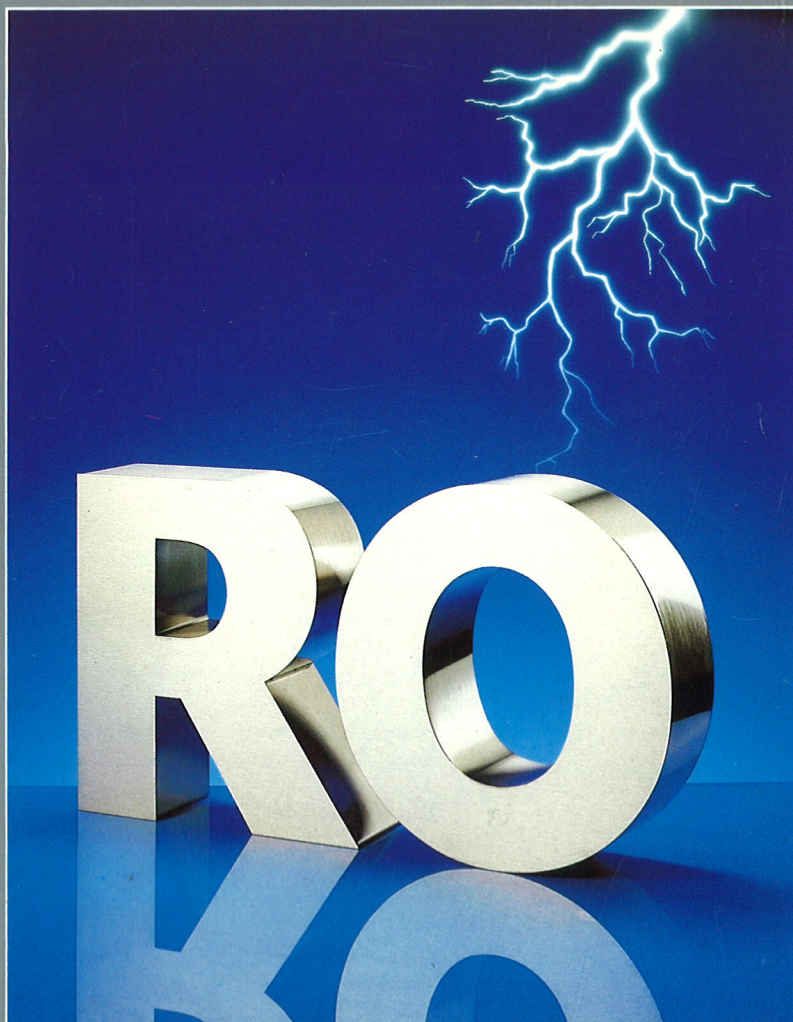


WASC 2103
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Royal Ordnance
'Product Guide'

PRODUCT GUIDE



ROYALORDNANCE

Defence systems, sub-systems and components

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OVERVIEW

Company Organisation

Royal Ordnance is organised on a product basis related to market needs. It comprises a holding company with two Divisions, each of which has three Systems Directors totally responsible for specific groups of products.

These are:

Naval, Air and Engineering/Vehicles Division

- Naval Systems Director
- Air Systems Director
- Engineer/Vehicle Systems Director (also responsible for explosive stores and bridging equipment)

Land Weapons Division

- Director Weapon Systems Director (also responsible for land, pyrotechnics and internal security stores)
- Indirect Weapons System Director
- Land Guided Weapons Director

There are also corporately based Sales and Research and Development organisations assisting in the development of a market-related product range and in product sales and promotion. In the USA, there is a wholly owned subsidiary company, RO USA, which has a marketing and support role. In addition:

- The Future Systems Group located at the UK Royal Military College of Science is able to offer advice on future weapons systems development both with the company and direct to customers.
- A comprehensive after-sales service for many Royal Ordnance and other products is available from the Product Support Group located within the Nottingham site.
- The Technology Centre at Clydebank can also offer customers a widely based technology transfer service for the entire company.

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105 mm TANK AMMUNITION



The ammunition includes kinetic and chemical energy rounds, providing an excellent performance against all types of target. All natures are fixed rounds with the projectiles attached to a brass cartridge case containing the propellant and electric primer.

Armour-piercing round

The armour-piercing discarding sabot (APDS) round is also used for attacking armour and is similar to the APFSDS in concept and operation, but the penetrator is not fin-stabilised.

DS practice round

The discarding sabot practice (DS Prac) round is a less expensive practice round representing APFSDS and APDS. It consists of a steel projectile with a light alloy nose, mounted in a sabot similar to the APDS. This round matches the APDS ballistically up to 1100 m, and matches the APFSDS trajectory at 2000 m, using the same sighting equipment. It has little penetrative effect and a much smaller safety trace on the ranges.

Fin-stabilised round

The armour-piercing fin-stabilised discarding sabot (APFSDS) round is the main 105 mm round for the attack of armour. It consists of a long rod-shaped monobloc penetrator of dense tungsten alloy which is stabilised in flight by extruded aluminium alloy fins. The penetrator is mounted in a light alloy sabot. The high velocity and flat trajectory increase accuracy. Once outside the muzzle of the gun, the penetrator separates from the sabot and concentrates a large amount of kinetic energy over a small area at the target. The penetrator geometry ensures a balanced performance against

the wide range of targets to be encountered under battlefield conditions.

High-explosive round

The high-explosive squash-head (HESH) round is a general-purpose round with a thin-walled blunt nose. It is filled with a rapidly detonating high-explosive initiated by a base fuze. On impact with the outer surface of vehicle armour it causes a large scab to fly off the inner surface at high velocity. It is effective against armoured targets, concrete fortifications, buildings and soft vehicles. Against troops in the open or under light cover, the effect is only a little less than that of a nose-fuzed HE shell.

SH practice round

The squash-head practice (SH Prac) round is an inert practice round for training purposes. It has the same empty body as the HESH, but is filled with an inert HE substitute. In the most common version the SH Prac is fitted with a base fuze together with a flash pellet to give a good visible indication of point of impact, but designs are available for an entirely inert projectile.

Smoke round

The smoke base ejection (Smoke BE) round uses a base ejection shell. A time fuze ignites and ejects three canisters filled with a smoke mixture from the base of the shell at the required point in flight. These fall to the ground, burning and discharging dense clouds of smoke for 50 seconds. The smoke screen builds up more slowly than that from a white phosphorus bursting shell, but lasts longer and usually keeps closer to the ground.

Projectile designation	APFSDS-L64	APDS-L52	DS Prac-L63	HESH-L35	SH Prac-L38	Smoke BE-L39
Complete round weight (kg)	18.91	19.11	14.91	21.23	21.23	26.35
Projectile weight (kg)	6.12	6.48	3.91	11.25	11.26	19.60
Nominal propellant weight (kg)	5.62	5.60	3.97	2.81	2.81	0.40
Propellant type	LM 1900	NQ/M12	NQ/M07	NH033	NH033	WM04
Explosive Weight (kg)				2.17		

ROYALORDNANCE
Defence systems, sub-systems and components

120 mm TANK AMMUNITION



Projectile designation	HESH-L31	APFSDS-L23	APDS-L15	Smoke L34	SH Prac-L32	DS Prac-L20
Charge propelling designation:	L3	L8	L4	L3	L3	L5
Charge container type:	Bag	Combustible case	Combustible case	Bag	Bag	Combustible case
Projectile weight (kg):	17.86	7.89	10.36	17.36	17.10	5.82
Nominal propellant weight (kg):	3.04	6.65	8.40	3.04	3.04	5.16
Propellant type:	NQ/S27-09	AX/S64-20	NQ/S53-12	NQ/S27-09	NQ/S27-09	NQ/S27-09
Explosive weight (kg):	4.10					

The 120 mm ammunition has been designed for one of the most powerful tank guns in the world, the 120 mm tank ordnance L11, which is mounted on the Challenger and Chieftain main battle tanks. The range of ammunition available includes both kinetic and chemical energy rounds, providing an excellent performance against all types of targets. The projectile and propelling charge are loaded separately.

Armour-piercing discarding sabot shot

Armour-piercing discarding sabot (APDS) shot is the main tank projectile for the attack of armour. The shot consists of a sub-projectile containing a dense tungsten alloy core mounted in a light alloy sabot.

Performance

Its high muzzle velocity and flat trajectory give a short time of flight and a high probability of a first-round hit. It can penetrate most current main battle tanks at normal battle ranges.

A less expensive practice shot representing APDS (DS Prac), which matches it ballistically up to about 1100 m, is available for training purposes. It has little penetrative effect on armour and a much smaller safety trace on ranges.

Fin-stabilised shot

The armour-piercing fin-stabilised discarding sabot (APFSDS) shot complements the APDS shot as the main projectile for the attack of armour. It consists of a long rod penetrator of dense tungsten alloy which is stabilised during flight by aluminium fins.

Performance

Its accuracy is similar to that of APDS but it has an increased penetrative effect on armour. DS Prac can still be used for training purposes.

High-explosive squash head shell

The high-explosive squash-head (HESH) shell is a general-purpose high-explosive shell fitted with a base fuze. On impact with the outer surface of an armoured vehicle, this round causes a large scab to fly off the inside surface at great velocity, causing widespread internal damage.

Performance

As well as having a good anti-armour performance, this round is very effective against concrete fortifications, buildings and soft vehicles. Against troops in the open or under light cover, the effect is only slightly less than that of a nose-fuzed HE shell.

An inert shell filled with HE substitute (SH Practice) is available for training purposes. The most common version is entirely inert but designs are also available in which a live fuze is fitted together with a flash pellet to give a good visible indication of the point of impact.

Smoke shell (WP)

This is a bursting type of smoke shell filled with white phosphorus and fitted with a base fuze. It produces a dense white smoke screen very rapidly. The shell is designed to have the same ballistic characteristics as HESH, so the propelling charge and sighting arrangements are common.

Charge system

Until recently bag charges were supplied for all natures, but combustible case charges (CCC) are now available for use with APFSDS, APDS and DS Prac projectiles. These CCCs appreciably increase barrel life, improve ignition regularity and make handling easier.

ROYALORDNANCE
Defence systems, sub-systems and components

76 mm AMMUNITION



The 76 mm ammunition system was designed for the L5 gun fitted to the Saladin armoured car. It is now used with the L23 gun which is the lightweight weapon fitted in the highly successful Scorpion light tank. The ammunition is available as a complete system. All natures are fixed rounds, with the projectiles being attached to a brass cartridge case containing the propellant and percussion primer.

High-explosive round

The high-explosive squash-head (HESH) round is the general-purpose anti-hard target high-explosive round with a thin-walled blunt nose filled with a rapidly detonating high-explosive initiated by a base fuze. On impact this round causes a large scab to fly off the inner surface of the armour at high velocity. It is also effective against concrete fortifications, buildings and soft vehicles. Against troops in the open and under light cover it is only a little less effective than a nose-fuzed HE shell. This round also has a very good graze performance. A modified HESH round for removing excess copper from the barrel rifling can be supplied.

An inert shell (SH Prac) is available for training purposes. The most common version is entirely inert, but designs are also available in which a live fuze is fitted together with a flash pellet to give a good visible indication of point of contact.

Projectile designation	HESH-L29 Decoppering-L44 SH/Prac-L40	HE-L24 HE/Prac-L25	Smoke BE-L32	Illuminating-L42	Canister-L33
Complete round weight (kg)	7.42	7.34	10.20	9.69	6.69
Projectile weight (kg)	5.40	5.36	8.52	8.81	4.64
Nominal propellant weight (kg)	0.61	0.57	0.27	0.27	0.64
Propellant type	NQ/M028	NQ/M07	FNH/M04	FNH/M04	NQ/M07

High-explosive round

The high-explosive (HE) anti-soft target round is designed for the general support of infantry. It is fitted with a nose fuze which explodes on impact. Optimum performance is obtained by using a high-tensile steel for the shell body which bursts into the maximum number of fragments moving at a high velocity.

An inert shell (HE Prac) is available for training purposes.

Smoke base-ejection round

The smoke base-ejection (smoke BE) round is fitted with a time fuze and ejects three canisters at a selected point in flight. These fall to the ground, emitting dense clouds of smoke for 50 seconds. The smoke screen builds up more slowly than that from a white phosphorus bursting shell, but lasts longer and usually keeps closer to the ground.

Illuminating round

This round contains a star case and parachute in a modified smoke shell. The time fuze ejects the flare at the appropriate elevation; it then burns suspended from the parachute providing illumination for a minimum of 30 seconds.

Canister round

For engaging massed infantry attack at close quarters, this round consists of a thin-walled cylindrical body filled with steel pellets. The pellets spread out after leaving the gun muzzle and are highly lethal to a range of about 100 m.

ROYAL ORDNANCE
Defence systems, sub-systems and components

105 mm LOW RECOIL FORCE TANK GUN, TURRET SYSTEM



Royal Ordnance and the Cadillac Gage Company have combined technologies to develop an advanced 105 mm low recoil force gun and turret system for mounting on light combat vehicles. Without sacrificing strategic or tactical mobility, this new weapons system enhances the staying power and armour-defeating capabilities of rapid deployment and other light armoured forces.

The main ordnance for this system is the combat proven 105 mm L7 gun complete with cradle and a specially designed recoil system to soften the force exerted at the trunnions. This means that the full lethality of the most modern kinetic energy ammunition can be effectively fired from a lightweight chassis without unacceptable dynamic response of the vehicle.

Specification

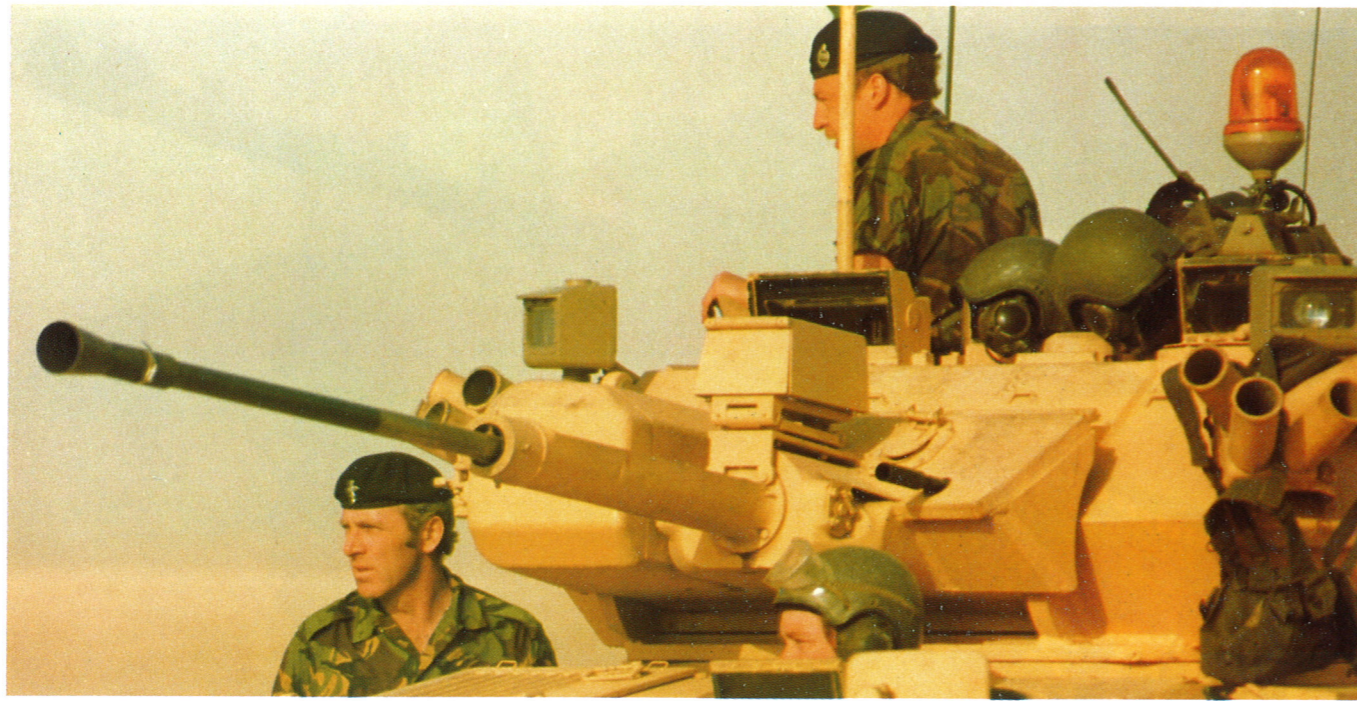
Calibre:	105 mm
Weight of gun and turret, combat-ready:	4740 kg
Weight of elevating mass:	1932 kg
Length of elevating mass:	6753 mm
Rate of fire:	6 rounds per minute
Muzzle velocities (m/s):	APFSDS 1490 APDS 1426 HESH 730 DS/T practice 1540 smoke 258 SH practice 730

Although the 105 mm low recoil gun and turret system is designed initially for mounting on appropriate commando vehicles, it can easily be fitted to the M41, M47, M551, several T-series tanks and several wheeled vehicles.

The weapon system has been fully tested and successful firing trials of the complete gun and turret system fitted to lightweight vehicles has resulted in high levels of confidence in the system performance.

ROYAL ORDNANCE
Defence systems, sub-systems and components

RARDEN 30 mm GUN



The Rarden 30 mm gun is manufactured by Royal Ordnance to perform at the highest standards of accuracy and reliability. With a small inboard volume, low trunnion load and lightweight, it is particularly well suited as the main armament for tracked or wheeled light reconnaissance vehicles and armoured personnel carriers. It is designed with features which enable easier mounting in vehicle turrets than smaller guns, even those down to 20 mm calibre which are belt fed.

MAIN FEATURES

- Accuracy
- Reliability
- Ease of mounting
- Low weight
- Flexibility of application
- Low toxicity
- Armour-piercing ammunition

To ensure the defeat of future armoured targets, greater lethality and an economic use of ammunition are required. Rarden 30 is specifically designed to cope with mass attacks using the minimum number of shots at the greatest range. It has three main roles, attacking armour, soft targets and aircraft, mainly slow low flying spotters and helicopters.

