

WASC 2186

Brochure
- Royal Small
Arms Factory
and Technical
Summary -
Ammunition Design

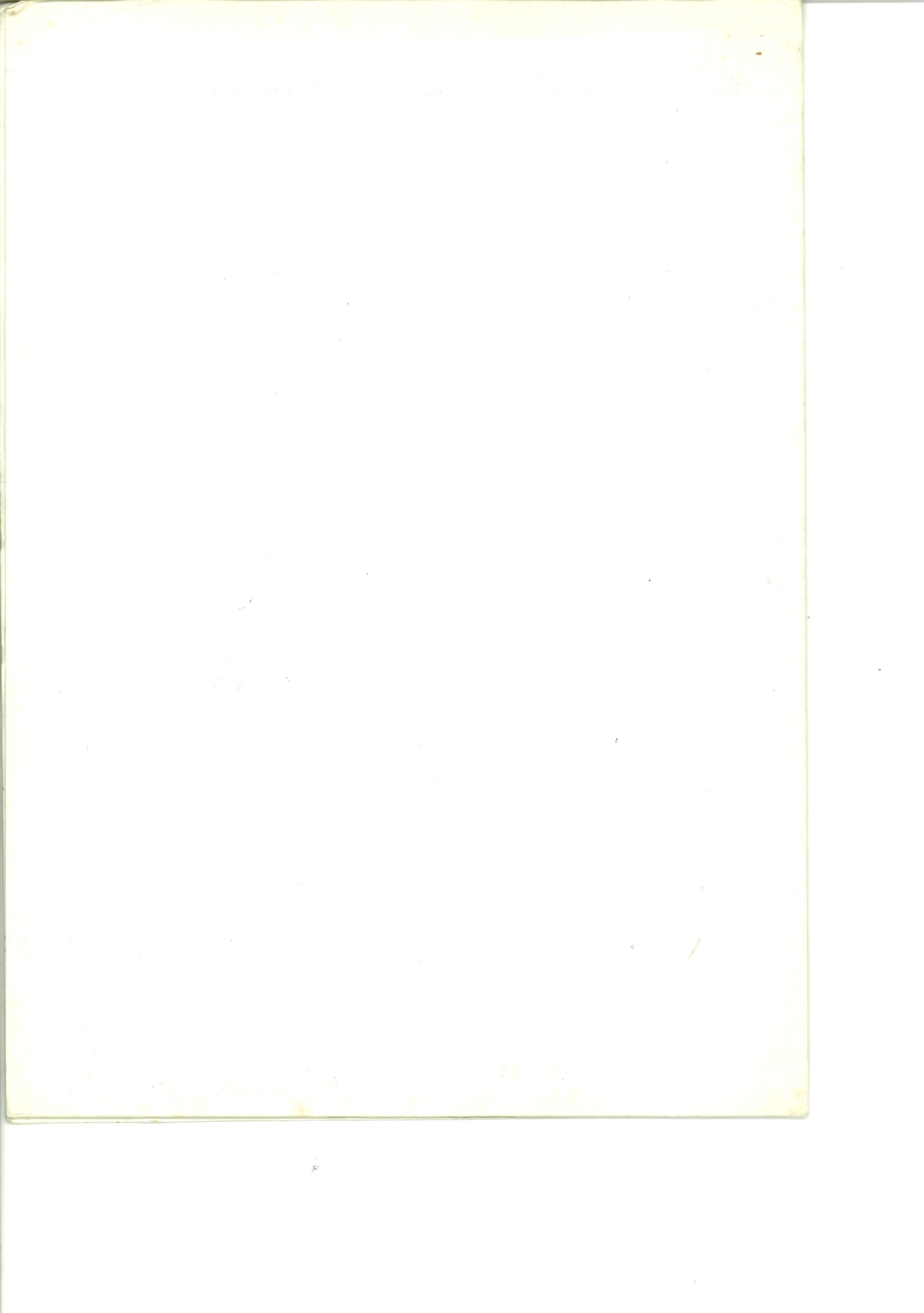
**Royal
Small Arms
Factory**







THE DIRECTOR
ROYAL SMALL ARMS FACTORY
ENFIELD LOCK ENFIELD MIDDLESEX
TELEPHONE LEA VALLEY 763333





RS&AF ENFIELD 4.85 WEAPON SYSTEM (SMALL ARMS)

The Enfield weapon system of the 1980s is designed to equip an infantry section or squad with a family of two weapons and common ammunition which will give much increased mobility and flexibility with an improved chance of hit in a role requiring single shot or automatic fire within the estimated battle ranges for future infantry actions. The data sheet tabulates the major features of the new 4.85mm weapons and compares them with those of the present UK service weapons. The photographs show the compactness and rugged construction of the unconventional configuration pioneered at Enfield.

1. THE AMMUNITION

The ammunition has been optimised at a calibre of 4.85 mm after detailed studies of operational requirements and design parameters. As a guide it can be considered to be fully effective to 1000 m range which is in excess of that required in infantry operations. A variety of ammunition types will be available, i.e. Ball, Tracer, Blank and Grenade cartridge.

An important feature of the ammunition is that it is less than half the weight of standard NATO 7.62mm ammunition, which enables a great increase in the quantity that can be carried so extending operational effectiveness.

