

WASC 2016

WAI 504

Gun Propellants

RO Explosives

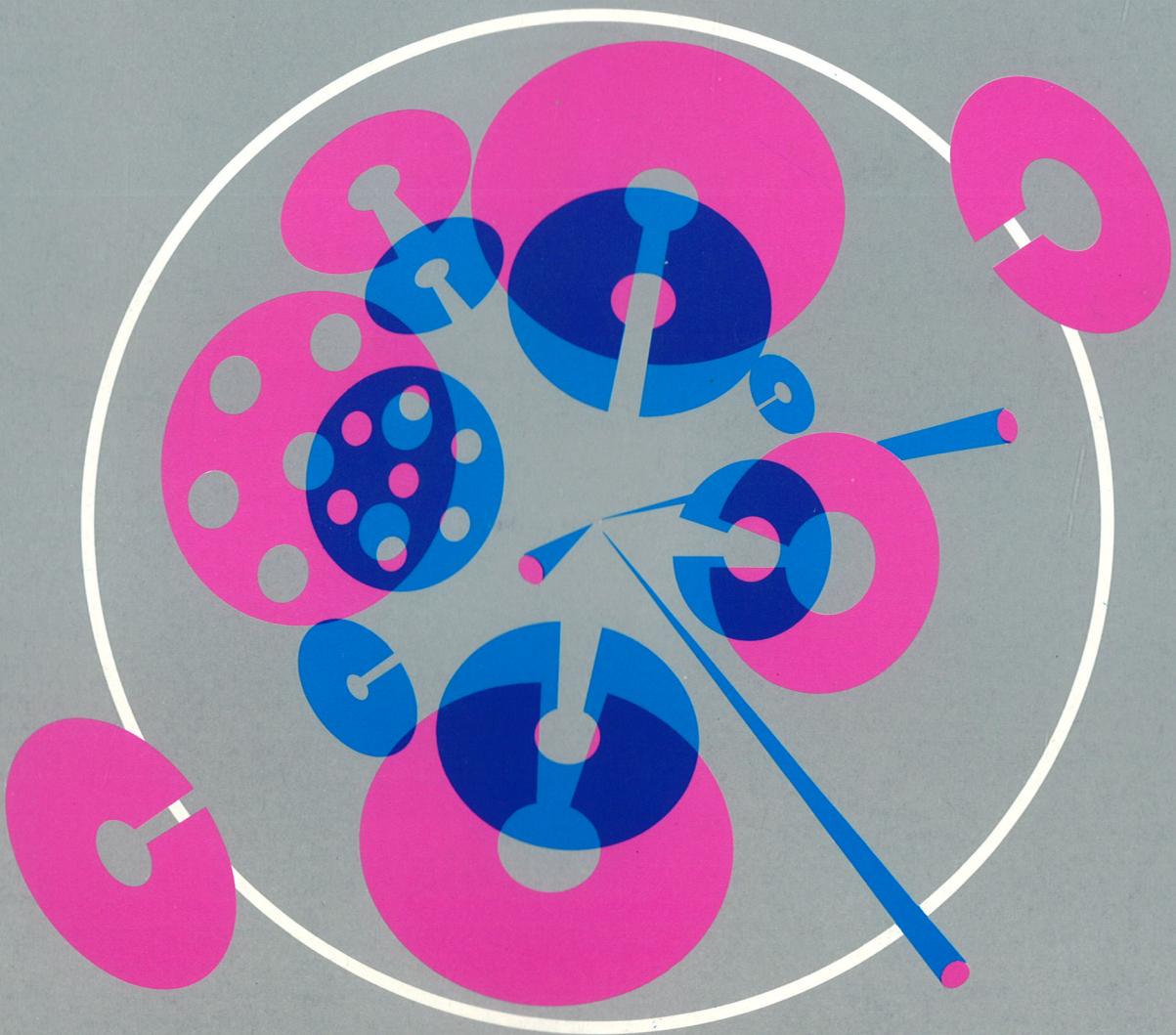
Division

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WASC 2016.
WAI 504

Gun propellants

A unique, integrated facility



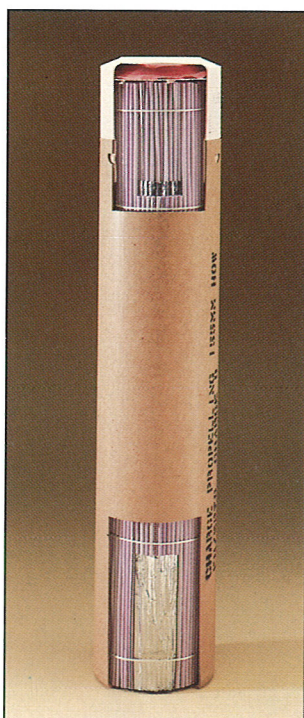
ROYALORDNANCE

Defence systems, sub-systems and components

Gun propellants and combustible charge containers

Royal Ordnance Explosives Division is the biggest UK producer of gun propellants and combustible charge containers for medium and large calibre propelling charges. Manufacture is centred at Royal Ordnance Bishopton, which also undertakes propelling charge design, development and manufacture. Royal Ordnance Waltham Abbey is responsible for research and development of propellant formulations. This integrated facility for propellant research, charge design, development and production is unique in the world.

155mm propelling charge, showing combustible charge container and slotted tubular stick propellant.



Loading of propelling charge for 120 mm APFSDS ammunition, developed by Royal Ordnance Explosives Division.



A range of stick and granular propellants – produced by strictly controlled manufacturing processes to give consistent performance over the service temperature range.

Gun propellant compositions

Explosives Division has developed a comprehensive range of double base, triple base and nitramine propellant compositions, which provide the propelling charge designer with a wide and varied range of propellant properties to fit the required propelling charge performance criteria.