TECHNICAL DATA

Rear Loading

Rear loaded with clips of 3 rounds.

Firing Modes

Two modes, repeat and automatic.

Breech Operation

Breech, recoil and feed mechanisms enclosed within casing.

Low Toxicity

Empty cases are ejected forward and out of the turret, products of combustion vented into the atmosphere through ejection opening.

Inboard Length

Transverse sliding breech block incorporated to provide maximum recoil stroke within minimum gun length. Short inboard length achieved by clip loading controlling all operational requirements from rear of the weapon.

Trunnion Load

Long recoil action, hydraulically buffered provides low trunnion load and recoil forces.

Operation

Self-loading weapon firing from a closed breech with repetition and automatic fire capability.

Rifling

18 grooves, uniform right-hand, 6°.

Breech Mechanism

Horizontal sliding block with rolling cam action.

Firing Mechanism

Percussion, spring energised hammer.

Recoil Mechanism

Hydraulic with compressed air recuperator.

Current Applications

Fox, Scimitar, and MCV80 vehicles.

DIMENSIONS

Calibre:	30 mm
Overall length:	3150 mm
Inboard length:	430 mm
Width:	335 mm
Depth:	256 mm
Overall weight:	110 kg
Barrel weight:	24 kg
Barrel length:	2438 mm
Recoil length:	317.5 mm
Cyclic rate of fire:	90 rpm
Trunnion load:	13.34 kN
AMMUNITION	APDS
Muzzle velocity:	1175 mps
Complete round wt:	837 g
Projectile wt:	300 g
Nominal propellant wt:	150 g
Propellant type:	DXM07/NQ M06
HE, APSE, TP rounds also available.	

ROYALORDNANCE
Defence systems, sub-systems and components

5.56 mm ENFIELD WEAPON SYSTEM^(TM)



The new Enfield Weapon System is designed to equip the modern infantry man with a family of two weapons with common ammunition. Both give the infantryman increased mobility and flexibility combined with improved and effective single shot or automatic fire strike capability. Their compact construction and rugged dependability make them the complete weapon in combat efficiency.

The Individual Weapon

This weapon is designed to be a replacement for the conventional rifle and sub machine gun. The accuracy of the rifle is retained in the single shot mode with the short range fire-power of the sub-machine gun. Firing is from a closed breech in both modes. Ammunition feed is from a standard 30 round magazine.

The Light Support Weapon

The weapon is similar to the I.W. except that a longer barrel and a bipod are incorporated to give an increased range performance and a better rapid fire capability. The 30 rd. magazine, all major sub-assemblies and many components are interchangeable with the I.W. A mechanism operating from a rear sear is also available.



Technical Data

	Rifle	Machine Gun
Calibre:	5.56 mm	5.56 mm
I.W.:		L.S.W.
Weight (kg)		
Weapon (less Magazine and Optical Sight):	3.8	5.6
Sight Optical:	0.7	0.7
Sight Iron:	0.3	0.3
Empty Magazine:	0.12	0.12
Loaded Magazine:	0.48	0.48
(filled with)	(30rds)	(30rds)
Weapon (complete with Sight and loaded magazine):	4.58/4.98	6.18/6.58
Length (mm)		
Weapon:	785	900
Mechanical Features		
Firing Modes:	S.S.&Auto	S.S.&Auto
Method of Operation:	Gas	Gas
Type of Locking:	Rotary Bolt Forward Locking	Rotary Bolt Forward Locking
Method of Feed:	Magazine	Magazine
Ammunition		
Calibre (mm):	5.56	5.56
Types:	Ball Tracer Blank	Ball Tracer Blank
Round Weight (g):	12	12
Firing Characteristics (approximate)		
Muzzle Velocity (m/s):	940	970
Recoil Energy (joules):	4	4

ROYALORDNANCE
Defence systems, sub-systems and components

ENSIGN RIFLE®



The Ensign rifle® is the latest in the family of infantry weapons designed, developed and manufactured by Royal Ordnance Enfield, collectively known as the Enfield Weapon System.

Purpose

Careful design has ensured that many parts are common with those of the individual weapon, while meeting the special needs of cadet forces for a training weapon and inhibiting unlawful conversion to automatic fire.

The Ensign is a hand-operated weapon fed from a ten-round magazine, but compatible with both 20- and 30-round magazines. The affinity of the Ensign to other members of the EWS family renders it an ideal instruction weapon for drill and tuition purposes.

Features

The Ensign rifle® is accurate and of proven military design. Its low recoil force and short length make it most appropriate to the average cadet physique.

Despite its low weight the Ensign is very robust. All furniture is self-coloured. It is also easy to handle strip and clean. The carrying handle incorporates an adjustable sight. A 0.22-inch adaptor is available, as is a non-firing version for drill purposes.

Specification

Weight Weapon (complete with sight and loaded magazine):	4.1 kg
Length overall:	755 mm
Length of barrel:	495 mm
Firing mode:	single-shot
Type of locking:	Rotary bolt, forward locking
Method of feed:	10-, 20- or 30-round magazine
Ammunition calibre:	5.56 mm
Ammunition types:	Ball, tracer, blank, low velocity training round
Wt. per round:	12 g
Muzzle velocity:	900 m/s
Recoil energy:	4.5 joules

ROYALORDNANCE
Defence systems, sub-systems and components

7.62 mm GENERAL PURPOSE MACHINE GUNS



7.62 Machine Guns produced by Royal Ordnance form a family of weapons for a variety of specific purposes, including:

- L7A2 - as an infantry weapon in the light machine gun and sustained fire machine gun rôles, bipod or tripod mounted.

When pintle mounted the L7A2 is also used as a policing weapon in Patrol Boats, helicopters and personnel carriers.

- L8A2 - a derivative of the infantry weapon developed for use in Armoured Fighting Vehicles.

- L37A2 - suitable for use on Armoured Fighting Vehicles, Scout cars and Armoured Personnel Carriers.

- L42A1 - a ranging gun mounted co-axially with the 76 mm main armament of the Scorpion Light Tank.

Technical Data

Overall weight:	L7A2 10.9 kg (24 lb)
Overall length:	1230 mm (48.5 in)
Barrel length:	629 mm (24.8 in)
Rifling type:	Conventional
Rifling grooves:	4
Rifling twist:	1/305 mm RH (1/12 in)
Trigger pull:	3.6 to 6.3 kg (7.9 to 13.9 lg)
Method of operation:	Gas
Type of locking:	Dropping link - rear locking
Type of fire:	Auto
Feed system:	200 round disintegrating belt
Rate of Fire:	650 to 900 rounds per minute
Muzzle velocity:	800 m/sec (2627 fps)
Calibre:	7.62 mm
Ammo types:	Ball-tracer-blank
Round weight:	24.6 gm
Effective range:	1800 m

ROYALORDNANCE
Defence systems, sub-systems and components

7.62 mm CHAIN GUN®



After extensive and rigorous trials, the 7.62 mm Chain Gun® weapon has been selected by the British Ministry of Defence for fitting into tracked and wheeled Armoured Fighting Vehicles. It is also designed for helicopters, light aircraft and ships, with its external power source making it particularly suitable for remotely controlled installations. As the weapon functions independently of ammunition ballistics, system malfunctions and other defects are reduced. Misfires are extracted and then ejected, and the powerful electric motor is more than capable of lifting and feeding an unsupported 400-round belt. A simple mounting bracket allows the weapon to be positioned radially to suit ammunition feed requirements or other vehicle internal constraints.

Because empty cases are ejected forward out of the turret, the gas build up in the vehicle produced by firing the weapon is negligible. Evaluation trials have shown that the level of toxicity from a Chain Gun® machine gun is less than 5% that of a conventional weapon. Tests conducted in an MBT produced no discomfort to the crew after firing 2,000 rounds with the ventilation switched off. NBC equipment specifications may therefore be 'down-graded' for new vehicles employing a Chain Gun® system. In-service AFVs may be easily updated with this highly reliable armament, because of its simple installation requirements, short in-board length and general configuration. It will also extend the service life and improve the efficiency of existing NBC systems.

Ammunition and Firing Characteristics

Ammunition Standard NATO 7.62 mm x 51 mm disintegrating linked belt.

Type	Ball Ball: Tracer 4:1 Armour piercing Blank, Dummy, Inspection.
Weight of round:	393 g
Rate of fire:	520 rounds per minute at 24 volts
Accuracy	100% dispersion 2.54 mils (ball) 80% dispersion 1.46 mils (ball) 100% dispersion 3.43 mils (4:1 ball:tracer) 80% dispersion 1.78 mils (4:1 ball:tracer)
Muzzle velocity:	862 m/s
Muzzle energy:	3,465 J
Trunnion load (average):	409.6 kgf (903 lbs f)
Trunnion load (max):	455 kgf (1003 lbs f)
Range:	3,725 metres
Electrical data	
Motor:	Single speed (6,400 rpm)
Operating voltage:	24 ± 4 volts
Running current:	13 amperes
Start up current:	52 amperes (up to 0.2 secs)
Horsepower:	0.3 (903 lbs f)
Trunnion load (average):	409.6 kgf (103 lbs f)
Range (average):	3,725 metres

Technical Data

Chain gun long barrel:	For AFV turret mounting
Chain gun short barrel:	For AFV cupola, pintle mounting and remote controlled installation
Calibre:	7.62 mm
System of operation:	Externally powered from open bolt
Locking system:	Rotating bolt
Feeding device:	Disintegrating link
Ejection:	Forward
Rifling:	4 grooves 1 right hand turn in 305 mm

Weights

Complete weapon (long):	17.86 kg
Complete weapon (short):	13.7 kg
Barrel (long):	2.93 kg
Barrel (short):	2.2 kg
Body assembly:	10.28 kg

Dimensions

Overall length (long):	1250 mm
Overall length (short):	660.4 mm
Barrel length (long):	703 mm
Barrel length (short):	580 mm
Width:	150 mm
Length rearward from back face of mounting clamp:	275 mm

ROYALORDNANCE
Defence systems, sub-systems and components

SMALL ARMS AMMUNITION

5.56 mm

A range of 5.56 mm Ammunition has been designed to meet NATO Standard 4172 for use in the new range of 5.56 mm weapons incorporating the 1 in 180 mm barrel twist. Production of this ammunition is undertaken using manufacturing plant incorporating the latest technology in order to assure the highest quality standards. In addition, every round undergoes 100% inspection to ensure correct functioning in the weapon.

Ammunition range —

Ball round

Normal service round for operational use. Defeats 10 gauge NATO plate at ranges in excess of 600 metres.

Tracer round

Dark ignition followed by bright orange/red trace to 650 metres.

Black round

Full length brass cased blank for training purposes.

Low power training round

A frangible round for use on ranges with limited safety distances (maximum range 750 metres). It will provide full automatic weapon function and will operate automatic targets at 300 metres.

Drill/Inspection round

Inert round for use in training or by armourers and weapon inspectors.

Technical data

	Ball round	Tracer round
Weight of round (g):	12.0	12.0
Bullet weight (g):	4.0	4.0
Muzzle velocity (m/s):	915	865
Accuracy (600 m):		
max horizontal and vertical SD (mm):	225	340

7.62 mm

7.62 mm Ammunition for small arms is produced to the highest quality, meeting the stringent standards set by the British Army. Manufactured at the most modern ammunition plant in Europe, every round undergoes 100% inspection to ensure correct functioning in the weapon.

Ammunition range

The full range available is listed below. Ball and tracer rounds conform with NATO STANAG 2310.

Ball L2A2

Normal service round for operational use.

Tracer L5A3

Dark ignition followed by bright orange/red trace to 1,000 metres.

Blank L13A1

Full length, brass cased blank for training purposes.



5.56 mm

Drill L1A2

Inert training round.

Inspection L3A1

Inert round for use by weapon inspectors and armourers.

Ball, tracer and blank rounds can be supplied in cartons, 5 round charges or in disintegrating belts linked to customer requirements.

Technical data

	Ball L2A2	Tracer L5A3
Weight of round (g):	24	23
Bullet weight (g):	9.3	8.75
Muzzle velocity m/s:	840	795
Accuracy (550 m)		
Max. Mean radius (mm):	250	375

ROYALORDNANCE
Defence systems, sub-systems and components

PYROTECHNICS

1.8 kg (4 lb) practice bomb

Providing an inexpensive method of training aircrew, the finned body gives this store the necessary stability and realism of flight pattern. On striking the target area it produces both smoke and flash for ease of checking accuracy.

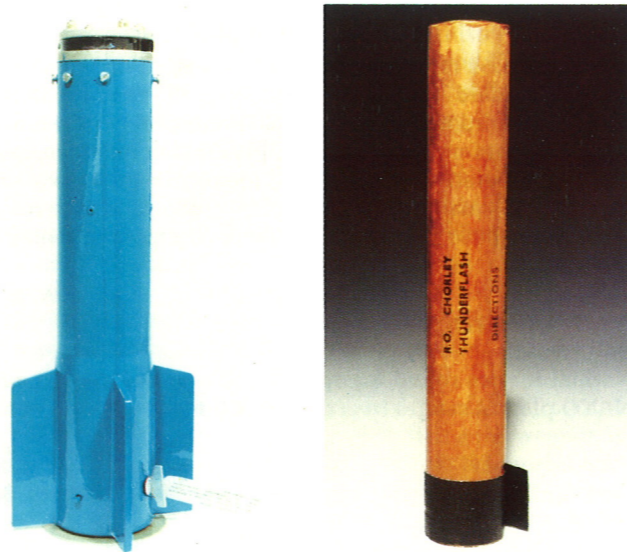
Thunderflash

A well-proven pyrotechnic device with a safety record second to none, Thunderflash is designed to provide a low-level explosion simulating battlefield conditions for action training purposes. Constructed to provide maximum reliability under adverse conditions and to produce no dangerous fragments in use, it can be safely hand-thrown with its 7-second delay fuze.

Hand signal smoke grenades

These hand-thrown coloured smoke grenades are robust, waterproof and highly reliable. They are designed to withstand environmental conditions in all areas of the world. They are available in four versions to emit smoke of different colours for 45 seconds.

Igniter system:	cocked striker with percussion cap
Time to smoke emission:	2-4 sec
Smoke emission time (min.):	45 sec
Colour range:	red, blue, green, orange
Number of grenades per pack:	12
Weight:	350 g
Height:	135 mm
Diameter:	55 mm



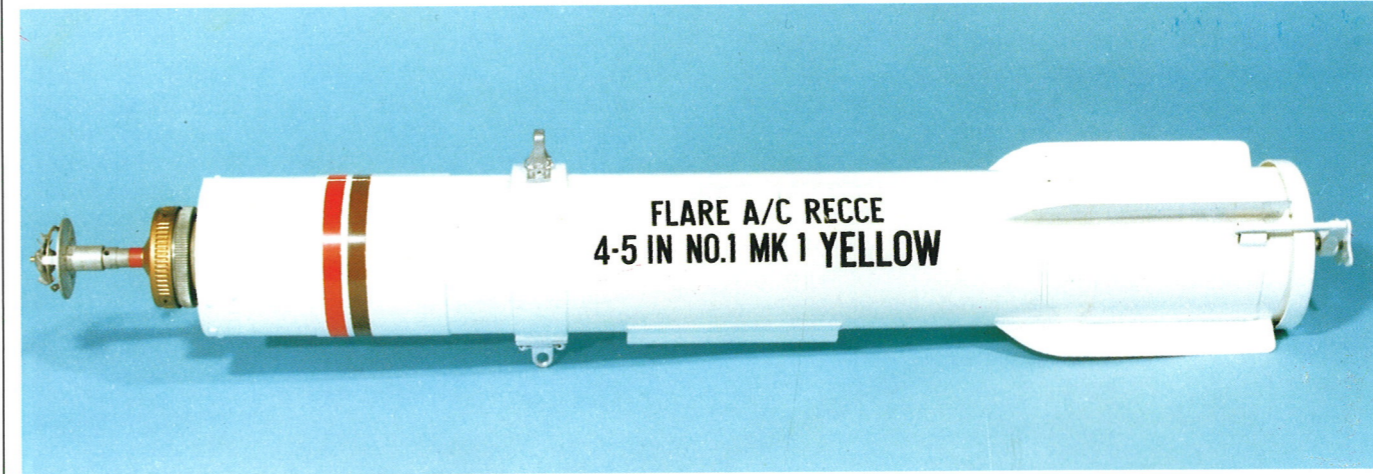
L8 Grenade

The L8 grenade produces an immediate smoke screen for vehicle protection. The grenade is electrically ignited and fired from multi-barrelled smoke dischargers and consists of a metal housing which contains the propelling charge and fuze and a black rubber case filled with a pellet of red phosphorus which, when ignited, bursts the case and produces an immediate cloud of smoke in the form of a curtain in front of the vehicle. Fragments of burning phosphorus fall to the ground and continue to produce smoke. Cover is complete in approximately 2 seconds.



Range:	25 m
Delay time:	0.75 sec
Height of burst:	6 m
Weight of main filling:	360 g
Screen width:	approx. 35 m
Duration of smoke cloud (at wind velocity of 24 km/h):	3 min minimum
Operation voltage:	3 V
Weight complete:	680 g
Length:	185 mm
Diameter:	66 mm

PYROTECHNICS



115 mm (4.5 in) aircraft flare No 1 MK1

This is a very large flare fitted with an air-operated delay fuze giving up to four minutes of burning time. It has an extremely high light output providing daylight conditions over a wide area.

Length:	975 mm
Weight:	10.5 kg
Delay time:	4.5-12 seconds
Burning time:	3-4 minutes
Light output:	approaching 1,000 000 cd
Delivery:	dropped from aircraft

Packaging:	singly in metal tube
Burning time:	70 seconds
Delivery:	from on-board rocket launcher

51 mm mortar illuminating flare

Used as a target area illuminator and fired from a standard 51 mm mortar, this parachute-supported flare gives infantry the capacity to illuminate a target at normal mortar ranges. The all-metal shell is strongly constructed to withstand all normal charges.

