On Her Majesty's Service

PERME
Recruitment Package

PROPELLANTS, EXPLOSIVES AND ROCKET MOTOR ESTABLISHMENT

Westcott, Aylesbury, Buckinghamshire

Waltham Abbey, Essex

A Ministry of Defence R and D establishment within the Procurement Executive.

RESEARCH AND DEVELOPMENT ON ROCKET PROPULSION, PROPELLANTS AND EXPLOSIVES

Total Staff 1500

Qualified Scientists and Engineers 250 :

Engineers (mechanical, chemical, aeronautical)
Chemists (physical, organic, inorganic)
Mathematicians (pure and applied: computing)
Physicists
Materials Scientists

Activities from FUNDAMENTAL RESEARCH

D.H. Richards	"A one-step alternative to the Grignard Reaction", J. Chem. Soc. Perkin I 1972, p.1655
D.E. Jensen	"Prediction of soot formation rates: A new approach", Proc. Roy. Soc. A 1974, 338, p.375

to COMPLETE PROPULSION UNIT DEVELOPMENT

4, 5, 6

PERME FACILITIES

- Laboratories for pure and applied research
- Computers (ICL 1904S main-frame and others)
- Plants for small-scale production of special chemicals, propellants, explosives and materials
- Extensive chemical analysis facilities
- Engineering, hardware and instrumentation workshops and drawing offices
- Test sites for static motor firings: access to flight ranges
- Component and complete motor assembly and testing shops
- Environmental and non-destructive and destructive test facilities
- Comprehensive support services (from libraries to welfare)

PERME WALTHAM ABBEY DIVISIONS

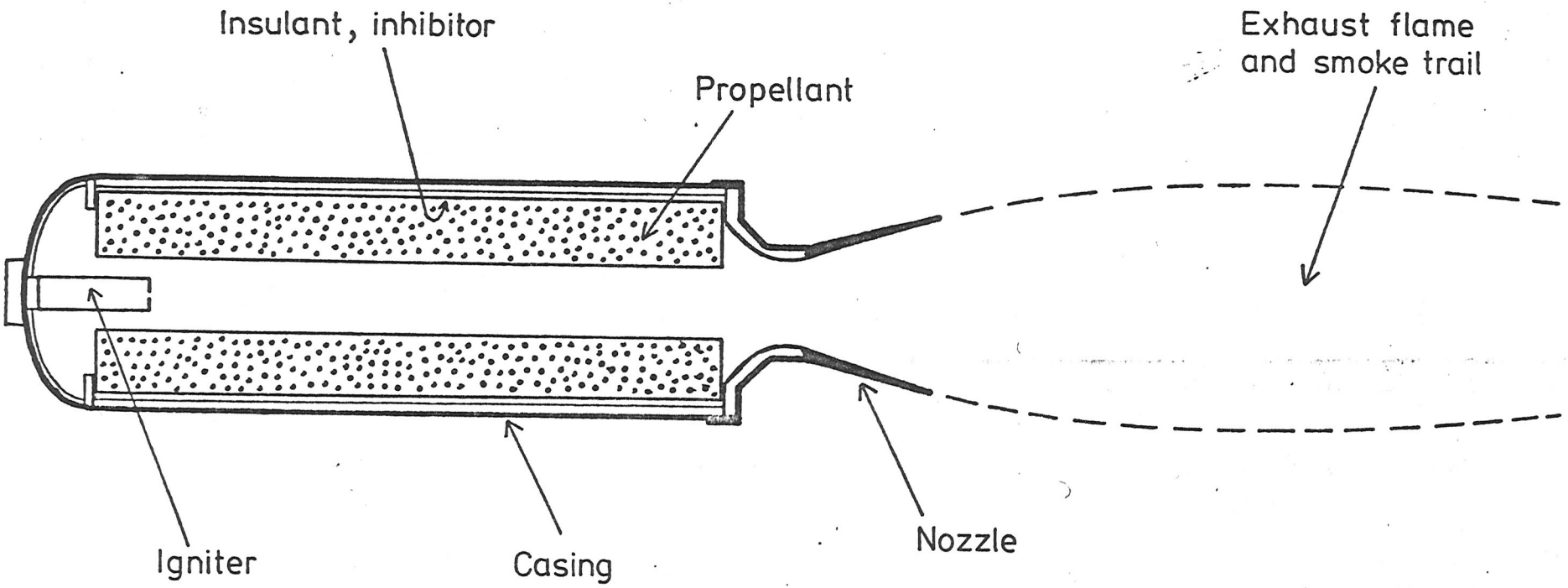
PROPELLANTS I	-	Nitrocellulose/nitroglycerine propellants for rockets and guns.
PROPELLANTS II	-	Composite propellants (ammonium perchlorate, aluminium, organic binders). Adhesives and fibre-reinforced structures.
EXPLOSIVES	-	Primary explosives; synthesis, initiation, sensitivity and hazards.
PROCESS RESEARCH	-	Processing of propellant ingredients, explosives: laboratory to production.
GENERAL CHEMISTRY	-	Organic and inorganic: research and analytical techniques.

