

No great pressure
change

- Section A: 1. Combustion is general burning of a substance by thermal conduction. Deflagration is the rapid burning of a substance which propagates at a velocity lower than the speed of sound in that material. Detonation is the combustion of a substance which propagates faster than the speed of sound, causing a shockwave through the material.
2. When deflagrating the explosive ahead of the combustion zone becomes compressed. A pressure wave then propagates through the unburnt material. When this increases in intensity it can initiate the explosive causing it to detonate.
3. To adjust the blast of a munition changing the ~~fst~~ explosive fill can increase this. Adding other explosives to TNT, such as RDX, and additives such as aluminium can increase the blast ~~of~~.
To increase fragmentation the case material needs to be sufficiently brittle to fragment. Having thicker or thinner walls will vary the velocity and range of fragmentation along with its penetration on the target. This will be because thicker ~~wall~~ cases will give larger and slower fragments over a shorter distance. Adding Pre-formed fragmentation to the case will create a more uniform fragment size and frag distribution.
4. A primary explosive is primarily used within the ignition train of a system. They are very sensitive materials which will either detonate or deflagrate with minimal stimulus due to a low activation energy.
A secondary explosive is primarily used in warheads ^{or demolition charges} ~~as~~ they are less easy to initiate and have a relatively high activation energy. A booster is an article within the ignition train which is used to transmit the detonation of the initiator into the secondary explosive, main charge. These will ~~be~~ contain an explosive which has a higher activation energy than the primary but less than the ~~main~~ main charge. These may include Tetrah or PETN.

Section A:

5. Some propellant grains have holes within them to control the burning rate. Having the burn rate ~~is~~ related to the surface area of the propellant. As the surface area decreases the burn rate falls. Having holes in the grains means that the surface area can remain either constant or increase ~~it~~ as the grain burns because it is burning from the inside out as well as outside in.



6. Changing the particle size of the ~~fuel~~ fuel will impact the burn rate. A smaller size will give a faster burn whilst a larger size will give a longer burn time. ~~Also~~ Adjusting the particle size may also cause problems with the mixing of the composition.

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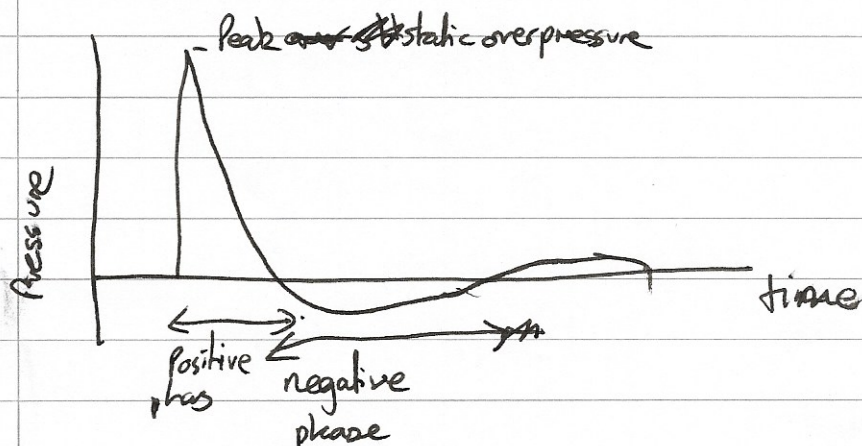
Section B: 1. When a blast warhead detonates in air the blast waves are transmitted through the air. These waves are reflected off the ground and can combine with the original blast wave. The point this occurs is the Mach stem.



These blast waves will die out in the air over time. The thickness of the air will impact how long the blast wave will last for. In thinner air, such as at altitude, the wave won't last as long however in denser air, closer to the ground or in fog the blast wave will have a longer duration. The altitude above ground level (AGL) will determine whether there are any reflected waves. If the blast waves have died out before they hit the ground then there will be no reflected waves. If detonated at the right point ^{in the air} there is a much greater impact on the target than if it detonated on impact due to the combined blast and reflected waves.