Length:	275 mm
Weight:	0.65 kg
Burning time:	30 seconds (min)

51 mm (2 in) head rocket flare No 3 MK N6

Affixed to a 50 mm (2 in) rocket, this flare is designed primarily to illuminate targets at sea. By the operation of a pre-launch selector incorporated in the rocket the firer can choose any one of three ranges. The flare is parachute-supported to provide a long, stable period of illumination.

Length:	435 mm
Weight:	2.3 kg
Ranges:	short 1500 m, medium 2500 m long 5300 m

Hand-thrown flare illuminating L1A1

For close-range illumination this hand-launched flare has its own self-contained ignition system. It is weather sealed for arduous service in the field.

Length:	100 mm
Weight:	47 g
Delay time:	2-3 seconds
Burning time:	12 seconds



105 mm LIGHT GUN



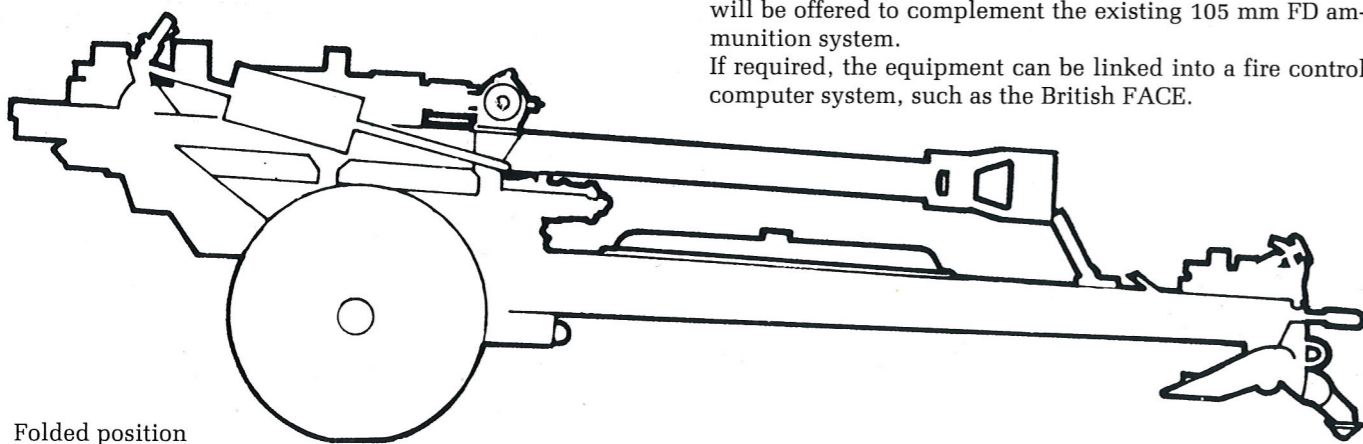
The 105 mm Light Gun is the most advanced field artillery system available today. It performs equally well as a field gun or a howitzer and is an invaluable close support weapon. It can also operate in a direct fire role. A low silhouette and fast all round traverse combined with lightness and strength facilitates the use of the gun anywhere in the world.

The 105 mm Light Gun has the following main features:

- Extremely portable, weighing only 1860 kg, the complete weapon can be lifted by a PUMA helicopter or with its towing vehicle can be carried in a Hercules C 130 transport aircraft
- Firing at elevations up to 70° it can be used as a howitzer
- Quick and simple to operate
- Fires the full range of 105 mm Abbot ammunition and US 105 mm M1 ammunition can also be fired with a simple ordnance charge
- Ranges of 2,500 to 17,000 m.

Royal Ordnance are currently developing an extended range shell capability (20.5 km) for the 105 mm Light Gun system. HE and Bomblet Shells with significantly improved lethality will be offered to complement the existing 105 mm FD ammunition system.

If required, the equipment can be linked into a fire control computer system, such as the British FACE.



ROYAL ORDNANCE
Defence systems, sub-systems and components

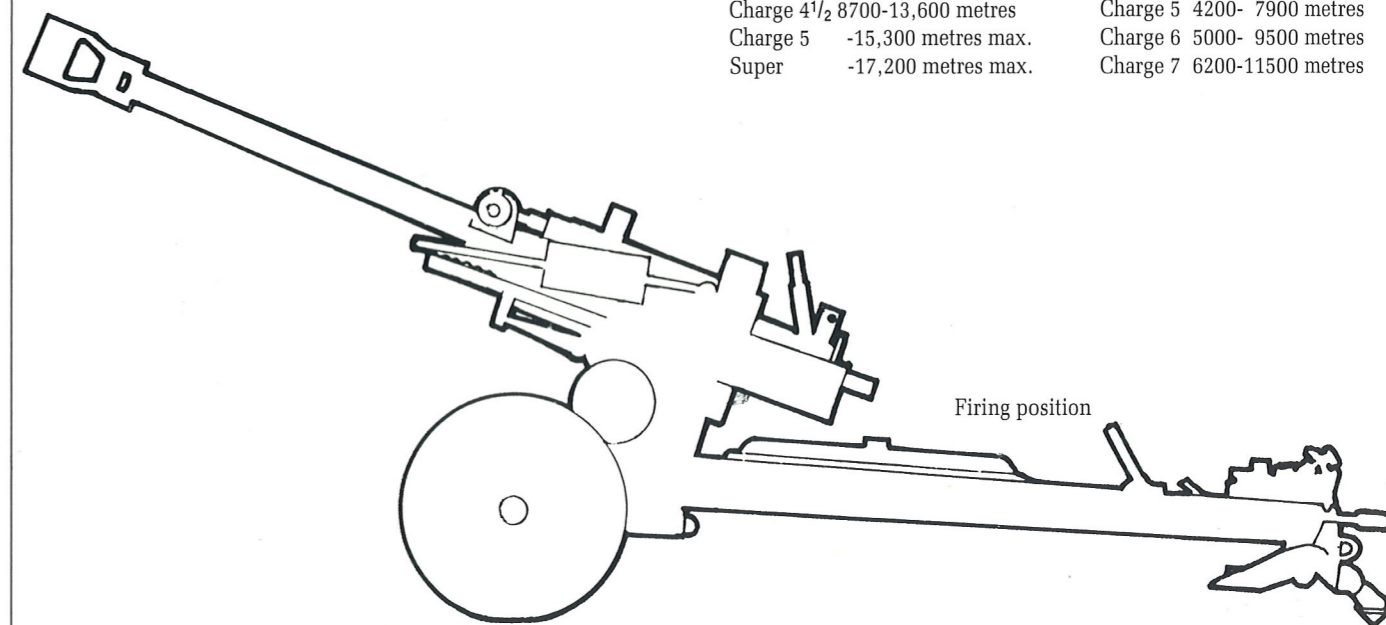
105 mm LIGHT GUN

TECHNICAL DATA

Range maximum:	17.2 km	10.63 miles
Range minimum (high angle):	2.5 km	1.55 miles
Total weight:	1860 kg	4100 lbs
Comprising-elevating mass:	1066 kg	2350 lbs
lower carriage and essential stores:	794 kg	1750 lbs
Rate of fire - normal:		6 rounds per minute
- sustained:		3 rounds per minute
Overall length-travelling (folded position):	4.87 m	16 ft
Overall length - travelling (with gun forward):	6.63 m	21 ft 9 ins
Overall height - travelling (folded position):	1.37 m	4 ft 6 ins
Overall height - travelling (with gun forward):	2.63 m	8 ft 8 ins
Overall width:	1.78 m	5 ft 10 ins
Track width:	1.4 m	4 ft 7 ins
Maximum - elevation:	1,244 mils	70°
Minimum - elevation:	-100 mils	-5.5°
Top traverse (fine):	100 mils	5.5° left and right
Traverse on platform:	6,400 mils	360°
Recoil length - at 0° QE:	1.07 m	42 ins
Recoil length - at 70° QE:	0.33 m	13 ins
Loading angle:		All elevations
Tyres:	9.00 x 16	900 x 16 (6 ply)
Downward load on towing eye:	168 kg	370 lbs

AMMUNITION for L 118 (ABBOT) version

All rounds for L 19 ordnance are of the separate loading type in which the propelling charge, contained in a brass cartridge case, is loaded into the gun after the projectile. The charge can be easily adjusted to give the necessary range and is initiated by an electric primer.



Rounds can be fitted with a variety of fuzes, including point-detonating with safe arming, post-impact delay, mechanical time or electronic time. All rounds are reliable, accurate, extremely effective and have a long shelf life.

105 mm ABBOT AMMUNITION

High Explosive (HE) Shell
Smoke, Base Ejection (BE) Shell
Illuminating Shell
Coloured Smoke Marker Shell
Currently in development: —High Explosive (HE) Base Bleed Shell
Bomblet Base Bleed Shell.

US 105 mm Ammunition (M1) for L 119, M1 version

M 1 shell types comprise of High Explosive (HE), High Explosive Squash Head (HESH), White Phosphorus Bursting Smoke, Base Ejection Smoke (BE), and Illuminating. These natures can be fired with the British 105 mm Light Gun by using a complete interchangeable percussion fired ordnance, also manufactured by the Royal Ordnance. This L 20 ordnance will produce ranges from 1800 to 11,500 metres.

Charge System

The multi-stage system is designed to provide two types of charge, each contained in a brass cartridge case. Normal charge consists of a series of increments from 1 to 5 with effective ranges from 2.5 to 15.3 km. Super is a fixed charge with range of 17.2 km. The minimum ranges in high angle for charges 1 and 2 are achieved by fitting spoiler rings to the shell. A special training charge is available, pre-packed with increments 1, 2 and 3 only.

British Charge System (ABBOT) US Charge System (M1)

Charge 1	2500-5700 metres	Charge 1	1800- 3400 metres
Charge 2	2700-7200 metres	Charge 2	2100- 4100 metres
Charge 3	5900-9500 metres	Charge 3	2600- 4800 metres
Charge 4	7500-12,200 metres	Charge 4	4100- 6300 metres
Charge 4½	8700-13,600 metres	Charge 5	4200- 7900 metres
Charge 5	-15,300 metres max.	Charge 6	5000- 9500 metres
Super	-17,200 metres max.	Charge 7	6200-11500 metres

ROYAL ORDNANCE
Defence systems, sub-systems and components

105 mm FIELD AMMUNITION

The 105 mm FD ammunition is designed for use with the Abbot self-propelled gun and the 105 mm Light Gun. Outstanding improvements in range and lethality over the M1 system have been achieved by advanced ammunition design. All rounds are of the separate-loading type in which the propelling charge contained in a brass cartridge case is loaded into the gun after the projectile. The propelling charge can be easily adjusted to give the required range and is initiated by an electric primer. All rounds are reliable, accurate, extremely effective and have a long shelf life.

High-explosive shell

The high-explosive (HE) shell is the standard projectile used by artillery for the close support of infantry. It is fitted with a nose fuze which can be set to explode on impact or after a short delay to allow penetration of the target before detonation. A mechanical time fuze is also available to burst the shell in the air.

Optimum performance is obtained from a shell which can burst into the maximum number of high-speed fragments. This is achieved with the HE shell by the use of a high-tensile steel body and explosives of the highest power commensurate with safety from premature functioning. The lethal area of this shell (weighing 16 kg) is 25 % greater than that of the US M1 shell (weighing 15 kg).

105 mm FD Ammo

Royal Ordnance are currently developing an extended range shell capability (20.5 km) for the 105 mm Light Gun system. HE and Bomb shell with significantly improved lethality will be offered to complement the existing 105 mm FD ammunition system.

Smoke base-ejection shell

The smoke base-ejection (Smoke BE) shell has a cylindrical cavity in which are mounted three smoke canisters. These are ejected at the required point in flight by a mechanical time fuze and fall to the ground, discharging dense clouds of smoke for 60 seconds. The smoke screen builds up more slowly than that for a white phosphorus bursting shell, but lasts longer and usually keeps closer to the ground.

Marker (coloured smoke) shell

These shells burst on the ground and are used to mark a position such as a target for an air strike. Red and orange smoke shells are available.

Illuminating shell

This shell provides 1 million candela power illumination for 15-20 seconds.

Charge

Charge 1:	2500 to 5700 m
Charge 2:	2700 to 7200 m
Charge 3:	5900 to 9500 m
Charge 4:	7900 to 12200 m
Charge 4 1/2:	
(Increments 1,2,4,5):	8700 to 13600 m
Charge 5:	15300 m max
Charge super:	17200 m max

The minimum ranges in high angle for charges 1 and 2 are achieved by fitting spoilers to the shell.

Charge system

Three types of charge are provided:

1. A normal cartridge, which consists of a six-zone system which can be easily adjusted to obtain the required range.
2. A super-cartridge which is a fixed charge.
3. A training cartridge is also available and consists of increments 1, 2 and 3 only.

All types are contained in a brass cartridge case.



Designation	High-explosive L31	Smoke L45	Illuminating L43	Marker L37/38	Cartridges Normal	Cartridges Super	Training TRG L45
Projectile weight (kg)	16.10	15.56	16.10	16.10			
Nominal propellant weight (kg)					2.40	2.86	0.89
Propellant type					N04		N04
					N/S 31-11		
					N/S 42-12		
Explosive weight (kg)	2.43						

ROYAL ORDNANCE
Defence systems, sub-systems and components

105 mm HOWITZER AMMUNITION

The 105 mm ammunition designed for the pack howitzer is of the separate-loading type, incorporating a variable charge system. High-explosive squash-head and high-explosive rounds are available, both manufactured under stringent quality control procedures, ensuring products of maximum reliability and consistency.



High-explosive squash-head round

High-explosive squash-head

The high-explosive squash-head (HESH) round is designed for use against tanks and other armoured targets. The shell is fitted with a base fuze and filled with a RDX-based high-explosive composition. The cartridge consists of a percussion-primed case holding the six propellant charges in cloth bags.

Operation

On striking the armour, the shell squashes and the detonation of the resultant pool of explosive causes scabbing of high velocity fragments from the inside surface of the armour.

High-explosive round

The High-Explosive (HE) round is used by artillery for the close support of infantry units. The shell is fitted with a direct action and graze fuze and filled with an RDX/TNT high-explosive composition. The cartridge consists of a percussion-primed case holding seven propellant charges in cloth bags.

Smoke round

The base-ejection smoke round provides rapid accurate smoke cover.

Round:	HESH	HE
Projectile weight:	10.19	15.07
Explosive weight:	2.55	2.08



High-explosive round

ROYAL ORDNANCE
Defence systems, sub-systems and components

155 mm HOWITZER AMMUNITION

A new range of 155 mm ammunition has been designed jointly by the Federal Republic of Germany, Italy and the United Kingdom, for use with the FH70 howitzer. The new ammunition gives a significant increase in range and in lethality against all types of target.

High-explosive shell

The high-explosive (HE) shell is of the thin-walled type with a high fragmentation effect and a large capacity for explosive. It is fitted with a nose fuze which can be set to explode on impact or after a short delay.

The advanced filling technique employed ensures safety from premature functioning even at the highest charge.

High-explosive shell (L15A1)

The high-explosive (HEL) shell is of the thin-walled type with a high fragmentation effect and a large capacity for explosive. It can be fitted with a nose fuze which can be set to explode on impact or after a short delay or with an above ground burst fuze.

Smoke Shell DM105

The smoke shell is designed to eject 4 canisters at a pre-determined distance (controlled by the fuze) and these fall to the ground emitting dense clouds of smoke for a minimum time period of 3 to 3.5 minutes. The smoke screen produced does not pillar.

Illuminating Shell DM106

The illuminating round contains a star case and parachute. Actuation of the time fuze ejects the flare at the appropriate elevation which then burns suspended from the parachute for a minimum time period of 60 seconds. The average luminosity during this time period is not less than 2 million candelas.

Charge system

The charge system is divided into eight zones, using a triple-based propellant to give the eight increments in range. The system uses three separate cartridges:

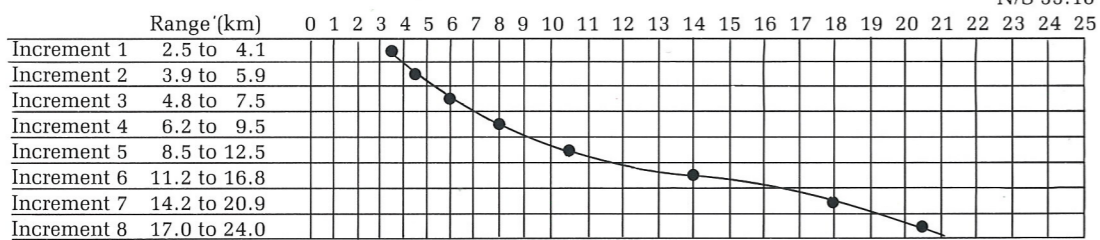
Cartridge 1 for increments 1 and 2;

Cartridge 2 for increments 3, 4, 5, 6 and 7; and

Cartridge 3 for increment 8.

The charge system is ballistically balanced. Combustion is initiated by a percussion igniter tube and is exceptionally clean.

Designation	HE-L15	DM105	DM106	Cart 1-L2	Cart 2-L8	Cart 3-L10
Projectile weight						
Fuzed (kg)	43.51	43.42	43.52			
Length Fuzed mm	873	874	874			
Explosive weight (kg)	11.32					
Nominal propellant weight (kg)				1.21	7.55	12.48
Propellant type				SC/202	No 6 N/S 33.10	N/S 54.14



Increase in range obtained by incremental charges.



ROYALORDNANCE
Defence systems, sub-systems and components

120 mm BREECH LOADED MORTAR for turret mounting



The Royal Ordnance 120 mm mortar has been designed to meet the requirement for a fully armoured protected vehicle mounted mortar to provide enhanced infantry fire support. It advances the state-of-the-art for mobile mortar fire support for lightweight vehicles. The system is designed to defeat not only soft targets but also the main battle tanks of the coming decades. Turret mounting gives the system a self defence capability with suitable ammunition.