2. THE WEAPONS

The two weapons in the system are the Individual Weapon (Rifle/Sub Machine Gun) and the Light Support Weapon (Light Machine Gun). Both weapons fire common ammunition and also use 80% common components which gives increased flexibility, reduces spares requirements and simplifies maintenance. The weapons are designed to take full advantage of the lighter ammunition enabling them to be considerably shorter due to the buttless configuration and about half the weight of most equivalent small arms. The recoil is very much less than with heavier calibre weapons which helps in recruit training and minimises weapon movement when fired. Both weapons are gas operated, self loading and magazine fed with the facility for single shot or automatic fire. The strength of construction enables muzzle launching of Mecar type grenades and adaption to fire 5.56 mm ammunition. Troop trials have clearly shown the big advantages of reduced weight and length giving comfortable handling.

THE PERSONAL 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 normally from a 20 round magazine but the larger light support weapon magazine can also be used.

THE LIGHT SUPPORT WEAPON

This weapon is identical to the PW in 80% of the component parts and also fires single shot and automatic. It is designed for a higher rate of sustained fire with an increased range performance and therefore is fitted with a longer and heavier barrel, and in the automatic mode fires from an open breech to prevent a round being fed in to the chamber at the end of a sustained fire cycle, so preventing a "cook off". The normal ammunition feed is from a 30 round magazine but the 20 round PW magazine is interchangeable. All the major sub assemblies can be interchanged with the PW including the complete trigger mechanism assembly if required.

3. SIGHTS

Both weapons are intended to be fitted with a robust, high performance optical sight (SUSAT) of x4 magnification which enables the weapons to be used operationally under poor light conditions and is also useful for surveillance. The sight is mounted on a bracket which incorporates range adjustment and zeroing. This bracket slides on to a dovetail base permanently fitted to the weapon body and which allows sight position adjustment. Because of the flat trajectory of the 4.85 mm ammunition the range adjustment is only necessary from 300 m in 100 m increments.

Two emergency open sighting systems are also included, one being permanently fitted to the body of the primary optical sight and the other in the form of a flip up foresight and a clip on rear sight which is stored in the hollow pistol grip.

Less sophisticated optical sights can be fitted if required.

4. CONSTRUCTION AND MAINTENANCE

The weapons are designed to be simple to dismantle without special tools in to the main sub-assemblies for cleaning and maintenance. The trigger mechanism is a self contained assembly in a pressed steel housing which is located to the main weapon body by two pins and a small butt plate. The main body is a steel pressing which houses the bolt and carrier assembly and guide rods which locate in the barrel extension welded in to the body and in to which the barrel is screwed. The nylon handguards are in two parts and clip together forming a protection to the gas system. Mass production techniques and ease of maintenance have been prime considerations throughout.

5. ACCESSORIES

A number of accessories will be available including sling, bayonet, blank firing attachment, butt extensions, cleaning kit and multi purpose tool. In general these could be designed to meet specific requirements.