The explosive fill of the warhead is key to increasing the initial blast. Adding other things such as aluminium to the fill will increase the blast duration and have a greater impact on the target. Other types of warhead such as fuel air or thermobaric will generate large blasts which will dissipate relatively quickly.

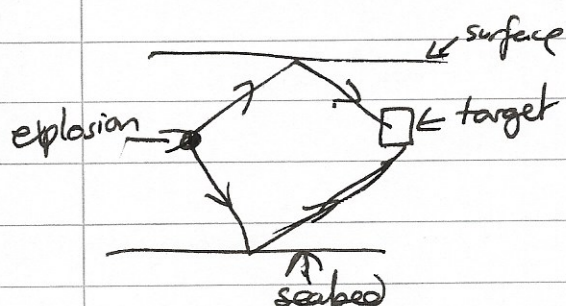
Having the correct fuze for the warhead is necessary to ensure it is initiated at the correct altitude. This can be done using spinning mines, radar, altimeters, and other means. As altitude increases to a point where there is no reflection from the ground the blast wave will look as follows:



Section B1.
cont

For an underwater explosion there will be reflections from both the surface and the seabed. The effect of these will depend on the distance from them to the explosion. Water is not as compressive as air so the gases from the explosion cannot disperse as they do in air. Underwater they form a bubble. The bubble will expand and contract multiple times and will move to any nearby surface. This pulsing action causes damage to the target.

Reflected waves from the surface or seabed will impact the target at different times depending on their relative distances and the density of the water.



If an underwater explosion happens underneath a ship the pulsing bubble of gas is likely to stress the vessel to the point it will break its back.

The advantages to an air burst weapon are that it can cause greater blast damage to a target than if it detonated on impact. It is limited, however, if the target is protected against blast using armour, ~~blast~~ designed blast protection etc. If a target is underground it is unlikely to be effective. It can also be harder to reduce collateral damage using an airburst weapon as it will affect anything in the blast radius. At altitude these effects are minimised.

Fragmentation ~~weapons~~ warheads are good for anti-personnel or attacking soft skinned vehicles but have limited use on armoured targets or against structures. The fragments can be designed to provide a certain pattern which increases the kill probability within an area, however it is indiscriminate within ~~that~~ this area. The frag does have limited range.

Blast/fragmentation warheads are relatively cheap as they do not require as much specialist engineering like a shaped charge / UEST warhead however their effect cannot be directed and is omni-directional.

Section B:

2

The ~~two~~ ^{three} most common directed energy warheads are shaped charges, EFPs and HESH.

Shaped charges depend on a number of factors to ensure they initiate properly, ~~and~~ and achieve the required effect on target. These include, the cone shape, ~~and~~ thickness and material, the explosive fill, fuzing/initiation stand off

~~Cone:~~ The ~~idea~~ Shaped charges are formed by the explosive force of the fill forcing the cone to collapse and form into a jet which penetrates the target.

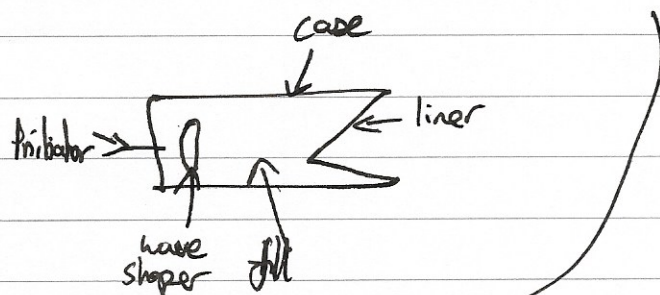
Cone: The material of the liner must be ductile enough to deform. Copper is often used as it is both ductile and relatively cheap. The thickness of the liner is important. Too thick ~~and~~ or too thin and the jet will not form. The ~~shape~~ ^{shape} of the cone will impact the formation. If the cone angle is too narrow the jet won't form as it will disrupt itself during formation, if it is too wide it will act more like an EFP and form a slug. The liner shapes are often cones however other liner shapes can be used such as hemi-spheres. The liner must be symmetrical in design.