The Royal Ordnance 120 mm Mortar provides a range of advances. The system features full under armour protection for mortar crew and ammunition, is suitable for retrofitting to lightweight wheeled and tracked armoured fighting vehicles, and has been designed to fire current types of conventional ammunition and future precision guided munitions (PGM's) and terminally guided sub-munition carriers. It also includes improved lethality against hard and soft targets, high rates of fire, and utilises hydro-pneumatic recoil system technology.

To complement the 120 mm mortar, Royal Ordnance are able to offer a range of 120 mm mortar ammunition. The bombs are aerodynamically shaped for low-drag with good ballistic co-efficient and excellent fragmentation effects. The entire family of Royal Ordnance 120 mm mortar ammunition will be fully interoperable with other 120 mm mortar systems. The charge and propellant assembly comprise of 6 augmenting cartridges (4 equal thickness and 2 half thickness) and a percussion primary cartridge.

To ensure the greatest accuracy, safety and effectiveness over the whole firing range, all natures of Royal Ordnance 120 mm mortar ammunition have been designed and manufactured to the highest quality standard. This includes high explosive, smoke, illuminating, bomblet and training bombs. Each bomb is weight controlled, machined to fine tolerances using quality controlled components tested and proofed before acceptance.

Ranges from 500 metres to 7500 metres are achieved by the use of augmenting charges issued with each bomb. Muzzle velocity of maximum charge will be 330-350 metres per second dependent on barrel.



ROYALORDNANCE
Defence systems, sub-systems and components

81 mm MORTAR



Sight Unit C2
 Weight (sight only): 1.25 kg
 Weight (including case): 3.4 kg
 (A Trilux modification for illumination can be provided).

Bipod Mount
 Weight: 12.3 kg
 Overall length (folded): 1143 mm
 Elevation range: 800-1515 mils
 Traverse range (800 mils elevation) 100 mils left and right
 Traverse range (1515 mils elevation) 325 mils left and right.

Base Plate
 Weight: 11.6 kg
 Overall diameter: 546 mm
 Socket diameter: 58 mm
 Base plate has four deep webs for bedding-in support

Mobile Operation
 Special mounting allows the mortar to be fired from British Armoured Personnel Carrier (FV 432).

Ammunition
High Explosive Bomb L36A2
 Weight: 4.21 kg
 Filling: 0.77 kg — 60/40 (RDX/TNT)
 Body: Spheroidal graphite/Cast iron
 Tail Unit: Aluminium alloy
 *Fuze: L127A2
 Propellant: NC30 Porous Disc (Nitrocellulose)

Number of augmenting charges: 6 (Mk 2 charge system)
 Primary cartridge: L33 Propellant WM04
 Obturating: Polycarbonate, heat treated
 Overall length: 483 mm
 Range bracket: 200 m-5650 m

Improved Fragmentation
 15% standing
 19% prone
 up to 50% entrenched

Improved Mean Area Effect
 14% standing
 19% prone
 approx. 10% entrenched

* L36A2 has an improved performance because it produces a large number of medium size fragments (average weight 0.9 grms) and the superquick fuze setting of the L127A2 fuze ensures an improvement in mean area effectiveness.

Smoke White Phosphorus Bomb L40A1
 Weight: 4.8 kg
 Filling: White Phosphorus
 Body: Grey cast iron
 Primer cartridge: L33 propellant WM04
 * Fuze: L127A2

Number of augmenting charges: 6 propellant NC30
 Overall length: 481 mm
 * L36A2 and L40A1 are supplied with L127A2 fuze. However, bombs are compatible with M734, M935, DM11 fuzes and the fuze cavity will take the standard NATO fuze.

Practice Bomb L27
 A re-usable bomb designed to fire using the primary cartridge only, to a maximum range of 80 m (an obturating ring is fitted).

The British 81 mm mortar is a highly accurate, portable and reliable mortar fully utilising the advantages of modern gun steel technology. This together with an extensive range of ammunition and the fact that the 81 mm mortar can perform tasks usually requiring field artillery make it the world's most efficient medium mortar system.

Main features

- Long Range Capability
- Great Accuracy
- Lightweight and Portable
- Maximum Lethality
- High Sustained Rate of Fire
- Ease of Operation
- Range of Ammunition

Technical data

Range: Maximum range 5650 metres
 Minimum range 200 metres

Accuracy
 0.5% probable error in range; 1 1/2 mils in line

Rate of Fire
 15 rounds/minute indefinitely with standard UK bombs.

Lethality
 Over 75% of bomb body forms lethal-size fragments in the ideal fragment mass range of 0.08 to 5.0 grams.

Weight and Mobility
 36.6 kg without sight.
 Three one-man loads, heaviest 12.7 kg.

Barrel
 Weight: 12.7 kg
 Calibre: 81 mm
 Outside diameter (Muzzle end): 86 mm
 Outside diameter (breach end): 94 mm
 Overall length, including plug: 1280 mm

ROYALORDNANCE
 Defence systems, sub-systems and components

51 mm MORTAR

The new British 51 mm mortar and ammunition is a highly improved version of the well tried and proven British 2 inch mortar system. Weighing only 6.275 kg and with a maximum range of 800 m, it provides the infantry platoon with a manportable weapon which enables a quick and accurate response when mortar fire is required.

General Features

- Lightweight and simple to deploy with accuracy enhanced by the provision of a sight unit
- Range from 50 m to 800 m
- Sets up smoke screens quickly and accurately
- Existing 2 inch mortar ammunition can be used.

TECHNICAL DATA

Weight (including harness): 6.275 kg
 Overall length: 800 mm
 Barrel c/w sight weight: 2.6 kg
 length: 543 mm
 bore diameter: 51.2 mm
 outside diameter: 55.5 mm
 Mechanism assembly c/w barrel removal sleeve and base plate length (firing hole bush fitted): 207.5 mm
 width (trigger mechanism fitted): 104 mm
 weight (with base plate): 305 kg
 Short range insert (SRI) length: 181 mm
 weight: 0.25 kg
 Ancillaries wallet (fitted) dimensions: 220 mm x 150 mm x 70 mm
 weight: 1.4 kg
 Sight: Trilux illumination of sight enables mortar to be laid at night.
 Performance range high angle: max 800 m:min 250 m
 low angle: max 800 m:min 150 m
 high angle with SRI: max 350 m:min 50 m
 low angle with SRI: max 350 m:min 100 m

AMMUNITION

Illuminating L3
 Weight: 800 g
 Filling: 190 g SRE 798
 Body/Tail unit: Aluminium alloy
 Delay: 13 secs
 Propellant: 85 grains of EX/T 06-02
 Obturation: Polyether sulphone obturating ring

Overall length: 275 mm
 Range: 775 metres
 Height of burst: 325 metres
 Time of burning: 30 secs min
 Rate of descent: 4.65 m/s
 Light output: 100,000 candella min
 150,000 candella min (10 times full moonlight)
 over a 200 metre radius circle throughout the burn

Rate of fire: 3 bombs per minute for 5 minutes
 8 bombs per minute for 2 minutes

Visual identification: White with black markings



Tactile identification: Embossed cone on nose lid
High explosive fuzed L 127
 Weight: 920 gms
 Filling: 170 gms RDX/TNT/60/40
 Body: Aluminium alloy
 Fragmentation coil: Mild steel notched wire
 Tail unit: Aluminium alloy
 Fuze: L127 (two modes, superquick and delay)

Propellant: 65 grains of EX/T 06-02
 Obturation: Polyether sulphone obturating ring
 Overall length: 290 mm
 Range bracket: 50 to 800 metres
 Consistency: 50% zone at max. range.
 Range 22 m. Line 18 m

Lethality: Lethal area 5 times greater than with the 2 inch HE bomb
 Rate of fire: 3 bombs per minute for 5 minutes
 8 bombs per minute for 2 min.

Visual identification: Deep bronze green, yellow markings
 conical fuze

Tactile identification: **Smoke screening L2**
 Weight: 850 g
 Filling: 4 increments of smoke composition PN 800
 Body/Tail unit: Aluminium alloy

Delay: 14 secs
 Smoke Emission: 90 secs min
 Propellant: 65 grains of EX/T 06-02
 Obturation: Polyether sulphone obturating ring

Overall length: 273 mm
 Range bracket: 50 to 800 metres
 Consistency: 50% at max. range
 Range 30 m Line 18 m

Rate of fire: 3 bombs per minute for 5 minutes
 8 bombs per minute for 2 min.

Visual identification: Eau-de-nil with black markings
 Tactile identification: Plain nose

ROYALORDNANCE
 Defence systems, sub-systems and components

PROPELLANTS & CHARGE SYSTEMS

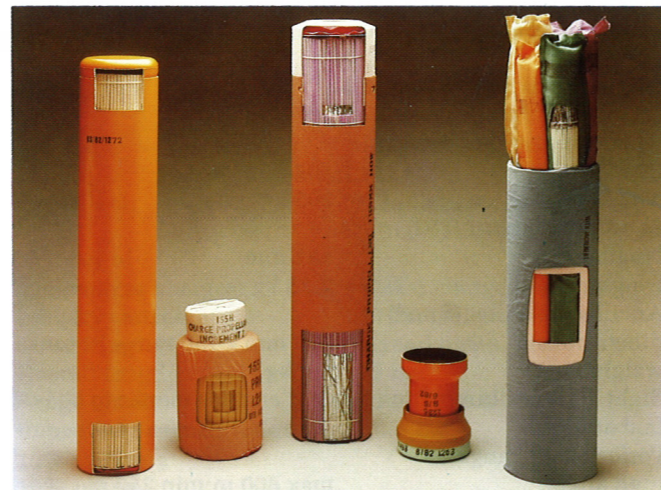
The new generation of tank and artillery guns are much less tolerant towards the charge system employed than the equipments they replaced. The ammunition for these new guns is required to produce a high and consistent level of performance in terms of range, accuracy and penetration. The associated charge systems must operate within strict tolerance bands with each element - propellant, combustible charge container and ignition system - carefully optimised to achieve the overall effect.

Stick Propellants

Stick propellant forms an essential constituent of such charge systems, since it displays the regularity of performance, with smooth ignition characteristics and freedom from pressure waves which is demanded by modern performance requirements.



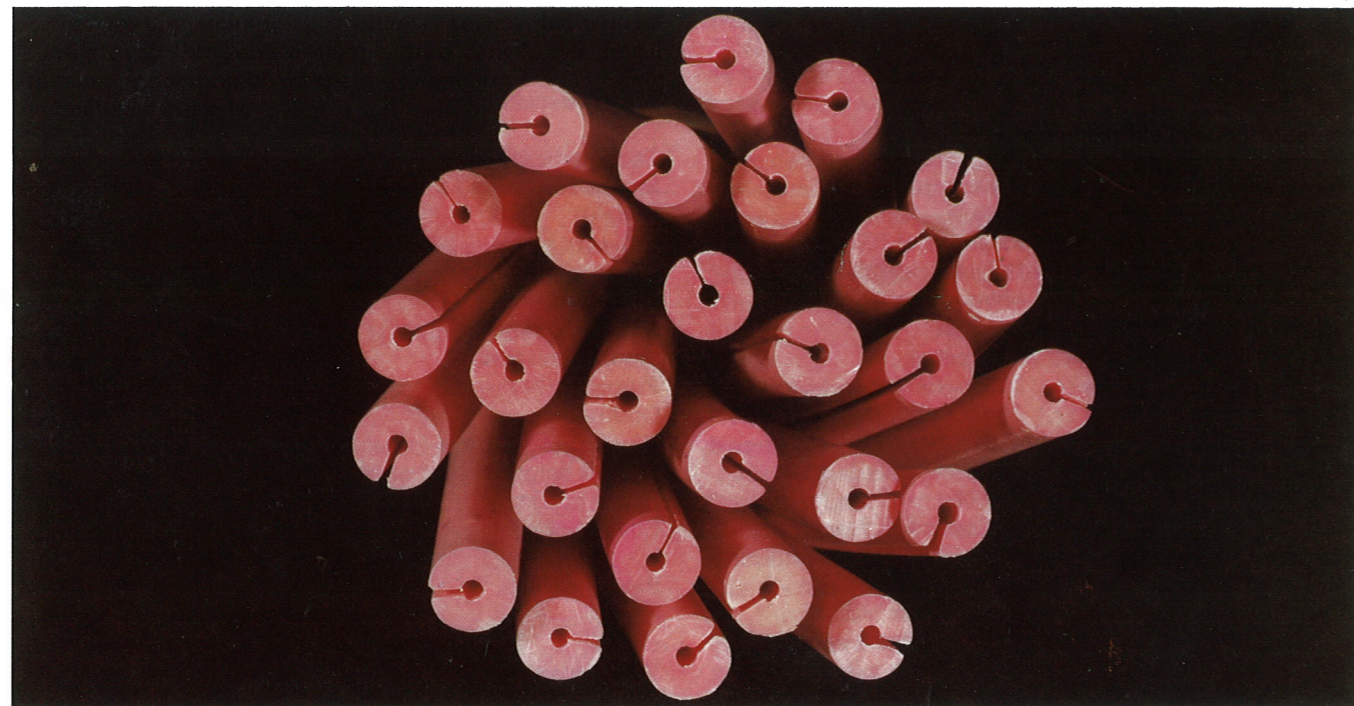
Slotted tubular granular propellant



Combustible charge containers

Granular Propellants

Many equipments still in service are designed to employ granular propellant charges. The standard of both performance and safety of these equipments directly depends on the quality of the propellant employed. It is essential that granular propellants, are manufactured with the same high degree of process control which Royal Ordnance has evolved for high performance stick propellants to ensure ballistic regularity over the service temperature range. All Royal Ordnance propelling charges are designed to NATO safety and quality standards.



Slotted tubular stick propellant

NAVAL AMMUNITION



The 4.5" ammunition has been designed and developed for Mk 8 naval guns. Careful design of the shell has increased the ballistic accuracy and lethality of this fixed ammunition. A high-grade steel shell with a thinner wall permits a higher explosive payload to be carried with a corresponding increase in fragmentation and blast damage.

High-explosive round

The high-explosive (HE) round can be used for both air and surface targets, being fitted with a general-purpose proximity and direct-action fuze. It is designed to cause maximum fragmentation and blast damage.

4.5" ammunition for naval guns

Projectile designation:	HE-N1	STAR-N4	RE-N3	AAP-N5	SUP-N7
Weights Complete round (kg):	36.54	34.97	36.99	36.54	36.54
Projectile weight (kg):	19.97	19.76	20.82	19.52	20.87
Nominal propellant weight (kg):	7.15	6.92	6.92	7.15	7.15
Propellant type:	MNLF/2P/ M08	MNLF/2P/ M08	MNLF/2P/ M08	MNLF/2P/ M08	MNLF/2P/ M08



Decoy and illuminating devices

Decoy and illuminating devices are available for naval use. These stores are designed to meet the stringent requirements set by the Royal Navy and can be relied upon to give safe and predictable performance in all conditions.

3" Radar echo rocket

This rocket is designed to be used tactically by ships to confuse the enemy by producing decoy radar signals. It consists of a head filled with metallised dipoles cut to match radar frequencies, a motor and a tail fin assembly. The nose of the rocket is fitted with a time fuze (N8).

Illuminating (star) round

This round provides illumination for approximately 40 seconds and is initiated by a mechanical time fuze.

Radar echo round

The chaff payload of the radar echo (RE) round produces an echo on radar screens, so confusing enemy radar and guided missiles. This round is fitted with a mechanical time fuze.

Practice anti-aircraft round

The practice anti-aircraft (AAP) is a less expensive round than the HE, and is used for anti-aircraft and other practice firings. The round contains an inert filling with flash composition in place of an exploder. It is fitted with a general-purpose proximity fuze and provides a visible record of the fuze and shell functioning.

Practice surface round

The practice surface (SUP) round is designed for surface practice firings. It consists of an HE shell body filled with inert material and fitted with a plug-representing fuze (PRF).

