the diameter of the bomb from Table 2 which gives approximate wt/size relationship of H. E. Bombs of different types. (Table 2) and any other available evidence.

(ii) Probe to determine the angle of the hole of entry and the direction in which the bomb Ties Where probing is not possible, as in rubble or shingle, these factors may be deduced from a knowledge of the direction of flight and altitude of the sit-craft.

(iii) Determine the average depth and offset from Table 1.

(iv) Make adjustment to these figures, to allow for the type of ground, low level release, small angle of entry, any obstacles the bomb has passed through, and any known

structural features of the bomb which will affect penetration (e.g. rocket propulsion attachments or parachutes).

TABLE 1

Depths at which UXBs are likely to be found when dropped from 15,000 feet or more

Weight of the bono (a) lbs	Average depth of (d) feet
100	12
250	15
500	20
1,000	30
2,000	35
4,000	40
8,000	50
12,000	55
22,000	70

Multifaction factors:-

(i) For graved, soft rock and sand multiply by 2/3.
(ii) For moist clay multiply by 3/2.
(iii) For very wet clay or sit where there is also negligible off-set multiply by 2.

TABLE-2

Approximate weight/size relationship in different types of H.E. Bombay

Total Weight (lb)	Penetration and Fragmentation		Blast and General Purpose		Armour Piercing	
	Length (ft.)	Diameter (in.)	Length(ft.)	Diameter (in.)	Length (ft.)	Diameter (in.)
20	-	4	--	--	--	--
50	1 ½	6	1 ½	6	--	--
100	2	8	2 ½	8	--	--
250	2 ½	9	2 ¾	10	--	--
500	3 ¾	12	3 ¾	14	--	--
1,000	4 ¾	16	4 ½	18	5	--
2,000	5	20	6	24	6 ½	43
4,000	6	22	8	30	--	--
8,000	-	--	8 ½	38	--	--
12,000	10	38	--	--	--	--
22,000	12 ½	46	--*	--	--	--

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CHAPTER NO. 19

DISPOSAL OF STRAY AMMUNITION ARTILLERY SHELLS AND OTHER PYROTECHNICS

1. **Aim**

During war time along with the UXB there aright be many other misses used during air warfare that might remain unexploded. They might be of various odd shapes and sizes, which the Civil Defence personnel have earlier come across although they might not be bombs but still they might be dangerous if they contain some high explosive charge or other dangerous liquids. The bomb reconnaissance parties should be able to assess the dangers associated and report accordingly. This place deals with the responsibility of disposal of such stray ammunition, artillery shells and pyrotechnics etc.

Common Types of Missiles

2. **AA Shells**:

(i) All AA shells are designed to explode in the air and failing that, on his- ting the ground. With the large numbers fired however, inevitably the failures are numerous.

(ii) **Fusing**-Various types of fests may be used. The most dangerous in an unexploded round is one in which a striker has buried itself in a cap without firing it. A jolt or a movement which makes the striker move and rub against the powder in the cap may detonate the round.

(iii) **Reconnaissance**:

(a) A falling AA shell is usually spinning and often makes a deceptively large hole. Careful inspection will show that the hole tapers as it deepens.

(b) AA shells which explode on the surface form small craters which are often reported as entry holes of bombs. Proof to the contrary is provided by signs of explosion and the firm base to the crater.

(iv) **Precautions**:

(a) Some fuses used in AA shells may be operative for a short period after falling. Do not approach for five minutes.

(b) Shells which are partially buried should be pulled out of the ground by remote control. They may them be removed by hand.

(v) **Action if unexploded:**

(a) Buried AA shells should be reported through the usual channels for disposal by Engineers.

(b) In the absence of instructions to the contrary it may be assumed that AA shells lying on the surface may be removed by troops of all arms to a convenient site for subsequent demolitions by AOC or Engineers.

3. **Aeroplane Cannon Shells**

In war the recovery and transporting of unexploded cannon shells which have been fired from aeroplane will probably be the duty of all arms. Some cannon shells may be extremely sensitive and the following precautions should be taken:-

(a) Do not touch the pointed end.

(b) Pick up by gripping the centre of the round.

(c) Keep horizontal.

(d) Avoid jolting and rapid changes of direction.