INFORMATION SHEET METRIC

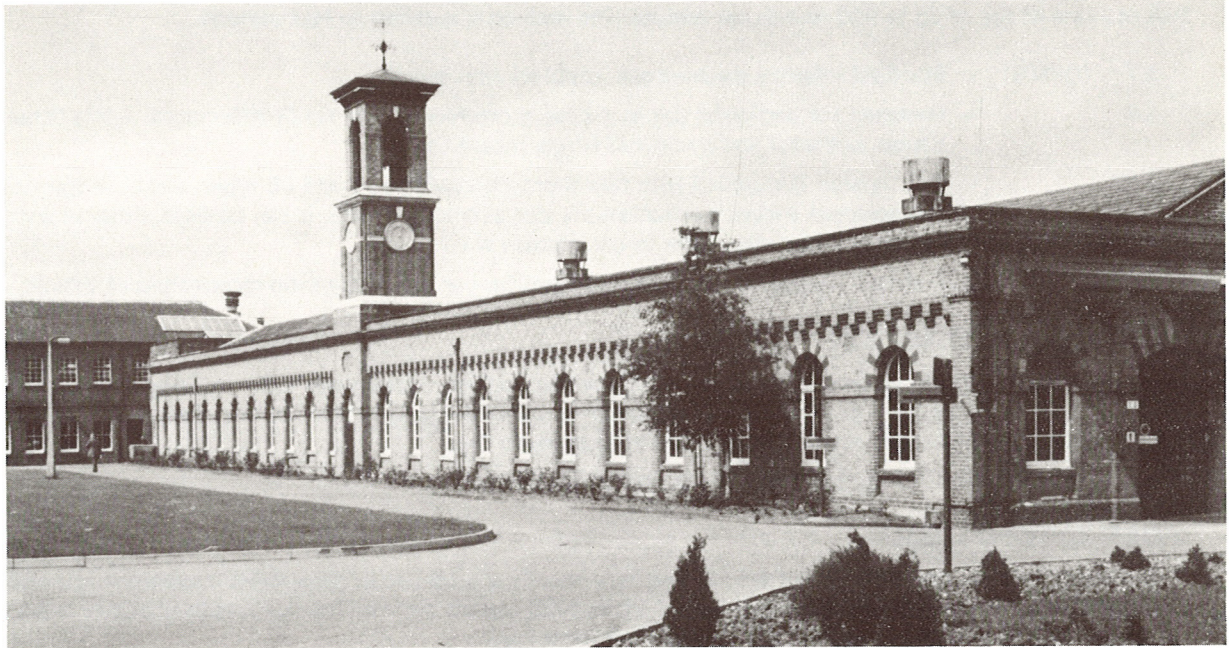
	RIFLE		MACHINE GUN	
	4.85 INDIVIDUAL WEAPON	7.62 SELF LOADING RIFLE	4.85 LIGHT SUPPORT WEAPON	7.62 GENERAL PURPOSE MACHINE GUN
1. WEIGHT				
Weapon (less Magazine and Optical Sight)	3.12 Kg	4.29 Kg	4.08 Kg	10.9 Kg
Sight Optical	.6 Kg	.6 Kg	.6 Kg	.62 Kg
Empty Magazine	.174 Kg	.263 Kg	.242 Kg	N/A
Loaded Magazine (filled with)	.398 Kg (20 rds)	.755 Kg (20 rds)	.584 Kg (30 rds)	.870 Kg (30 rd Belt)
Weapon (complete with loaded magazine)	4.12 Kg	5.65 Kg	5.26 Kg	12.39 Kg
2. LENGTH				
Barrel (including flash hider)	51.85 Cm	62.2 Cm	64.6 Cm	62.9 Cm
Weapon	77 Cm	114 Cm	90 Cm	123 Cm
3. MECHANICAL FEATURES				
Rifling: Grooves	4	4 or 6	4	4
Turns	1/125 mm	1/305 mm	1/125 mm	1/305 mm
Trigger Pull	3.12-4.5 Kg	3.12-4.5 Kg	3.12-5 Kg	3.6-6.3 Kg
Method of Operation	Gas	Gas	Gas	Gas
Type of Locking	Rotary Bolt Forward	Falling Breech Block Rear Locking	Rotary Bolt Forward Locking	Dropping Link Rear Locking
Method of Feed	Magazine	Magazine	Magazine	Belt
4. AMMUNITION				
Calibre	4.85 mm	7.62 mm	4.85 mm	7.62 mm
Types:	Ball Tracer Blank Ballistite	Ball Tracer Blank Ballistite	Ball Tracer Blank Ballistite	Ball Tracer Blank
Round Weight	11.6 grams	24.6 grams	11.6 grams	24.6 grams
5. FIRING CHARACTERISTICS				
Muzzle Velocity	900 m/s	835 m/s	930 m/s	843 m/s
Recoil Energy	4.42 J	16.58 J	3.78 J	8.65 J
Rate of Fire (Cyclic)	700-850 r/m	Single Shot	700-850 r/m	650-900 r/m





ROYAL SMALL ARMS FACTORY

ENFIELD MIDDLESEX



RSAF Enfield is one of the best known small arms manufacturing factories in the world. It is basically a light engineering factory, equipped for the design, development and manufacture of small arms, which it produces to an extremely high standard.

The factory has facilities for producing engineering components, in large quantities, to a high quality standard of inter-changeability. There is a large section employing skilled labour to produce smaller quantities of complex components.

Special machining facilities available at this factory include deep hole drilling from 5 mm up to 30 mm diameter in round bars up to 10 ft long; high volume production of complex contoured components is possible, using the extensive range of surface broaching machines available.

The factory has a large numerical control machining section and can undertake the manufacture of complex components.

There is a ferrous precision casting foundry using the lost wax technique capable of producing castings up to 6 lbs in weight.

The factory has a wide variety of metal finishing and heat treatment processes such as chromium plating, anodising and sealed quench furnaces, all of which are under the control of a Metallurgical Laboratory embracing mechanical testing, chemical analysis, micro-photography, hardness testing and crack detection.

There are facilities for the long-term preservation and packaging of weapons and components to service standards.

The factory is responsible for the design, development, modification and evaluation of small arms and small arms ammunition and there are drawing offices, ranges and climatic chambers for carrying out experimental evaluation. The tool room as well as providing the tools and gauges for the manufacturing workshops also provides facilities for producing experimental weapons and associated components.

RSAF Enfield has built up a world-wide reputation for accuracy and quality since the early 1850's.

Product Range

GENERAL PURPOSE MACHINE GUN

A fully automatic gas operated machine gun, firing 7.62 mm NATO ammunition from a disintegrating link belt at a rate of fire of up to 900 rounds per minute. The weapon is available in four variants.

- L7 (GPMG) – Standard infantry machine gun, supplied with bipod.
- L8 – Designed for particular use as a coaxial machine gun in the Chieftain tank – it is fitted with a fume extractor and a solenoid trigger mechanism.
- L37 – This version is supplied with two alternative barrels, L7 and L8 types, and both the standard and solenoid trigger mechanism are also provided so that it can be used either in armoured vehicle installations or else in the infantry role.
- L43 – A special ranging gun version developed for use in the Scorpion reconnaissance vehicle.

RARDEN 30 MM CANNON

A lightweight 30 mm cannon of exceptional power and accuracy. Its unique fully enclosed recoil mechanism results in the weapon having low trunnion loads which permits mounting in light vehicles. Empty cases are ejected forwards and the gun can fire single shot or six round automatic fire.

