PROPELLANTS

Propellants are those explosives that are used to propel projectiles (hence the name) from Guns, Howitzers, Mortars, Pistols, machine guns and anti-submarine weapons, to eject bombs from aircraft, cut cables in emergencies, drive nails into concrete and a thousand other applications. They operate ejector seats on jet aircraft and they also start jet engines in some systems. They are used to drive guided and unguided missiles through the air, and they will be found in two forms:

Solid **Liquid**

Solid propellants are by far the most common although much work is being done on the application of liquid propellants to Artillery cartridges and Small Arms Ammunition. If you compare the firing of a .22 cartridge and the launch of a Space Shuttle you will have some idea of the awesome power and diversity of propellants when you realize that the same material is driving both of them, a solid propellant. Liquid propellants are the rarer of the two. Perhaps the most immediate historical example that will spring to mind is the WWII launch of a German V2 liquid fuelled rocket. Who can forget the striking spectacle of the V2 that rises slightly before falling back to the launch pad to explode in a giant ball of fire? This is liquid propellant at work. (Albeit not very well)

Propellants are those substances which, because of their regularity of burning and their relatively low pressures are suitable to propel missiles from gun, howitzer and mortar tubes. They are required to possess conflicting characteristics not all of which can be satisfied in the one variety, as is usual compromise is the name of the game.

The original propellant for over 500 years was gunpowder but the great problems associated with it spurred the chemists of the day to seek something more tractable and this resulted in the adoption of smokeless powder. Which is a complete misnomer as it is neither smokeless or a powder.

THE DISCOVERY AND INTRODUCTION OF SMOKELESS POWDER

As already mentioned the problems associated with Gunpowder spurred the chemists of the day to seek other materials that might be used as a propellant. These early attempts were centered on the nitration of cellulose and several names and dates stand out as pioneers and landmarks.

1845/46
Christian Schoenbein (1790-1868)
Studies nitration of cotton He discovers the explosive properties of this substance

1865
Frederick Abel (1827-1902)
Showed that accidents with nitrated cotton were caused by traces of acid trapped in the fibres

1865
Schultze produces EC powder for use in shotguns (EC stands for Explosives Company)

1872
Introduction of nitrocellulose in the Royal Ordnance Factory

Paul Vielle (1854-1934) treats nitrocellulose with Ether/Alcohol and produces "Poudre B" for use in the 8mm Lebel. The first service use of a smokeless powder.

1888
Alfred Bernhard Nobel (1833-96)
Perfects “Ballistite”

1890
He develops “Cordite Mk I”

By the end of the 19th Century smokeless powder was the established form of propellant and remains so to this day.

ATTRIBUTES

Ideally a propellant should possess the following attributes:

- Its burning rate should not change under any conditions of service or storage
- It should not erode the bore
- It should ignite readily, burn uniformly at the surface and not break up during burning
- It should not produce smoke or flash
- It should be chemically stable
- It should be mechanically stable
- It should be cheap

As you will appreciate no one substance will meet all these requirements. So, as with most things in life, propellants are compromises.

COMPOSITION MANUFACTURE AND NOMENCLATURE

Modern smokeless powders are composed of various chemicals blended together to produce a gelatinous material suitable for use as a propellant the chemicals used to achieve this product are:

Nitrocellulose	(NC)
Nitroglycerine	(NG)
Nitroguanadine	(Picrite)

These chemicals are known as "bases" and a propellant is quite often described as being as either a "single base" if it has only one of these bases as the main constituent, "double base" if it has two and so on. Various other chemicals are added to modify the propellant in some way. Some of these modifications required are:

- Stabilizers to prevent deterioration in storage
- Flash reducers
- Flow improvers
- Acid neutralisers
- Plasticisers
- Gelatinisers
- Coolants
- Wear reducers

PROPELLANT NOMENCLATURE

In the British and Australian systems each type of propellant is allocated a code letter or letters and numbers to indicate its composition, its shape and its size. It should be noted that more than one letter may be included in the propellant nomenclature.

British and Australian composition codes are as follows

Code letter	Significance
A	NC made from Cotton
BAL B	Ballistite type B
C	Carbamite
F	NC made from Wood
FNH	Flashless non hygoscopic
H	Hotter composition
K	Potassium Cryolite added
M	Modified
N	Picrite
NH	Non hygroscopic
NPP	Nobels parabellum powder
NRN	Nobels Rifle Neonite
P	Potassium sulphate added
Q	Higher calorimetric value
S	Solventless propellant
U	Rocket Motor Propellant
W	Developed at Waltham Abbey in the UK

SHAPE AND SIZE CODES

SHAPE	CODE LETTER
Cord	none
Tubular	T
Slotted Tubular	S
Multi-Tubular	M
Ribbon	R
Scroll	Z
Drilled Tube	D
Slotted Grooved Tube	SG
Star centered	E
Cruciform	X
Cogged	C

For gun propellant, size is indicated in thousandths of an inch, for cord it is expressed as the diameter. Tube and Slotted Tube are expressed as the internal and internal Diameters. Rocket motors are normally expressed as the diameter in inches. Multi-Tubular is expressed as the web thickness and Flake is expressed as the dimensions of the flake. Cruciform Rocket Motors are known by the weight in pounds.