

TYPES OF PROPELLANT

Solid propellant

In ballistics and pyrotechnics, a **propellant** is a generic name for chemicals used for propelling projectiles from guns and other firearms.

Propellants are usually made from low explosive materials, but may include high explosive chemical ingredients that are diluted and burned in a controlled way (deflagration) rather than detonation. The controlled burning of the propellant composition usually produces thrust by gas pressure and can accelerate a projectile, rocket, or other vehicle. In this sense, common or well known **propellants** include, for firearms, artillery and solid propellant rockets:

- Gun propellants, such as:
 - Gunpowder (black powder)
 - Nitrocellulose-based powders
 - Cordite
 - Ballistite
 - Smokeless powders
- Composite propellants made from a solid oxidizer such as ammonium perchlorate or ammonium nitrate, a rubber such as HTPB, or PBAN (may be replaced by energetic polymers such as polyglycidyl nitrate or polyvinyl nitrate for extra energy) , optional high explosive fuels (again, for extra energy) such as RDX or nitroglycerin, and usually a powdered metal fuel such as aluminum.
- Some amateur propellants use potassium nitrate, combined with sugar, epoxy, or other fuels / binder compounds.
- Potassium perchlorate has been used as an oxidizer, paired with asphalt, epoxy, and other binders.

Propellants that explode in operation are of little practical use currently, although there have been experiments with Pulse Detonation Engines.

Grain

Propellants are used in forms called grains. A grain is any individual particle of propellant regardless of the size or shape. The shape and size of a propellant grain determines the burn time, amount of gas and rate produced from the burning propellant and consequently thrust vs time profile.

There are three types of burns that can be achieved with different grains.

Progressive Burn

Usually a grain with multiple perforations or a star cut in the center providing a lot of surface area.

Digressive Burn

Usually a solid grain in the shape of a cylinder or sphere.

Neutral Burn

Usually a single perforation; as outside surface decreases the inside surface increases at the same rate.

Composition

There are four different types of solid propellant compositions:

Single Based Propellant: A single based propellant has nitrocellulose as its chief explosives ingredient. Stabilizers and other additives are used to control the chemical stability and enhance the propellant's properties.

Double Based Propellant: Double based propellants consist of nitrocellulose with nitroglycerin or other liquid organic nitrate explosives added. Stabilizers and other additives are used also. Nitroglycerin reduces smoke and increases the energy output. Double based propellants are used in small arms, cannons, mortars and rockets.

Triple Based Propellant

Triple based propellants consist of nitrocellulose, nitroguanidine, nitroglycerin or other liquid organic nitrate explosives. Triple based propellants are used in cannons.

Composite

Composites contain no nitrocellulose, nitroglycerin, nitroguanidine or any other organic nitrate. Composites usually consist of a fuel such as metallic aluminum, a binder such as synthetic rubber, and an oxidizer such as ammonium perchlorate. Composite propellants are used in large rocket motors.

Liquid propellant

Common propellant combinations used for liquid propellant rockets include:

- Red fuming nitric acid (RFNA) and kerosene or RP-1
- RFNA and Unsymmetrical dimethyl hydrazine (UDMH)
- Dinitrogen tetroxide and UDMH, MMH and/or hydrazine
- Liquid oxygen and kerosene or RP-1
- Liquid oxygen and liquid hydrogen
- Liquid oxygen and ethanol
- Hydrogen peroxide and alcohol or RP-1
- Chlorine pentafluoride and hydrazine

Common monopropellant used for liquid rocket engines include:

- Hydrogen peroxide
- Hydrazine
- Red fuming nitric acid (RFNA)

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