At present the RARDEN is mounted in FOX and SCIMITAR AFVs.

ADEN 30 MM CANNON

An automatic gas operated gun of the revolver type specifically for use in the aircraft interceptor role and in air attack on ground targets. It has a rate of fire of 1200/1400 rounds per min, can be mounted at any angle in the longitudinal axis and can be supplied with right or left hand feed.

ENFORCER

An extremely accurate sniper rifle specifically developed for UK Police Forces. The rifle utilises the well proved No.4 action and is supplied with a variable magnification telescope and/or target shooting type iron sights.

ENVOY

Designed to conform with the National Rifle association specifications, the Envoy is mainly intended as a civilian target rifle.

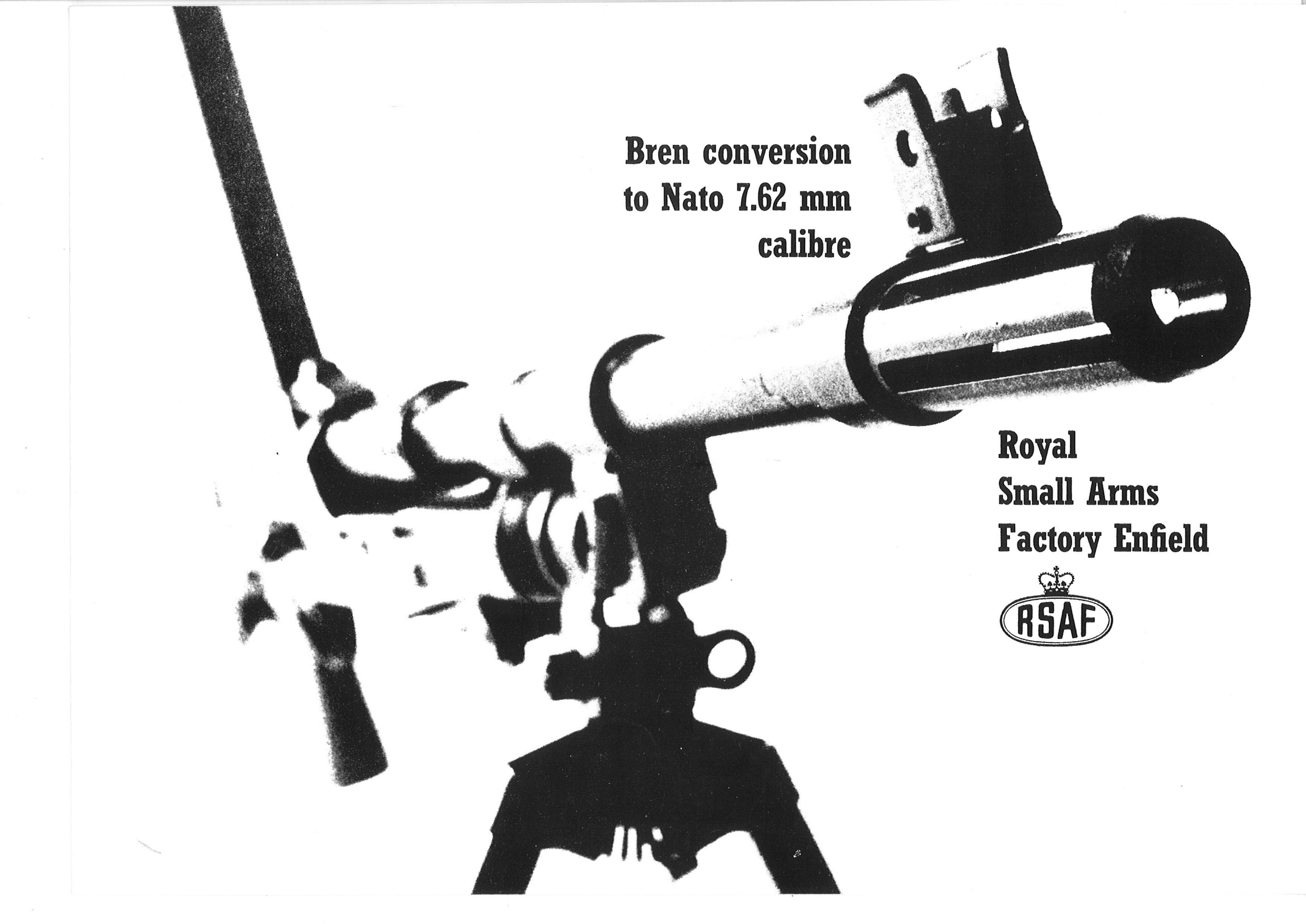
CS GRENADE DISCHARGER

This is a lightweight anti-riot weapon for firing aerial bursting CS and smoke grenades at ranges of up to 100 meters.

L67 RIOT GUN

A riot control weapon designed for accurate firing of kinetic energy baton rounds at ranges of up to 75 meters.





