EMPIRICAL PRECISION

A TREATISE ON SMOKELESS RIFLE PROPELLANTS — HISTORY, CHEMISTRY, MANUFACTURERS, AND REFERENCE

In This Book

- **Part I. Chemistry, Manufacturing, and Combustion.** Black powder's limits, the invention of smokeless propellants, nitration and stabilizer chemistry, extruded and spherical production, surface engineering, and the internal ballistics of bottleneck cases.
- **Part II. Historical Evolution of Smokeless Rifle Propellants.** Four eras from 1884 to the present: early military pioneers, wartime and post-war surplus, the temperature-insensitive precision revolution, and modern high-efficiency and REACH-era formulations.
- **Part III. Nomenclature, Manufacturers, and the Global Supply Chain.** Why legacy numbers repeat across brands, profiles of the world's primary OEM chemical plants and commercial packagers, and cross-reference tables of twins, sister families, recalls, and discontinuations.
- **Part IV. Propellant Behavior, Lot Variance, and Aging.** How bottleneck cartridge classes govern burn-rate windows, the physical drivers of lot-to-lot variance, nitric ester decomposition kinetics, moisture equilibrium, and field inspection protocols.
- **Part V. Empirical Burn Rate Reference and Propellant Compendium.** An empirical burn-rate chart paired with individual technical and historical profiles for historical milestones and bottleneck rifle propellants, followed by chronological, conversion, and glossary appendices.

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LE Precision

Empirical Precision: A Treatise on Smokeless Rifle Propellants — History, Chemistry, Manufacturers, and Reference

First Edition

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Before You Begin

Smokeless rifle propellants are engineered energetic compounds whose stability and burning behavior depend on proper storage, identification, and handling.[1] Review these rules before handling or storing any canister propellant. They are repeated as a single-page reference card in Appendix B.

Storage and handling

1. Keep every propellant in its original factory container with the label and lot number intact.
2. Store canisters in a cool, dry, well-ventilated space away from heat sources, sunlight, sparks, and open flames.
3. Never lock smokeless propellant inside a tightly sealed metal vault or pressure vessel; store it only in containers designed to vent safely in a fire, following local codes.
4. Keep primers, black powder, solvents, and flammable liquids separated from smokeless propellants.
5. Never allow open flame, smoking, vaping, or static-generating clutter near open containers.
6. Handle one propellant canister at a time and return unused powder to its original container immediately.

Identification and degradation

7. Never mix different propellants, brands, or production lots—even confirmed OEM twins.
8. Never substitute propellants by burn-rate chart rank, visual appearance, or OEM cross-reference without consulting published data for the exact canister in hand.
9. Inspect older canisters periodically for an acrid acidic odor, reddish-brown fumes, rust-colored dust, clumping, or container swelling.
10. Do not use, tightly seal, or place degraded powder in household trash; wet it thoroughly with water and follow manufacturer and local hazardous-waste guidance.
11. Check manufacturer safety bulletins for active stability recalls before using legacy or second-hand canisters.

How to Use This Treatise

What this treatise is—and is not

This volume is a standalone historical and technical reference on smokeless rifle propellants. It is written for readers who already grasp the basic purpose of smokeless powder and want an accurate desk reference on how propellants evolved, how industrial plants manufacture and coat them, who actually produces the powders sold under commercial canister labels, why legacy numerical designations repeat across brands, and how individual bottleneck rifle propellants compare in chemistry, lineage, and empirical burn rate.

It is **not** a reloading manual. It contains no charge-weight tables, starting or maximum loads, load-workup recipes, reloading-bench procedures, barrel-harmonic tuning claims, or ballistic-software calibration walkthroughs. Whenever two commercial powders share an OEM plant or a close burn-rate rank, this treatise documents their relationship while explaining why lot-to-lot variance and independent packager specifications prohibit blind grain-for-grain substitution.

The historical narrative in Part I and early Part II opens broadly—covering black powder and the early military, pistol, and shotgun milestones where smokeless chemistry and corporate lineages overlapped—before narrowing firmly to **bottleneck rifle propellants**. Bottleneck cartridges operate across wide case-to-bore ratios, high chamber pressures, long barrels, and severe thermal demands, making them the segment where propellant chemistry, grain geometry, and surface engineering reach their highest complexity.

Reading paths by question

You may read this treatise sequentially from Chapter 1 or jump straight to the section that answers your question:

- **Chemistry, manufacturing, and internal ballistics.** Read Part I (Chapters 1–3) for nitration chemistry, stabilizers, extruded versus spherical production, surface deterrents, thermochemical parameters, and bottleneck combustion physics.
- **Propellant history and introduction timelines.** Read Part II (Chapters 4–7) for the chronological evolution from Poudre B (1884) through WWII surplus, the Australian temperature-insensitive revolution, modern impregnated and stabilized propellants, and EU REACH disruptions.
- **Naming lineages, OEM plants, and commercial packagers.** Read Part III (Chapters 8–10) to untangle the `4350`, `4895`, `4831`, and `4064` families, profile the world's major industrial plants, and consult the OEM twins, sister families, and recall tables.
- **Cartridge matching, lot variance, and chemical aging.** Read Part IV (Chapters 11–12) for burn-rate windows across bottleneck cartridge classes, physical causes of lot drift, moisture equilibrium, nitric ester decomposition kinetics, and field inspection signs.
- **Empirical burn-rate lookup or individual powder research.** Turn directly to Part V for the complete empirical burn-rate reference table and the alphabetical-by-brand Propellant Compendium.

- **Quick dates, unit conversions, and definitions.** Consult the Back Matter for the Master Chronological Timeline (Appendix A), the 1-page Safety Card (Appendix B), Thermochemical Conversions (Reference), Notes, Sources, Glossary, and Index.

Using the Part V Compendium

Part V is divided into two linked sections. Section A presents an empirical relative burn-rate reference compiled from multi-cartridge published test data, ordered from fastest to slowest, alongside OEM plant attribution, grain class, bulk density, heat of explosion, and page pointers into the Compendium.

Section B profiles four foundational historical propellants followed by individual bottleneck rifle propellants grouped by brand with right-edge thumb tabs. Each Compendium entry pairs a concise narrative history (introduction timeline, naming lineage, chemistry, OEM twins or sister families, and bottleneck role) on the left with a standardized **Specification Card** on the right. Each active database powder card carries a compact QR code and direct URL to its live technical record at `empiricalprecision.com`.

Because the commercial propellant market changes continuously as new formulations appear and legacy lines are retired, the live Burn Rate Chart is also maintained online at `empiricalprecision.com/burn-chart`:

ONLINE REFERENCE · EMPIRICAL BURN RATE CHART

View the live, searchable empirical burn-rate chart—updated continuously from published rifle load data—at empiricalprecision.com/burn-chart.

empiricalprecision.com/burn-chart

Safety and evidence callouts

Two structured callouts appear sparingly through the narrative chapters:

- **Safety** callouts highlight genuine energetic hazards such as autocatalytic decomposition, thermal storage limits, warning signs of degraded powder, and the risk of substituting powders by burn-rate chart or OEM cross-reference.
- **Evidence** and **Contested** callouts examine recurring technical claims where physics and controlled test data separate fact from oversimplification—for example, whether base chemistry alone predicts temperature sensitivity, or whether confirmed OEM twins behave identically across separate production lots.

Part I

Chemistry, Manufacturing, and Combustion

Modern smokeless rifle propellants are precision-engineered energetic polymers, not simple granular fuels. Part I traces how nitrated cellulose replaced black powder, how industrial chemical plants shape and surface-treat individual grains, and why the thermochemistry and geometry of bottleneck rifle cartridges govern every aspect of combustion.

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Chapter 1

From Black Powder to Smokeless Propellants

Key points

- Black powder hit a hard physical ceiling in the late nineteenth century: low energy density, heavy solid fouling, dense smoke, and degressive burning limited service-rifle velocity and practical rate of fire.
- Paul Vieille's Poudre B (1884), Alfred Nobel's Ballistite (1887), and British Cordite (1889) established the two enduring families of smokeless small-arms propellants—single-base and double-base—from which rifle, artillery, pistol, and shotgun powders later diverged.
- Propellant base classes differ in energetic plasticizers: single-base relies on nitrocellulose alone, double-base adds nitroglycerin or DEGDN, and triple-base adds nitroguanidine to cool flame temperature in heavy ordnance.
- Nitric ester bonds decompose slowly over time, releasing nitrogen dioxide that triggers autocatalytic heating unless intercepted by sacrificial chemical stabilizers.

The mechanical ceiling of black powder

For more than five centuries, firearms relied on a single mechanical mixture: black powder. Standard military black powder combined roughly 75 percent potassium nitrate (saltpeter), 15 percent charcoal, and 10 percent sulfur, milled into an intimate physical blend, pressed into cake, broken into grains, and glazed with graphite.[1] It was not a chemical compound but a compacted mixture of oxidizer and fuel. That distinction dictated every limitation of nineteenth-century small arms.

More than half of a black powder charge converts to solid combustion products—chiefly potassium carbonate, potassium sulfate, and potassium sulfide—rather than expanding gas.[2] Those solids coated rifle bores within a few shots, degrading accuracy and forcing soldiers and target shooters to wipe barrels or accept oversized fouling tolerances. The suspended particulate cloud hung over firing lines in thick white smoke, blinding riflemen and betraying firing positions immediately.[3]

Thermochemically, black powder delivered a modest specific heat of explosion of roughly 2,700 to 3,000 kJ/kg, with low gas yield per gram compared with nitrated organic polymers.[4] Worse still, black powder burned degressively: even when pressed and screened into coarse granulation, each irregular grain shrank in surface area as it burned, producing a sharp early pressure peak followed by rapidly falling gas generation down the bore.[5] Large-bore service cartridges such as the .45-70 Government and .577/450 Martini-Henry pushed heavy lead bullets at roughly 1,300 to 1,400 fps, and even bottleneck black-powder express rifles struggled to pass 2,000 fps without excessive fouling and recoil. Breaking past that barrier required a propellant that converted almost entirely to hot gas and burned at a controlled, mathematically predictable rate.

Nitrocellulose and the three foundational inventions

The chemical breakthrough began in 1846, when Swiss-German chemist Christian Friedrich Schönbein nitrated cotton fibers with a mixture of nitric and sulfuric acids, producing guncotton (cellulose nitrate).[6] Early guncotton was powerful and nearly smokeless,

converting overwhelmingly to gaseous carbon monoxide, carbon dioxide, nitrogen, water vapor, and hydrogen. Yet in raw fibrous form it was disastrously unsuitable for gun barrels. Microscopic hollow cotton capillaries allowed hot combustion gases to penetrate the entire charge almost instantaneously, transitioning from orderly deflagration to violent detonation that shattered iron and steel breeches. Early storage magazines also exploded spontaneously because residual manufacturing acid remained trapped inside unwashed fibers.[6]

Two separate problems therefore stood between Schönbein's discovery and a usable rifle propellant: chemical purification and physical gelatinization.

In 1865, British chemist Sir Frederick Abel solved the purification problem at the Royal Gunpowder Factory at Waltham Abbey. By pulping nitrated cotton in paper-mill beaters and boiling it repeatedly in fresh water, Abel flushed trapped nitrating acid out of the hollow fiber lumens, yielding chemically clean guncotton suitable for blasting and military demolition.[6] Even purified, however, fibrous guncotton still burned far too violently for small-arms barrels.

Poudre B (1884)

The decisive transformation came in 1884 from French physicist and engineer Paul Vieille at the Laboratoire Central des Poudres et Salpêtres in Paris. Vieille dissolved a blend of soluble and insoluble nitrocellulose in a volatile mixture of ethyl ether and ethyl alcohol, kneading the fibers into a dense, horn-like dough called a colloid.[7] Rolled into thin sheets, dried to drive off the solvent, and cut into uniform square flakes, the resulting non-porous solid—designated **Poudre B** (after General Georges Boulanger, or simply *poudre blanche* to distinguish it from black powder)—burned strictly from the outside surface inward in parallel layers.[6]

Adopted immediately by the French Army in the 8×50mmR Lebel cartridge (1886), Poudre B tripled the effective flat-shooting range of infantry rifles, eliminated concealing battlefield smoke, cut bore fouling dramatically, and launched a 232-grain jacketed bullet past 2,000 fps from a compact bottleneck case.[8] Every military power in Europe and North America was forced into an overnight race to adopt smokeless small-arms ammunition.

Ballistite (1887)

Three years after Vieille's single-base colloid, Swedish chemist Alfred Nobel took a different chemical path. Rather than relying solely on volatile solvents that evaporated away during drying, Nobel plasticized lower-nitrogen nitrocellulose directly with liquid **nitroglycerin** (about 40 to 50 percent in his original 1887–1888 patent, stabilized with camphor and later diphenylamine or aniline derivatives).[7] Because nitroglycerin served as both a gelatinizing plasticizer and a high-energy liquid explosive, the resulting propellant—**Ballistite**—packed far greater chemical energy per gram than Poudre B and required little or no volatile solvent recovery.[2] Italy adopted Ballistite for its 1891 Carcano service rifle, and flattened Ballistite flakes became foundational across both European rifle cartridges and early smokeless pistol and shotshell loads.[9]

Cordite (1889)

Britain sought its own double-base propellant while avoiding Nobel's patent claims. In 1889, Sir Frederick Abel and Sir James Dewar patented **Cordite**, combining high-nitrogen guncotton (insoluble in nitroglycerin alone) with nitroglycerin using acetone as a mutual volatile solvent, plus roughly 5 percent mineral jelly (petroleum Vaseline) added originally as a die lubricant that unexpectedly acted as a coolant and mild stabilizer.[6] Extruded through dies into long spaghetti-like strands—hence the name—Cordite Mk I contained roughly 58 percent nitroglycerin, 37 percent guncotton, and 5 percent mineral jelly.[10]

Cordite proved powerful and reliable in the .303 British service rifle, yet its high nitroglycerin content produced ferocious flame temperatures that eroded rifle barrels and naval cannon tubes rapidly. Britain subsequently introduced Cordite MD (Modified, 1901), inverting the ratio to roughly 65 percent guncotton, 30 percent nitroglycerin, and 5 percent mineral jelly to lower flame temperature and extend barrel life.[10]

One chemical root, many later branches

During the first two decades of the smokeless era, rifle, artillery, handgun, and shotshell propellants overlapped heavily in chemistry and manufacturing plants. Early shotgun powders such as Schultze and E.C. used partially gelatinized nitrocellulose granules; Laflin & Rand's **Bullseye** (1898/1904) adapted double-base nitroglycerin-nitrocellulose flake chemistry to handguns; and early German Rottweil and Troisdorf flakes powered Mauser military rifles alongside sporting cartridges.[10] Only as small-arms cartridges diverged in chamber pressure, bore volume, and velocity demands did industrial makers separate thin, porous, fast-burning handgun and shotshell flakes from the thick-webbed, surface-deterred, thermally engineered propellants required by modern bottleneck rifles.