PERME WESTCOTT DIVISIONS

S DIVISION - R and D on rocket motors with solid propellants. Design, development and proof.

L DIVISION - R and D on rocket engines with liquid propellants. Design, development and proof.

C DIVISION - Fundamental and applied research on combustion, materials science, non-destructive and destructive testing, organic and inorganic chemistry.



ROCKET MOTOR

GENERAL CHEMISTRY

- o X-ray crystallography
- o Gas chromatography and high-pressure liquid chromatography
- o Flame photometry
- o UV/visible/IR spectrophotometry
- o Calorimetry and gravimetry
- o Mass spectrometry (including GCMS)
- o Nuclear magnetic resonance spectroscopy (various isotopes)
- o Wet chemistry

for

- * analysis of propellants
- * structural analysis of individual compounds
- * measurements of polymer configurations
- * measurement of propellant ageing rates: diffusion and chemical decomposition
- * study of compatibility of propellant ingredients with other motor components

CHEMISTRY AND APPLIED PHYSICS

- Application of microwave, optical, acoustic, ultra-sonic and holographic techniques to non-destructive testing of rocket motors and components: development of techniques; instrumentation; and analysis.

- Fluid dynamics and chemical kinetics of combustion; radiative, transmission and electrical properties of flames; numerical analysis and measurement of exhaust flame and smoke.
  Missile detection, tracking, guidance, homing.

- Application of steels, alloys, carbon fibres, plastics, refractories and glasses to construction of motor hardware components.

- Reaction of propellant ingredients with container materials; inorganic and organic chemistry; diffusion and chemical processes.

- Numerical and analytical computation of stresses in rocket motor components; internal combustion; total systems analysis.

PROPELLANTS R and D: 1

- Development of new processing techniques for liquid/solid propellant ingredients: from laboratory to plant
- Removal of solvent materials from gun propellants
- Internal ballistics: erosive burning: ignition shock stressing
- Solid propellant stability and burning characteristics
- Interdiffusion of solvent and solid propellant materials

PROPELLANTS R and D: 2

- Plastic propellants (e.g. ammonium perchlorate with polyisobutylene): processing and manufacture. New binders for low-temperature applications.

- Rubbery propellants (e.g. ammonium perchlorate with hydroxy-terminated polybutadiene). Extrusion into esoteric shapes. Research on basic chemistry and mechanisms of binders and curing.

- Propellant rheology.

EXPLOSIVES

- Highly sensitive initiatory explosives (lead azide, heavy metal derivatives of nitro-aromatic compounds, tetrazoles: new compounds).
- Application of explosives to warheads, grenades, percussion caps.
- Sensitivity to impact and frictional forces: detonation.
- Explosions: vulnerability of propellants to fragment attack; influence of propellant grain and casing materials; confined explosions.