**Bren conversion
to Nato 7.62 mm
calibre**

**Royal
Small Arms
Factory Enfield**



General particulars:

Type of Feed	Magazine, 30 round
Position of Feed	Top, downward
Position of Ejection	Bottom, downward
System of Operation	Gas, four-position adjustment
Type of Fire	Single shot and automatic
Rate of Fire	500-575 rounds per minute
Muzzle velocity	869 m/sec.
Type of Cooling	Air, removable Barrel
Type of Cocking	Hand, right hand side, folding
Type of Front Sight	Blade
Type of Rear Sight	Leaf, graduated to 2,000 yds, or metres
Bore diameter	7.54 + .05 mm.
Rifling diameter	7.798 + .10 mm.
Rifling width	2.79 + .02 mm.
Number of Rifling grooves	6
Twist of Rifling	1 Turn in 305 mm. right hand
Shot Travel5 m.
Chamber Chromium Plated025 mm. thick minimum
Bore and Rifling Chromium Plated05 mm. thick minimum

New lease of life for the BREN

The BREN gun has long been a deservedly popular weapon with the men in action the world over. By converting it to use modern N.A.T.O. 7.62 mm. ammunition—now made possible by the Royal Small Arms team at Enfield—the many excellent features of this weapon have been given a valuable new lease of life and the overall flexibility of the gun greatly increased.



What the ENFIELD conversion comprises. At the Royal Small Arms Factory, Enfield, all marks of .303 in Bren light machine gun are converted to fire present-day ammunition. Conversion comprises the supply of several entirely new components, including barrel, magazine and breech-block assembly; also modification and machining of the body and other units, requiring special plant and tooling.

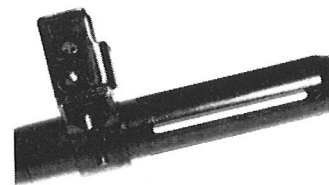
Main Dimensions of converted BREN:

Overall length	1237 mm.
Overall height (magazine removed and bipod folded)	224 mm.
Overall height (magazine fitted and bipod extended)	422 to 460 mm.
Overall width (bipod folded)	114 mm.
Length of Barrel Assembly	613 mm.
Length of Magazine	216 mm.
Weight of complete weapon, less magazine	9.52 kg.
Weight of magazine (empty)39 kg.
Weight of magazine (full)	1.09 kg.
Weight of Barrel Assembly	2.63 kg.

Important: All original parts retained in the converted BREN are carefully checked for wear or other defects and are renewed where necessary. Thus, every Enfield BREN conversion means delivery of virtually a brand-new gun.

Improved flash eliminator—better barrel too. One of the features of the Enfield BREN conversion is the introduction of a much improved flash eliminator. Also a new barrel, chromium plated in the chamber to give better operation under adverse conditions and in the bore for greatly-prolonged barrel life.

Interchangeable magazines for greater flexibility. The new 30-round magazine has been specially designed to be interchangeable with the 20-round magazine of the L1A1 rifle, which will give welcome flexibility in the field.



Further information and quotations

If you require more details about the BREN conversion, or firm quotations on price and delivery, please contact the Director, Royal Small Arms Factory, Enfield Lock, Middlesex.

Main features of R.S.A.F. Bren conversion

New barrel (complete with improved Flash Eliminator)

New 30-round magazine (interchangeable with 20-round LIAI Rifle magazine)