Nitration chemistry and propellant base classes

At the molecular level, cellulose is a linear polymer of anhydroglucose rings, each carrying three hydroxyl (`-OH`) groups capable of esterification by nitronium ions (`NO2+`) in a mixed nitric-sulfuric acid bath.[11] Replacing all three hydroxyl groups on every ring produces theoretical cellulose trinitrate with 14.14 percent nitrogen by mass. Practical industrial nitration stops below that ceiling because physical equilibrium and water dilution limit complete substitution, and because nitrogen percentage directly controls both energy content and solubility in industrial solvents.[12]

- **Pyrocellulose (soluble nitrocellulose, ~12.5–12.6% N).** Readily dissolves in ether-alcohol mixtures. It became the traditional U.S. military single-base feedstock (Pyro DG) and remains central to classical solvent-extruded single-base rifle propellants.[13]
- **Guncotton (high-nitrogen nitrocellulose, ~13.1–13.4% N).** Delivers higher specific energy and gas yield, does not dissolve completely in ether-alcohol alone, and is blended with lower-nitrogen nitrocellulose or colloided with acetone and energetic plasticizers.[12]
- **Feedstock origin.** High-purity **cotton linters** (short fibers left on cotton seeds after ginning) were the historical gold standard for high-nitrogen nitrocellulose. Refined alpha-cellulose **wood pulp** emerged during the twentieth century as an economical, scalable industrial alternative; modern plants qualify either cotton linters or high-purity chemical wood pulp depending on nitration grade, viscosity target, and regional supply.[14]

From nitrocellulose as the structural polymer backbone, smokeless propellants split into distinct chemical base classes, illustrated in Figure 1-1 and summarized in Table 1-1.

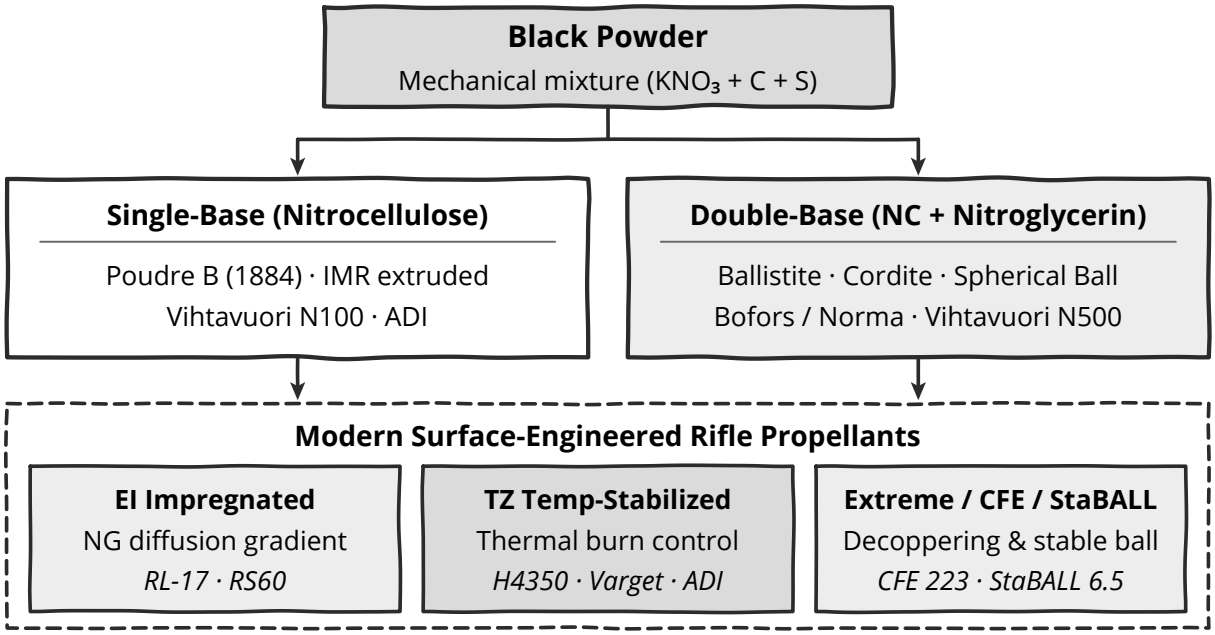


Figure 1-1. Chemical genealogy of smokeless propellants from black powder through single-base nitrocellulose, double-base mixtures, and modern impregnated and temperature-stabilized rifle propellants.

- **Single-base propellants.** Built on nitrocellulose as the sole energetic ingredient, plus stabilizers, surface deterrents, and minor functional additives. Single-base extruded propellants exhibit relatively low flame temperatures, gentle barrel-throat erosion, and a long history of thermal stability, though their specific heat of explosion is lower than nitroglycerin-bearing formulations.[15]
- **Double-base propellants.** Combine nitrocellulose with a liquid nitric ester plasticizer—most commonly **nitroglycerin** (NG) in commercial small-arms powders, or **diethylene glycol dinitrate** (DEGDN) in select European and military formulations designed for cooler combustion.[15] Adding nitroglycerin raises energy density (`Qex`), reduces moisture uptake because NG is hydrophobic, and eases extrusion or spherical droplet formation, at the cost of higher flame temperature and faster throat erosion.[16]
- **Impregnated and infused rifle propellants.** A modern hybrid class—exemplified by Nitrochemie's **EI®** (extruded impregnated) process and Vihtavuori's **N500** series—starts with an extruded single-base grain skeleton and diffuses nitroglycerin into the grain after extrusion, combining extruded geometry and progressive surface deterrence with double-base energy output.[17]
- **Triple-base propellants.** Add crystalline **nitroguanidine** (picrite) to a nitrocellulose-nitroglycerin matrix. Because nitroguanidine produces a high volume of cool nitrogen-rich gas, triple-base propellants deliver high impetus with dramatically reduced flame temperature and muzzle flash.[15] They are standard in heavy naval and tank artillery but rarely used in small-arms bottleneck rifle cartridges because nitroguanidine reduces bulk energy density and complicates fine-web small-arms extrusion.[14]

Class	Principal energetics	Typical Qex (kJ/kg)	Relative flame temperature	Primary role
Black powder	KNO_3, charcoal, sulfur (mechanical mix)	2,700–3,000	Low (high solid slag)	Historical baseline; muzzleloaders
Single-base	Nitrocellulose (NC)	3,100–3,800	Cool to moderate	Standard & precision bottleneck rifles
Double-base (NG / DEGDN)	NC + nitroglycerin or DEGDN	3,600–5,200	Moderate to high	Spherical rifle, magnum, pistol, shotshell
Impregnated / infused	Extruded NC skeleton + infused NG	3,800–4,200	Moderate to high	High-velocity & overbore bottleneck rifles
Triple-base	NC + NG + nitroguanidine	3,200–3,800	Cool (high N_2 gas yield)	Large-caliber artillery & naval ordnance

Table 1-1. Representative energetic ranges and roles across propellant classes. Exact heat-of-explosion (`Qex`) values vary with nitration level, plasticizer ratio, and deterrent content.[18]

Chemical instability, magazine disasters, and sacrificial stabilizers

Nitric esters—both nitrocellulose and nitroglycerin—are thermodynamically metastable. The oxygen-nitrogen ester bond (`R-O-NO2`) is relatively weak and undergoes slow homolytic cleavage and hydrolytic breakdown even at ambient room temperature.[12] Left unchecked, that slow cleavage releases acidic nitrogen oxides, chiefly **nitrogen dioxide** (`NO2`) and nitric oxide (`NO`). In the presence of trace moisture, those oxides form nitric and nitrous acids that attack neighboring nitrate ester chains, accelerating further bond cleavage and releasing heat. Because reaction rate rises roughly exponentially with temperature, an unstabilized or poorly purified mass of nitrocellulose enters **autocatalytic decomposition**: heat accelerates acid generation, acid accelerates heat release, and a confined stockpile can spontaneously ignite.[19]

The early smokeless era learned this chemistry through catastrophe. In March 1907, spontaneous decomposition of aged Poudre B ignited the aft magazine of the French pre-dreadnought battleship *Iéna* in dry dock at Toulon, killing more than a hundred sailors; four years later, in September 1911, the battleship *Liberté* suffered a similar magazine explosion in Toulon harbor.[6] Investigation traced the disasters to inadequately stabilized Poudre B exposed to warm shipboard magazines, where amyl alcohol—used as an early nominal stabilizer—evaporated or failed to neutralize acidic nitrogen oxides effectively.[2]

Modern propellant longevity rests on **sacrificial chemical stabilizers** compounded directly into the colloid at roughly 0.5 to 2.0 percent by mass.[20] Stabilizers do not stop nitric ester cleavage from occurring; instead, they react rapidly with liberated `NO2` and acid radicals before those products can catalyze further breakdown of the nitrocellulose matrix:

- **Diphenylamine (DPA).** The classic stabilizer for single-base propellants, introduced widely in the early twentieth century. DPA reacts sequentially with nitrogen oxides through N-nitrosodiphenylamine and nitrodiphenylamine derivatives, neutralizing acidic radicals across decades of cool storage.[7] DPA is generally avoided in high-nitroglycerin double-base propellants because its basicity can promote hydrolysis of nitroglycerin.[11]

- **Ethyl centralite (N,N′-diethyl-N,N′-diphenylurea) and methyl centralite.** Mildly basic urea derivatives developed in Germany (at the Centralstelle für Wissenschaftlich-Technische Untersuchungen, hence *centralite*) that serve simultaneously as chemical stabilizers, plasticizers, and surface deterrents in double-base propellants.[7]
- **Akardite II (N-methyl-N′,N′-diphenylurea).** A modern high-efficiency stabilizer widely adopted in contemporary European single-base, double-base, and impregnated rifle propellants, prized for clean thermal aging and reduced formation of nitrosamine byproducts compared with legacy DPA.[4]

Because stabilizers act sacrificially, every smokeless propellant has a finite chemical service life governed by storage temperature and humidity (detailed in Chapter 12). Cool, dry storage preserves stabilizer reserves for decades; sustained heat consumes them rapidly.

Safety · Propellant Stability

Autocatalytic decomposition can turn an overheated or severely aged canister of smokeless propellant into a self-ignition hazard. Any canister emitting a sharp, acrid acidic odor, reddish-brown fumes, or rust-colored powder dust has exhausted its stabilizer reserve and must be removed from service immediately (see Before You Begin and Chapter 12).[21]

Chapter 2

Industrial Manufacturing and Surface Engineering

Key points

- Nearly all modern commercial bottleneck rifle propellants come from one of two industrial architectures: solvent extrusion (tubular rods) or Fred Olsen's water-slurry spherical process (Ball Powder).
- Grain geometry—specifically **web thickness**, the shortest solid wall consumed during combustion—sets baseline burning duration independently of chemical energy.
- Surface engineering governs modern rifle performance: diffused deterrents, post-extrusion energetic impregnation (EI / N500), temperature-stabilization coatings (Extreme / TZ), decoppering agents, flash suppressants, and graphite glazing tailor gas generation to high-pressure bottleneck cases.
- Bottleneck rifle cartridges demand far greater geometric, thermal, and surface precision than handgun or shotshell powders because they must sustain controlled pressure across high expansion ratios and long barrels.

Solvent-extruded tubular manufacturing

Solvent extrusion is the direct industrial descendant of Paul Vieille's colloiding process, refined over a century by plants such as DuPont (later GD-OTS Canada at Valleyfield), Thales/ADI (Mulwala), Vihtavuori (Laukaa), Eurenco Bofors (Karlskoga), Nitrochemie (Wimmis), and Explosia (Pardubice). Although proprietary solvent ratios and drying cycles vary by facility, the core chemical-engineering sequence remains remarkably consistent.[1]

1. **Cellulose preparation and nitration.** Purified cotton linters or refined chemical wood pulp are dried, shredded, and immersed in metered nitric-sulfuric acid baths. Acid ratio, water content, temperature, and residence time fix the target nitrogen percentage (typically 12.6 to 13.3 percent for rifle grades).[2]
2. **Purification and pulping.** Spent acid is centrifuged away. Nitrated fibers undergo boiling, pulping in beater mills to open internal lumens, and alkaline poaching washes until residual acid falls below strict stability limits.[1]
3. **Dehydration.** Wet nitrocellulose holds roughly 25 to 30 percent water for safe handling. Hydraulic presses force ethanol through compressed blocks, displacing water without ever creating dry guncotton dust.[2]
4. **Incorporation (colloiding).** Alcohol-wet nitrocellulose enters jacketed sigma-blade mixers with ethyl ether (or acetone for high-nitrogen or double-base blends), stabilizers, flash suppressants, and optional plasticizers, forming a rubbery colloidal dough.[2]
5. **Blocking, screening, and extrusion.** Hydraulic blocking presses force the dough through fine macaroni screens to remove grit and uncolloided fibers. Extrusion presses then push it through steel dies fitted with centered pins that form the continuous axial perforation.[2]
6. **Cutting and solvent recovery.** Rotating knives slice the strands into uniform cylinders. Closed recovery chambers strip and condense ether and alcohol vapors, followed by water-steeping or warm-air drying to fix residual solvent and moisture.[2]

7. **Surface treatment, glazing, and blending.** Dried grains enter tumbling drums for deterrent coating, optional energetic impregnation, graphite glazing, screening, and multi-batch blending to hit target ballistic specs.[2]

Extruded manufacturing excels at geometric precision: die diameter, pin diameter, and cut length hold tight tolerances, producing single-perforated cylinders whose burning surface stays nearly constant. Its drawbacks are batch labor, solvent recovery overhead, and coarser volumetric metering when cut lengths are long.[3]

Water-slurry spherical (Ball) powder manufacturing

In the late 1920s and early 1930s, chemist Fred Olsen at Western Cartridge Company (later Olin Corporation, East Alton, Illinois) devised an entirely different architecture—patented in 1936—that eliminated dry colloiding, extrusion presses, and cutting knives altogether.[4] Today, General Dynamics St. Marks Powder (Florida) and PB Clermont (Engis, Belgium) are the world's premier practitioners of this spherical process.