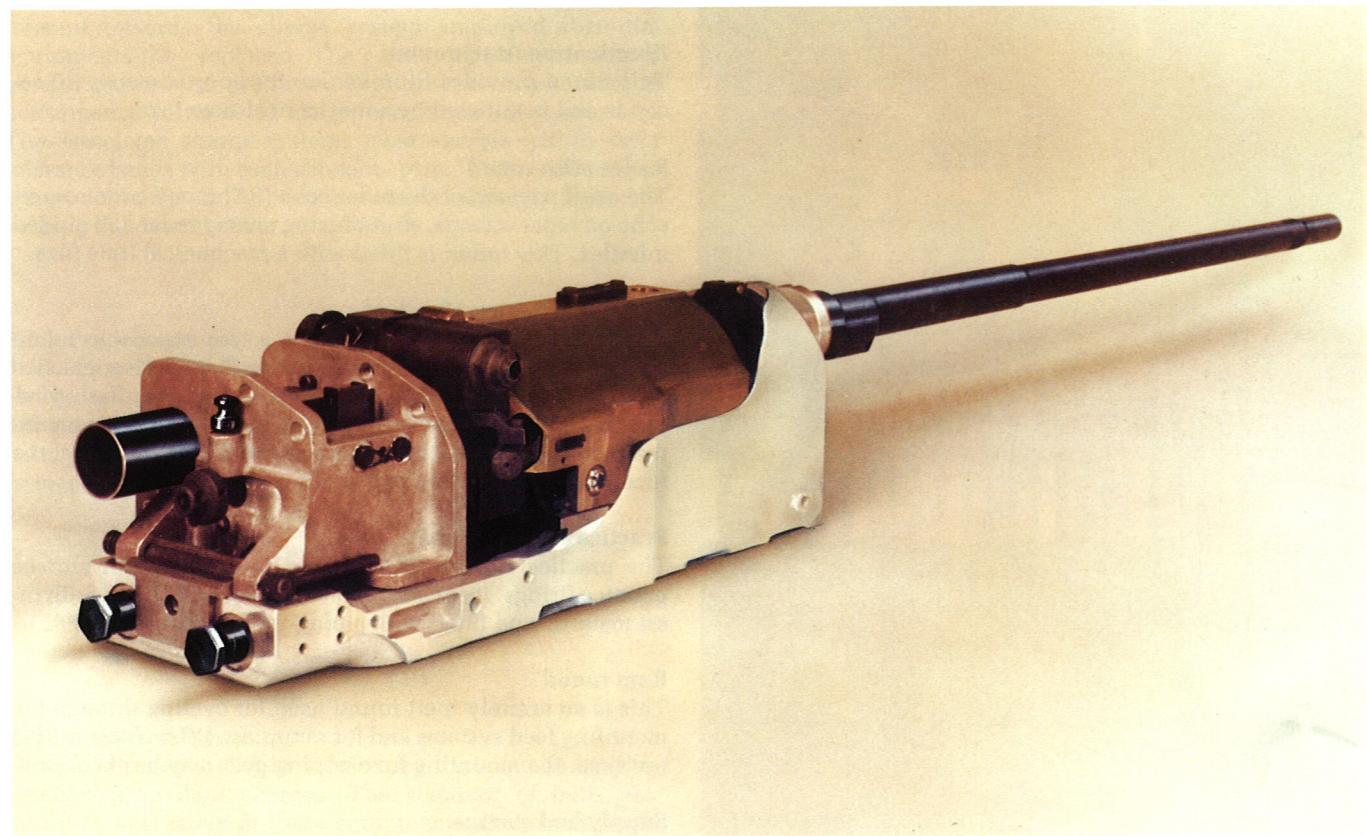
Ram round

This is an entirely inert round used for cycling through the mounting feed systems and for ramming. When fitted with a test fuze, the mounting fuze wiping gear may be checked.

Supply and storage

Firing rounds are supplied fuzed, each round in a separate container. The rounds may be stowed in their containers in the ship's magazine. The containers are self-stacking and interlock. A special tool is provided for removing container lids and extracting the rounds.

ADEN 25



Aden 25 is built to take advantage of the powerful 25 mm (NATO standard) ammunition within the same space envelope and with the same mounting points as its predecessor. At less than 10% extra weight over Aden 30, it will deliver three times the kinetic energy - firing at up to 1850 rounds per minute. Percussion firing enhances safety by eliminating radiation hazard.

Air-to-air or air-to-ground, Aden 25 has a firepower-to-weight capability unmatched by any other 25 mm calibre gun system. Selected for the Harrier GR 5 being developed jointly by British Aerospace and McDonnell Douglas, Aden 25 is under consideration for current Jaguar and Hawk projects. Its versatility means that it is also available for up-gunning of aircraft currently equipped with Aden 30, where the common features make it particularly suitable.

Aden 25 has a pedigree which guarantees its performance. It has improved terminal effects over current gun armament systems. And its flexibility of application has made it today's choice for tomorrow's aircraft.

Design principle.

The Aden 25 Cannon consists of a barrel assembly including blast suppressor and a gun assembly. Being a revolver type the gun is compact and simple in design, with the whole assembly being contained within the cradle unit. Installation mounting points are at the rear and at the front barrel entry position of the cradle. Aden 25 may be mounted at any attitude through 360° on the longitudinal axis to suit the specific aircraft installation requirement. Left or right hand feed versions are available. Cocking is pneumatic, with provision for manual operation and the ammunition which is belt fed (disintegrating link) is percussion fired.

Basic operating principle.

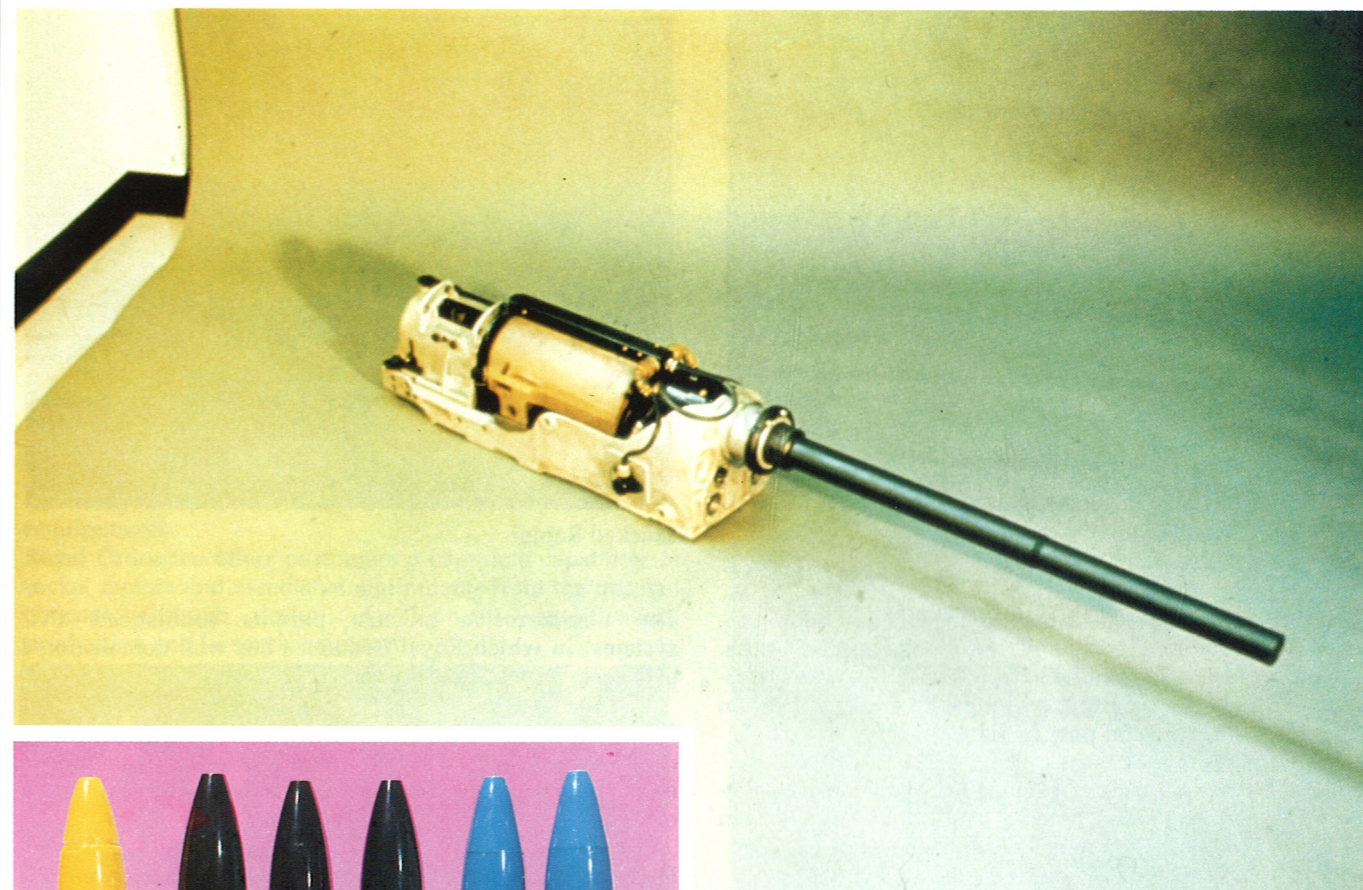
The well-proven principle of the gas-operated revolver system has been maintained within the design of Aden 25. Gas is diverted from the barrel as the projectile uncovers a port. This provides energy for the automatic cycle of feeding and firing the round of ammunition, and then ejecting the link and empty case. Elements of this principle, fully proven during the Aden 30 mm development programme, have been retained in detail. For example, by retaining cam form which generates constant acceleration/deceleration of the beech cylinder and ammunition belt, development time and technical risk were minimized. This also applies to the gas system and ejection mechanism.

ADEN 25 Specification

Calibre:	25 mm
Type:	Gas-operated revolver
Total system weight (twin pod installation):	430 kg (with 200 rounds)
Gun length:	2.285 m
Barrel length:	1.7 m
Barrel weight:	18 kg
Max gun cross-section:	240 x 246 mm
Rifling:	R.H. progressive parabolic twist 16 grooves
Muzzle velocity:	1050 m/s
Rate of fire:	1650-1850 rpm
Time of rate:	< 20 ms
Cocking:	Pneumatic
Ammunition:	25 mm NATO Stanag 4173
Recoil load:	22 kN fitted with standard muzzle device

ROYAL ORDNANCE
Defence systems, sub-systems and components

ADEN 30



Specification

Calibre:	30 mm
Overall length of gun:	1590 mm
Total weight of gun:	87 kg
Barrel weight:	12.25 kg
Barrel length:	1080 mm
Rifling:	progressive right-hand parabolic twist, 16 grooves
Rate of fire:	Aden Mk 4 and 5 1200-1400 shots per minute
Muzzle velocity:	790 m/s
Cocking:	pneumatic
Firing:	electric 26 V dc
Ammunition feed:	left-hand or right-hand, disintegrating belt
Ammunition:	30 mm high-explosive 30 mm armour-piercing 30 mm practice
Recoil load:	31.4 kN
Typical system weight (gun and 200 linked rounds):	196 kg

Ammunition Data

30 mm for Aden Cannon:	HE	Prac	AP
Complete round weight (g):	496	440	495
Propellant weight (g):	46	46	46
Propellant type:	NRN 141	NRN 141	NRN 141

The Aden is a 30 mm automatic gas-operated cannon of the revolver type, specifically for use in the aircraft interceptor role (air-to-air), and for air attack on ground targets. It is belt-fed. The ammunition is electrically fired.

Original development of the weapon by the Royal Armament Development Establishment (RARDE) was carried out at Royal Ordnance Small Arms Enfield and it has been the prime conventional armament of the Royal Air Force in a variety of aircraft over a number of years. Previous installations were in Swift, Javelin, Hunter and Gnat; it is now installed in Lightning Mk6, Harrier, Jaguar and Hawk.

The present Mk 4 gun is the result of progressive product improvement since the original Mk 1 version was introduced in the early 1950s. Recent development has been aimed at further improving the reliability of the gun and increasing the rate of fire to 1500 to 1700 shots per minute. The improved reliability version is now in service and is shown as Aden Mk 5.

ROYAL ORDNANCE
Defence systems, sub-systems and components



McDonnell Douglas Harpoon

Royal Ordnance has a total capability in solid and liquid propellant rocket motors for all land, sea, air and space systems. A complete service is available from feasibility and assessment studies through design, development and qualification to final manufacture and post design support.

The propellant systems are designed to be capable of operating in the severest environmental conditions anywhere in the world with complete reliability and safety.

Current performance ranges from 0.008 seconds to 600 seconds, charge mass from 0.012 kg to some 500 kg and thrust levels from 100 N to over 300,000 N.

Solid rocket motors

Royal Ordnance manufacture both composite and double base propellants.

It is an acknowledged world leader in plume technology and produces a range of CDB and EDB propellants giving optimised plume signatures.



Tracked Rapier

The non-corrosive exhaust permits sophisticated TVC systems, in which Royal Ordnance has well demonstrated expertise.

For applications where plume characteristics are less significant Royal Ordnance HTPB composite propellants offer a combination of maximum performance with minimum charge cost.

Royal Ordnance has a unique extruded composite propellant technology permitting extremely cost effective design of ultra short burning time motors.

Using the latest production facilities, including one of the worlds largest mixers, Royal Ordnance is able to produce efficiently all types of solid propellant motor, from 25 mm to 1 m in diameter.



Swingfire



Shorts Javelin

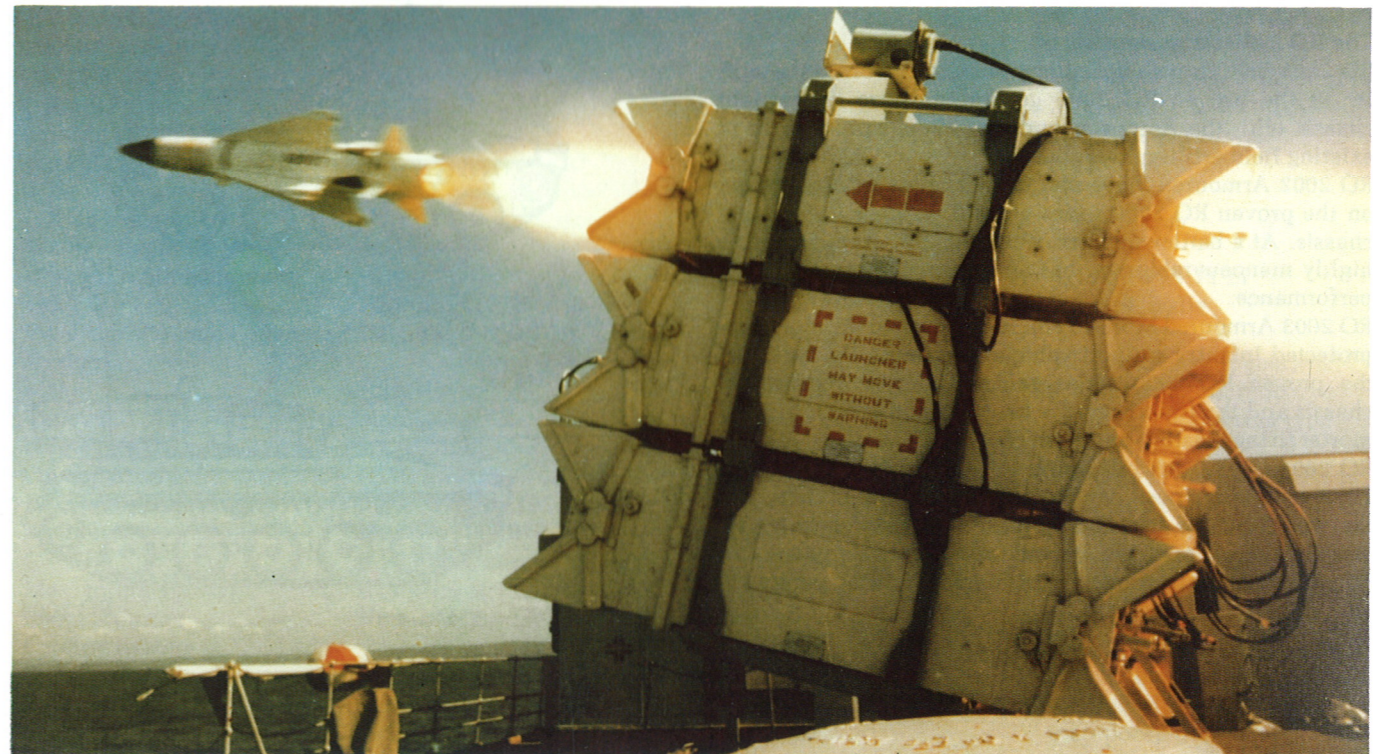
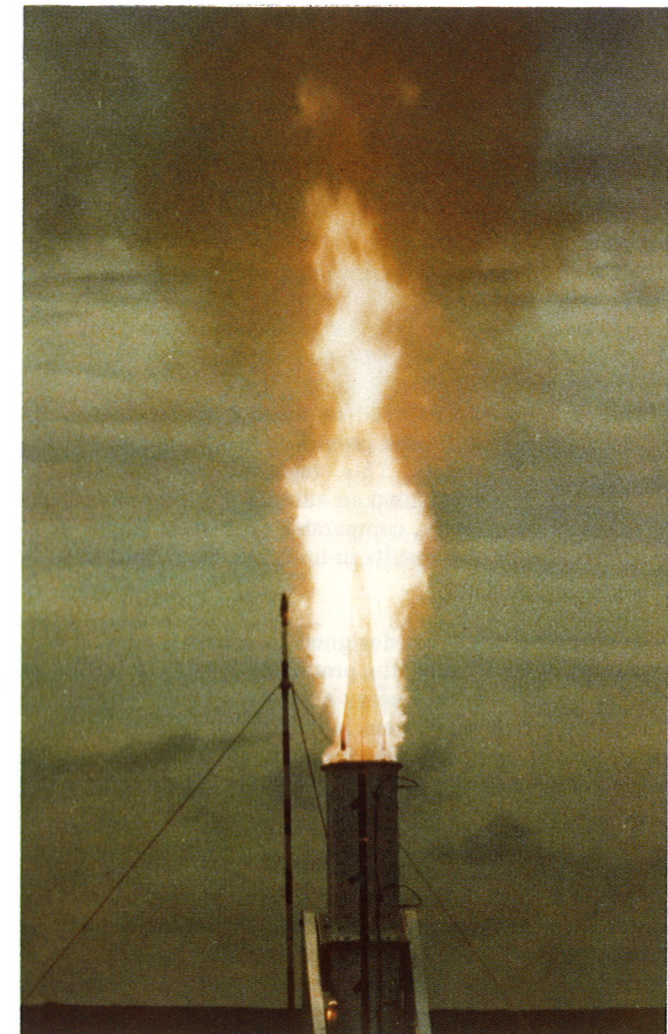
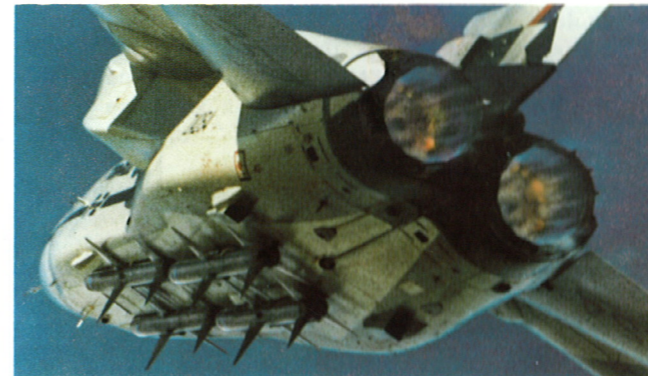
Liquid Rocket Motors

With over 40 years experience in design, development and production of propellants, components and rocket motors, Royal Ordnance applies its liquid propellant technology to tactical, strategic and space orientated systems. Liquid propellants are particularly attractive for strategic post boost propulsion and satellite attitude control. Royal Ordnance experience with both mono- and bi-propellants has led to a wide range of product applications from ancillary power units and gas generators to torpedoes, liquid propellant guns and space propulsion systems.