(e) Ensure that rounds are not dropped-

(i) For transporting, the rounds should be placed in a container lined with cotton wool, felt or other soft materials.

(ii) The accumulated shells should be kept in a safe area in a small covered trench and should be reported for subsequent demolition by an Engineer unit.

4. **Pyrotechnics**:

(i) **Description**-Pyrotechnics are so numerous and varied that no attempt is made to describe them all in this pamphlet. Typical pyrotechnics are parachute flares, photographic flash bombs or "photo- flashes", flame floats, smoke markers, and smoke screen bombs. Any of these may or may not be of the conventional bomb shape. Many of them may be fitted with parachutes and may be found on the surface,

(ii) **Fusing**-The fusing used will depend on the intended function of the missile.

(iii) **Reconnaissance**:

(a) Photoflashes and pyrotechnics with high explosive components may form craters if they function on the ground.

(b) Some pyrotechnics function in the air and discard their outer casings. These may be found on the surface and are harmless.

(c) Colouring and markings should aid identification.

(iv) **Precautions**:

(a) Exploding photoflashes cause nearly as much damage as high explosive bombs of the same size.

(b) Any pyrotechnic may function when disturbed if the fuse is in a sensitive state but the majority, although they may start fires, are otherwise harmless.

(c) Don't pull on parachutes or strings. They may be connected to friction igniters.

(d) A few pyrotechnics which function on the surface such as target flares, may be fitted with explosive charges designed to detonate at intervals and deter attempts to extinguish them.

(v) **Action if unexploded**-If in doubt the identity, fusing or function of a pyrotechnic do not move it but mark and report it.

5. **Rocket Propelled Ammunition:**

(i) **Description**-Rocket propelled ammunition used in air warfare may be employed either offensively or defensively from air- to-surface or from air-to-air or defensively from surface-to-air. Similar missiles may be used as an alternative to artillery from surface-to-surface. In the 1939-45 war a shell or small bomb weighing between 25 and 300 lb. was used as a warhead. The rocket operated either on liquid or solid fuels.

(ii) **Fusing**-Depending on the function of the projectile, the fuse may be impact. short delay or proximity.

(iii) **Reconnaissance**:

(a) Buried rocket propelled ammunition usually leave clear-cut entry holes in which the marks of the fins may be detected.

(b) The propellant tube or fins frequently become detached if the missile passes through a build ng. These afford a good clue to identity.

(c) When the missile explodes in the air the propellant tube falls to the ground and may become partially buried. If the exposed portion is obviously pitted by splinters the tube may be withdrawn and disposed of. If no splinter marks are apparent it must he assumed that the warhead is attached.

(iv) **Precautions**-As for an unexploded bomb of the same size,

(v) **Action if unexploded**-Report and mark. Disposal of Stray Ammunition Bomb Disposal Units-In addition to their primary function of dealing with unexploded enemy aircraft bombs. Bomb Disposal Units will be responsible for the disposal of:

(a) All beach mines, whether laid in recognised mine fields or washed up on beaches.

(b) Blind AA shells, whether on the surface or wholly or partially buried.

(c) Pipe mines.

AOC Responsibility-

(i) The AOC is responsible for the disposal of all other sorts of stray ammunition, which includes any dangerous object (explosive incendiary, chemical warfare or smoke) whether designed for operational use, for training or for practice. Such objects may have been discovered in a public place, washed up on a beach, reported or surrendered by private collection of such objects at the particular request of civil defence authorities, or by standing arrangements with them...

(ii) The term "stray ammunition" does not include blinds on ranges, which will be dealt with at all times according to the safety regulations applicable to the range in question.

(iii) All reports of the existence of stray ammunition will be passed to AOC in commands, who will arrange for disposal by an Inspecting Ordnance Officer. If, however, the reported object is one which would be dealt with by another Service or authority, the AOC will either: -

(a) put the informant into direct touch with the appropriate authority, or

(b) record full details for onward transmission to the appropriate authority through official channels, whichever may be expedient.

(iv) Units other than AOC in commands will not attempt to deal with the stray ammunition, but will report it direct to command by the quickest means. In particular Bomb Disposal Units will not normally deal with ammunition of any type outside their immediate charter, except when specially detailed to do so. In order to avoid wastage of effort, however, Bomb Disposal Units are permitted to dispose of ammunition of other types discovered during the course of bomb disposal operations, as for instance during the clearance of beach mine- field.