Every hazardous mechanical step runs submerged in water:[5]

1. **Slurry formation and lacquer dissolution.** Water-wet nitrocellulose (including salvaged stocks, a major economic breakthrough) is suspended in heated, agitated water with chalk (calcium carbonate) to neutralize residual acid. Water-immiscible ethyl acetate and dissolved stabilizers convert the fibers into liquid lacquer suspended in the water.[2]
2. **Globule formation.** A protective colloid (such as animal glue or gum arabic) and sodium sulfate are added while tuned agitators shear the lacquer into fine droplets pulled into smooth spheres by surface tension.[6]
3. **Solvent distillation.** Raising tank temperature boils off ethyl acetate through condensers while the suspended spheres solidify into dense, non-porous nitrocellulose balls.[2]
4. **Screening and nitroglycerin impregnation.** Vibrating screens sort wet spheres into tight diameter bands—coarse for slow rifle grades, fine for pistol and shotshell powders. For double-base rifle grades, emulsified nitroglycerin migrates selectively out of warm water into the hydrophobic nitrocellulose spheres.[2]
5. **Mechanical rolling (flattening).** To tune web thickness precisely without changing diameter fraction, wet spheres often pass between precision-gapped steel rolls that flatten them into oblate or cracked-ball profiles.[2]
6. **Surface deterrence, drying, and glazing.** Heated slurry stills diffuse surface deterrents (such as dibutyl phthalate or centralite) into the outer shell to counteract naturally degressive geometry, followed by drying, graphite glazing, and final blending.[2]

Figure 2-1 contrasts the solvent-extruded and water-slurry spherical production streams side by side.

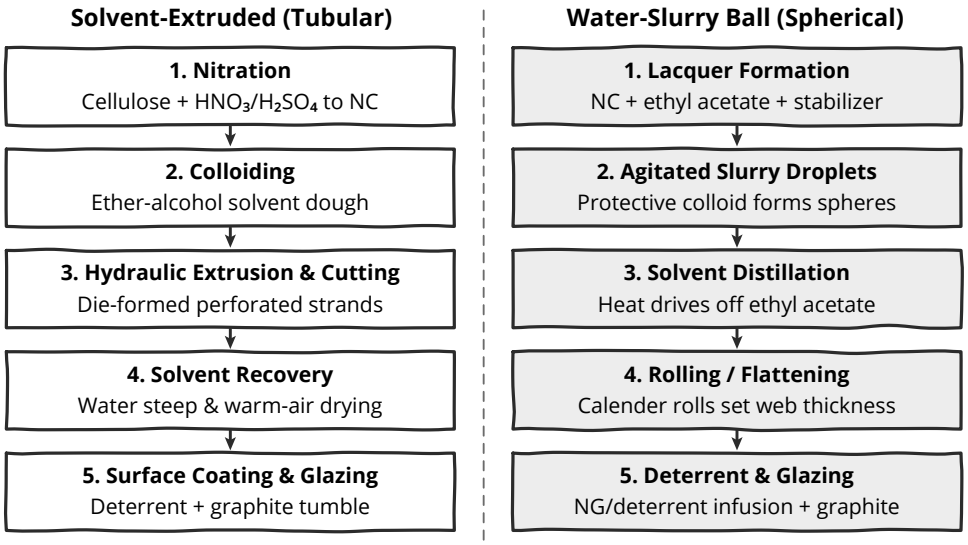


Figure 2-1. Side-by-side industrial process flows for solvent-extruded tubular propellants and water-slurry spherical ball propellants.

Spherical manufacturing runs safer (wet-process handling reduces static and dust ignition risks), scales continuously to massive defense-contract volumes, and produces high-bulk-density grains that meter smoothly through automated ammunition-loading equipment.[7]

Grain geometry and web thickness

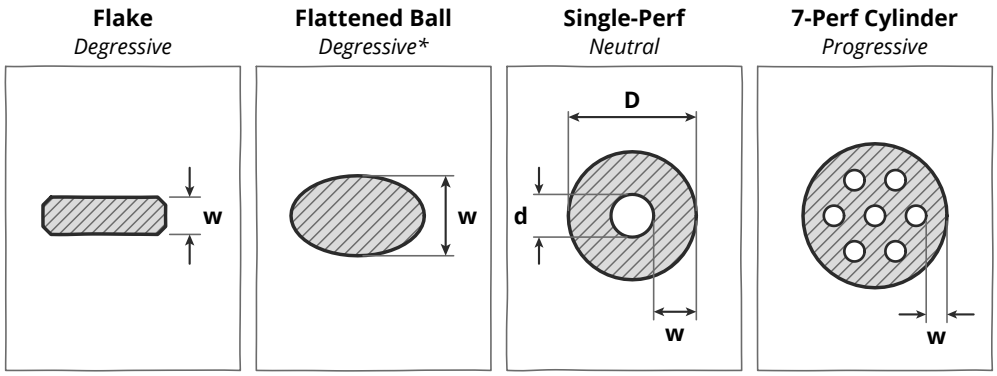
Once chemical formulation fixes a propellant's intrinsic linear burning rate at a given pressure, **grain geometry** controls how long the grain burns and how rapidly its gas-generation surface area evolves.

The single most important geometric dimension of any propellant grain is its **web thickness** (`w`), defined as the minimum solid thickness of propellant between opposing burning surfaces.[8] Because smokeless propellant burns inward from every exposed surface simultaneously at the same linear rate, total burning time at a fixed pressure is proportional to half the web thickness (`w / 2`). Doubling a grain's web roughly doubles its burn duration—allowing the exact same nitrocellulose chemistry to fuel either a fast small-bore cartridge or a slow magnum rifle simply by changing die and pin geometry or roll-flattening gap.

Four primary grain cross-sections dominate small-arms and ordnance propellants (Figure 2-2):

- **Flake (disc or square wafer).** Very thin web thickness (`w` equals wafer thickness), high surface-to-mass ratio, and rapid burnout. Ideal for low-expansion-ratio handgun and shotshell cartridges; rare in modern bottleneck rifles except early historical formulations such as Poudre B and Rottweil rifle flakes.
- **Spherical and flattened ball.** In an unrolled sphere, `w` equals the full diameter; passing the sphere through calendar rolls compresses it into an oblate disc whose web equals its flattened minor thickness, fine-tuning burn time while preserving high bulk density and smooth volumetric flow.[2]

- **Single-perforated cylinder (tubular / stick).** The classic bottleneck rifle geometry. Web thickness equals half the difference between outer grain diameter (`D`) and inner perforation diameter (`d`), so `w = (D - d) / 2`. As the outer wall shrinks inward, the inner perforation expands outward, keeping total burning surface area nearly constant until the wall burns through.[9]
- **Multi-perforated cylinder (typically 7 perforations).** Standard in large-caliber artillery and ultra-slow heavy rifle cartridges such as .50 BMG. Six outer perforations arranged around one central perforation create multiple expanding internal burning fronts, causing total surface area to grow substantially during combustion until the webs coalesce into residual slivers.[8]



*Hatched area = solid propellant; w = web thickness. *Surface-deterred ball burns progressively.*

Figure 2-2. Propellant grain cross-sections showing web thickness across flake, flattened ball, single-perforated cylinder, and multi-perforated cylinder geometries.

Cut length (`L`) also matters mechanically in tubular rifle propellants. Long-cut cylinders bridge inside narrow bottleneck case necks and shear under volumetric powder-measure rotors; short-cut ("SC") extruded versions—such as Hodgdon H4831SC relative to standard H4831—shorten cut length while adjusting web or coating so the powder packs more densely and meters more uniformly while maintaining comparable burn-rate behavior.

Surface engineering, impregnation, and functional additives

Bare nitrocellulose grains rarely match the pressure-time demands of modern bottleneck rifles. Instead, twentieth- and twenty-first-century propellant plants turned the grain's outer micrometer-scale shell into an engineered chemical gradient.

Surface deterrents

A **deterrent** (also called a moderant) is a slow-burning or non-energetic organic plasticizer diffused into the outer skin of a dried propellant grain to a controlled penetration depth.[1] When the primer ignites the charge, combustion starts slowly through the cooler, deterred outer layer while the bullet is still seated in the throat and chamber volume is minimal. As the flame front burns past the deterred shell into the undeterred energetic core—just as the bullet accelerates down the bore and internal volume expands—gas generation ramps upward. This chemical progressivity is essential to spherical ball powders, compensating for their naturally shrinking geometric surface area, and is equally central to modern progressive tubular rifle powders.[2]

Historically, **2,4-dinitrotoluene (DNT)** and **dibutyl phthalate (DBP)** served as workhorse deterrents across single-base extruded and spherical rifle lines. Under European Union **REACH** chemical regulations enforced from 2018 onward, both DNT and DBP faced severe authorization restrictions due to toxicity concerns, accelerating industry migration toward ethyl/methyl centralite, polyester-based polymeric deterrents, and non-phthalate surface coatings (Chapter 7).[10]

Impregnated and temperature-stabilized architectures

Two landmark late-twentieth- and early-twenty-first-century advances reshaped bottleneck rifle propellants:

- **Post-extrusion energetic impregnation.** Conventional double-base extrusion mixes nitroglycerin uniformly throughout the dough prior to pressing, which limits die geometry and often heightens temperature sensitivity. By contrast, **Nitrochemie's EI® (Extruded Impregnated)** process and **Vihtavuori's N500** high-energy process first extrude a mechanically robust single-base nitrocellulose cylinder and then infuse liquid nitroglycerin (together with surface deterrents) into the grain in a controlled post-extrusion step.[11] The resulting concentration gradient delivers high specific energy and velocity potential while preserving progressive combustion and manageable thermal behavior.
- **Temperature-zone stabilization.** Conventional deterrent skins burn faster when warm and slower when cold because ambient grain temperature changes the enthalpy needed to reach surface ignition. Modern temperature-stabilized systems—pioneered commercially by **Thales/ADI's Extreme** extruded line in the 1990s, **Eurenco Bofors's TZ® (Temperature Zone)** technology in Sweden, and later stabilized spherical lines from General Dynamics St. Marks—pair specialized deterrent chemistry and tailored diffusion profiles so that burning-rate temperature dependence flattens across wide cold-to-hot ambient ranges.[12]

Decoppering, flash suppression, and glazing

Beyond burn-rate control, rifle propellants incorporate targeted trace additives (Table 2-1):

- **Decoppering agents.** High-velocity gilding-metal rifle jackets smear microscopic copper deposits onto barrel lands, gradually constricting bore diameter and altering friction. Trace additions of **bismuth**, **tin**, or **zinc** compounds (such as bismuth trioxide or tin dioxide, originally developed for military machine-gun and cannon propellants and popularized commercially in Hodgdon's CFE line and Vihtavuori's decoppering formulations) react with copper fouling in the hot bore gas stream to form brittle, low-melting intermetallic alloys that scour out with subsequent shots.[13]
- **Flash suppressants.** Unburned hot carbon monoxide (CO) and hydrogen (H_2) exiting a rifle muzzle mix with atmospheric oxygen and reignite in a bright secondary muzzle flash. Adding 0.5 to 2.0 percent alkali-metal salts—chiefly **potassium sulfate** (K_2SO_4) or **potassium nitrate** (KNO_3)—releases potassium ions into the exhaust plume that quench free-radical chain branching and suppress secondary flash, at the minor cost of slightly increased solid particulate smoke.[1]
- **Graphite glazing.** Tumbling finished grains with roughly 0.1 to 0.3 percent fine powdered graphite coats each grain in a conductive, low-friction dark sheen. Graphite bleeds dangerous electrostatic charges during pneumatic conveying and metering, prevents

grains from clumping in storage, increases bulk density slightly, and gives most commercial smokeless powders their familiar charcoal-gray color.[2]

Additive class	Representative compounds	Primary function	Technical or regulatory note
Stabilizers	Diphenylamine (DPA), ethyl centralite, Akardite II	Scavenge NO_2 and acid radicals to prevent autocatalysis	Sacrificially consumed over storage life
Surface deterrents	2,4-DNT, DBP, centralites, polymeric coatings	Slow initial outer-shell burn for progressive pressure curve	DNT and DBP restricted under EU REACH (2018+)
Energetic plasticizers	Nitroglycerin (NG), DEGDN	Raise Qex and impetus; reduce hygroscopicity	Increases flame temperature and throat erosion
Decoppering agents	Bismuth, tin, and zinc oxides/salts	Form friable alloys with bore copper fouling	Reduces copper buildup in high-velocity bores
Flash suppressants	Potassium sulfate (K_2SO_4), potassium nitrate	Quench secondary CO/H_2 muzzle-plume ignition	Slightly increases solid smoke residue
Glazing agents	Powdered graphite (0.1–0.3%)	Dissipate static electricity; improve flow and bulk density	Gives smokeless powders charcoal-gray finish

Table 2-1. Principal chemical additive families in modern bottleneck rifle propellants.[14]

Why bottleneck rifle propellants demand peak engineering

Handgun and shotshell cartridges operate in a comparatively forgiving internal-ballistic regime. A 12-gauge shotshell runs near 11,500 psi in a straight-walled hull with a wide bore; a 9mm Luger runs near 35,000 psi with a barrel only four to five inches long. In both cases, propellant combustion must finish within a fraction of a millisecond using thin-webbed, fast-burning flakes or fine spheres, and variations in ambient temperature or bore friction rarely carry dramatic downrange consequences.