Components, Materials and Design

An extensive range of sub-components is available which embodies Royal Ordnance's advanced capability in the development and use of composite materials and specialised production processes. Royal Ordnance also specialises in the design of systems tailored to meet individual customer requirements.

Royal Ordnance offers customers a complete capability in rocket motors and associated equipments from the original concept, through design, development, qualification, production and in-service support.



RO 2000 - A FAMILY OF LIGHT ARMoured VEHICLES

The Royal Ordnance RO 2000 offers a fully developed basic design based upon the concept of a family of vehicles. In any conflict situation the need for military vehicles is complex and it is impossible to combine major battlefield functions into one vehicle. Current strategic philosophy therefore relies on the use of a family of vehicles; each vehicle with its defined role within the battlefield infrastructure.

Mobility

The front engine configuration gives maximum flexibility for a complete range of vehicles whilst the basic design philosophies are those of simplicity and maintainability. The highly efficient automatic gearbox and steering system, together with the method of cooling fan drive and the design of final drive used, ensures that parasitic losses through the power train are minimised providing maximum horsepower at the drive sprockets. This, together with the efficient suspension, gives RO 2000 an automatic performance, particularly cross country, comparable with more highly powered vehicles. It also results in low crew battlefield fatigue.

Protection

The structure has been designed to accept a new armour system which will allow the protection level to be optimised against both chemical energy and kinetic energy weapons. This new armoured system is capable of further enhancement should any particular threat level increase and it enables Royal Ordnance to offer unequalled protection for this class of vehicle.

Maintainability

Maintainability is ensured by such concepts as the use of one single lubricant throughout the vehicle, hydraulic track adjusters and self sealing couplers for fuel and hydraulic lines. Typical removal and replacement times for major units using the simplest of equipment, are as follows: Engine - 40 minutes, Gearbox - 35 minutes, Final Drive Unit - 25 minutes.

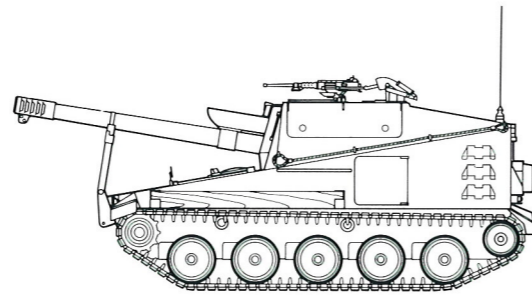
The RO 2000 series consists of:

RO 2001 Self Propelled Artillery vehicle combines the agility of the proven RO 2000 general purpose lightweight chassis with the firepower and operational procedures of existing field artillery weapons.

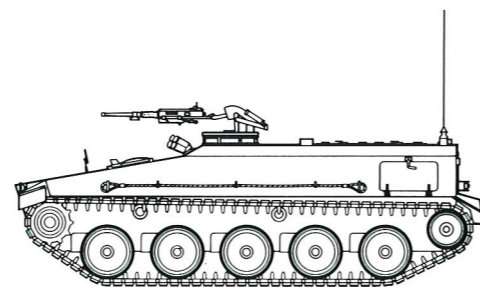
RO 2002 Armoured Personnel Carrier offers a design based on the proven RO 2000 series general purpose lightweight chassis. At a battleweight of 18 tonnes this APC variant is highly manoeuvrable and has an impressive cross-country performance.

RO 2003 Armoured Mortar vehicle offers an advanced, fully-protected Infantry support vehicle combining the agility of the proven RO 2000 series general purpose lightweight chassis and the firepower of a new 120 mm breech loading mortar firing existing ammunition.

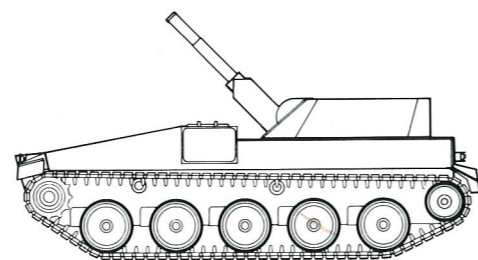
RO 2004 Light Tank integrates the agility of the proven RO 2000 general purpose lightweight chassis, the firepower of the world famous L7 105 mm gun - firing standard NATO ammunition - and the protection of newly developed dynamic armour to achieve a formidable fighting vehicle.



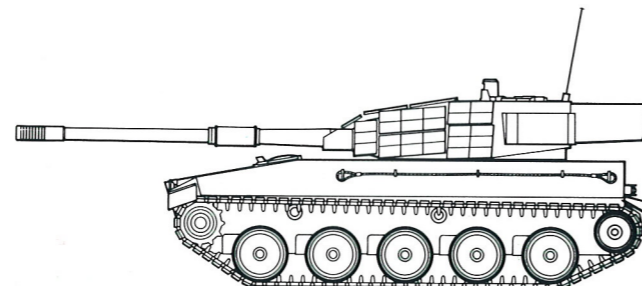
RO 2001



RO 2002



RO 2003



RO 2004

COMBAT ENGINEER TRACTOR

The Combat Engineer Tractor (CET) is a unique armoured vehicle designed specifically to provide integral engineer support for the battle group. It combines a versatile and effective engineer capability with the protection and mobility needed for survival on the battlefield of the 1980s, including an outstanding water crossing ability. It can be transported by air to the theatre of operations and can be used in a wide variety of situations.

Technical Data

General

Crew:	Two men
Battleweight:	18 tonnes
Nominal Ground Pressure:	46.2 kPa
Power/Weight ratio:	13.5 kW/t
Fuel Capacity:	418 litres
Bridge classification:	18

Performance

Maximum road speed:	56 km/h
Vertical obstacle:	0.61 m
Trench:	2.06 m
Brakes: Main:	Stop the vehicle from 8.9 m/s in 6.7 m max. on dry road
Hand:	Hold on 1 in 1.73 slope
Maximum swimming speed:	2.5 m/sec. (5 knots)
Water: entry (max. angle):	45°
exit (max. angle):	45° winch assisted
Wading depth:	1.83 m with 4.5 t remaining on track
Earthmoving performance:	300 m ³ /h over 100 m haul distance
Tractive effort: reverse:	133 kN at the draw bar

Dimensions

Length: hull:	5.334 m
overall:	7.3 m
Width: hull:	2.87 m
bucket:	2.921 m
tracks:	2.769 m
Height: overall:	
(less RP Anchor):	2.83 m
(with RP Anchor):	3.41 m
Ground clearance:	457 mm
Bucket: Struck (SAE):	1.53 m ³
Heaped (SAE):	1.91 m ³
Lifting capacity:	67.5 kN
Wading depth:	1.83 m
Draught (with swimming aids):	2.24 m
Freeboard (to hatch opening):	356 mm

Engine

Make:	Rolls-Royce
Type:	Diesel, C6TFR
Number of cylinders:	Six (in line)
Capacity:	12.17 litres
Bore and stroke:	130.175 mm x 152.4 mm
Maximum power (gross):	240 kW (320 BHP) at 2100 rev/min
Max. torque (gross):	1.19 kNm at 1500 rev/min
Injector pump:	Simms Majormec
Cooling System	
Radiators:	Two-air cooled on land, water cooled when swimming
Fans:	Two (380 mm dia) — mixed flow, light alloy



Fan drive system:	Hydrostatic, variable speed, thermostatically controlled from coolant temperature. System can be manually shut down for swimming.
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Transfer Box

Ratio:	1:1.68 overdrive
Power take-offs:	Six
Cold start disengage:	Dog clutch
Water jet engagement:	Synchro-mesh clutch

Gearbox

Type:	TN 26 manually controlled power shift type, providing 4 speeds in each direction
Torque Converter:	Schneider 330 mm dia
Gear Ratios:	Forward Reverse
First:	3.52:1 7.53:1
Second:	2.22:1 4.75:1
Third:	1.53:1 3.25:1
Fourth:	1.00:1 2.14:1

Steer unit

Type:	Rolls-Royce CGS 312. Controlled differential and clutch/brake steering by selection in cab: differential locked out when clutch/brake system in use.
Ratio:	2.07:1 reduction

Differential steering turning circle:	6.8 m radius
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Clutch/brake steering turning circle:	Skid turn 11.71 m between walls
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Final Drive

Type:	Single stage spur gear, 3.44:1 reduction ratio
Driving sprocket:	12 teeth, double ring type

Suspension

Type:	Transverse torsion bar - five units per side
Wheel deflection:	0.203 m bump 0.101 m rebound
Dampers:	Hydraulic double acting ram type on front and rear wheel stations mounted inside hull
Lock-out:	Air actuated hydraulic system controlled from cab and incorporated in dampers on rear wheel stations only

Clansman is an integrated system of radio equipments designed for operation in combat zones anywhere in the world. The system can provide communication facilities over long and short distances for armoured vehicles and ground forces, operating in a large number of different roles. A wide range of vehicles has been equipped with Clansman, including the Challenger main battle tank, wheeled and tracked reconnaissance vehicles, self-propelled guns and armoured personnel carriers. Inherent flexibility enables simple as well as comprehensive systems to be assembled to meet individual user requirements.

The Clansman vehicle system is comprised of four main equipment groups: radio sets, control harness, antennas and audio ancillaries. The control harness produced by Royal Ordnance Blackburn forms the basis of the vehicle system and is described below.

The Clansman Radio Control Harness (CRCH) is a family of units which provides the vehicle crew with intercommunication and access to the installed radios. It has superseded the Larkspur system, and its superior design reflects a new philosophy by recognising the needs of users who many not require the total inventory available. The harness may be fitted to any vehicle in a one, two or three radio installation.

Electrical design

The harness is powered from the main vehicle battery supply, nominally 28V, with regulation being maintained from supplies in the range 21 to 33V.

Spike and surge suppression is included which gives the harness immunity from excessive voltage transients generated within the vehicle.

Individually adjustable volume controls are available so that comfortable listening levels can be established.

Climatic durability

An important characteristic of CRCH design is its simplicity of operation under difficult conditions, DEF 133 Table L3 (Ground Equipment exposed and immersible unpackaged). The harness is capable of continuous operation over the ambient temperature range of -40°C to 75°C under conditions of driving rain, salt spray, driving sand and dust. In addition the harness can operate in 95-100% humidity at a temperature of 30°C.

Use

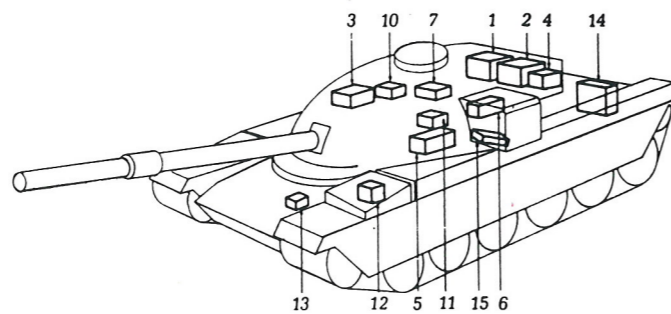
Only a brief period of instruction is necessary to enable the equipment to be used effectively in darkness, under conditions of high ambient noise or when the vehicle is crossing open country.

Logistics

Proven high reliability means that spares requirement is minimal and only a small range of sub-assemblies need to be carried.



Installation diagram for main items



Typical Clansman installation comprising two radio sets and appropriate radio control harness. The system can be modified to suit requirements.

Key

- 1 and 2 VRC 353 vehicle radio sets
- 3 and 4 TUAAM tuning units, automatic antenna-matching
- 5 IB2 two-set interconnecting box
- 6 CB2 two-set crew box, with headset
- 7 CBF commander's fixed box, with independent pressel
- 8 CPU commander's personal unit, with headset
- 9 CASE Cable assembly switch electric
- 10 CB2 two-set crew box, with headset
- 11 DBS driver's set selector box
- 12 RBJ rotary base junction
- 13 DB driver's box, with headset
- 14 TT tank telephone
- 15 RJB radio junction box
- 16 and 17 ARFAT automatic tuning attenuator box
- 18 ECC Emergency crew control
- 19 ICJB Intercom junction box
- 20 FWCB Fire wire control box

Communications facilities.

The range of facilities depends on the selected system, the main functions are listed below:

IC - Normal intercommunication between crew positions with 'press to talk' facilities.

Live IC - Intercommunication between crew positions with 'hands free' operation.

Communal IC - Intercommunication between vehicles via communal terminal and line.

Rebroadcast - Signals received by one radio are retransmitted by the other. This facility is provided by the harness using two installed radios or one installed radio connected to a remote radio using standard twin field cable.

Override - This facility allows any crew member's voice to be heard by all the crew irrespective of their switch settings without interfering with their selected working channels.

Monitor - This allows reception of signals on a selected channel without the ability to transmit.

Remote - Operation of a radio or intercommunication via a telephone cable up to 5 km in length.

Systems.

The basic harness configuration is the two radio installation which can provide radio selection, IC, Live IC, Monitor and Override facilities for all crew positions. Provision is made for automatic or manual rebroadcast between the two local installed radios or between an installed radio and a remote radio. The system will also accept a central warning indicator tone.

A three radio installation would normally be used in a command vehicle rôle where rebroadcast and remote facilities are not normally required. Communal IC and Normal IC facilities are provided in addition to the operation of the three radios and an Override function.

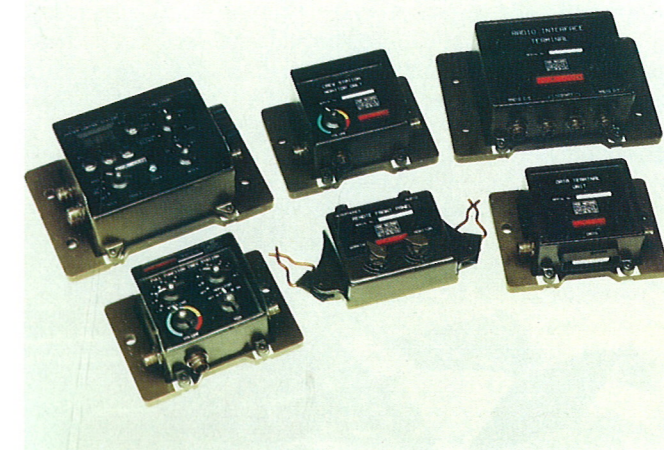
Ancillary items.

In addition to the standard range of items there are ancillary units that can be supplied to extend the range of facilities. These include adaptor boxes which enable other types of radios to be connected into the harness. Remote personal units, loudspeakers and extension leads are also available to suit user requirements.

Alternative fittings are available for use in vehicles with special tasks: eg self-propelled guns and 4 or 5 radio command posts. A 'simplified harness' has also been produced which provides basic intercom facilities at minimal cost in a 1 or 2 radio installation. Further details of these additional units and the full range of standard harness equipment are given in a comprehensive Clansman data book which is available on request.

Advanced Vehicular Intercom System

The Electronics Group of Royal Ordnance have developed a completely new intercom and radio management system using the very latest technology. It has been designed to meet



the demanding requirements of modern installations, such as the multiradio command vehicle operating in an electronic warfare environment. The system uses the technique known as Time Division Multiplexing (TDM), to carry voice or data traffic along a slim cable, giving greater capacity and versatility. By using custom LSI circuits and modern manufacturing facilities of Royal Ordnance it has been possible to reduce the cost whilst improving on the high reliability levels set by Clansman.

A significant advance is the incorporation of Quiescent Noise Reduction (QNR) to minimise the unwanted background noise prevalent in military vehicles, particularly important when several microphones are 'live' at the same time. Other important features include:

- Interfacing with up to 6 radios
- Standardised inter-unit cabling
- Up to 8 radios access stations + 8 listen only stations
- Self testing with centralised indication of fault condition
- Radio silence control by commander
- Inter-vehicle conference facility
- Automatic or manual retransmission on 1 or 2 radios
- Fast data handling (up to 19 kBits/sec)

In addition there are two major options available to the customer when he purchases the system, these depend upon his operating procedures or complexity of his installation. One is the option to select a split earphone mode, which gives a crewman the ability to 'work' any one of the radios whilst 'monitoring' any one (or all) of the others and still maintain hands free intercom. In an emergency, each crewman has an override facility which enables him to be heard by all of the crew without disturbing radio traffic. A programmable option is available which enables the vehicle commander to restrict or allocate various levels of access to radios for each member of his crew, this is particularly useful in a command station where tacticians can assigned their 'own' radios without the risk of accidental interruption.

GIANT VIPER MINEFIELD BREACHING SYSTEM



Giant Viper clears a path 7.3m wide and 183m long through a minefield containing mines with blast susceptible fuzes to allow the safe passage of MBTs and similar vehicles. This unique system incorporates a trailer mounted explosive hose which is projected across a minefield by a rocket cluster and detonates within seconds of landing.