(v) The clearance of training ranges and other such areas no longer in use is a General Staff responsibility, the function of the AOC in this matter being limited to the disposal of ammunition when located. The responsibility of the AOC does not at any time include searching for ammunition except under special instructions from Army HQ.

(v) Stray missiles in unit hands, whether or not on unit charge, will be dealt with by inspecting Ordnance Officers in the course of their normal duties.

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CHAPTER NO. 20

UNEXPLODED BOMBS IN CIVIL, VITAL, PLACES- PRECAUTIONS & REPORTING ETC.

1. **Aim**

This precis deals with the problems of recon- naissance and disposal of UXBS at vital places. The following instructions are applicable in the case of UXBS on Railways, Air Ports, Ports and Harbours, Factories and other industrial installations etc.

2. **Railway Premises**

Reconnaissance and reporting of UXBS on railway premises (including stations, workshops, yards, goods sheds etc.) having their own full- fledged C. D. Organisations, are the responsibilities of the Civil Defence Authorities under the railway administrations. Even in case where such bombs are located by Police, Home Guards or the Town's Civil Defence Authorities, the preliminary should be sent to the Railway Authorities. It will be for the Railway authorities to despatch their Civil Defence personnel to the spot and to arrange for reconnaissance and confirmation and to inform the State Govt, direct. The report should clearly indicate the location of the bomb, its type and size, if possible, category of priority, the name and address of the authority to whom the Bomb Disposal Unit should report and such other information as may be necessary for the State Government to determine the priority. A copy of such a report will be endorsed to the District Magistrate/Local Civil Defence Organisation for in- formation. In the case of smaller stations which do not have full-fledged Civil Defence Organisations, the Civil Defence plants for such stations should provide for reporting UXBS and obtain an emergency assistance from the nearest Town's Civil Defence Organisation. In these cases, reconnaissance and confirmation will be the responsibility of the local Civil Defence Organisation or in cases where no such organisation exists, the District Magistrate concerned will arrange to secure assistance from the nearest Town having a Civil Defence Organisation. The local Civil Defence Authorities will, soon after the bomb has been located and the Reconnaissance Party's report has been available, pass on the message, to the District Magistrate (or his local representative) who will communicate the message to the State Government for determination of priority and calling for the Bomb Disposal Unit. A copy of such a report will be endorsed to the Railway Divisional Head- quarters for information.

3. **Factories and Industrial Installations**

If it is known that an UXB has fallen in factory premises, the factory authorities should immediately report the matter to the nearest Warden's post who will arrange to obtain the services of the Bomb Disposal Unit through the normal channel. Where, however, such factories etc. have their own Control Posts, the report on the UXB may be sent by the authorities in charge of such posts direct to the Town's Civil Defence Controller who will arrange to obtain the services of the Bomb Disposal Unit through the District Magistrate.

4. **Ports, Harbours Aerodromes and such other vital installations which have their own civil Defence organisation**

Report on UXBs found in the premises of ports, harbours, aerodromes etc. will be communicated by the C. D. Controllers of the Port etc. concerned direct to the State Government. The report should clearly indicate the location of the bomb, its type and size, if possible cate-

gory of priority, the name and address of the authority to whom the Bomb Disposal Unit should report and such other information as may be necessary for the State Government to deter- mine the priority. A copy of the report should also be endorsed to the District Magistrate so that the latter may arrange to inform the heads of Public Utility Services that may be affected.

5**. Army, Naval and Air Force Installations**

The responsibility, for all operations connected with the detection and disposal of Unexploded Bombs in Army, Naval and Air Force premises, as pointed out earlier, is that of the respective services. Where, however, the local installations of these services do not have the necessary facilities for the purpose, they may send report direct to the State Government, indicating priority for the disposal of the Bombs. In such cases and in cases where civil property is likely to be affected a copy of the report will be endorsed to the District Magistrate as well. In the case of military cantonments which have their own Civil Defence Organisations, the Controller-in-charge will be responsible for reconnaissance and confirmation of the location of the Bomb. But he should send UXB Recee/ duly/report filled in to the District Magistrate and it will be for the latter to pass on the re- port to the State Government who will allocate the necessary priority.

