THE OPTIMISATION OF EXISTING HARDWARE AND NOVEL TECHOLOGIES TO DEVELOP A MULTI PLATFORM SOLUTION FOR BRITISH MAIN BATTLE TANKS (MBT'S)

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SUMMARY

- 80% common components with Rifled and Smoothbore variants
- HESH capability maintained for Rifled platform
- HESH capability introduced to Smoothbore platform
- Superior blast performance in both airburst and breach function
- Fragment MAE comparable with 155mm large calibre ammunition
- Interchangeable components, including payload.

The design changes suggested as an output from this research activity can confidentally deliver a smart munition that can surpass current 120mm smoothbore and rifled high explosive options without compromising the existing capability.

The modelling activity has identified that the common conception that the HESH will not work when fired from a smoothbore system is only in relation to flight stability, and not its terminal effect.

Although still not entirely effective against modern spaced or reative armour, this general purpose round will still offer a solution against personnel, light armoured vehicles and buildings, more effective than those already on the market. This gives the UK defense industry a large platform to demonstrate recently developed technologies and fly the flag for soverign capabilties and UK manufacture.

INTRODUCTION

The Challenger 2 MBT has a limited munitions portfolio with only long rod technology having suitable read across to smoothbore gun systems.

The High Explosive Squad Head (HESH), has decades of proven battle success but has never been transferred over to a smoothbore munition. Recent conflict means that current stocks are deminishing without a qualified manufacturing route for replenishment.

This research activity analyses the current munition and recommends subtle changes to allow the munition to function effectively from both old and new MBT's whilst also offering benefits to the design authority. This is done by utilising a large amount of common components, menaing the current manufacturer does not need to develop two seperate processes and the product can be available for CH2 before the roll out of CH3.

METHODOLOGY

The study started with a detailed look at the current 120mm HESH munition and the features that currently limit its use to rifled gun systems only.

End user interviews were conducted to determine how the current system is used, given the development of modern armour and the learnings from recent conflict.

This feedback was used to identify potential changes to the current build standard which would increase :

- Overall performance
- Versatility
- Market Attractiveness
- Adaptability

Predictive modelling packaged were used, as well as calculations based upon the scientific principles of OME to assess the effectiveness of the proposed changes.

Current 120mm Smoothbore solutions were used to compare the predicted results.

Predictive toolsets used include Split-X, Autodesk CFD, Fi-Blast and ABAQUS

MAIN GOALS

The main goals of this research activity were to :

- Develop an interchangable Driving Band solution for both Gun Systems - Using the existing geoemtry
- Redesign the existing system to allow for the maximum amount of common components
- Demonstrate flight stability of a fin stabilised variant of the 120mm Hybrid
- Demonstrate maintained "Squad Head" capability over both platforms
- Predict the performance of the product in several other engagement scenarios
- Utilise novel technologies currently under develop in the UK

MARKET SHARE

A published market study was carried out and it was determined that the 120mm smoothbore market was the second largest munitions market, behind only155mm ammunition during the ongoing invasion of Ukraine.

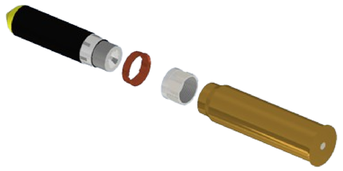
This presents a new opportunity for UK defense contractors as this market is currently dominated my the USA and Germany.

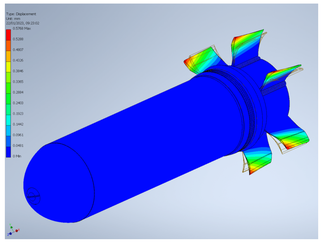
AREAS OF RESEARCH

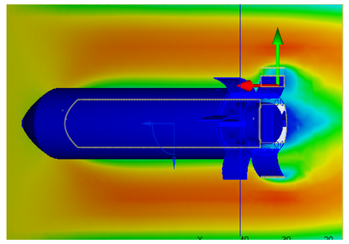
COMMON COMPONENTS

Utilising 80% of the same components as well as the development of a new, non destructive driving band mounting solution allows for the manufacturer to build the munition core independantly with no difference between the Smoothbore or rifled round. A Common fuse - that no longer detects spin - is fitted within these common components with only the driving band and base nut being interchangable. Stress calculations and modelling confirmed that the solution was capable of gun launch survival and rifling engagement.