Technical Data

Performance:	Type of mines cleared. Anti-tank and anti-personnel with pressure operated, blast susceptible, single impulse fuzes
Clearance zone:	7.3 m width 183 m (min.) length to 230 m (max.) length
Deployment time:	1 - 3 minutes
Operating temperature capability:	The system is operational in extreme temperature conditions
Flight Characteristics	
Head Range:	300 m - 350 m average
Tail Range:	110 m - 120 m average
Directional Accuracy:	10° either side of aim
Towing Vehicles	
Routine:	4 tonne wheeled vehicle
Operational:	Armoured Fighting Vehicle, Armoured Personnel Carrier, Combat Engineer Tractor
Giant Viper Trailer	
Type:	3 tonne Rubery Owen
Suspension:	Longitudinal, semi-elliptic springs dampened by piston type hydraulic shock absorbers

Tyres:	1200 x 200 run flat
Brakes:	3 line air system
Fixtures:	Anti-ditch skid
Hose	
Charge Box dimensions:	3.15 m length x 1.74 m width x 1.18 m height
Hose Type:	Woven terylene and nylon with red PVC coating to reduce elongation during projection
Hose dimensions:	228 m length x 67 mm diameter
Hose Filling:	Aluminised Plastic Explosive, PE6/Al
Arrester Gear:	Consists of 3 x 3.66 m diameter parachutes, 1st parachute at 15.25 m from tail to straighten hose in flight, twin 2nd and 3rd parachutes attached for deceleration and activation of striker mechanism

Rocket Motor Cluster

No. of Rocket Motors:	8
Type:	5 inch, L9A2
Propellant weight:	7.8 kg per motor
Thrust:	1.65 kN - 1.96 kN from each motor depending on temperature
Filled package weight:	53 kg per insulated motor
Practice Equipment	
	Practice equipment using an inert hose is available for training personnel to prepare and fire Giant Viper. This consists of sufficient equipment to project the hose six times.

BAR MINE SYSTEM

The Bar Mine system represents a major breakthrough in mine warfare, being a simple, fully effective and economic method of countering enemy mobility. Advanced design of both the mine and laying equipment has resulted in a dramatic reduction in the manpower and time required to lay minefields and considerably lower logistic loads in comparison with conventionally hand-laid minefields. The palletised mines can be quickly and safely deployed from forward ammunition areas.

General Features

- Layer can be towed by most medium or heavy load carrying vehicles
- Mines are fitted with fuzes in store in order to save time when deployed and are totally safe to handle in this state
- Fuze is armed automatically when mine is laid
- Dependant upon terrain up to 600 mines per hour can be laid with a single plough
- Several fuze options - pressure, mechanical, electronic and anti-disturbance giving full width attack mine capability
- The mine, rectilinear in shape, laid in end to end configuration, provides a formidable anti-tank barrier
- The complete system is fully air-portable.

Technical Data

Bar Mine

Overall length:	1175 mm
Overall height:	81 mm
Overall width:	108 mm
Total weight:	11 kg
Weight of explosive:	7.2 kg min

Fuze options available

Pressure-Single or double impulse
Mechanical
Electronical
Anti-disturbance

Laying plough

Overall length:	4190 mm
Overall width (including cage wheels):	1600 mm
Overall height:	1270 mm
Weight (ready to use):	1240 kg

Unit load of 72 bar mines

Height:	840 mm
Length:	1220 mm
Width:	1020 mm
Weight including pallet:	855 kg
Effective density (load/package ratio):	88%

Bar Mine

The new bar mine has a tough plastic casing housing the explosive charge and the fuze, which contains only very few small metal parts. The mine cannot be detected by any current electro-magnetic mine detector.

Extensive trials have shown that this mine is completely effective against any tank track and causes severe damage to suspension systems.

Seventy-two mines are packed in a special-to-contents container to NATO palletised load standards. Such a load is ideally suited for handling by the Eager Beaver fork lift tractor. Bar mines can also be assembled in manpacks of four mines each for use in situations where trucks cannot be used. The logistics of mine-laying are therefore greatly simplified.

Mine-laying plough

The bar mines are laid by a trailer-type plough of purely mechanical design; neither hydraulic nor electrical equipment is involved in its operation.

All wearing parts, such as the plough point, are quickly and simply replaced. The machine can be used on any type of soil capable of being ploughed.

The plough is capable of laying buried mines at the rate of 600 - 700 mines per hour and at even higher rates on the surface. Conveyor, tow bar and cage wheels can be quickly removed for transport. The equipment is fully air-portable.



ANTI-PERSONNEL GRENADES

The anti-personnel grenade L2A2 with fuze L25A6 is produced for use by the British armed forces. The weapon is made operational by hand-screwing the fuze into the recess of the grenade body.

The grenade can be thrown by hand or launched by any standard 7.62 mm rifle fitted with a special adapter.

Grenade L2A2

The grenade consists of an internal notched wire coil enclosed in a thin steel seamed casing, having a screwed recess to accept the L25A6 fuze. The explosive is RDX/TNT which, when detonated, gives an average velocity of 1,500 metres per second to approximately 1,200 fragments, each weighing between 0.1 and 0.5 gram.

Fuze L25A6

This fuze screws directly into the L2A2 grenade and incorporates a conventional lever which fires a fixed-time pyrotechnic delay, which in turn fires the detonator.

The accurate delay time system is housed in a steel adaptor which is screwed into the fuze mechanism. It gives a delay time of 4.4 ± 0.5 seconds. The steel adaptor is necessary to allow satisfactory functioning when the grenade is rifle-launched and hits a hard target in short ranges.

Rifle-launching

The L2A2 grenade is assembled to the adaptor projector which is supplied complete with the 7.62 mm L1A2 grenade cartridge, and can be fired from any standard 7.62 mm rifle with launcher.

The fuze is armed by setting back the sleeve of the adaptor projector which releases the fuze lever, the safety pin of the fuze having been removed after assembling the grenade to the projector.

Lethality

The 1,200 high-velocity fragments of regular weight and dispersion confer a high degree of lethality at and near the point of burst, but are innocuous beyond a range of 10 m.

Packaging

Five grenades are packed in steel canister and five fuzes are packed in a similar hermetically sealed canister. Four canisters of grenades and four canisters of fuze are packed in a strong wooden box, giving a total of twenty grenades and twenty fuzes for each box.

Specification

Grenade

Type:	L2A2
Weight:	395 g
Overall length:	81 mm
Diameter (at widest point):	60 mm
High-explosive:	RDX/TNT
Composition:	55/45
Weight of high-explosive:	170 g

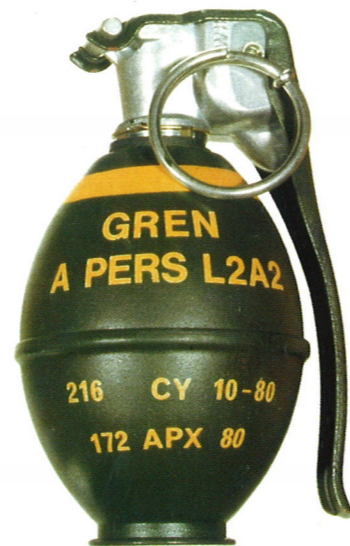
Fuze

Type:	L2A6
Delay mechanism:	Fixed-time pyrotechnic

Performance

Lethal radius:	10 m
Delay time:	4.4 ± 0.5 s

L2A2



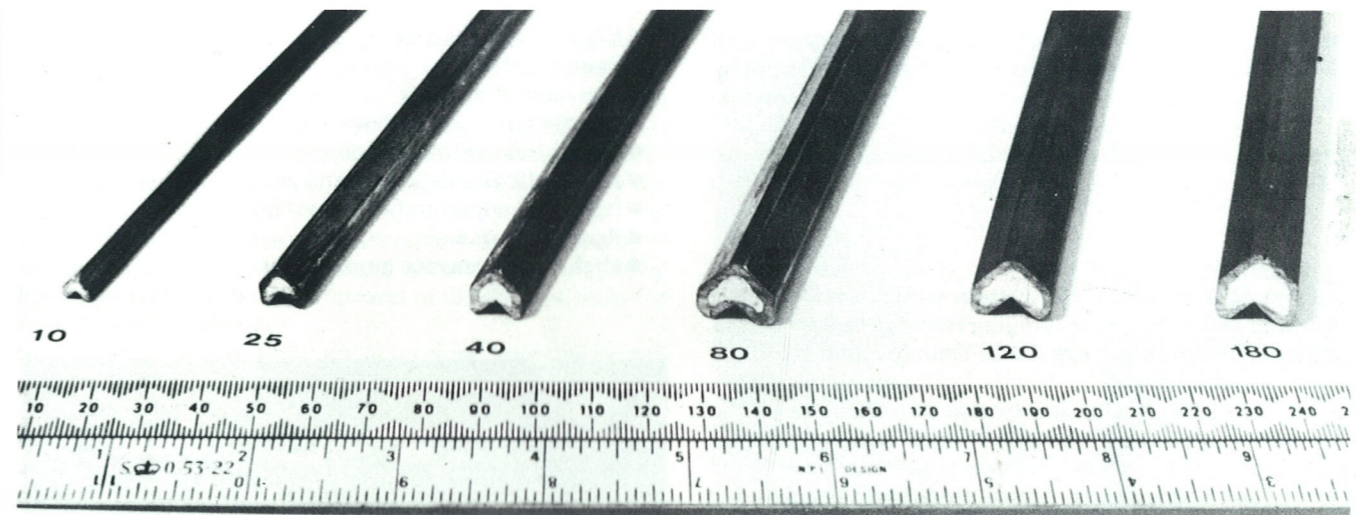
L2A2



L25A6
Fuze



EXPLOSIVE DEVICES



CLC Demolition Cords

Demolition charge

The demolition charge No. 1 6-In Mk 6 is a 152 mm dia shaped charge containing 3.1 kg high explosive and is fitted with a built-in primer. It has excellent penetration in all materials including reinforced concrete, mild steel and armour plate, and punches a hole of 50 mm average diameter.

Catering kit

This kit can rapidly produce a crater in airfields, paved roads, tracks and other surfaces, which effectively obstructs all wheeled and tracked vehicles.

An 8.5 kg shaped charge is used to blow a 2 m deep hole through any surface. Two cratering charges totalling 19.5 kg are placed in this and exploded, using a safety fuze initiating train. The crater produced in most soils is normally 6 to 8 m in diameter and 2 to 3 m deep, and can prevent the passage of tanks.

Demolition necklace

The demolition necklace charge L1A1 is designed for rapid demolition of steel structures, reinforced concrete girders, and bridge arches. The kit consists of five shaped charges which may be used singly or connected. Each charge contains 5 kg of high explosive and has a built-in primer.

CLC Demolition Cords

The CLC system can be used for demolition work, explosive ordnance disposal (EOD), fire and damage control, rapid ac-

cess to buildings and strongpoints, salvage work, etc.

It is made as a plastics sheath filled with a special explosive. The sheath has a chevron-shaped cross-section to concentrate the blast towards the open side. It can be shaped to follow the contour of the target, to which it can be secured by adhesive tape.

Plastic explosive (PE4)

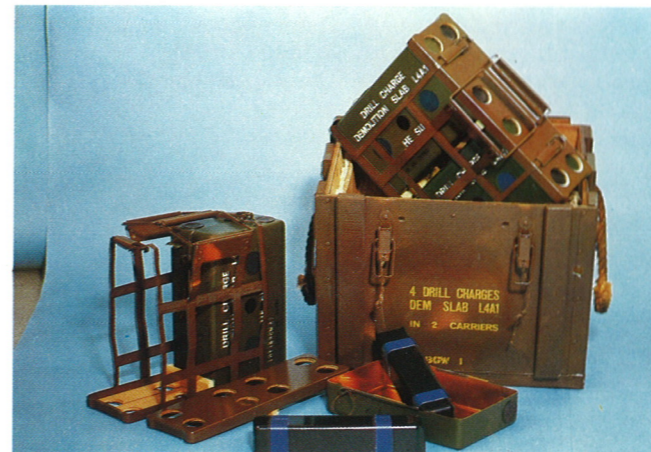
PE4 is an RDX based high explosive which is plastic over a wide range of temperatures. It is non-toxic, unaffected by moisture and may be used underwater. It is hand mouldable and is supplied in three main forms: bulk, cartridge (0.23 kg) and slab.

Slabcharges

The complete charge is a metal container, hinged in the middle, holding six slabs of explosives. Each slab consists of 0.9 kg of Plastic Explosive (PE 4) wrapped in metal foil and contained in a plastic container with one open face. When the open face is pressed against a target, the plastic explosive moulds itself around any irregularities.

Sheet explosive No. 2

SX2 is an RDX based explosive in flexible sheet form. Standard sheet thickness is 458x254x3 mm. It may be easily cut with a knife or scissors. It is therefore a very economical and effective material for carrying out specialised tasks as the blast effect may be tailored to requirements such as EOD.



REGUNNING KITS

T54/55 and Type 59 Battle Tanks are robust and reliable well armoured vehicles. However, their 100 mm main armament is not considered adequate to meet the need of modern warfare. Royal Ordnance has designed and developed a regunning package which dramatically increases offensive capability by replacing the existing ordnance with the British 105 mm L7 Tank Gun.

The Royal Ordnance L7 Tank Gun is in service with the majority of the armies of the western world. Versions have been fitted to various tanks, ranging from the Centurion MK 10 to the latest United States Battle Tank, the M1.

The 105 mm L7 Tank Gun is a combat proven, quick-firing, accurate weapon, effective in both the anti-tank and infantry support roles. The gun has an autofrettaged rifled barrel and a horizontal sliding breech. A fume extractor is also fitted in order to remove residual gases from the breech.

Fitting the Royal Ordnance 105 mm tank gun regunning kit offers key undeniable advantages to users of these vehicles.

Improved performance

The Royal Ordnance 105 mm tank gun regunning kit dramatically increases first time hit probability of T-series vehicles as well as substantially increasing the vehicles ability to defeat both RHA and spaced armour configurations.

Ease of maintenance

The Regunning Kit is designed with low maintenance requirements in mind. If necessary, the removal and replacement of the complete gun can be achieved without the need to remove the turret.

Minimal vehicle modification

The regunning package is designed to restrict vehicle modifications to a minimum, thus limiting the time the vehicle is out of service whilst undergoing modification.

Advanced ammunition natures

Regunning with the Royal Ordnance 105 mm tank gun provides the customer with a high performance tank gun which is standard NATO equipment and the ability to employ a wide range of 105 mm kinetic and chemical energy ammunition, including US HEAT ammunition. The weapon system is thereby provided with exceptional performance against all types of target, and extensive world-wide use of the 105 mm Tank Gun ensures that development of advanced ammunition types is both intensive and continuous.

Additional equipment

In addition to the basic regunning package, Royal Ordnance can also supply the following optional equipment for T-series vehicles:

- Smoke grenade dischargers
- Thermal sleeve

Although the required adjustments to the vehicle sighting system are included in the regunning package, the effectiveness of the vehicle can undoubtedly be increased by the incorporation of one or all of the following associated devices:

- Night vision devices
- Range finders
- Fire control systems
- Muzzle reference systems
- Gun/turret control equipment
- Automatic fire detection and suppression systems
- Improved communication systems
- Applique armours
- Higher performance automotives



Technical Data

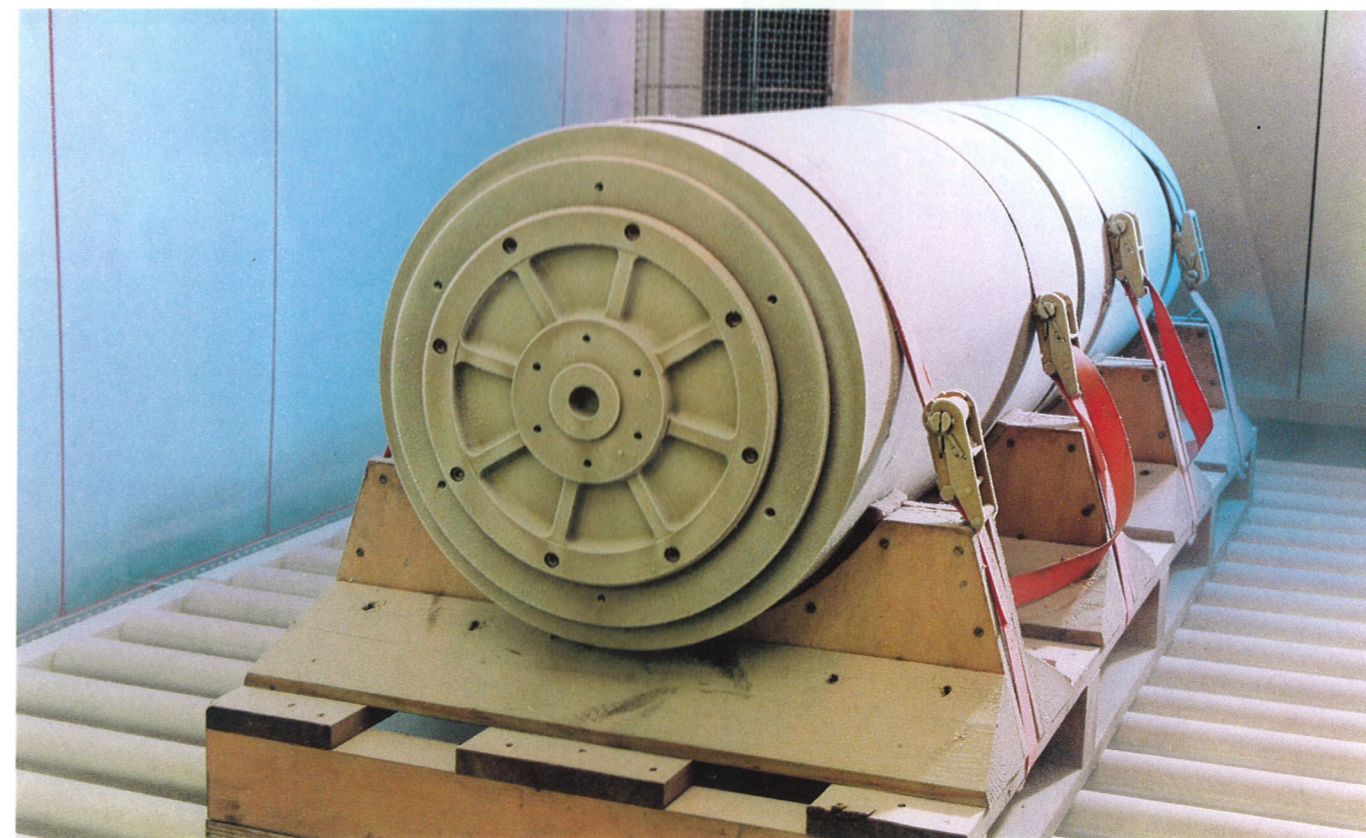
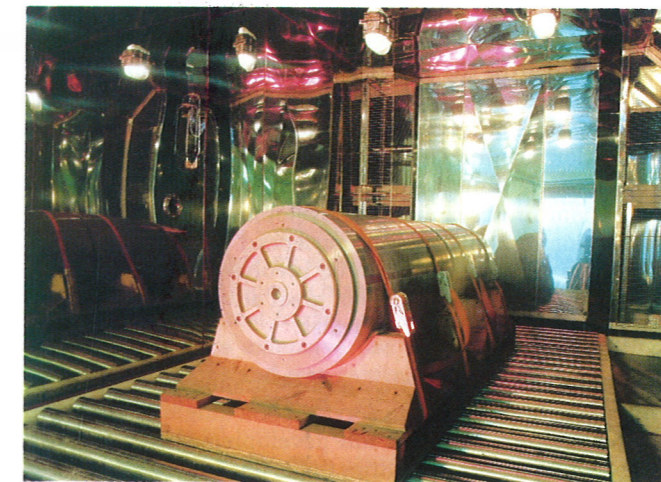
Crew stations:	Unchanged
Ammunition storage:	Modified to suit 105 mm ammunition and customer's mix of natures
Elevation/depression:	+ 17° - 4° as existing
Fatigue life of barrel:	2000 cycles
Wear life of barrel:	380 rounds (APFSDS)
Muzzle velocities:	APFSDS 1490 m/s APDS 1426 m/s HESH 730 m/s DS/T Prac 1540 m/s SH/Prac 730 m/s Smoke 258 m/s
Barrel construction:	Monobloc
Rifling:	Constant RH twist (28 grooves)
Fume extractor:	Eccentric mounting
Firing system:	Electrical (24 volts)
Emergency firing system:	Hand operated generator
Shot travel:	4.75 m (APDS)
Recoil system:	Hydro-pneumatic
Mass of gun:	1287 kg
Mass of recoiling parts:	1350 kg

ENVIRONMENTAL TESTING FACILITIES

Stringent testing plays a vital part in the development of successful new products and in industry's efforts to improve the standards of quality it can offer its customers. In the defence industry, guaranteed product performance to specification is absolutely essential - mistakes cannot be allowed to happen. Royal Ordnance has always placed great emphasis on the importance of thorough and comprehensive testing. The company's network of environmental test facilities has been established against the background of the key rôle played by Royal Ordnance in the development of the defence industry in the United Kingdom.