- isochoric flame temperatures 2100°K–3600°K
- force constants 8.85 MJ/kg–1.26 MJ/kg
- linear burning rate coefficients 0.05 cm/MPa–0.26 cm/MPa

Using the high standard of expertise and facilities at Royal Ordnance Waltham Abbey, Explosives Division is continuing to research and develop new propellant compositions for specific performance criteria optimisation.

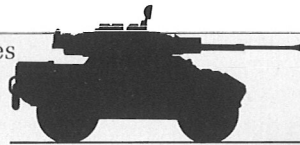
Applications and calibres

Applications and calibres currently in production or under development include:

Land

Calibres

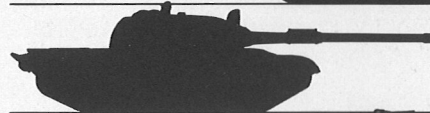
Armoured Fighting Vehicles



30mm



76mm



105mm



120mm



165mm

Artillery weapons



105mm



155mm

Mortar systems



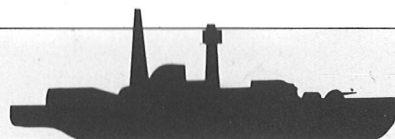
51mm



81mm

Sea

Naval guns



4.5 ins

Air

Aircraft guns



25mm

30mm

Explosives Division offers a comprehensive propellant range to customers worldwide who wish to benefit from the unparalleled Royal Ordnance technical performance and quality.

In addition to these products, Explosives Division has the proven capability to design and develop propellants and components for customers' particular requirements or to manufacture to customers' specifications.

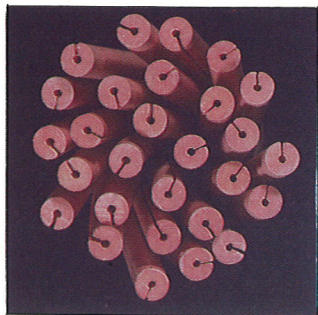
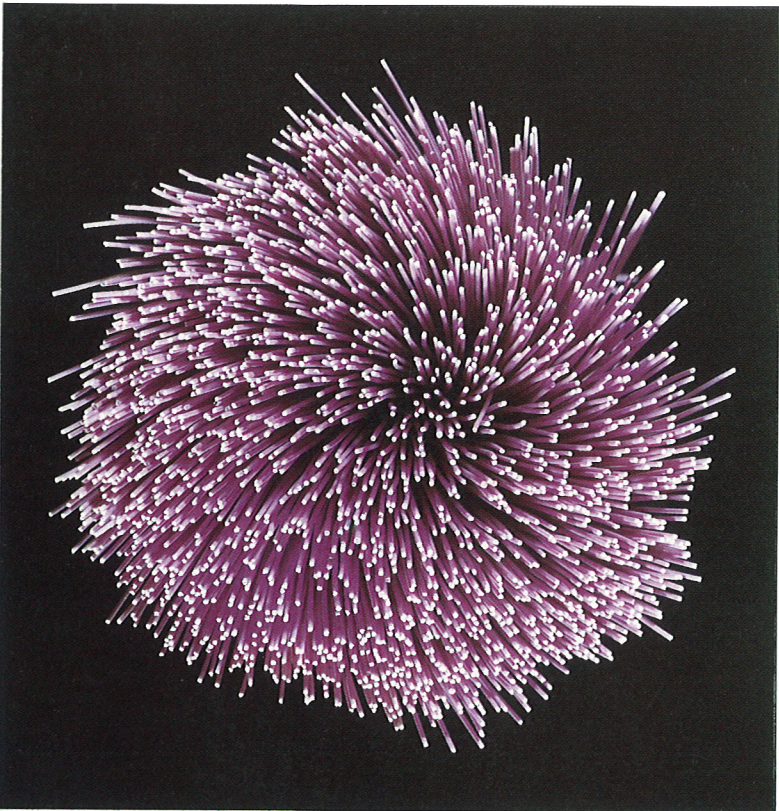
High performance stick propellants