Bottleneck rifle cartridges push every physical boundary simultaneously. Standard centerfire rifle cartridges operate at SAAMI Maximum Average Pressures of 55,000 to 65,000 psi (380 to 448 MPa) and C.I.P. ceilings up to 440 MPa, driving jacketed bullets down 16- to 30-inch barrels at 2,500 to 4,000 fps.[15] The narrow bottleneck bore restricts gas expansion behind a massive propellant charge, turning small errors in web thickness, deterrent penetration, or thermal burn-rate shift into steep chamber pressure excursions or unacceptable velocity swings. Semi-automatic service rifles add a further constraint: chamber pressure must peak safely early yet remain within a narrow port-pressure window farther down the barrel to cycle the gas system without beating the action. That combination of high pressure, long dwell time, intense throat heat, and tight ballistic tolerance is why bottleneck rifle propellants sit at the apex of industrial small-arms chemistry—and why the remainder of this treatise focuses specifically on them.

Chapter 3

Thermochemistry and Internal Ballistics of Bottleneck Cases

Key points

- Five physical properties govern how a propellant behaves in a chamber: heat of explosion (`Qex`), impetus (`F`), covolume (`b`), flame temperature (`Tv`), and bulk density.
- Barrel throat erosion scales steeply with propellant flame temperature (`Tv`) and hot reactive gas species, creating an unavoidable engineering trade-off between maximum velocity and barrel life.
- Propellant combustion follows Piobert's parallel-layer law and Vieille's pressure-dependent burn law (`r = a × p^n`), modulated by grain geometry (degressive, neutral, progressive) and surface deterrence.
- Bottleneck expansion ratio—usable case capacity relative to bore cross-sectional area—and barrel length determine why small-bore, mid-bore, and overbore magnum cartridges require completely different burn-rate regimes.

Thermochemical energy, gas yield, and barrel erosion

Inside a sealed cartridge chamber, burning propellant converts solid chemical potential energy into high-pressure, high-temperature gas—predominantly carbon monoxide (`CO`), carbon dioxide (CO_2), water vapor (H_2O), nitrogen (N_2), and hydrogen (H_2). Five thermochemical and physical quantities describe that transformation (Table 3-1).[1]

- **Specific heat of explosion (`Qex`, kJ/kg or J/g).** The total chemical energy released per unit mass of propellant burned in a constant-volume calorimeter bomb (with water vapor or liquid state specified by test convention). Single-base rifle propellants typically span roughly 3,100 to 3,800 kJ/kg, whereas double-base and NG-infused rifle propellants commonly reach 3,800 to 4,200 kJ/kg or higher.[2]
- **Adiabatic isochoric flame temperature (`Tv`, K).** The peak temperature reached by combustion gases burning at constant volume with zero heat loss to the barrel steel, typically roughly 2,600 to 3,400 K across small-arms single- and double-base rifle propellants.[1]
- **Impetus or force constant (`F`, J/g or kJ/kg).** The true measure of mechanical pressure-generating capacity per gram of propellant. Because pressure depends on both gas temperature and the number of moles of gas produced per kilogram (`n`), impetus equals the product of gas yield, the universal gas constant (`R`), and flame temperature:

```
F = n × R × Tv
```

A propellant that generates lighter, smaller gas molecules (higher `n`, such as hydrogen- or nitrogen-rich mixtures) can achieve high impetus at a cooler flame temperature than a denser-gas formulation with identical `Qex`.[3]

- **Covolume (`b`, cm³/g or m³/kg).** At rifle chamber pressures exceeding 60,000 psi (414 MPa), combustion gases are compressed to densities approaching liquid water. Ideal gas assumptions fail because gas molecules themselves occupy non-negligible space. The

Noble-Abel equation of state corrects for that excluded molecular volume (`b`, typically near 0.95 to 1.05 cm³/g for rifle propellants):[3]

```
p × (v − b) = F
p = F / (v − b)
```

where `p` is gas pressure and `v` is specific volume (available chamber volume divided by burned propellant mass). As loading density climbs and `(v − b)` shrinks, chamber pressure rises sharply and nonlinearly.

- **Bulk density (`kg/m³` or `g/L`).** The mass of poured propellant grains—including air gaps between grains—per unit volume. Spherical ball powders pack densely (roughly 900 to 1,000+ g/L), whereas long-cut single-base tubular powders pack more loosely (roughly 800 to 930 g/L). Bulk density determines how much total chemical energy physically fits inside a given bottleneck case.

Parameter	Standard units	Physical role in the chamber	Practical trade-off
Heat of explosion (Qex)	kJ/kg (or J/g)	Total chemical energy released per unit mass	Higher Qex raises velocity potential and heat load
Impetus / force (F)	kJ/kg (or J/g)	Mechanical pressure-generating work per unit mass	Governs efficiency; rises with gas moles and Tv
Flame temperature (Tv)	K (or °C)	Thermal intensity of combustion gases	Dominant driver of barrel-throat erosion
Covolume (b)	cm³/g	Volume occupied by compressed gas molecules	Amplifies pressure rise at high loading densities
Bulk density	g/L (or kg/m³)	Mass of poured grains fitting inside case volume	High density enables heavier charges; affects fill ratio

Table 3-1. Core thermochemical and physical parameters governing bottleneck rifle propellants.[4]

Why flame temperature governs barrel throat erosion

Barrel life in high-velocity bottleneck rifles is limited far less by mechanical bullet friction than by **thermal-chemical throat erosion** in the first few inches ahead of the chamber.[5] During each shot, transient gas temperatures exceeding 2,800 to 3,200 K sweep across the steel leade at supersonic velocity. A microscopic surface layer of barrel steel briefly exceeds its austenitic transformation temperature (~1,000 K), absorbs carbon and reactive gas species (`CO`, `H₂O`, `H₂`) that form brittle low-melting iron compounds, quenches rapidly back into stressed martensite after the shot, develops microscopic heat-checking cracks ("firecracking"), and washes away under the high-velocity gas jet of subsequent rounds.[6]

Experimental erosion studies demonstrate that erosion rate per round rises exponentially with maximum bore-surface temperature, which in turn scales tightly with propellant flame temperature (`Tv`) and total charge mass burned per unit bore cross-sectional area.[6] For that reason, high-energy double-base and NG-infused propellants typically deliver measurably higher muzzle velocity in a given cartridge than cooler single-base propellants, yet wear out competition rifle throats noticeably faster—a fundamental thermochemical trade-off rather than a manufacturing defect.

Burning mechanics: Piobert's law, Vieille's law, and form functions

Smokeless rifle propellant does not detonate; it **deflagrates**—burning subsonically by conductive and radiative heat transfer across the solid grain surface. Two empirical laws govern that combustion.[3]

First, **Piobert's law** (1839) states that homogeneous, non-porous propellant grains burn in parallel layers strictly perpendicular to every exposed surface. Because gas generation equals solid density times burning surface area times linear burning rate, maintaining intact, uncracked grains is essential to predictable chamber pressure. If mechanical crushing, severe cold embrittlement, or defective porosity fractures grains inside a chamber, total exposed surface area multiplies suddenly, causing rapid overpressure.[7]

Second, **Vieille's burning-rate law** (1893) expresses linear regression rate (`r`, mm/s) as a power function of instantaneous chamber pressure (`p`):[3]

```
r = a × p^n
```

where `a` is the burning-rate coefficient (sensitive to chemical composition and initial grain temperature) and `n` is the pressure exponent (typically roughly 0.7 to 1.0 across small-arms rifle pressures). Because `r` rises steeply with pressure, smokeless combustion is self-reinforcing: higher pressure burns propellant faster, generating more gas, which drives pressure higher still until bullet motion down the bore expands chamber volume faster than new gas is produced.

How gas generation evolves across the burn depends on the grain's **form function**—the curve of relative burning surface area versus fraction burned (`z`), shown in Figure 3-1:[3]

- **Degressive burning (solid sphere, thin flake, unperforated rod).** Surface area shrinks continuously from ignition to burnout. Peak gas generation occurs immediately, producing a steep early pressure spike when bore volume is smallest.
- **Neutral burning (single-perforated cylinder).** As the outer cylindrical diameter decreases, the inner axial perforation expands at an equal radial rate, keeping total exposed surface area nearly flat (declining only slightly as end faces burn inward) until the web is consumed.
- **Progressive burning (multi-perforated cylinder or surface-deterred grain).** Exposed surface area—or effective chemical energy release rate—increases through most of the burn, holding peak chamber pressure lower while sustaining broad, steady pushing pressure as the bullet accelerates down the barrel.

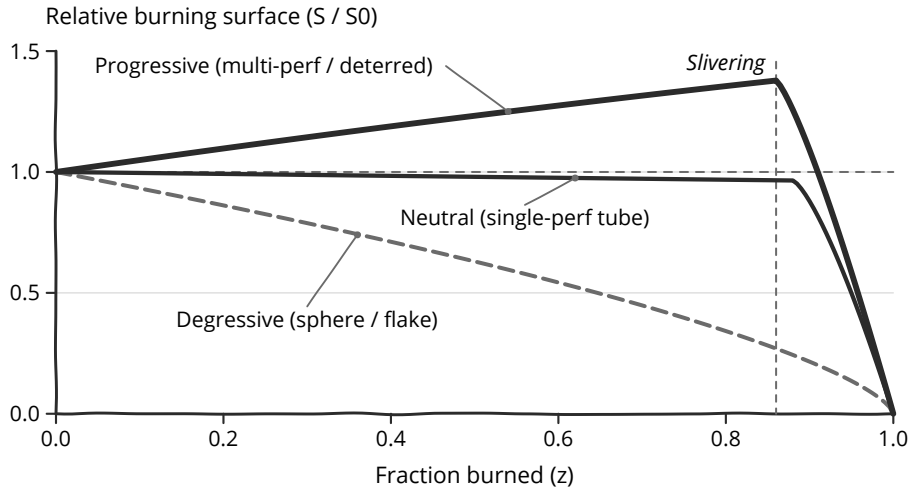


Figure 3-1. Relative burning surface area versus fraction burned for degressive, neutral, and progressive grain geometries.

Ignition dynamics, loading density, and temperature sensitivity

Steady-state Vieille burning assumes all grains ignite uniformly. In reality, combustion begins with a violent millisecond-scale ignition transient driven by the primer's hot incandescent particles and gas jet penetrating the propellant column.[8] Two physical variables—**loading density** and **initial propellant temperature**—strongly influence how consistently that transient unfolds.

Loading density and fill ratio

Loading density is charge mass divided by total available internal case volume behind the seated bullet; **fill ratio** expresses the fraction of usable case volume physically occupied by the poured powder column. Bottleneck rifle propellants perform most consistently at relatively high fill ratios (typically above roughly 80 percent of usable capacity without crushing grains). At high fill ratios, powder position relative to the flash hole barely changes from shot to shot, minimizing ignition-delay variance.[8]

Conversely, severely reduced fill ratios in large bottleneck cases—especially with slow-burning, heavily deterred propellants—can leave powder spread thinly along the lower case wall. Poor initial gas pressurization slows ignition, causes erratic velocity swings, and in extreme under-loaded scenarios with slow ball or magnum powders can trigger unpredictable secondary pressure excursions (often termed Secondary Explosion Effect, or SEE) when flame propagation and pressure waves reflect unevenly along the empty headspace.[3] At the opposite extreme, heavy mechanical compression that fractures brittle extruded grains violates Piobert's law by creating unpredictable extra surface area.

Temperature sensitivity

Propellant temperature directly affects chamber pressure and muzzle velocity through two mechanisms: warmer grains require less thermal energy to reach surface decomposition temperature (shortening ignition delay), and higher initial enthalpy increases the burning-rate coefficient a in Vieille's law.[3] Because pressure drives burning rate recursively,

a modest initial shift in grain temperature amplifies into a measurable swing in peak pressure and muzzle velocity between winter hunting conditions and hot summer competition stages.

Contested: single-base propellants are always less temperature-sensitive than double-base propellants

The claim. Shooters and older technical manuals often treat base chemistry as a binary rule: single-base extruded propellants are temperature-stable, while double-base and spherical ball propellants always swing wildly with ambient temperature.

The physics. Historically, that rule rested on real chemistry. Unstabilized double-base spherical propellants relied on nitroglycerin and conventional phthalate or centralite surface deterrents whose burning-rate temperature coefficients were noticeably steeper than classic single-base extruded formulations.[9] Yet temperature sensitivity is governed not just by whether nitroglycerin is present, but by deterrent chemistry, diffusion-layer architecture, ignition pressure matching, and surface-coating formulation.[10]

The evidence. Controlled temperature-chamber firing tests of modern bottleneck rifle propellants show wide overlap across base classes. Surface-engineered single-base lines (such as Thales/ADI Extreme powders) achieve very low velocity drift across freezing-to-hot swings, while several legacy undeterred or older single-base extrusions exhibit substantial seasonal drift.[11] Simultaneously, modern temperature-stabilized double-base and infused formulations—including Eurenco Bofors TZ® extruded powders and St. Marks StaBALL spherical powders—deliver thermal stability rivaling or matching top single-base competition powders in controlled testing.[12]

> **Evidence · Supported by data**
> Modern controlled temperature testing confirms that surface-deterrent and stabilization engineering—not the simple single-base versus double-base label—determines a propellant's thermal sensitivity.[12]

The verdict. As a historical generalization about mid-twentieth-century propellants, the single-base rule was broadly true. For twenty-first-century bottleneck rifle propellants, it is obsolete; thermal stability must be evaluated by specific formulation and surface-engineering technology rather than base class alone.

Bottleneck cartridge geometry and burn-rate matching

A propellant's "burn rate" is not an absolute physical constant like density or melting point—it is a relative engineering balance between a grain's chemical burning rate, web thickness, and surface deterrence on one side, and a cartridge's internal geometry on the other.