Royal Ordnance has built up a level of knowledge and understanding of defence requirements and of geographical and climatic conditions around the world that few other defence contractors can match. Royal Ordnance has invested heavily in the most sophisticated state-of-the-art environmental test equipment available which enables it to build upon its already enviable reputation for product reliability. The company's impressive range of environmental test facilities at 10 sites throughout the United Kingdom is now available for use by other UK and overseas companies and Organisations outside Royal Ordnance.

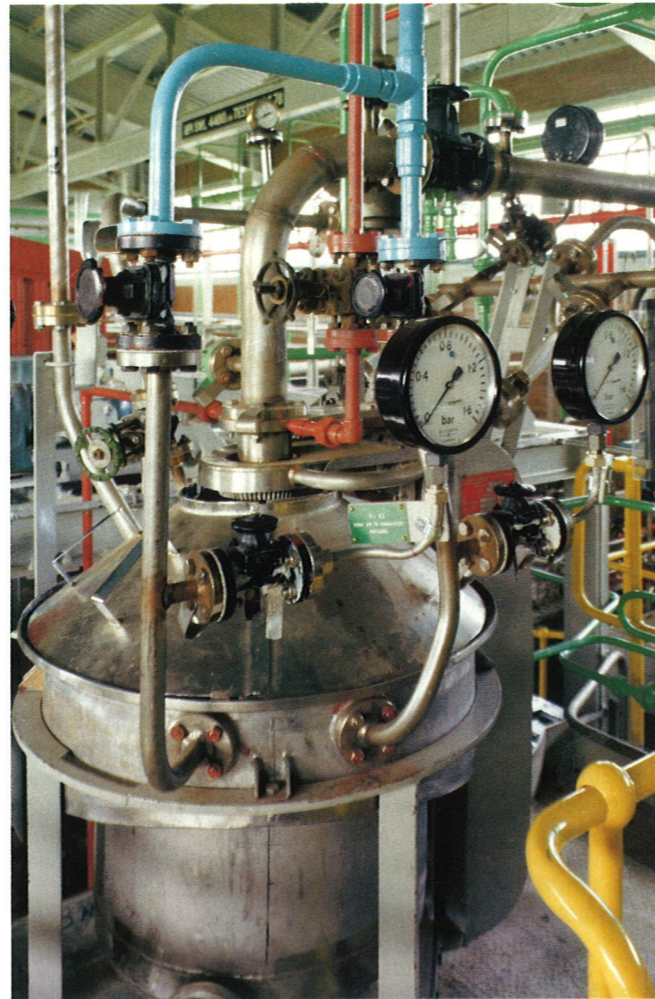
In addition to the exceptional facilities, testing equipment and instrumentation, highly experienced physicists as well as chemical, mechanical and electronic engineers are available to provide specialist advice in a wide range of areas. Advanced electronic measurement equipment, instrumentation and data logging facilities are also available. Clients are most welcome to be present during testing and may take an active part.



TECHNOLOGY TRANSFER

The transfer of technology from an experienced company with a proven design and production base over a wide product range can be the effective solution to the problems inherent in developing or improving weapon systems manufacturing capability. Easy access to state of the art design and production techniques and to highly qualified experts can replace much of the need for extensive and time consuming investment in Research and Development and the difficult acquisition of skilled and experienced personnel. Today a multitude of disciplines can be involved. Instant access to these skills can therefore be of great advantage in minimising costs and reducing timescales.

Royal Ordnance's experience of technology transfer is extensive, ranging from the services of a single technical expert to the provision of a full development team and from refurbishing existing facilities to the total development from a green field site of finished turnkey systems with a modern defence equipment manufacturing capability. This depth of



experience spans the whole of the Royal Ordnance and its manufacturing divisions, each of which has its own integral research and development capability and all are geared to the provision of technology transfer services. In addition, these divisions are complemented by a Future Systems Group which undertakes system assessments and operational analysis studies for Royal Ordnance and their clients. The expertise and experience of Royal Ordnance is now available to countries outside the UK to enable them to meet their national and international commitments.

The services available include factory design; design and layout of plant; logistic and materials planning; full commissioning of equipment; quality assurance and testing programmes; and in-country support. Services specifically relating to explosives include proven explosives technology; hazard analysis; guidance on handling and storage of sensitive materials; factory safety procedures; propellant technology; and charge design.



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Defence systems, sub-systems and components

FUTURE SYSTEMS GROUP

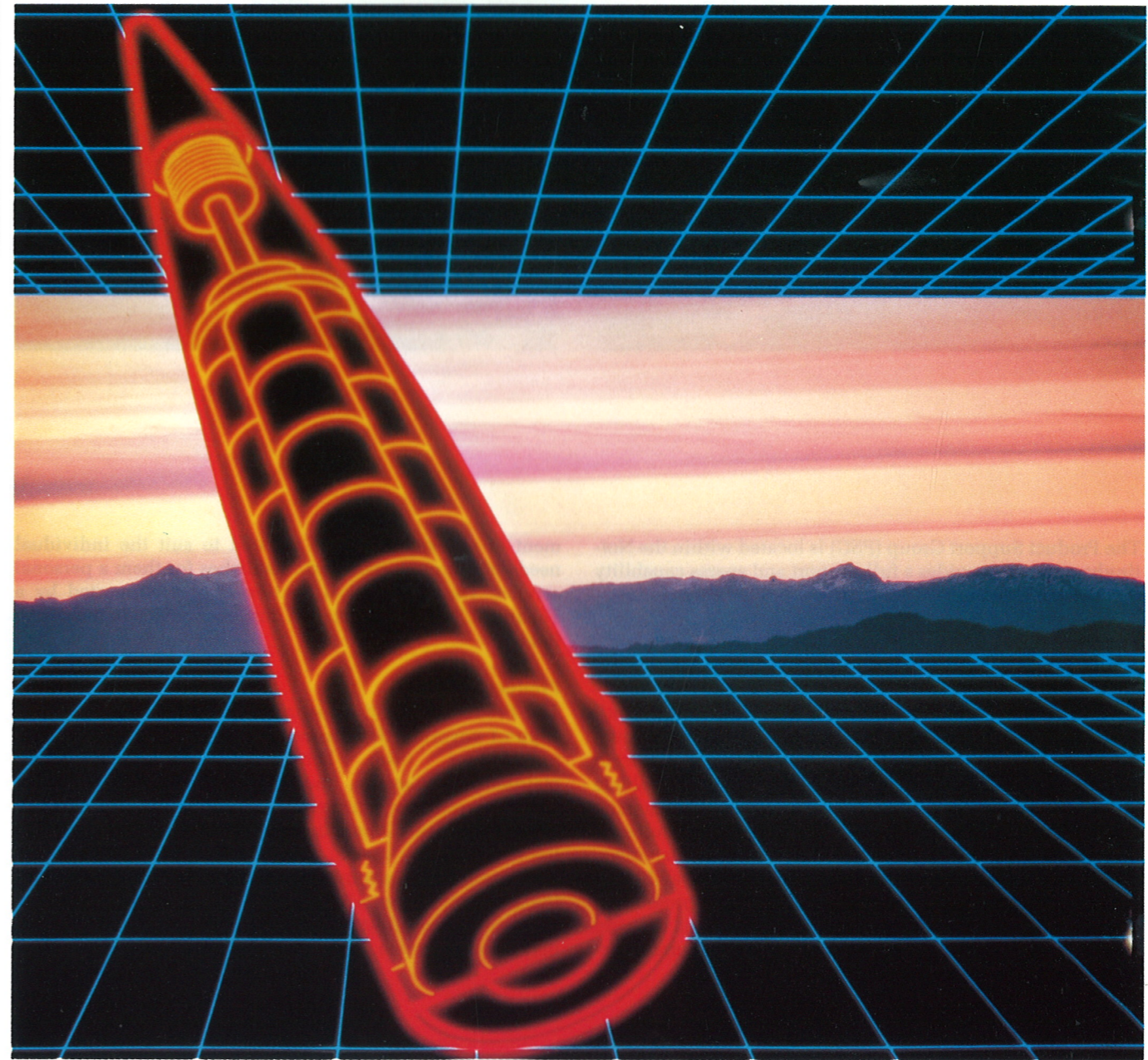
The Royal Ordnance Future Systems Group is the main focus in the company for assessment studies and cost effective analysis of existing and potential future weapons.

Located at Shrivenham, Oxfordshire on the campus of the Royal Military College of Science the Group reports directly to the Research and Development Director in the Corporate Headquarters. It serves all parts of the company and undertakes studies not only on its own initiative and at the request of the Research and Development Director, but also for the Sales and Marketing Director and the four Manufacturing Divisions. Externally funded work is also accepted from both government and commercial sectors at home and abroad. The Group comprises a Systems Assessment Unit and an Operational Analysis unit each headed by an Assistant Director. The Systems Assessment Unit is primarily concerned with the formulation of new system concepts, working closely with other parts of Royal Ordnance, and carries out assessment of novel weapon and system concepts. It also

works closely with the Operational Analysis Unit which undertakes a broad sweep of studies, cost-effectiveness analyses and logistic assessments.

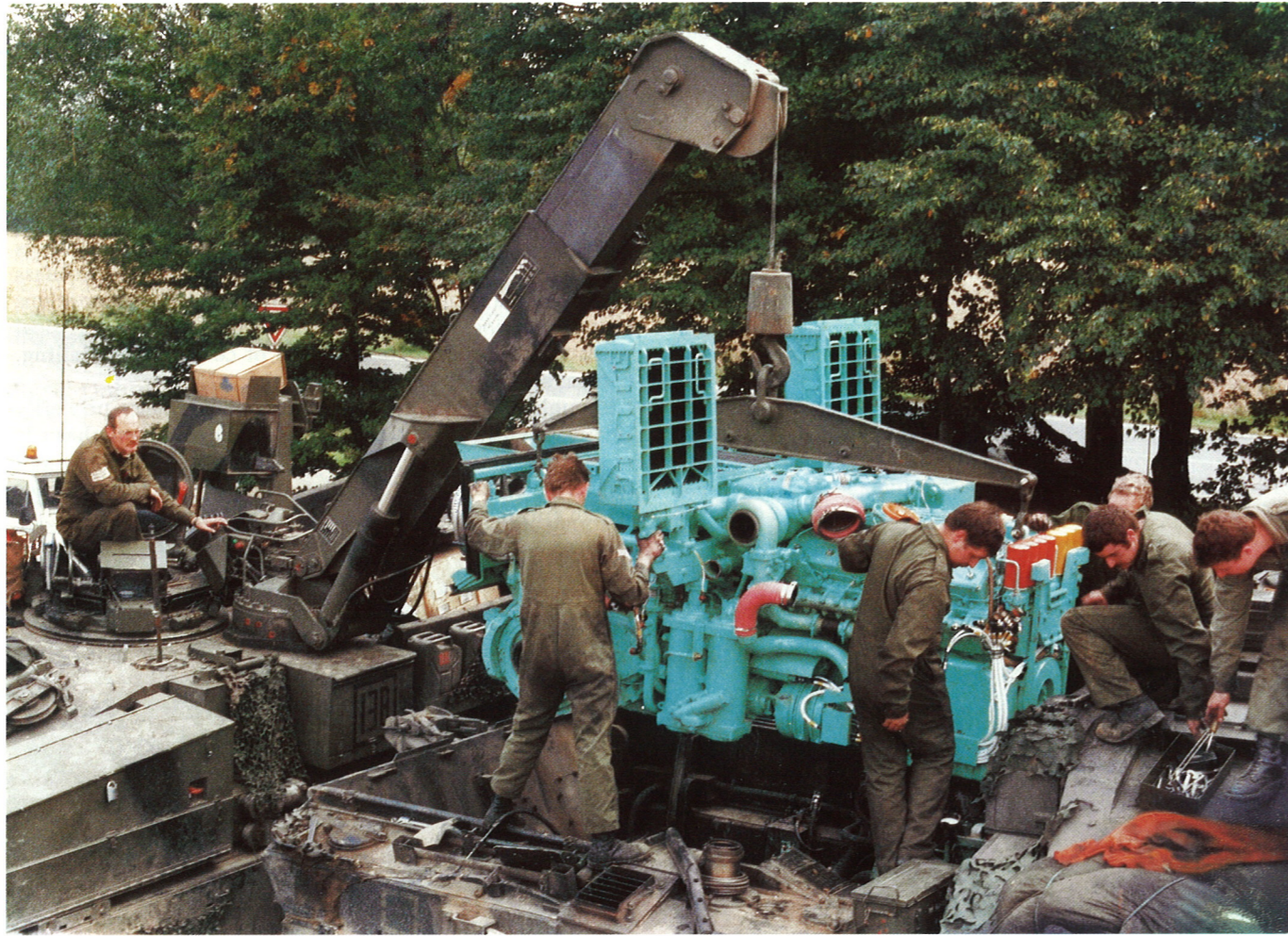
The scope of Future Systems Group studies varies from detailed analyses of weapon terminal effectiveness and one-on-one engagements through to higher level tactical studies investigating force mix and cost trade-off questions. The distinctive nature of the work is to put potential future weapon systems into realistic battlefield and environmental settings with the aim of studying their likely relative effectiveness under combat conditions. This requires careful assumptions about scenarios, threat forces and tactics prior to analytical work which makes extensive use of computer modelling, combat simulations and war-gaming.

Although historically Royal Ordnance has been primarily involved with land weapon systems, increased emphasis is now being given to air and naval systems and this is reflected in the balance of studies and modelling capabilities which currently exist in the Future Systems Group.



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PRODUCT SUPPORT GROUP



The Product Support Group (PSG) is located within the Nottingham site. It provides a full support and spares capability for overseas customers. The services provided are as follows:

Spares

A fully computerised and fast response spares service is available. A special agreement has also been signed with Ministry of Defence (UK) allowing access to a wide range of military equipment spares. PSG has already established its own warehouse facility on site at Nottingham to allow it to react to priority requests for spares ie "Gun out of Action", "Vehicle off Road" and "Urgent Requirements". The Commercial Section deals with a very wide range of approved sub-contractor, for the production of spares for overseas customers. The spares service includes a full monitoring capability on customer enquiries and more especially on the progress of orders monitored against production quantities and delivery dates. This capability is regarded as a most important ele-

ment of our support. It is tailored to suit the individual needs of our customers and establishes for them a personal service. The Commercial Section is also supported by a Technical Section for detailed customer advice in the spares field.

Product Support

The Product Support Department provides a full range of support covering demonstrations (in-country if required); publications (user handbooks, parts catalogues, maintenance manuals, and full documentation); training aids; tools and test equipment; training and in-country commissioning teams. There is also a full scaling service for initial and on-going spares, tools and test equipment, to support customers' equipment throughout its life. In addition, the Product Support Department provides full after-sales support on modifications and product improvements that may arise in service.

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This brochure has been produced by Mönch Publishing Group's marketing department in cooperation with Royal Ordnance plc, Griffin House, 5 Strand, London WC2N 5BB, Great Britain, as a reprint from the International Defence Equipment Catalogue (IDEC).

Concept: Manfred Sadlowski

Typesetting: Grafik + Satz GmbH, Bonn, West Germany

Printed in the Netherlands by Van Boekhoven-Bosch B.V., Utrecht

Jules Perel's Publishing Company is a subsidiary of the Mönch Publishing Group.