Due to the continued quest for improved technical performance, the new generation of tank and artillery guns is much less tolerant of the charge system employed than are the equipments they will replace. Ammunition for these new guns is required to afford a high and consistent level of performance in terms of penetration or range and associated charge systems must operate within strict tolerance bands, with each element carefully optimised to achieve the overall effect. Stick propellant forms an essential constituent of such charge systems, since it displays a regularity of performance, with smooth ignition characteristics and freedom from pressure waves.

In the United Kingdom the virtues of stick propellant have long been recognised. Although they are more difficult to manufacture than the granular types which have found favour elsewhere, stick propellant has almost completely displaced granular from British charge systems. This approach, combined with expert process control, has made possible the development by Royal Ordnance of highly successful tank and artillery charge systems, particularly for 120mm and 155mm equipments, the excellence of which is universally recognised.

A gun and its ammunition are designed to operate at a specific temperature, usually around ambient, but the system must perform safely and effectively over a range of climatic environments. This in particular demands propellant systems which display low temperature coefficients and which are highly resistant to shatter at subambient temperatures. Explosives Division has developed stick propellants with meticulous care in design and manufacture, choice of geometry and formulation, control of dough rheology, refinement of die design and optimisation of pressing conditions to achieve consistent and regular ballistics over worldwide climatic conditions.

Solid cord stick propellant. ▼



Slotted tubular stick propellant. ▲

▶ Artillery ammunition performance in the 105 mm Light Gun is improved by stick propellant formulations.



High quality granular propellants

Many equipments still in service accept only granular propellant charges. The standard of both performance and safety of these equipments depends very directly on the quality of the propellant employed. Selection of a granular propellant made to the same high standards of manufacturing control which Explosives Division has evolved for high performance stick propellants is highly advantageous. Granules made in this way also display the favourable temperature coefficients and resistance to shatter, characteristics which make a major contribution to ballistic regularity. Royal Ordnance Explosives Division has retained the capability to produce granular propellants on a large scale including those of both British and M30 compositions.



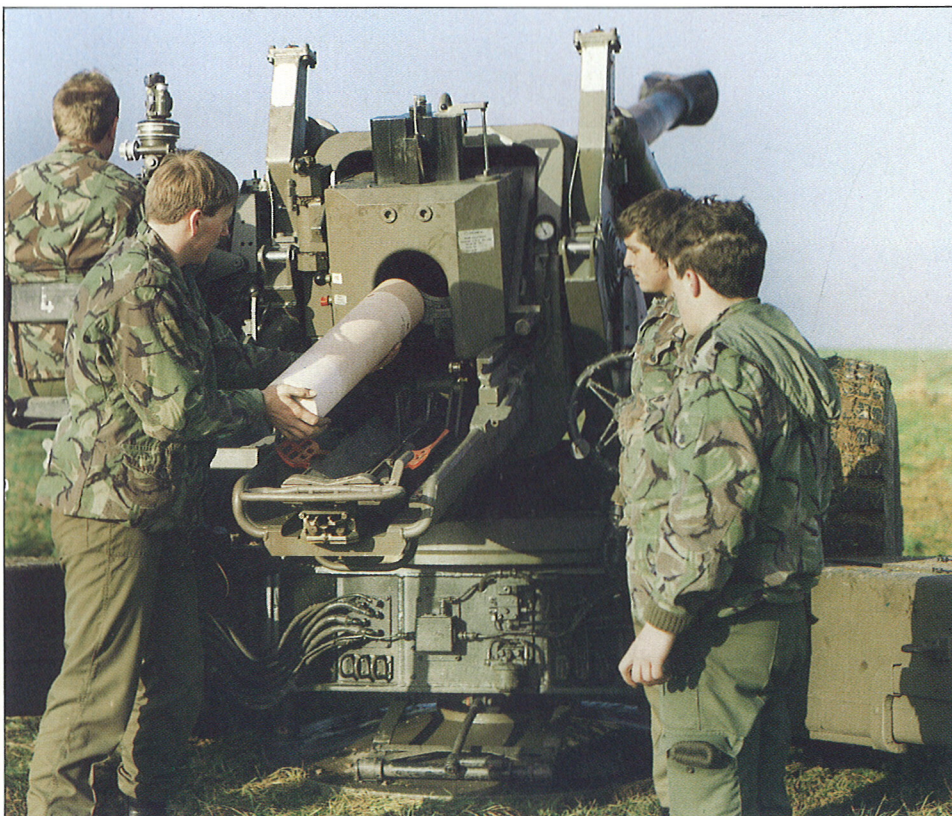
Multi-tubular granular propellant.