The governing geometric ratio for bottleneck rifles is the **expansion ratio** (closely related to the informal term "overbore"): the ratio of usable cartridge case capacity to bore cross-sectional area, evaluated together with bullet mass and barrel length.[8] Because bore

cross-sectional area scales with the square of bullet diameter ($\pi \times d^2 / 4$), changing caliber transforms gas-expansion physics dramatically:

- **Small-bore moderate cases (e.g., .223 Remington, 55,000 psi SAAMI MAP).** Small case volume and modest bullet mass accelerate rapidly out of the chamber, leaving short residence time before the bullet exits a 16- to 24-inch barrel. These cartridges require relatively fast-burning rifle propellants with thinner webs so combustion reaches full pressure and completes before muzzle exit.[13]
- **Mid-bore balanced cases (e.g., 6.5 Creedmoor and .308 Winchester, 62,000 psi SAAMI MAP).** Moderate case capacity paired with mid-weight bullets and medium bore cross-sections matches medium-burn-rate extruded or stabilized spherical propellants—the heart of modern target and hunting rifle production.[14]
- **Overbore magnums (e.g., .338 Lapua Magnum, 65,000 psi SAAMI MAP; .300 Win Mag; 6.5/7mm PRC).** Large propellant charges funnel hot gas through a comparatively narrow bore behind heavy, high-inertia bullets. A fast powder would peak violently while the bullet has barely moved; only slow-burning, thick-webbed, heavily deterred or infused propellants can fill the large case safely, keep peak pressure within SAAMI or C.I.P. limits, and sustain broad pushing pressure down a 24- to 30-inch barrel.[15]

Figure 3-2 illustrates how burn-rate matching shapes the chamber pressure-time curve inside a single bottleneck rifle cartridge.

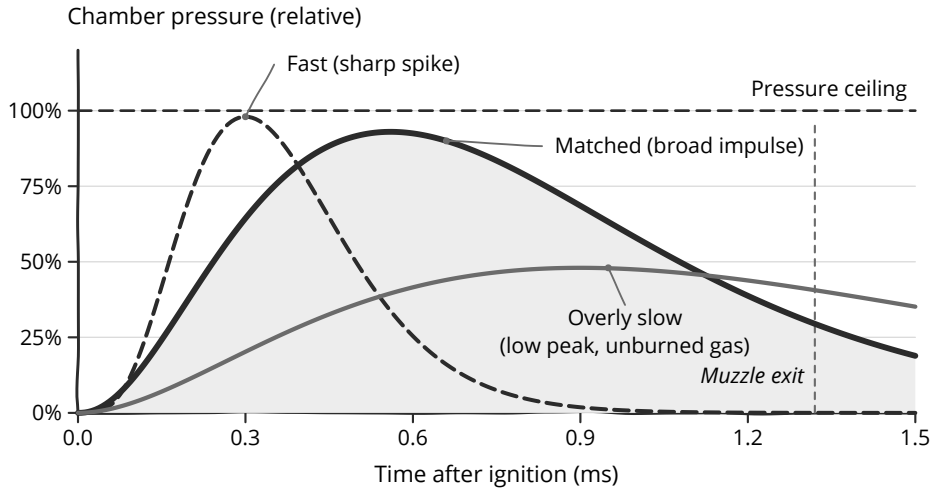


Figure 3-2. Representative chamber pressure-time curves comparing fast, matched, and overly slow propellants in a bottleneck rifle cartridge.

The physical goal of burn-rate matching is clear from the area under those curves. Because muzzle kinetic energy reflects the integral of base pressure acting on the bullet over bore travel, a propellant that is **too fast** hits the chamber pressure ceiling too early and runs out of gas halfway down the barrel, sacrificing velocity. A propellant that is **too slow** fills the case to capacity before generating efficient operating pressure, leaving unburned grains and high residual muzzle pressure that produces fierce blast without full velocity. A **matched** propellant reaches safe working pressure cleanly at high loading density and holds a broad, progressive pressure plateau down the bore—the exact internal-ballistic problem that drove a century and a half of propellant innovation explored in Part II.

Part II

Historical Evolution of Smokeless Rifle Propellants

Smokeless propellant history runs from nineteenth-century military necessity to modern chemical engineering. Over four eras, rifle propellants evolved from volatile flakes and erosive double-base cords into temperature-stabilized extrusions and decoppering ball powders tailored for bottleneck cases. Tracing that lineage explains why modern canisters still carry century-old numbers, why eight primary chemical plants supply nearly the entire commercial world, and how regulatory and military shocks keep reshaping what sits on dealer shelves.

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Chapter 5. World War II and the Post-War Surplus Era (1940–1969) 26
Chapter 6. The Precision and Temperature-Insensitive Era (1970–2005) 31
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The Pioneer Era (1884–1939)

Key points

- France's Poudre B (1884), Alfred Nobel's Ballistite (1887), and Britain's Cordite (1889) rendered black-powder military rifles obsolete within a single decade.
- Early rifle, pistol, artillery, and shotgun smokeless powders grew from the same chemical plants before diverging into specialized grain geometries and burn rates.
- Severe barrel throat erosion in double-base military cartridges pushed the United States to adopt single-base Pyro DG (1908–1909) for the .30-06 Springfield.
- DuPont's dinitrotoluene-coated Improved Military Rifle (IMR) series and its 1930s four-digit classics (`3031`, `4064`, `4198`, `4227`, `4320`) established the enduring burn-rate map for bottleneck rifles.
- Finland's Vihtavuori (founded 1922, first production 1926) and Sweden's Bofors Nobelkrut laid the industrial foundations of Scandinavian precision rifle propellants.

From black powder to the first smokeless military rifles

By the early 1880s, black powder had reached its physical ceiling in small arms. It generated dense obscuring smoke, deposited heavy corrosive fouling after a handful of shots, and converted more than half of its mass into solid residue rather than expanding gas (see Chapter 1). Worse still, black powder burned fast and degressively, making it poorly suited to pushing small-caliber jacketed bullets at high velocities down long rifled barrels.[1]

In 1884, French chemist Paul Vieille broke that ceiling by gelatinizing nitrocellulose with an ether-alcohol solvent, rolling the plasticized dough into thin sheets, cutting it into small flakes, and drying it into a dense, non-porous horn-like solid.[1] Because combustion could proceed only across the exterior surface of each dense flake rather than flashing through porous pores, gas generation became predictable and controllable. France fielded Vieille's single-base propellant—designated *Poudre B*—in the 8×50mmR Lebel cartridge in 1886, achieving roughly three times the ballistic efficiency of black powder while eliminating the telltale smoke cloud over infantry firing lines.[1]

Every major European power scrambled to match the Lebel. Within five years, three rival chemical philosophies had emerged across Europe, each leaving a permanent imprint on rifle propellant design.

Ballistite and Cordite: the double-base alternative

In 1887, Swedish chemist Alfred Nobel took a different route. Instead of using volatile ether-alcohol solvents that had to be evaporated after pressing, Nobel gelatinized soluble nitrocellulose directly with liquid nitroglycerin, producing a dense double-base sheet propellant called **Ballistite**.[1] Italy adopted Ballistite for its 6.5×52mm Carcano service rifle, and its high specific energy drew immediate interest from ordnance boards across Europe.

Britain followed a parallel double-base path in 1889. Sir Frederick Abel and Professor James Dewar combined high-nitrogen insoluble nitrocellulose (guncotton) with nitroglycerin and

mineral jelly (petroleum jelly), using acetone as a solvent to extrude spaghetti-like strands that Britain named **Cordite**.[1] Adopted for the .303 British cartridge as Cordite Mark I, the formulation delivered strong ballistic performance but carried a steep metallurgical cost. Its high nitroglycerin content produced extreme flame temperatures that washed away rifle barrel throats during sustained firing. In 1901, Britain reformulated the propellant as **Cordite MD** (Modified), raising the nitrocellulose share and cutting nitroglycerin to lower flame temperature and extend barrel life.[1]

German nitrocellulose flakes and the Mauser bottleneck lineage

German arsenals and commercial chemical houses—most notably the Rottweil-Hamburg and Troisdorf works—rejected high-nitroglycerin cords for infantry rifles. They developed gelatinized single-base nitrocellulose flake propellants (*Blättchenpulver*) for the 8×57mm *Patrone 88* (1888) and the 7×57mm Mauser (1892), refining the flake chemistry again for the higher-velocity pointed-bullet 8×57mm *S-Patrone* in 1905.[1]

The 7×57mm Mauser and 8×57mm Mauser cartridges demonstrated what a modern bottleneck case paired with a well-matched single-base propellant could accomplish. During the Spanish-American War (1898), U.S. troops armed with .30-40 Krag rifles and black-powder Trapdoor Springfields faced smokeless Spanish 7×57mm Mauser fire that exposed the tactical gap between older service cartridges and high-velocity European bottleneck designs.[2]

America's pivot: from double-base erosion to Pyro DG

The United States entered the smokeless rifle era cautiously. Early .30-40 Krag and experimental .30-03 ammunition relied on imported European powders or domestic double-base formulations made by Laflin & Rand and DuPont, such as W.A. (.30 caliber) nitroglycerin powder.[3] When the U.S. Army adopted the pointed-bullet .30-06 Springfield (Ball Cartridge, Caliber .30, Model of 1906) at higher muzzle velocities, double-base propellants produced severe throat erosion—ruining match and service barrels in only a few thousand rounds.[2]

In 1908–1909, working jointly with DuPont, the U.S. Army and Navy standardized on a pure single-base propellant designated **Pyro DG** (pyrocellulose stabilized with diphenylamine and glazed with graphite).[4] Pyrocellulose contained roughly 12.6 percent nitrogen, dissolving cleanly in ether-alcohol solvents to extrude into uniform single-perforated cylindrical grains. Adding diphenylamine halted autocatalytic nitric ester breakdown in long-term storage, while graphite reduced static electricity and smoothed metering through factory loading machines.[4] Pyro DG remained the backbone of U.S. .30-06 service ammunition through World War I and proved that single-base cylindrical grains could deliver military velocity with dramatically longer barrel life than early double-base formulations.

Shared origins: pistol, shotgun, and early civilian rifle powders

During the first three decades of smokeless manufacture, commercial handgun, shotgun, and rifle powders did not live in separate industries. They emerged from the same nitration houses and corporate portfolios.

In the United States, the **Laflin & Rand Powder Company** developed **Bullseye**—a fast-burning double-base flake handgun propellant introduced commercially around 1898 and refined by 1904—before E.I. du Pont de Nemours and Company acquired Laflin & Rand in 1902.[5] A decade later, a landmark 1912 federal antitrust decree broke up DuPont's near-monopoly on American explosives, spinning off two major competitors: Atlas Powder Company and the **Hercules Powder Company**.[5]

Hercules inherited Bullseye along with Laflin & Rand's smokeless small-arms expertise. Alongside its handgun and shotshell lines, Hercules built a formidable early rifle reputation with **HiVel** (later **HiVel No. 2**), a double-base extruded rifle propellant prized by 1920s and 1930s National Match .30-06 competitors for its clean ignition and tight velocity uniformity.[5] In 1933, Hercules released **Hercules 2400**, a fine-grained double-base propellant engineered specifically for the new high-velocity .22 Hornet small-bore bottleneck cartridge—named for the approximate muzzle velocity it achieved with standard .22 Hornet bullets—though it later became equally famous in magnum handguns.[5]

DuPont's MR and IMR revolutions

While Hercules leaned on double-base energetics, DuPont transformed bottleneck rifle ballistics through surface-engineered single-base chemistry.

Military Rifle (MR) to Improved Military Rifle (IMR)

DuPont initially adapted its Pyro DG technology for commercial sporting and match handloaders as the **Military Rifle (MR)** series—including MR No. 20 (essentially commercial Pyro DG) and MR No. 21—beginning around 1909.[5] Uncoated single-perforated tubes burned neutrally, maintaining nearly constant surface area from ignition to burnout (see Chapter 3). That profile worked well in straight-walled and moderate bottleneck cases, but it left velocity on the table in high-capacity bottleneck cartridges where a slower initial pressure rise followed by sustained acceleration down the bore would raise muzzle velocity without exceeding safe chamber pressure.

DuPont chemists solved that problem in the mid-1910s by tumbling single-base extruded nitrocellulose grains in a surface-deterrent coating of **dinitrotoluene (DNT)** (and later tin-based anti-fouling additives in select wartime lots).[6] Because DNT burns cooler and slower than pure nitrocellulose, the coated outer skin throttled early gas generation while the bullet began moving down the throat. Once combustion burned through the deterred surface layer into the faster-burning core, the powder released energy progressively into the expanding bore volume behind the accelerating bullet.

DuPont branded these progressive single-base extrusions **Improved Military Rifle (IMR)**. Early two-digit and fractional designations—**IMR 15**, **IMR 15½**, **IMR 16**, **IMR 17½**, **IMR 18**, and the World War I heavy-bullet military propellant **IMR 1185**—pushed .30-06 and sporting-rifle velocities to unprecedented levels without returning to the throat erosion of high-nitroglycerin double-base cords.[3]

The 1930s four-digit classics

Between 1934 and 1935, DuPont overhauled its commercial canister lineup, replacing the older two-digit IMR grades with a cleaner, more stable, and tightly graded series of

four-digit laboratory specification numbers (see Chapter 8).[5] Five introductions from that two-year span proved so chemically sound and ballistically versatile that four of them remain in production nearly a century later:

- **IMR 3031 (1934):** Introduced to replace IMR 17½ for medium-capacity cartridges such as the .30-30 Winchester, .257 Roberts, and .300 Savage, combining progressive DNT-coated tubular geometry with clean burning.[5]
- **IMR 4064 (1935):** A slower, longer-grained single-base extrusion that rapidly became the benchmark commercial powder for the .30-06 Springfield, .250-3000 Savage, and .220 Swift.[5]
- **IMR 4198 (1935):** A fast-burning tubular rifle powder tailored for small-capacity bottleneck cartridges like the .222-class precursors, .25-20, and .32-20, later becoming a staple in the .222 Remington and .223 Remington.[5]
- **IMR 4227 (1935):** The fastest of the 1935 IMR rifle line, bridging small bottleneck cartridges like the .22 Hornet and .218 Bee with large magnum handgun cases.[5]
- **IMR 4320 (1935):** A shorter-cut counterpart sitting close to IMR 4064 in burn rate, formulated to meter more smoothly through mechanical powder measures while serving .30-06 and mid-capacity hunting rounds.[5]

With those five powders, DuPont created a continuous, well-spaced burn-rate ladder spanning nearly the entire pre-World War II bottleneck rifle spectrum.

Early European state and industrial factories

Across northern Europe, national defense needs during the interwar period created two specialized propellant ecosystems that would later dominate international precision shooting.