PROCESS RESEARCH

- Synthesis-to-manufacture studies of explosives: from TNT and hexanitrostilbene to new compounds.
  Development of new process routes with high yields and low toxicity by-products.
- Synthesis and production of new composite materials (aligned fibres).
- Processing of rubbers and plastics for coating propellants.
- Processing of heat-insulating materials (e.g. polybutadiene rubbers).
- Development of synthetic routes for new adhesives.
- Synthesis of block polymers (e.g. from styrenes, tetrahydrofuran; anionic, free radical and cationic mechanisms).

SOLID PROPELLANT ROCKET MOTORS

- Complete design of rocket motors to deliver required missile performance:
  - charge design (propellant type, weight, shape)
  - structural component design (casing, insulation, inhibition, obturator)
  - nozzle design (shape, material)
  - manoeuvring (thrust vector or aerodynamic control)
  - production engineering
- Fabrication and testing of solid propellant propulsion units meeting requirements of thrust, strength, durability, manoeuvrability, low smoke
- Management of motor R and D, and prototype production, in collaboration with scientists and technologists, ordnance factory personnel and service users
- Integration of advancing component technology into reliable propulsion units for motors with burn times from a few milliseconds to hundreds of seconds
- Development of gas generators and power cartridges

LIQUID PROPELLANT ROCKET ENGINES

- Design and development of liquid fuel/oxidiser combinations for missions where accurate control of variable thrust is a prime requirement.

  Fuels include kerosene
  amines and hydrazines
  liquid hydrogen

  Oxidisers include hydrogen peroxide
  red fuming nitric acid
  liquid oxygen

  Monopropellants include isopropyl nitrate
  hydrazine

- R and D on: fuel and oxidiser flow supply systems;
  combustion mechanisms;
  propellant/container compatibility;
  cryogenic systems;
  gelled fuels.

- Tailoring of individual components of liquid propellant engines to meet overall performance requirements.

A SEQUENCE IN APPLICATION OF RESEARCH

OBJECTIVE : prevent enemy detection of rocket-powered missile by suppressing exhaust flame and smoke.

PROGRAMME :

(1) Fundamental laboratory flame studies of chemical kinetics of free radical reactions.

(2) Numerical analysis of interaction of kinetics and fluid dynamics of turbulent exhaust flames from proposed motors.

(3) Engineering solution to problem of supplying suppressant to exhaust.

(4) Testing under controlled static conditions.

(5) Flight test of full design.

(6) Incorporation of design into total missile system.

OPPORTUNITIES FOR ENGINEERS

* Propellant ignition with pyrotechnics: conductive, radiative and convective heat transport.

* Application of microwave, optical, acoustic, ultrasonic and holographic techniques to non-destructive testing of rocket motors.

* Design of new liquid propellant engines with precisely controllable variable thrust.

* Design and development of prototype solid propellant rocket motors with high thrust, long life propellant, light but strong casing and nozzle, high manoeuvrability and low emissions of smoke and flame.

* Management of rocket motor design and development for individual projects.

* Design, development, installation and operation of pilot plant for production of new explosives.

* Pilot plant studies of production of high quality butadiene/styrene polymers.

* Plant scale processing of composite propellants and their ingredients.

* Control instrumentation for automation of plant polymer production.

OPPORTUNITIES FOR CHEMISTS

* Chemical kinetic and diffusion processes controlling reaction between fuels and oxidisers and container materials.

* Analysis of combustion processes in chambers of liquid propellant rockets.

* Development of controllable, smoke-free gas generators.

* Curing and ageing of rubbery propellants.

* Synthesis of new explosives and intermediate compounds, both organic and inorganic

* Synthesis of novel block copolymers.

OPPORTUNITIES FOR MATERIALS SCIENTISTS

* Application of refractories, graphites, glasses and composites to rocket motor cases, nozzles and other components.