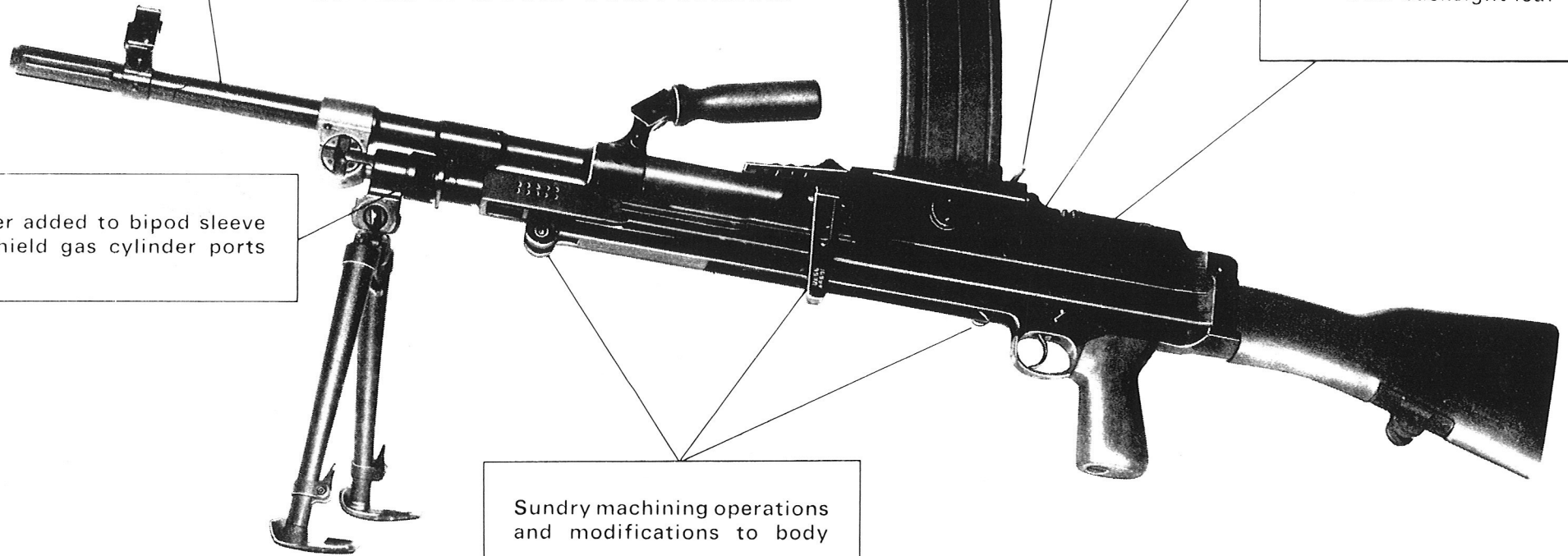
New magazine catch/ejector block

New breech-block and extractor

New backsight leaf

Cover added to bipod sleeve to shield gas cylinder ports

Sundry machining operations and modifications to body



ENFORCER

7.62mm SNIPER RIFLE



Royal Small Arms Factory Enfield 

ENFIELD ENFORCER

The Enforcer has been developed to meet the needs of the British Police Forces for a sniper rifle.

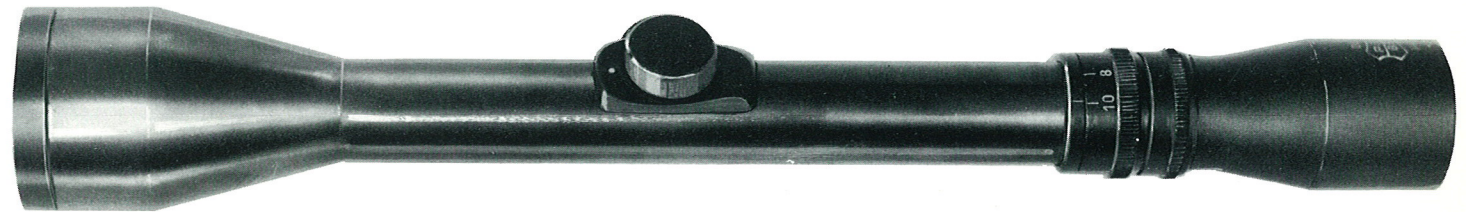
It's design is based on the well known No.4 action and incorporates many features to satisfy the requirements of sniper shooting. These include:

- a heavy barrel manufactured in high grade alloy by precision swaging
- a close toleranced chamber
- accurately adjusted trigger pull
- a specially designed butt with high cheek piece
- powerful telescope for accurate and easy aiming.

SPECIFICATION

Overall length	1206 mm
Barrel length	699 mm
Overall weight (less telescope)	4.75 kg
Barrel weight	1.7 kg
Trigger pull — 1st pull	1.1 — 1.6 kg
2nd pull	1.8 — 2.1 kg
Bore diameter	.299 ins
Rifling — 6 groove chordal	1 turn in 305 mm RH
Magazine capacity	10 rounds

The Enforcer is fitted with a variable magnification (4 to 10 times) Pecar telescope which is readily and quickly removed from the weapon by means of a "Roll off" type mount without affecting telescope zeroing.



The telescope has full adjustment for range and windage thus enabling full use of the rifle accuracy to be made at all ranges.