Finland: Vihtavuori (founded 1922)

Following Finnish independence in 1917, the young republic needed domestic propellant independence for its defense forces. In **1922**, the Finnish government established the State Powder Factory (*Valtion Ruutitehdas*) in the forested region of **Vihtavuori** in Laukaa, central Finland.[7] After constructing acid, nitration, and extrusion lines from the ground up, the plant began commercial and military smokeless powder production in **1926**.[7]

Vihtavuori's earliest small-arms mission was producing clean-burning, single-base tubular nitrocellulose propellants for Finland's 7.62×53R Mosin-Nagant service rifles—formulations engineered to burn consistently in sub-arctic winter combat. That interwar 7.62×53R tubular propellant became the direct chemical ancestor of **Vihtavuori N140**, one of the longest-lived and most respected match rifle powders in the world.[7]

Sweden: Bofors Nobelkrut and Norma

In Karlskoga, Sweden, **AB Bofors' Nobelkrut**—founded in 1898 with Alfred Nobel's direct financial and technical backing—developed deep expertise in both single-base nitrocellulose and nitroglycerin-bearing double-base propellants.[8] Working alongside **Norma Projektilfabrik** (established in 1902 and soon centered in Åmotfors, Sweden), Bofors supplied smokeless rifle propellants for Sweden's 6.5×55mm Swedish Mauser service and target-shooting community.[9] That Scandinavian emphasis on tight chemical lot

control and cold-weather ballistic stability set the institutional template for both Norma's post-war commercial rifle powders and the Bofors-manufactured Alliant Reloder series decades later.

Year	Milestone / Propellant	Maker / Origin	Chemical Class	Historical Role
1884	Poudre B	Paul Vieille (France)	Single-base NC flake	First military smokeless propellant (8×50mmR Lebel)
1887	Ballistite	Alfred Nobel (Sweden/Italy)	Double-base NC/NG sheet	First solventless double-base smokeless propellant
1889	Cordite (MD in 1901)	Abel & Dewar (Britain)	Double-base NC/NG extruded cord	.303 British service propellant; exposed NG throat erosion
1898/1904	Bullseye	Laflin & Rand / Hercules (USA)	Double-base flake	Early commercial pistol milestone sharing rifle plant roots
1908–1909	Pyro DG	U.S. Ordnance / DuPont (USA)	Single-base NC (DPA, graphite)	Replaced erosive double-base in .30-06 Springfield
1914–1918	IMR 15, 16, 17½, 1185	DuPont (USA)	Single-base NC (DNT-deterred)	First progressive surface-deterred rifle extrusions
1922 / 1926	Vihtavuori factory & 7.62×53R line	State Powder Factory (Finland)	Single-base NC tubular	Founding of Vihtavuori; ancestor of N140
1933	Hercules 2400	Hercules Powder Co. (USA)	Double-base extruded/flake	Small-bore bottleneck (.22 Hornet) & magnum crossover
1934–1935	IMR 3031, 4064, 4198, 4227, 4320	DuPont (USA)	Single-base NC (DNT-deterred)	Four-digit commercial bottleneck standards

Chapter 5

World War II and the Post-War Surplus Era (1940–1969)

Key points

- World War II drove massive industrial production of IMR 4895 for the gas-operated M1 Garand and introduced IMR 4350 (1940) for slow-burning magnum and hunting cartridges.
- Bruce Hodgdon launched the modern civilian surplus-powder market with 50,000 lb of WWII 4895 in 1947, 80 tons of .303 British ball powder as BL-C in 1949 (replaced by newly made BL-C(2) in 1961), and WWII DuPont 20mm cannon powder as H4831 in 1950.
- Fred Olsen's Olin Ball Powder water-slurry process scaled during WWII and Cold War NATO contracts, creating WC 846 (7.62mm NATO) and WC 844 (5.56mm NATO) along with commercial staples BL-C(2), H335, W748, and W760/H414.
- As WWII surplus stocks depleted in the late 1950s and 1960s, Hodgdon transitioned from a surplus broker into a commercial packager contracting Olin and overseas extruded plants, permanently decoupling brand names from factory ownership.

Wartime bottleneck standards: IMR 4350 and IMR 4895

The onset of World War II pushed smokeless rifle propellant manufacturing from specialized batch chemistry into continental-scale industrial production. Two DuPont formulations defined the era for bottleneck riflemen: one built for high-expansion-ratio sporting cartridges on the eve of war, and one built to feed millions of semi-automatic infantry rifles.

IMR 4350 (1940)

In **1940**, DuPont released **IMR 4350**, its slowest commercial single-base rifle propellant to date.[1] Designed with thicker web dimensions and heavier surface deterrence than IMR 4064, IMR 4350 unlocked the ballistic potential of overbore hunting cartridges such as the .270 Winchester, .300 H&H Magnum, and .257 Roberts—and later became the gold standard for the .243 Winchester and 6.5mm-class cases. Its commercial success was so enduring that three rival packagers eventually named their own distinct powders `4350` to signal burn-rate territory (see Chapter 8).

IMR 4895 and the gas-system constraint

World War II also reshaped military small-arms propellant tolerances through the U.S. **M1 Garand** semi-automatic rifle. Unlike bolt-action rifles, which tolerated modest burn-rate drift so long as peak chamber pressure stayed safe, the Garand's gas port near the muzzle required a tightly controlled pressure curve at the forward end of the barrel. Powder that burned too slowly raised port pressure and risked bending the operating rod; powder that burned too fast under-gassed the action in freezing weather.[2]

IMR 4895—a medium-burning, single-base extruded nitrocellulose propellant coated with DNT—became the signature wartime propellant for .30-06 M2 Ball ammunition.[2] To meet wartime volume, DuPont and government-owned contractor-operated (GOCO) plants such as the Hercules-operated Radford Ordnance Works in Virginia produced tens of millions of

pounds of 4895 across hundreds of military lots.[2] Because wartime blending aimed at matching ammunition velocity and port pressure in specific factory brass and bullets rather than strict canister-to-canister uniformity, individual surplus lots varied noticeably in burn rate—a fact that would soon educate an entire generation of post-war American handloaders.

Bruce Hodgdon and the post-war surplus revolution

Before 1947, commercial handloading in the United States was a relatively costly niche supplied mainly by small, high-priced canisters from DuPont and Hercules. Victory in 1945 left the U.S. government sitting on mountainous stockpiles of surplus small-arms and cannon propellants slated for open-pit burning or ocean dumping.

1947: 50,000 pounds of surplus 4895

In **1947**, Brewster Eltinge "Bruce" Hodgdon—a World War II Navy veteran, salesman, and avid Kansas rifleman—bought **50,000 pounds** of WWII surplus **4895** .30-06 propellant from government liquidation.[3] Working initially with his wife Amy and sons J.B. and Bob out of Kansas, Hodgdon packaged the surplus propellant into inexpensive mail-order containers and sold it directly to handloaders as **H4895** at roughly one-third the price of commercial DuPont canisters.[3]

Because wartime lots varied slightly in burn rate, Hodgdon tested and published lot-specific data for his customers, turning low-cost military surplus into a practical, approachable foundation for mass-market American reloading.[3]

1949: BL-C and the road to BL-C(2)

In **1949**, Hodgdon expanded into spherical propellants by purchasing **80 tons** of WWII surplus **.303 British** Olin Ball Powder, marketing it to civilian shooters as **BL-C** ("Ball Powder, Lot C").[3] Handloaders immediately prized BL-C's fluid, uniform metering through mechanical powder measures and its strong performance in mid-capacity bottleneck cartridges such as the .222 Remington, .308 Winchester, and .30-06. When the wartime BL-C stockpile finally ran dry, Hodgdon contracted Olin to manufacture a fresh, canister-grade commercial successor—introducing **BL-C(2)** in **1961**, a propellant that remains in production more than six decades later.[3]

1950: H4831 and the 20mm Oerlikon cannon salvage

Hodgdon's most consequential surplus acquisition arrived in **1950**.[3] During World War II, **DuPont** had manufactured large quantities of a slow-burning, single-base extruded nitrocellulose propellant—designated **IMR 4831** in wartime ordnance records—for **20mm Oerlikon anti-aircraft cannon** ammunition.[3] Rather than letting the leftover cannon powder be destroyed, Bruce Hodgdon purchased the DuPont surplus and introduced it to civilian riflemen as **H4831**.[3]

(Historical accounts occasionally misattribute H4831's origin to a 1941 or 1947 Australian design at Mulwala. In fact, H4831 began in 1950 strictly as salvaged WWII DuPont 20mm cannon propellant; newly manufactured H4831 moved first to Scotland and only much later to ADI Mulwala in Australia.)

H4831 filled a void no commercial canister powder had touched. It burned significantly slower than IMR 4350, allowing wildcatters and factory cartridge designers to drive heavy-for-caliber bullets in overbore bottleneck cases—most famously the .270 Winchester, .25-06 wildcat (standardized by Remington in 1969), .264 Winchester Magnum, and 7mm Remington Magnum—with mild pressures and remarkable accuracy.[3] Demand for H4831 became so overwhelming that DuPont itself eventually launched a newly manufactured commercial **IMR 4831** in 1973, formulated to a slightly faster burn rate than Hodgdon's H4831—cementing one of the most famous naming divergences in rifle history (see Chapter 8).[3]

The Olin Ball Powder revolution

While surplus extruded propellants reshaped the civilian reloading bench, a completely different manufacturing technology was transforming military ammunition plants and, by extension, commercial rifle canisters.

Fred Olsen's water-slurry process

In **1933**, Dr. Fredrich ("Fred") Olsen—a former Picatinny Arsenal chemist working for Western Cartridge Company (soon Olin Industries) in **East Alton, Illinois**—invented the **Ball Powder** manufacturing process, securing foundational U.S. Patent 2,027,114 in 1936.[4] Instead of laboriously pressing colloided nitrocellulose dough through heavy hydraulic extrusion dies and drying the grains in hazardous air ovens for days, Olsen dissolved nitrocellulose (including aged military surplus powder) in ethyl acetate inside a warm water bath, emulsified the lacquer into suspended droplets, and distilled off the solvent under water to harden the droplets into dense microscopic spheres.[5]

The industrial advantages were immense (see Chapter 2). Water-bath processing slashed fire risk, shortened production cycles from days to hours, allowed precise tuning of burn rate by rolling spheres into flattened oblate spheroids and impregnating them with nitroglycerin and dibutyl phthalate (DBP) deterrents, and yielded a high-bulk-density powder that flowed like liquid through high-speed military loading machines.[4]

Scaled rapidly during World War II for U.S. .30 Carbine and British Lend-Lease .303 ammunition, Olin's East Alton plant ran at capacity into the Cold War.[6] As suburban growth closed in around East Alton in the late 1960s, Olin built a dedicated, modern Ball Powder complex on forested coastal land in **St. Marks, Florida**—completing construction in **1969** and entering full production in **1970**.[6]

Cold War NATO military propellants and commercial descendants

Olin's spherical technology anchored both standard NATO small-arms rifle cartridges of the Cold War, and each military specification spawned enduring civilian canister staples:

- **WC 846 (7.62×51mm NATO):** Developed for M80 Ball ammunition in the M14 rifle and M60 machine gun, this double-base flattened ball propellant formed the technological baseline for both Hodgdon's newly manufactured **BL-C(2)** (1961) and Winchester's commercial **Winchester 748**.[7]

- **WC 844 (5.56×45mm NATO):** A slightly faster spherical propellant standardized for M193 (and later M855) 5.56mm service ammunition, closely paralleled on the commercial market by **Hodgdon H335**.[6]
- **Winchester 760 and Hodgdon H414:** Slower-burning, heavily deterred double-base spherical rifle powders engineered for .243 Winchester, .270 Winchester, and .30-06-class hunting loads. Sharing the same St. Marks/Olin spherical lineage, W760 and H414 gave handloaders a clean-metering spherical alternative in the 4350 burn-rate bracket (see Chapter 10).[6]
- **Hodgdon H380:** Entering Hodgdon's spherical catalog during the 1950s, H380 bridged the gap between W748 and W760, gaining wide adoption in high-velocity mid-bore varmint cartridges such as the .22-250 Remington.[3]

The Vietnam-era M16 propellant controversy

The transition from extruded to spherical propellants in military service did not occur without severe growing pains. When the U.S. Army fielded the 5.56mm M16 rifle in Vietnam in the mid-1960s, the cartridge had originally been developed around DuPont's single-base extruded **IMR 4475**.[8] When DuPont could not meet updated military pressure-velocity specs at wartime volume, Army ordnance switched 5.56mm loading contracts to Olin's double-base spherical **WC 846** (and subsequently the cleaner-tailored **WC 844**).[8]

Compared with IMR 4475, the early WC 846 ball propellant generated higher gas-port pressure in the M16's direct-impingement system—raising cyclic rate—and contained higher levels of calcium carbonate stabilizer/neutralizer that contributed to chamber and gas-tube fouling in unchromed chambers.[8] Congressional investigations led to chrome-plated chambers, heavier buffers, cleaner propellant specifications (WC 844 with reduced calcium carbonate), and proper maintenance kits.[8] The episode underscored a lasting engineering lesson: in gas-operated bottleneck rifles, propellant burn-rate profile and residue chemistry must be matched to the rifle system as a whole.

From salvaged surplus to purpose-built commercial contracts

By the end of the 1960s, the golden age of cheap WWII surplus powder was drawing to a close. Military stockpiles of wartime 4895, BL-C, and 20mm 4831 were dwindling, and shooters who had built decades of rifle loads around Hodgdon's designations expected continuous, consistent supply.

Rather than closing shop, Hodgdon pioneered a business model that now defines much of the commercial reloading industry: the **marketing and specification packager** operating without owning a primary nitration plant. For spherical propellants (`BL-C(2)`, `H335`, `H380`, `H414`), Hodgdon contracted directly with Olin.[3] For newly manufactured extruded replacements—specifically **H4831** and **H4895**—Hodgdon turned across the Atlantic to **ICI / Nobel** in Ardeer, Scotland, contracting fresh single-base extruded production formulated to match the beloved burn-rate profiles of the original WWII surplus lots.[3]

At the same time, European commercial makers began widening their American footprint. Sweden's **Norma** introduced its Bofors-manufactured **200-series** rifle propellants (`200`, `201`, `202`, `204`) to U.S. handloaders during the 1950s and 1960s, while **Hercules** launched its commercial **Reloder** rifle series (`Reloder 7`, `11`, and `21`) in the mid-1960s.[9] The stage was

set for a globalized, competitive canister market in which shooters would soon demand far tighter consistency than wartime surplus had ever offered.