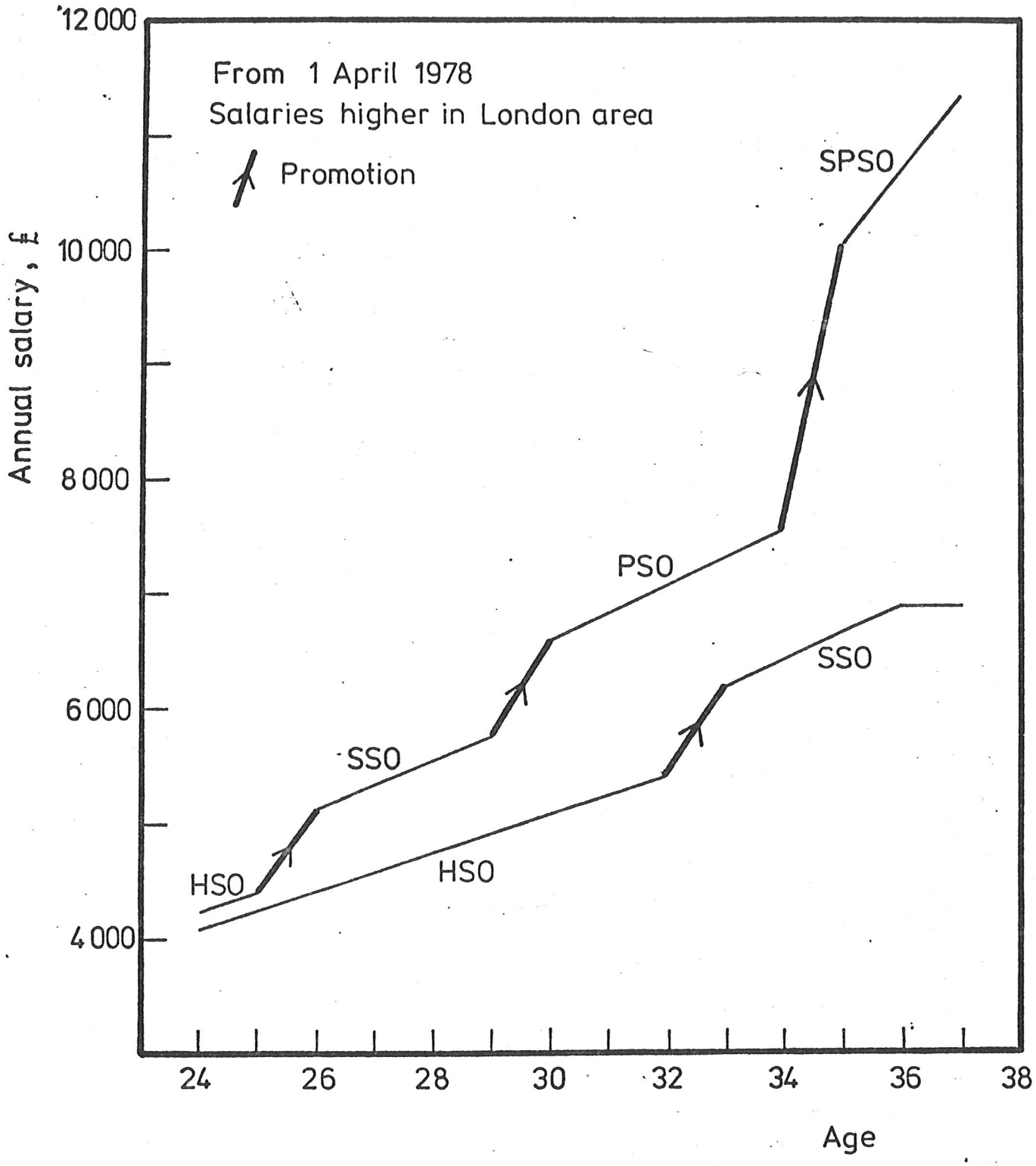
* Adhesion mechanisms and their application.

* Experimental and theoretical studies of fracture criteria and mechanisms in visco-elastic propellant materials: application to prediction of lifetimes.

OPPORTUNITIES FOR PHYSICISTS AND APPLIED MATHEMATICIANS

* Research on internal ballistic phenomena, including ignition processes, shocks and erosive burning. Computational analysis of multiphase flow.

* Computation of rocket exhaust structures: numerical analysis of interacting chemical kinetic and fluid dynamic processes.


From 1 April 1978
Salaries higher in London area
Promotion
Annual salary, £
12 000
10 000
8 000
6 000
4 000
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Age