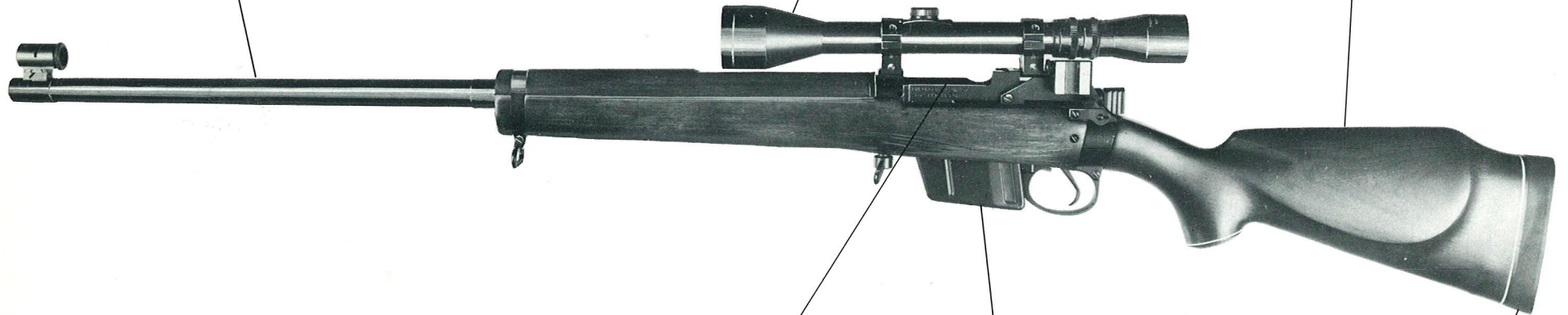
ENFIELD

ENFORCER

Free floating heavy barrel
with chordal rifling

Variable magnification
Pecar telescope

Monte Carlo butt with high
cheek piece



No. 4 Action

10 round magazine

Padded butt plate

ADDITIONAL FEATURES

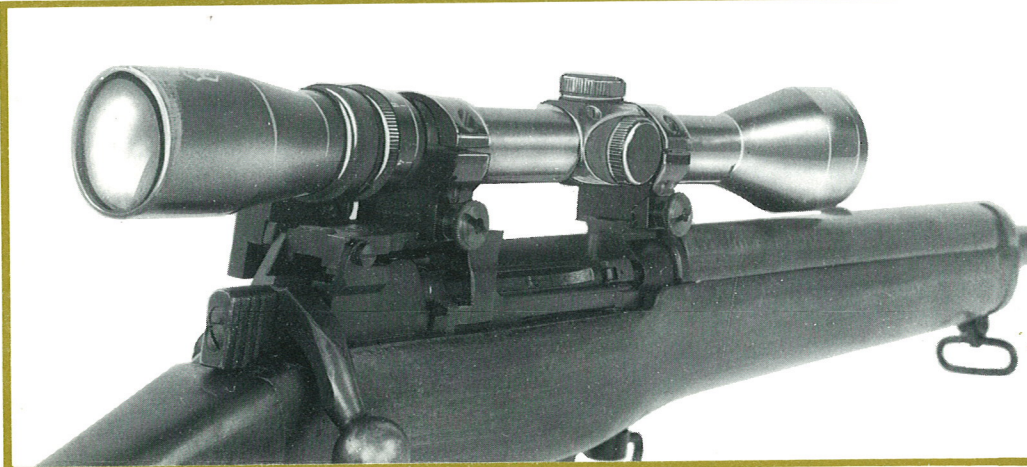
Close toleranced tight chamber,
allowing minimum case expansion.

Chordal rifling form – reduces bullet
drag and thus improves long range
ballistics.

Centre sling swivel to accept special
snipers shooter sling.

Body and barrel reinforce are
carefully stocked to ensure
maximum accuracy.

Target type aperture iron sights also
provided as standard equipment.



ROYAL SMALL ARMS



ENFORCER

SNIPER RIFLE

THE DIRECTOR
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ENFIELD
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RSAF ENFIELD - DESIGN AND DEVELOPMENT DEPARTMENT

AMMUNITION DESIGN

1. The Enfield Ammunition Design Section was formed in 1958, by the amalgamation of the former Fort Halstead Design and Swynnerton Research sections. One member of the present Section had been in the Swynnerton Section since 1941 and another since 1949, giving a high degree of continuity. The amalgamation brought within one Section the engineering design of SAA and the supporting experimental and theoretical research in ballistics and similar fields; of importance because of the various interacting parameters in SAA many of which are necessarily studied by experiment rather than theory.
2. Also in 1958, the Section was moved to Enfield and located with the Weapons Design Section bringing together in one organisation the weapon and ammunition design teams, so that major development projects, on complete weapon-ammunition systems can be readily tackled, and performance problems involving weapon-ammunition interaction investigated. In 1960 the Design Department - Weapons and Ammunition Sections were transferred to the Royal Ordnance Factory organisation.
3. The Section is responsible for research, design and development of all types of SAA, from small weapons such as pistols and sub-machine guns, through rifles and machine guns, up to rounds for aircraft cannon. The work covers ball, tracer, observing and ranging rounds, blank and grenade projecting cartridges, and conventional armour piercing rounds, practice rounds for cannon, drill and inspection rounds, and rounds for weapon proof. The only exceptions, for which RARDE is responsible, are HE fuzed shell, electrically fired devices, and RARDEN ammunition, which are treated as ordnance items. About 80% of the effort is for the Land Service and most of the remainder for the Air Force.
4. The Section is staffed by a Manager (PSO) directly responsible to the Director. It comprises two sub-sections, each headed by an Assistant Manager; one is a P&TO I and normally concentrates on engineering work, the other is an SSO and is more concerned with research and development.
5. Each Assistant Manager is assisted by Project Officers; they are also supported by junior scientific staff, by the Weapons Section Drawing Office and Design Trials Section. One of the ranges is specially equipped for Ammunition Ballistic studies, and we also control an Ammunition Laboratory, which will be referred to later.
6. The Section organisation and project responsibilities are shown on the attached chart, and may be summarised as follows:-

AM/SAA/1 - P&TO I

- a. Air Service - ADEN, MRCA, system studies
- b. Land Service - tracers, armour piercing, internal security rounds
- c. Engineering aspects

AM/SAA/2 - SSO

- a. Land Service - ball, tracer, grenade, blank, observing rounds, system studies.
- b. Development - propellant, caps, tracers.
- c. Supporting research - reduction of adverse effects, eg flash, smoke, barrel wear - ballistic studies.
- d. Control of Ammunition Laboratory.

Other Responsibilities

In the centre of the chart, reference is made to certain special projects, eg

- a. The Enfield Weapon System development, now controlled by a special team, to which one member of the Ammunition Section is seconded.
- b. Internation liaison - NATO, ABCA, FINABEL.

7. We will now consider the particular aspects of the work, which overlap between the two sub-sections, and cover:-

- a. Design
- b. Development
- c. System studies - mathematical/parametric analysis
- d. Supporting research
- e. International aspects/standardisation
- f. Miscellaneous

8. Design

The aim is to satisfy a service requirement, and the end product is a round to be fired in the weapon concerned, and the work may involve extensive evaluation or performance trials. Examples in recent years include:-

- a. Improved observing or ranging round with extended range, achieved by introducing a new heavier core material, tracer composition, cap and propellant.
- b. A 30mm Aden armour piercing round with good penetration.
- c. Ammunition for the Future Infantry Weapon System. Prototype ball and tracer rounds have been developed and evaluated as appropriate for ballistic performance, down-range effectiveness against various targets, trace length and weapon functioning.