Year	Milestone / Propellant	Origin / OEM	Chemical Class	Historical Significance
1933 / 1936	Olin Ball Powder patent	Fred Olsen / Western Cartridge (East Alton, IL)	Double-base spherical	Water-slurry spherical process; transformed military & civilian production
1940	IMR 4350	DuPont (USA)	Single-base extruded (DNT)	First commercial slow magnum/overbore rifle benchmark
1941–1945	IMR 4895	DuPont / Radford GOCO (USA)	Single-base extruded (DNT)	WWII M1 Garand .30-06 workhorse; strict port-pressure control
1947	Hodgdon H4895	Bruce Hodgdon (WWII surplus)	Single-base extruded	50,000 lb surplus purchase; founded Hodgdon Powder Co.
1949 / 1961	Hodgdon BL-C → BL-C(2)	WWII .303 surplus → Olin (USA)	Double-base spherical	80 tons surplus ball powder; replaced by newly made BL-C(2) in 1961
1950	Hodgdon H4831	Bruce Hodgdon (WWII DuPont 20mm surplus)	Single-base extruded	Salvaged Oerlikon cannon powder; catalyzed magnum rifle era
1960s	WC 844 / WC 846 → H335, W748, W760/H414	Olin (East Alton → St. Marks, FL)	Double-base spherical	Cold War 5.56mm/7.62mm NATO propellants & commercial staples
1969–1970	St. Marks Powder facility opens	Olin Corporation (St. Marks, FL)	Spherical ball plant	Replaced East Alton; still primary U.S. spherical rifle plant

The Precision and Temperature-Insensitive Era (1970–2005)

Key points

- Organized benchrest, Palma, High Power, and F-Class competition exposed two major limits of mid-century propellants: velocity drift across ambient temperature swings and uneven metering from long tubular grains.
- Hodgdon partnered with Australia's Thales/ADI Mulwala plant to launch the temperature-insensitive Extreme extruded line, opening with **Varget** (`AR2208`) in 1995 and expanding to **H4350** (`AR2209`), **H4831/H4831SC** (`AR2213`/`AR2213SC`), **H1000** (`AR2217`), and **Retumbo** (`AR2225`).
- Finland's Vihtavuori rose to global prominence with clean-burning single-base **N100** staples (notably **N133** in 6mm PPC benchrest) before introducing nitroglycerin-infused **N500** high-energy propellants in the 1990s.
- Sweden's Bofors supplied both Norma's **200-series / MRP** and Alliant's **Reloder 15 / 19 / 22 / 25** lines, while Belgium's **PB Clermont** and the Czech Republic's **Explosia** expanded into North American canisters through Ramshot and Accurate.
- Hodgdon's acquisition of **IMR (2003)** and the **Winchester** powder marketing license **(2005)** began a historic consolidation of North American retail brands.

Precision competition exposes thermal and metering limits

Between 1970 and 2005, precision rifle shooting matured from an informal pastime into an exacting instrument discipline. The introduction of the **6mm PPC** in 1974–1975 revolutionized short-range benchrest accuracy, while international Palma (long-range .308 Winchester), NRA High Power Service Rifle, and the emerging F-Class discipline pushed practical rifle competition out to 1,000 yards.

As electronic chronographs entered widespread civilian use during the 1970s and 1980s, shooters gained objective data on what had previously been blamed on barrels or wind. Two propellant shortcomings stood out immediately:

1. **Ambient temperature sensitivity.** A match load tuned in mild spring air frequently climbed into unsafe pressure signs during midsummer tournaments or dropped enough velocity in winter matches to miss vertical elevation targets at 1,000 yards (see Chapter 3). Traditional double-base spherical powders often showed steeper velocity-versus-temperature slopes than well-deterred single-base extrusions, though deterrent chemistry, ignition strength, and loading density also influenced thermal drift.
2. **Grain geometry and metering uniformity.** Classic long-cut single-base tubular propellants—such as traditional IMR 4064, IMR 4350, and long-grain H4831—bridged in small bottleneck necks and sheared unevenly inside rotary powder measures, forcing competitive shooters to trickle individual charges slowly by hand.

Solving both problems simultaneously—preserving or improving thermal stability while shortening grain length for smooth metering—became the central engineering race of the era.

The Australian connection: ADI Mulwala and Hodgdon's Extreme line

The decisive breakthrough in commercial temperature-insensitive propellants came from rural New South Wales, Australia. Established by the Australian government in **1943** during World War II to supply Allied small-arms and artillery ammunition, the **Mulwala Explosives Factory** evolved into **Australian Defence Industries (ADI Limited)** and later **Thales Australia / Australian Munitions**.[1] Because Australian defense forces operated across scorching outback summers and cool southern winters, Mulwala's propellant chemists focused heavily on single-base extruded formulations with specialized deterrent and surface-coating chemistry engineered to flatten burn-rate response across wide ambient temperature bands.[2]

1995: Varget and the Extreme revolution

Hodgdon had begun sourcing extruded propellants from ADI Mulwala to replace Scottish ICI/Nobel supply lines and expand its catalog with tighter lot control. In **1995**, Hodgdon launched **Varget** (manufactured at Mulwala as **ADI AR2208**), the first propellant explicitly engineered and marketed under Hodgdon's **Extreme** banner for thermal stability.[3]

Positioned right in the heart of the medium-rifle burn-rate zone—serving heavy-bullet .223 Remington, .308 Winchester, 6mm BR, and mid-capacity match cartridges—Varget combined short, uniform single-base cylindrical grains with remarkably flat velocity behavior from freezing cold to summer heat. Its adoption across Palma, Service Rifle, F-Class, and tactical precision shooting permanently altered market expectations: temperature insensitivity moved from an obscure military requirement to the primary buying criterion for serious riflemen.

Expanding the ADI Extreme family

Through the late 1990s and early 2000s, Hodgdon built an entire bottleneck spectrum around ADI Mulwala's `AR22xx` and `BM` (Bench Mark) extrusions.[4] Every major Extreme canister mapped directly to an Australian factory code—mappings that remain essential for historical clarity, though lot variance and independent packaging still preclude blind grain-for-grain substitution without consulting current data for the exact canister in hand (see Chapter 10):[4]

- **H4198** (`AR2207`), **H322** (`AR2219`), and **Benchmark** (`BM2`) anchored small-bore, varmint, and benchrest cartridges.
- **H4895** (`AR2206H`) modernized Bruce Hodgdon's original 1947 flagship into a temperature-stabilized short-cut extrusion.
- **H4350** (`AR2209`) emerged as the dominant mid-bore precision propellant of the early twenty-first century, especially as 6mm and 6.5mm match cartridges gained popularity.

- **H4831** (AR2213) and its shorter-cut metering twin **H4831SC** (AR2213SC) completed H4831's remarkable three-plant historical odyssey—from WWII DuPont 20mm Oerlikon surplus (1950), to ICI/Nobel in Scotland, and finally to ADI Mulwala in Australia.[3]
- **H1000** (AR2217) and **Retumbo** (AR2225) extended the Extreme single-base architecture into overbore magnums such as the .300 Winchester Magnum, 7mm Remington Ultra Magnum, and .338 Lapua Magnum. *(Note the exact factory codes: **AR2217** is **H1000**, and **AR2225** is **Retumbo**—a pairing frequently swapped in informal internet cross-reference tables.)*[4]

IMR's transition and Hodgdon's 2003–2005 brand consolidation

Meanwhile, DuPont's historic IMR line went through major industrial and corporate shifts. DuPont added **IMR 4831** (1973) and the slow magnum powder **IMR 7828** (1985, later joined by short-cut **IMR 7828 SSC**) while gradually divesting its commercial sporting-powder business.[5] IMR extruded manufacturing consolidated north of the border at the former Canadian Industries Limited (CIL) / Expro facility in **Valleyfield, Quebec**—today **General Dynamics Ordnance and Tactical Systems – Canada (GD-OTS Canada)** (see Chapter 9).

In **2003**, **Hodgdon Powder Company** acquired the **IMR** brand outright, reuniting the rival 4895, 4350, and 4831 names under one corporate umbrella while preserving their separate manufacturing plants (Mulwala for Hodgdon Extreme, Valleyfield for traditional IMR).[5] Two years later, in **2005**, Hodgdon secured the exclusive license to market **Winchester** smokeless reloading propellants (manufactured at St. Marks Powder in Florida, which Olin had sold to General Dynamics in 1996).[6] Within two years, the former Kansas surplus dealer had become the dominant commercial marketer of North American reloading propellants.

Scandinavian precision: Vihtavuori and Bofors

While Australia transformed American thermal-stability expectations, Finland and Sweden built an unmatched reputation for chemical purity, clean burning, and high-energy rifle chemistry.

Vihtavuori: N100 purity and the N500 high-energy launch

By the 1970s and 1980s, Finland's **Vihtavuori** plant had expanded aggressively into civilian sporting exports, earning worldwide acclaim for its single-base **N100 series**.[7] Produced from carefully refined nitrocellulose with strict moisture and solvent recovery controls, N100 powders burned notably cleaner than most legacy American extrusions.

In short-range benchrest competition, **Vihtavuori N133** became virtually synonymous with the 6mm PPC cartridge, winning national and world championships for decades on the strength of tight velocity spreads and clean-burning consistency.[7] Across mid-bore and magnum target shooting, **N140**, **N150**, **N160**, and **N165** established a clean, cool-burning, single-base standard favored across Europe and North America alike.[8]

In the 1990s, Vihtavuori introduced a major chemical departure: the **N500 high-energy series**—opening with staples such as **N540**, **N550**, and **N560** (later joined by **N530**).[9] By infusing nitroglycerin into extruded nitrocellulose grains, Vihtavuori increased specific energy density (heat of explosion, Qex), allowing handloaders to achieve higher muzzle velocities in high-capacity bottleneck cartridges without raising peak chamber pressure.[9]

The physics carried an honest engineering tradeoff: higher energy density brought higher flame temperatures and faster barrel throat wear than cooler-burning N100 counterparts (see Chapter 3). Shooters could now choose deliberately between N100 barrel longevity and N500 peak velocity.

Bofors, Norma, and Alliant Reloder

In Sweden, **Bofors AB** (Karlskoga, later **Eurenco Bofors AB**) became the quiet engine behind two of the world's most respected rifle propellant lines.[10] For domestic and international hunting and target shooters, Bofors manufactured **Norma's** commercial rifle lineup—the **200-series** (`200`, `201`, `202`, `203-B`, `204`) and the iconic magnum propellant **Norma MRP** (Magnum Rifle Powder).[11]

In the United States, Hercules' aerospace and sporting-powder division became **Alliant Techsystems (ATK)** in 1995, marketing its commercial propellants under the **Alliant Powder** name.[12] Alliant contracted Bofors in Karlskoga to manufacture its modern extruded **Reloder** rifle family: **Reloder 7**, **Reloder 10x**, **Reloder 15**, **Reloder 19**, **Reloder 22**, and **Reloder 25**.[12]

Reloder 15 earned particular fame when the U.S. military selected it for **M118LR** 7.62×51mm long-range match ammunition and **Mk 262** 5.56×45mm precision ammunition, validating Swedish double-base extruded chemistry in both military sniper systems and civilian Service Rifle matches.[12] Because Norma and Alliant sourced overlapping burn-rate classes from the same Karlskoga plant—such as Norma 203-B alongside Reloder 15, Norma 204 alongside Reloder 19, and Norma MRP alongside Reloder 22—shooters frequently treated them as identical twins. In reality, each packager maintained its own lot specifications and acceptance tolerances, meaning close Swedish counterparts still required independent published load data rather than blind 1:1 charge substitution (see Chapter 10).

Belgian and Czech commercial expansion

The final quarter of the twentieth century also brought two major continental European OEM plants into mainstream North American rifle canisters.

PB Clermont, Accurate Arms, and Western Powders' Ramshot

In **1952**, **PB Clermont** established a spherical propellant facility in **Engis, Belgium**, originally licensing Olin's Ball Powder technology to supply European NATO defense contracts.[13] Later integrated into France's SNPE group (and today part of **Eurenco**), PB Clermont refined rolled spherical ball propellants known for uniform grain sizing, high bulk density, and smooth metering.[13]

In the United States, **Accurate Arms**—founded in **1980** in McEwen, Tennessee—built its commercial catalog by sourcing high-quality military-spec surplus and newly manufactured propellants from overseas factories, including Israel Military Industries (IMI), Belgium's PB Clermont, and the Czech Republic's Explosia. In **1999**, Montana-based **Western Powders** launched the **Ramshot** brand as a dedicated U.S. commercial showcase for PB Clermont's Belgian spherical rifle propellants: **TAC**, **X-Terminator**, **Big Game**, **Hunter**, and **Magnum**.[13]

Western Powders acquired **Accurate Arms** in **2004**, consolidating both lines under one roof. Under Western Powders, PB Clermont supplied both Ramshot and key Accurate spherical rifle powders (`2230`, `2460`, `2520`)—with **Ramshot X-Terminator** serving as the direct Belgian counterpart to **Accurate 2230** (while **Ramshot TAC** sat slightly slower alongside `2460` and `2520`).[13]

Explosia / Lovex enters the Western canister market

Following the end of the Cold War, **Explosia a.s.** of **Pardubice-Semtín, Czech Republic**—one of Central Europe's oldest energetic-materials complexes—opened its **Lovex** commercial propellant lines (`S` for single-base extrusions, `D` for double-base formulations) to Western export markets.[14] Explosia supplied early extruded rifle propellants for Accurate Arms (including Czech-made lots of `2015`, `2495`, `4064`, and `4350` before Western Powders later moved several of those extruded lines to GD-OTS Canada in Valleyfield to Accurate's own specifications), laying the groundwork for Lovex's eventual U.S. rebranding under Shooters World in the following decade.[14]