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CHAPTER NO. 21

CRASHED AIRCRAFT-REPORTING AND RESPONSIBILITIES

1. **Aim**

The aim of this precis is to give action to be taken in case of crashed aircrafts.

2. The responsibility of dealing with all non- Civil crashed or force-landed aircraft on Indian soil will rest with the Indian Air Force and therefore no part of such an aircraft its equipment or armament will, in any circumstances be removed or interfered with or without the permission of the Air Headquarters, except as indicated below. Similarly, the responsibility for dealing with all Civil crashed aircraft rests in the Director General of Civil Aviation, New Delhi.

3. Immediately on the location of an aircraft which has crashed or has made a forced landing and pending the arrival of appropriate authority to take charge of the situation, the per- sons spotting it or Police, Civil Defence or Home Guard Personnel who may be in the vicinity will make a report to the nearest Civil Defence Control Centre or Police Station. The report should contain the following particulars: -

(a) Exact location;

(b) Date and time of crash/forced landing;

(c) Type of aircraft, if recognised;

(d) Whether hostile or friendly aircraft.

(e) Whether UXBs suspected/known to be present;

(f) Casualties.

4. In the case of railways, aerodromes, ports, harbours and other vital installations which have their own Civil Defence Organisations, the report should be made to the Officer-in-charge of the Control Centres of such organisations and they will take immediate steps to inform the Civil Defence Controller.

5. If the aircraft is on fire, immediate report will be made direct to the Fire Brigade. Since there may be danger from bombs or petrol tanks exploding on account of fire, the surrounding area should be kept clear.

6. Civil Defence, Home Guard or any other Government Officer present on the spot will immediately arrange to send a message to the nearest Police Station and till such time as the Police authorities arrive on the spot, they will keep a guard and prevent any unauthorised person from interfering with the aircraft. The police authorities will take over this responsibility on arrival. They also decide whether it is necessary to clear the area, divert traffic and enforce any other safety measures necessary. In case it is decided by the Police to clear the area, it should be done with the least possible disturbance to the wreckage, so that important evidence to the causes of accident may not be obliterated.

7. Every effort should be made to rescue the occupants of the aircraft and to render First Aid if necessary. In case it is known that the aircraft is a hostile one, immediate arrangements should be made for their being entrusted to Police custody. On receipt of the report, the Civil Do- fence Controller of the Officer-in-charge of the Control Centre will: -

(a) Despatch necessary Civil Defence personnel to the spot for reconnaissance, confirmation, rescue and for rendering First Aid to the occupants of the aircraft:

(b) Send a message to the Police headquarters and arrange for clearing the area and for posting guard.

(c) Send a message to the heads of public utility services, and

(d) On receipt of the report of the reconnaissance party, report the matter to the District Magistrate or his local representative.

8. The District Magistrate will immediately inform the State Government who will take steps to pass on the message to the Air Head- quarters, India, New Delhi or the Director General of Civil Aviation, New Delhi as the case may be, in case the place of incidence is within six hours travelling distance by road or rail from New Delhi. Otherwise, the State Government will pass on the message to the nearest Air Force Station, or the Director General of Civil Aviation's local representative.

9. These messages should not be sent by wireless except when telegraphic and telephonic communications are not available. In such cases they may be sent by wireless in cypher signals.

10. When the message is received by the Commander of the nearest Air Force Station or the local representative of the Director General of Civil Aviation, New Delhi, he will report to the Air Headquarters, India/Director General of Civil Aviation, New Delhi, and will arrange for preliminary visual inspection.

11. The Air Headquarters/Director General of Civil Aviation will decide whether the aircraft is to be examined by Air Force/Civil Aviation technical personnel and if so, will advise the State Government of the time and date of inspection and will also indicate whether any focal assistance will be required. The State Government will arrange, through the District Magistrate/Civil Defence Controller any help, if necessary, in obtaining the services of the local Heads of Services etc.

12. When the presence of unexploded bombs in crashed aircraft has been confirmed and the State Government are satisfied that they constitute a danger to vital installations, they will immediately take action to contact the nearest Military Division/Area Commander and take action as in the case of unexploded bombs of category A. In such an event, their report to the Commander of the Air Force Station/Air Headquarters will indicate the action taken by them.