The base nut includes Excaliber inspired, spring loaded fins to aid aerodynamic stability during flight. These fins were optimised using Autodesk Inventor and Autodesk CFD to ensure a static margin of one full caliber.





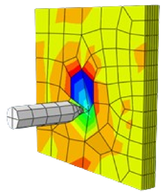


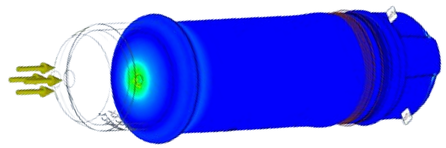
Other Notable Areas of Research, Development of Re-design Include :

- Nose form - Semi Armour Piercing Design to aid versatility by offering soft target breaches. Removal of the inert nose bad does hamper "Squash" performance but benefits include additional payload and strengthened nose section for bunker breaching.
- Inductively Set - Electronic Fuzing - Common component across both designs and offers the ability to be programmable through the firing control system. Functions include Air Burst, Point Detonation and Delay.
- Parallel Walls - To Allow for drop in Charges that can be removed because the rear end, re-entry features have been removed. This allows for in service payload upgrades and also removes the need for disposal if the payload becomes damaged. The Parallel wall also provides a far more predictable fragmentation pattern.
- Flexing Fins - The fins were deliberately designed to include weak points that allowed them to sit around the radius of the base - and therefore fit within the charge case - but would push flat under the incoming forces during flight.

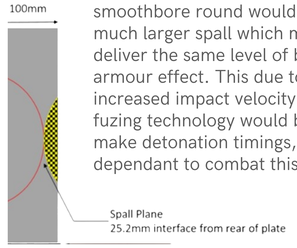
PERFORMANCE

The design changes, paired with new fuzing technology can offer several mechanisms that the existing round cannot do. These include airburst and point detonation. Firstly however, it was important to see if the HESH can still function as originally designed :

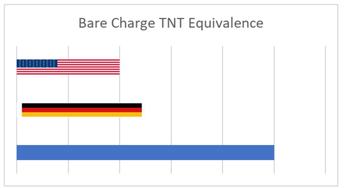




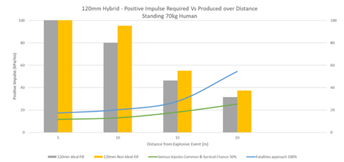
Although the scab diameter was reduced due to the removal of the inert pad, the corresponding impact and detonation waves still interacted. This formed a spall plane at 25.3mm from the rear face of a 100mm thick RHA target, during an ABAQUS simulation. This is consistant with decades of live firing evidence.



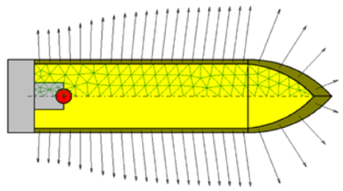
Under the same conditions, the smoothbore round would return a much larger spall which may not deliver the same level of behind armour effect. This due to the increased impact velocity. Smart fuzing technology would be need to make detonation timings, velocity dependant to combat this.

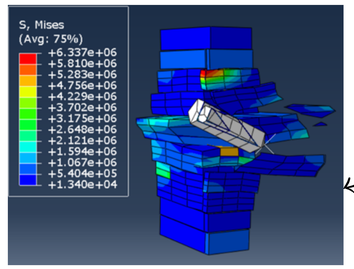


The Hybrid solution also provides a much higher bare charge TNT equivalence than both American and German alternatives.



This increased blast potential offers superior pressure impulse figures at range which increases effectiveness, especially when being functioned post structure breach, in an enclosed space.





Split-X was used to predict the fragmentation pattern and mass distribution. The throw angles were calculated at a range of velocities including residual velocities, post breach.

Multiple mean areas of effect (MAE) were calculated for Standing Personnel and Infantry Fighting Vehicles (IFV)

A NOVEL MULTI-PURPOSE, MULTI-PLATFORM MUNITION WITH SUPERIOR PERFORMANCE AND VERSATILITY