9. Development

This covers the evaluation of new materials of possible general application in various calibres, eg:-

- a. Propellants - evaluation of new materials produced by PERME and Nobels Explosives Company (NEC). The object is to increase energy without increasing barrel wear and other adverse effects.
- b. Caps, percussion and electric - this also involves evaluation of new materials, in association with PERME, RARDE and ROF Chorley, in an attempt to improve ignition, ie increase bullet energy, and reduce variability of ballistics and effect of temperature.

- c. Tracer composition - the object is to increase the burning time without loss of brightness, and a variety of compositions prepared at Chorley and filled at Radway are under evaluation. Special attention is being given to problems of small calibre tracers.
- d. Cartridge cases - the present material is brass which is unlikely to be replaced in the near future, except possibly by steel in larger calibres for aircraft cannon. It is difficult to manufacture steel cases to the tight tolerances necessary in small calibre weapons. The other alternative, light alloy cases, suffers from notch sensitivity, leading to bursts followed by severe damage due to burning of aluminium particles. Recent overseas work, however, suggests this problem may in due course be solved.
- e. Bullets and shell - study of alternative envelope and case materials for ball and armour piercing projectiles.

10. System Studies - Mathematical/Parametric Analysis

If the Department is tasked to develop a new weapon system and its ammunition, the first stage, before weapon and ammunition design, involves an overall performance assessment of the means of satisfying the requirements or defeating the target, the alternative ammunition options to achieve this, and the associated weapon parameters such as recoil and system weight. This work is normally led by the Ammunition Section; it involves extensive internal and external ballistic calculations and similar studies of target defeat requirements, which are linked with a Weapon Section study of possible weapons. The Design Department has a terminal to a Plessey 1906S computer, and programmes have been developed for internal, external and terminal ballistic calculations.

Recent system studies have included -

- a. Future Infantry Weapon System, leading to the Preliminary and Feasibility Studies mentioned earlier.
- b. Improved 7.62mm rounds for sustained fire use.
- c. Possible improved aircraft gun systems.

11. Supporting Research

- a. Reduction of adverse effects - flash, smoke, barrel erosion.
- b. Ballistic studies - mention may be made of an improved sealing technique in piezo-electric chamber pressure measurement, and of studies of penetration of hard targets.
- c. Special investigations, eg effects of prolonged climatic storage using the RARDE or QAD(W) Cold Meece climatic chambers followed by performance tests.
- d. Investigation of specific malfunctioning problems. An important example is the infrequent but serious breech explosions in 30mm Aden. This occurs at the secondary ramming stage; it has led to the development at PERME of a new less sensitive cap composition, evaluated by us and filled at Chorley.

12. International Aspects/Standardisation

- a. NATO Standardisation. The Section is represented on the Small Arms Ammunition Panel and certain Working Groups, and is co-opted as required on to Panels concerned with Future Infantry Systems and their evaluation.
- b. FINABEL, ABCA and TTCP Working Groups.
- c. Other liaison groups, eg bilateral collaboration with the US, France, Germany and Belgium.

13. Miscellaneous

- a. Engineering features - post design services as required - value engineering
- b. Certain studies to eliminate defects.
- c. Evaluation of foreign SAA types under consideration for UK use - this is necessary because of occasional unexpected increases in service requirements, and involves support from other departments.

14. Liaison with other Establishments

- a. ROFs - Radway Green, Chorley and occasionally Bishopton and Blackburn.
- b. Private firms, Nobel's Explosives Co., IMI (Kynoch), Wickman-Wimet.
- c. RARDE, PERME, CDE, MVIEE, SCRDE, OB, QAD(W), MQAD, DGW, D A Arm, D R Arm.
- d. QAD(W) Cold Meece, Proof and Trials Unit - certain experimental trials, eg to 900mm range.

15. Special Ammunition Section Facilities

a. Ammunition Laboratory

This is equipped for -

- (1) Initial assembly for ballistic tests of components from Radway Green and Chorley.
- (2) Breakdown of ammunition for critical examination.
- (3) Studies of defects and malfunctioning, by examination of fired cases and recovered bullets.
- (4) Preparation of equipment for ballistic tests.
- (5) Provision of changes for special requirements.

b. Ballistic Range

The facilities are indicated in the general description of the ranges, but mention may be made of

- (1) Velocity measuring equipment near the muzzle and at points down range to 90m.
- (2) Pressure recording equipment by copper and piezo techniques, the latter with pressure time variation.
- (3) Firing intervals - time from cap initiation to bullet emergence.

c. Special Studies

An example is the observation of tracer brightness by firing bullets through a darkened hut, viewing the trace by a photo-electric cell, and recording the output by an oscillograph.

d. Computer Terminal

See 10. above.

DESIGN AND DEVELOPMENT DEPARTMENT - (AMMUNITION)

Organisation of Department and Allocation of Projects - 31 October 1977