13. In cases where the aircrafts which have made successful forced landing or where the crashed-aircraft, or aircraft which have made a forced landing, do not have unexploded bombs or where such bombs are not likely to constitute any danger to vital installations, the State Government should not take any action till instructions for their disposal are received from the Air Headquarters/Director General of Civil Aviation, as the case may be.

14. If the Air Headquarters do not consider if necessary to carry out any technical inspection in respect of aircraft with which they are concerned, they will give instructions to the State Government for the disposal of the aircraft and its equipment.

15. The personnel of the Bomb Disposal Units will be trained to deal with UXBS in crashed or forced landed aircrafts and the Civil Defence, Police and other local authorities should render them all assistance.

16. The procedure for reconnaissance, re- porting and disposal of crashed or forced land- ed aircrafts in Railway, factory, harbour, aero- drome etc. premises will be similar, but there will be no objection to the authorities in charge of these services removing the aircraft if they are found impending their work. But such removal should be made only after rendering the aircraft safe for handling and with the least possible disturbance to the wreckage, so that important evidence to the causes of accident may not be obliterated.

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CHAPTER NO. 22

PLANNING FOR EVACUATION AND TRAFFIC CONTROL

(**Sand Modal Exercise**)

I. **Narrative General**

The Air Raid has taken place at ... hours. On reconnaissance of the area an unexploded bomb has been seen lying in the open as shown on the Sand Model. The area is busy one. Three feet water mains runs along the East High Court Road, towards the Reserve Bank Quarters. There is a fire hydrant at the road crossing, telephones and power cables run overhead along both the roads. A special underground power cable also runs along the Temple Road to the IAF transmitters which comes in the partial evacuation zone. The sewage line runs only along the High Court Road about 10 feet below ground as observed from the main holes.

II. Narrative

A 1,000 Lbs. G. P. U.X.B., on surface, 100 yards south of crossing of Temple Road and East High Court Road.

III. Problem

Prepare a plan for evacuation of the surrounding area. From which points on the affected roads will you divert the traffic?

IV. Timings

Time for consideration	40 minutes.
Time for discussion	30 minutes.

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CHAPTER NO. 23

EXERCISE PROTECTION

Narrative

There had been two air raids early morning over the town of Shivpur. The planes flew from north to south dropping bombs on railway station; NELP Power House and in main road Sitabuldi areas. Wardens of the respective areas have reported that there is an UXB near the railway overbridge, near main gate of Power Station and near the super Market in Sitabuldi areas. You have been detailed as officer-in- charge bomb recee party to survey the damage and make a suitable report of the following UXB incidents: -

(a) **Railway Station-** There is an entry hole 16" in diameter at Point X. The angle of the entry hole is slight from the vertical. Window panes in surrounding areas have shattered and the trees have been rendered bare of foliage. A few goods wagons were derailed but there has been no damage to tracks. The petrol oil dump east of the railway tracks have escaped damaged/fire. A shallow crater 15 feet wide is discovered in the open area known as Circus Ground. Railway traffic has been suspended. In the immediate vicinity of the entry hole the Electric Sub-Station appears damaged. The 24" water main runs along Station Road.

(b) **Nelp Power House**- There is an entry hole of diameter 14" at Point X. A number of houses in the bazar area have col- lapsed; and the 2' water main from Kanhan to Nagpur runs along the Kamptee Road. Roads have been cratered and the type and side of craters generally found have been type "B", diameter 23" and visible depth 10. It has also been noticed that some buildings exhibit cracks on walls originating from the foundations, The soil around is average sandy loam and the bombing has been high level. In the immediate vicinity of point "X" the buildings and power station are un- damaged.

(c) **Super Market Sitabuldi Area**- A tail unit of about 14" dia. is visible at Point X. Window panes in the surrounding areas have been completely shattered, and some buildings exhibit cracks. Traffic has been suspended on the road.

Problem

As Officer-in-Charge of bomb reconnaissance party make out a plan including the following:-

(i) Summary of the report.

(ii) Appreciation of type and size of UXB.

(iii) Suggested category.

(iv) Evacuation plan with rough sketch showing:-
- (a) Site
- (b) Zones of Evacuation
- (c) Traffic Control

(v) Any protective work. Estimate time and labour required for the same.

(vi) Special precautions for railways.

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