Combustible charge containers

Combustible charge containers are gradually replacing bags and metal cases (by use of a stub case) as charge containers. Designed and manufactured to burn without debris, they provide an optimum rate of fire and improved safety of operation. Gun barrel erosion is minimised by the inclusion of wear-reducing additives. Combustible cases provide exceptionally good protection to the contents of the charge during logistic and tactical transportation and from rough usage by the gun crew or detachment. Various compositions and complementary manufacturing techniques are used to design and produce a range of containers and components with the required physical and ballistic properties.



Combustible charge containers.



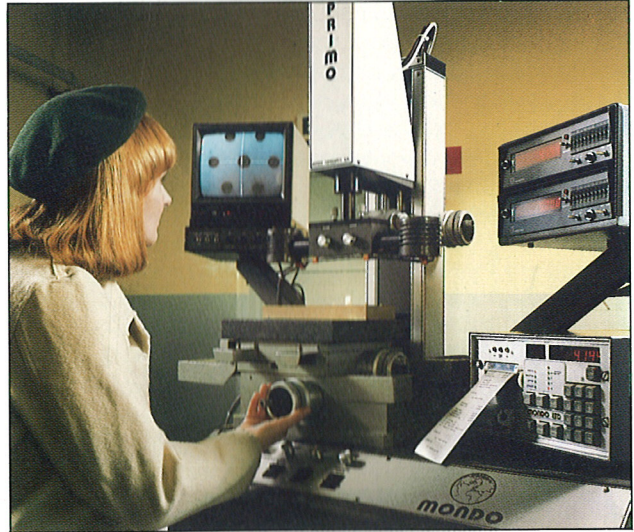
GBT155 uses highly successful artillery charge systems by Royal Ordnance.

Loading of propelling charge BIS14 in FH70. The robust nature of combustible charge containers facilitates both transport and handling.

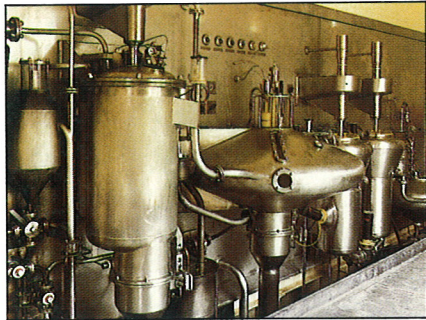
Quality

Quality control of propellants and their ingredients at all stages of manufacture is vital to ensure regular and safe ballistic performance. Explosives Division is equipped with the latest technology and systems to maintain its reputation for reliable products, including extensive chemical and physical laboratories and a computerised closed vessel system. Production and design and development facilities are approved to meet the requirements of Defence Standard 05-21 and AQAP 1.

Dimensional measurement of granular gun propellant during quality control processes.



Strict quality control is also applied to the production of intermediate materials, such as in the automatic continuous nitroglycerine plant.



Control console for research into new methods of instrumented propellant mixing.