Fill: The fill of the warhead must have intimate contact with the liner otherwise the jet will not form. The composition must be uniform in its composition and density, otherwise it will not create a uniform wave through the fill. The shockwave through the fill ~~must~~ must be uniform as it needs to hit the liner in a uniform ~~to~~ manner otherwise the jet will not form. To aid this wave shapers are often used to control ~~the~~ this. These are often metal, plastic or bakelite objects placed towards the source of initiation. ~~The~~ It is possible to get the same effect by altering the density of the explosive fill so the fill itself is the wave shaper however this is hard to manage. The point of initiation of the fill must be lined with ~~the~~ on the same axis as the apex of the liner. ~~but without~~ without this the wave will not propagate properly within the fill.

Section B: 2. cont

Warhead: The construction of the warhead must ^{supply} have a ~~jet~~ ^{approx} the correct stand off for the shaped charge. This is typically ~~2~~ ^{approx} 2 times the cone diameter. This is usually the nose cone of a warhead which will have a method of initiating the fuze, eg: on a PG-7 warhead there is a piezo crystal on the nose which sends an impulse to the fuze ~~on~~ when it impacts the target, creating the correct stand off. The fuze is point initiating, base detonating. The entire system when fired ~~it~~ cannot be spin stabilised in flight. If it is spin stabilised the jet will not form ~~properly~~.

The correct stand off is required to obtain the required armour penetration. When the jet is formed it will start to break up as it slows. The tip of the jet will also start to flatten as it ~~breaks~~ ^{is slower} than as the jet travels as it is slowed by air resistance and the faster jet behind (initially the tip is the fastest part of the jet). The breakup of the jet and the flattening of the tip ~~is~~ reduce armour penetration. Having the correct stand off ensures that as the jet hits the target the jet is still relatively intact ~~to~~ provide the best penetration.



→ If the stand off is too close then the jet will not have time to form correctly and will be ~~is~~ not have the required effect on target

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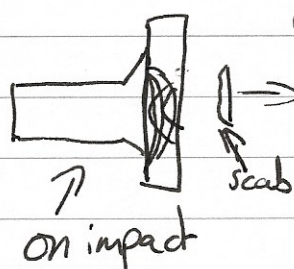
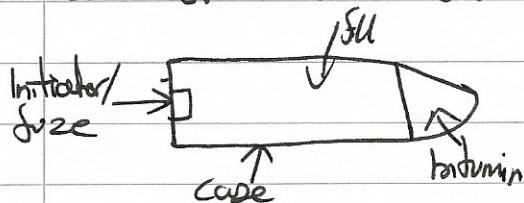
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Section B.2.
cont

A HESH (High Explosive Squash Head) round ~~is~~ isn't designed to penetrate a target but to create a "scab" on the inside of the target. When a round impacts the target the nose of the shell squashes onto the target. On impact the shockwave of the detonation is transmitted ~~into~~ into the target ~~and the inside of the target~~ causing spalling.

When designing a HESH warhead the ~~nose~~ ^{case} must be strong enough to survive the force of launch but the nose must be both ductile and ~~strong~~ strong enough to withstand the impact of the round on the target and deform sufficiently to allow the fill to get contact with the target.

The nose cannot be filled with explosive ~~as~~ but is often filled with a bitumin type material. The fill will be initiated from the rear, however unlike the shaped charge it cannot have anything on the nose to provide the initiation. Something such as an inertial ~~striker~~ ^{striker} or into a stab detonator would be required, and a booster ~~to~~ will be needed between the



det ~~fuse~~ and the fill to ensure it initiates