Research and Development

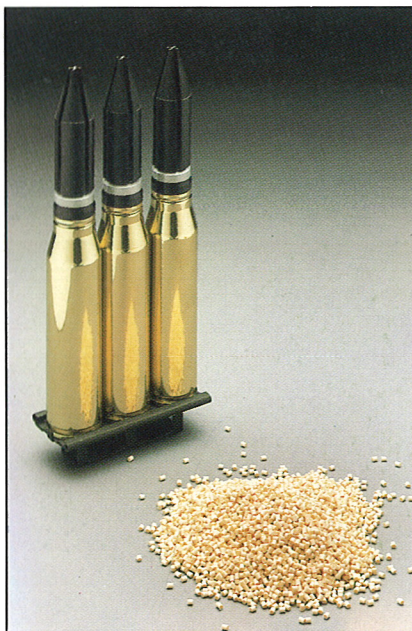
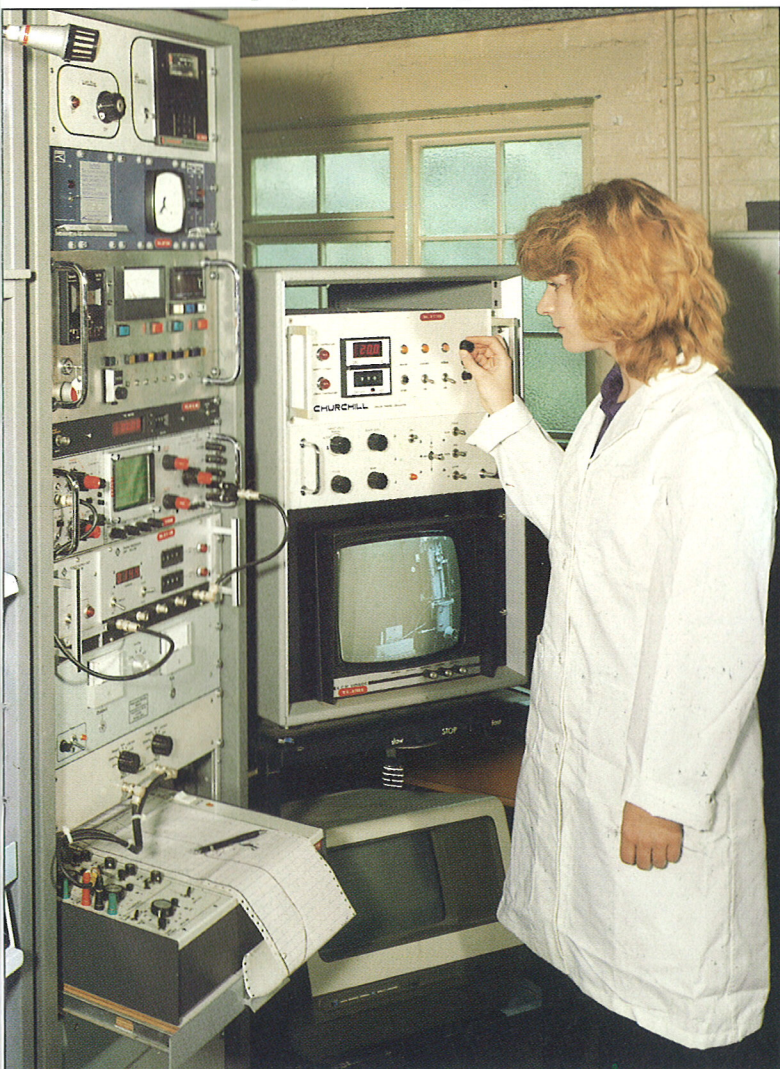
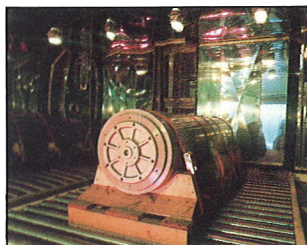
Royal Ordnance Explosives Division's ability to keep at the forefront of technical performance of propellants, combustible charge containers and propelling charges is due to its commitment and involvement in research and development.

Explosives Division has the resources and ability to undertake all aspects of gun propellant charge design, including:

- technical feasibility studies
- new composition research in the fields of propellant and combustible charge containers
- propelling charge design utilising computer modelling of propellants, combustible charge containers and ignition system
- process development and development scale manufacture of propellants, combustible charge containers and propelling charges
- development trials
- environmental testing
- full project management
- post design services

We are always interested in talking to individual customers about their specific requirements, whether it be improved performance of existing ammunition, or the design and development of propelling charges for new projectiles or weapon systems.

Environmental test facilities include hot and cold climatic chambers.



▲ Granular propellant for 30 mm Rarden APDS ammunition was researched, designed and developed by Royal Ordnance Explosives Division.

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