Year	Milestone / Propellant	Maker / OEM	Chemical Class	Significance
1973 / 1985	IMR 4831 & IMR 7828	DuPont / Valleyfield (USA/Canada)	Single-base extruded	Commercial IMR magnum responses to H4831
1980	Accurate Arms founded	Accurate Arms (TN; overseas OEMs)	Mixed spherical & extruded	Imported IMI, PB Clermont & Explosia rifle powders
1980s–1990s	Vihtavuori N133 & N100 rise	Vihtavuori (Finland)	Single-base extruded	Clean-burning 6mm PPC benchrest & target benchmark
1990s	Vihtavuori N500 series (`N540`, `N550`, `N560`)	Vihtavuori (Finland)	High-energy NG-infused extruded	Higher velocity / Qex with throat-wear tradeoff
1995	Hodgdon Varget (`AR2208`)	Thales / ADI Mulwala (Australia)	Single-base extruded (Extreme)	First flagship temperature-insensitive canister powder
1995	Alliant Powder (ex-Hercules)	ATK / Bofors (Karlskoga, Sweden)	Double-base extruded	Expanded Bofors-made Reloder 15 / 19 / 22 / 25
1995–2005	Extreme expansion (`H4350`, `H4831SC`, `H1000`, `Retumbo`)	Thales / ADI Mulwala (Australia)	Single-base extruded (Extreme)	`AR2209`, `AR2213SC`, `AR2217` (H1000), `AR2225` (Retumbo)
1999 / 2004	Ramshot launch & Accurate acquisition	Western Powders / PB Clermont (Belgium)	Double-base spherical	Brought Belgian `TAC`, `X-Terminator`, `Big Game`, `Hunter` to U.S.
2003 / 2005	Hodgdon acquires IMR & Winchester license	Hodgdon Powder Company (USA)	Commercial packager	Consolidated IMR, Winchester, and Hodgdon brands

Chapter 7

High-Efficiency, REACH, and Extreme Long Range (2006–Present)

Key points

- Two distinct European technologies redefined modern extruded rifle powders: **Nitrochemie EI®** (Switzerland/Germany) in Reloder 17 (2008), Reloder 26/33/50, and Reload Swiss (2013), and **Eurenco Bofors TZ®** (Sweden) in AR-Comp (2011), Reloder 23 (2014), Reloder 16 (2016), and Reloder TS 15.5 (2021).
- Decoppering chemistry and thermally stabilized spherical propellants transformed U.S. ball powders, from **Hodgdon CFE 223** (2012) to **Winchester StaBALL 6.5** (announced late 2019, retail 2020) and **StaBALL Match / HD** (January 2023).
- Extreme Long Range (ELR) and modern match cartridges drove specialized Vihtavuori releases—**N570** (2010), **N565** (2018), **N555** (2020), and **N568** (2021)—alongside ADI's **IMR 8208 XBR** (2010).
- **EU REACH** enforcement against **2,4-DNT** and **DBP** (~2018) halted European Union imports of ADI/Hodgdon Extreme and legacy IMR powders, while leaving U.S. and Australian markets unaffected.
- Supply-chain shocks—including the **2015 IMR 4007 SSC** and **2019 Valleyfield Accurate 2495/4064/4350** stability recalls, the **August 2022 discontinuation of IMR Enduron**, Hodgdon's **2020 acquisition of Western Powders**, and post-2020 defense procurement surges—remade global canister availability.

High-energy impregnated and temperature-stabilized extrusions

Entering the late 2000s, precision riflemen wanted a seemingly contradictory combination of traits: the high muzzle velocity of nitroglycerin-boosted propellants, the flat thermal curve of Australian single-base extrusions, clean copper-free barrels, and compliance with tightening European chemical regulations. Two European defense manufacturers answered with radically different—and frequently confused—proprietary processes.

Nitrochemie EI®: Reloder 17, Reloder 26/33/50, and Reload Swiss

In Switzerland and Germany, **Nitrochemie** (Nitrochemie Wimmis AG and Nitrochemie Aschau GmbH, a joint venture of Rheinmetall and RUAG) developed **EI® (Extrusion Impregnation)** technology.[1] Rather than applying a thin surface retardant only to the outside skin of a finished grain, Nitrochemie's EI® process impregnates nitroglycerin and burn-rate-moderating deterrents deep into the extruded nitrocellulose matrix along a controlled radial gradient (see Chapter 2).[1] That radial gradient broadens the pressure plateau, allowing a rifle cartridge to sustain higher average pressure during bullet travel without exceeding peak chamber limits.

The technology debuted in North American canisters in **2008** as **Alliant Reloder 17**, immediately demonstrating notable velocity gains over traditional single-base propellants in short magnums and mid-bore match cartridges.[2] Alliant soon partnered with Nitrochemie to extend the EI® family into high-capacity magnums and extreme long-range

cartridges with **Reloder 26**, **Reloder 33**, and **Reloder 50** (for .50 BMG and heavy ELR wildcats).[3]

Seeing strong civilian demand for its chemistry, Nitrochemie launched its own direct retail brand—**Reload Swiss**—in **2013**.[1] Organized on a clean numeric burn-rate ladder (`RS36` through `RS80` for bottleneck rifles), Reload Swiss gave European and international handloaders direct access to both EI®-impregnated formulations (such as **RS60**, the direct Swiss counterpart to Reloder 17, alongside **RS52** and **RS70**) and cooler-burning single-base companions (`RS50`, `RS62`).[1]

Eurenco Bofors TZ®: AR-Comp, Reloder 23, Reloder 16, and TS 15.5

Independently in **Karlskoga, Sweden**, **Eurenco Bofors AB** developed **TZ® (Temperature Zone)** technology—a separate Swedish chemical-stabilization architecture engineered to eliminate thermal velocity drift across extreme temperatures while removing restricted DNT and DBP additives and incorporating decoppering compounds.[4]

(Industry discussions frequently misattribute TZ® powders to Switzerland's Nitrochemie. In fact, TZ® is a registered trademark of Sweden's Eurenco Bofors AB, whereas EI® belongs to Nitrochemie.)

Alliant deployed Bofors TZ® chemistry across four major rifle introductions over a single decade:

- **AR-Comp (2011):** A clean-burning, thermally stabilized medium-speed powder tailored for gas-operated .223/5.56mm and .308/7.62mm rifles.[3]
- **Reloder 23 (announced 2014; retail 2014–2015):** A magnum-class successor in the Reloder 22 burn-rate zone engineered to cure the thermal sensitivity of older double-base magnum powders while reducing copper fouling.[3]
- **Reloder 16 (2016):** Launched at the 2016 SHOT Show directly into the fiercely contested 4350 burn-rate bracket, quickly becoming a favorite for 6.5 Creedmoor, 6mm Creedmoor, and .270 Winchester competitors.[3]
- **Reloder TS 15.5 (2021):** Positioned specifically between Reloder 15 and Reloder 16 for heavy-bullet .308 Winchester, .223 Remington, and mid-bore match rifles.[3]

Decoppering additives and temperature-stable ball powders

While European factories refined high-efficiency extruded grains, American and Australian plants tackled two other persistent bottlenecks: copper jacket fouling and the historic temperature sensitivity of spherical ball propellants.

IMR 8208 XBR (2010) and Hodgdon CFE 223 (2012)

In **2010**, Hodgdon partnered again with **ADI Mulwala** (`BM8208`) to launch **IMR 8208 XBR**—a finely cut, temperature-insensitive single-base extruded powder engineered specifically for benchrest precision, .223 Remington heavy-bullet service rifles, and .308 Winchester Palma loads.[5] Despite wearing the IMR label, 8208 XBR came from Australia rather than Valleyfield, demonstrating how fully modern brand labels had decoupled from OEM geography.

Two years later, in **2012**, Hodgdon and St. Marks Powder brought military-derived decoppering chemistry into mainstream commercial canisters with **Hodgdon CFE 223**.[6] Incorporating metallic copper-fouling-eraser (CFE) additives (tin/bismuth-class compounds originally developed to curb coppering in rapid-fire military cannons), CFE 223 minimized jacket build-up inside rifled bores while retaining the high bulk density and smooth metering of a spherical powder (see Chapter 2).[6]

The Winchester StaBALL breakthrough (2019–2023)

For more than sixty years, riflemen had treated a basic engineering tradeoff as permanent: extruded powders offered superior thermal stability, while spherical ball powders offered superior metering and higher charge density at the cost of greater temperature drift.

In **October 2019** (reaching retail shelves in **2020**), Hodgdon and St. Marks Powder broke that dichotomy with **Winchester StaBALL 6.5**—the first temperature-insensitive spherical rifle propellant formulated specifically for bottleneck cartridges in the 4350 burn-rate class (such as 6.5 Creedmoor, .243 Winchester, and .270 Winchester).[7] StaBALL 6.5 combined ball-powder metering, copper-fouling reduction, and REACH-compliant chemistry without DNT or DBP.[7]

At the **January 2023** SHOT Show, Winchester expanded the stabilized spherical platform across both ends of the bottleneck spectrum, unveiling **StaBALL Match** (faster, targeting .223 Remington, .308 Winchester, and 6mm match cases) and **StaBALL HD** (slower, targeting 6.5 PRC, 7mm PRC, .300 PRC, and overbore magnums).[7]

Extreme Long Range and modern competition releases

During the 2010s and early 2020s, cartridge design shifted decisively toward high-ballistic-coefficient bullets fired from efficient, steeply shouldered cases: the 6.5 Creedmoor, 6mm Dasher, 6.5 PRC, 7mm PRC, .300 PRC, .300 Norma Magnum, .338 Lapua Magnum, and .375/.416 CheyTac. These cartridges pushed demand for slow-burning, high-density, thermally stable propellants with anti-copper additives.

Finland's **Vihtavuori** answered with a targeted modernization of its N500 high-energy family:

- **N570 (2010):** A slow, high-energy coarse extruded powder that became a defining Extreme Long Range benchmark in .300 Norma Magnum, .338 Lapua Magnum, and heavy-bullet magnums.[8]
- **N565 (2018):** Engineered specifically for military and competitive .338 Lapua Magnum and 7mm/.300 magnum loads, pairing high density with decoppering chemistry and improved thermal stability.[8]
- **N555 (2020):** Purpose-built for the 6.5 Creedmoor and mid-capacity precision cartridges, featuring low temperature sensitivity and an anti-copper agent in the 4350 burn-rate window.[8]
- **N568 (2021):** A slower-burning companion between N565 and N570 tailored for high-capacity PRC and magnum cases running heavy modern projectiles.[8]

During the same decade, **Shooters World** entered the U.S. retail canister market around 2015 as the dedicated American packager for Czech **Explosia / Lovex** propellants

(`Precision Rifle`, `Match Rifle`, `SW4350`, `Long Rifle`), expanding commercial access to Central European single-base and double-base lines.[9]

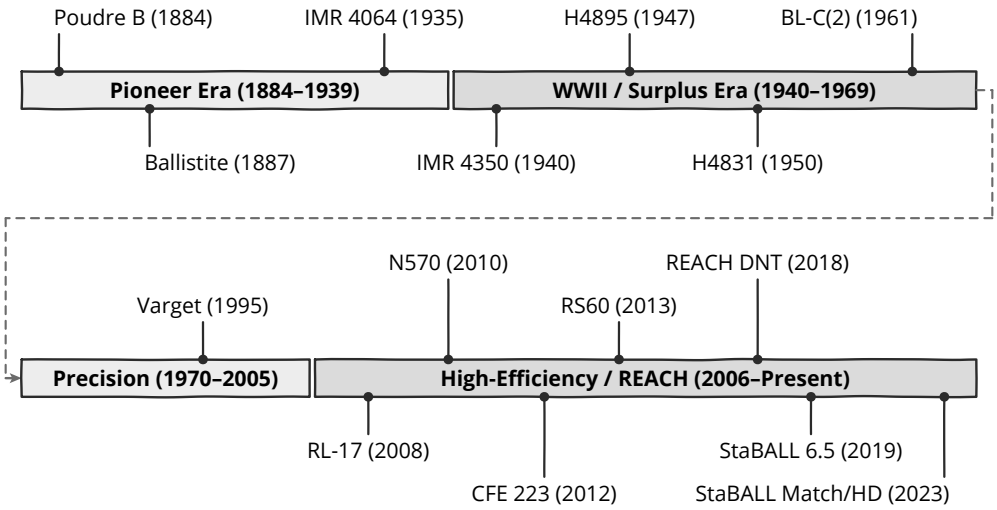


Figure 7-1. Chronological timeline of major smokeless propellant eras and landmark bottleneck rifle powder introductions from 1884 to 2025.

Regulatory, chemical-stability, and supply-chain shocks

The modern era has demonstrated that propellant history is no longer driven solely by ballistic innovation. Environmental regulation, chemical aging failures, corporate consolidation, and geopolitical defense procurement now reshape commercial powder shelves just as powerfully as chemistry.

EU REACH enforcement (2018)

Under the European Union's **REACH** (Registration, Evaluation, Authorisation and Restriction of Chemicals) framework, the European Chemicals Agency (ECHA) placed **2,4-dinitrotoluene (2,4-DNT)** and **dibutyl phthalate (DBP)**—two classic twentieth-century propellant deterrents and plasticizers—onto its Annex XIV Authorisation List as substances of very high concern.[10]

Once sunset dates and import enforcement took full effect across Europe around **2018**, commercial imports of traditional **Thales/ADI (Hodgdon Extreme)** propellants (including Varget, H4350, H4895, H4831SC, and IMR 8208 XBR) and legacy **IMR** powders were blocked from the European Union market.[10] Importantly, **North American and Australian markets remained unaffected** by EU REACH, where those propellants continued to be sold legally. Inside Europe, however, the regulatory wall accelerated a permanent migration toward REACH-compliant European propellants from **Vihtavuori**, **Reload Swiss**, **Norma**, **Eurenco Bofors TZ®**, and **Explosia/Lovex**.

The rise and 2022 discontinuation of IMR Enduron

Anticipating REACH rules and growing demand for thermally stable, decoppering extruded propellants, Hodgdon and **GD-OTS Canada (Valleyfield)** introduced the **IMR Enduron** series starting in 2015—spanning `IMR 4166`, `IMR 4451`, `IMR 4955`, `IMR 7977`, and `IMR 8133`.[11]

Formulated without DNT or DBP, Enduron combined temperature insensitivity with copper-fouling-eraser additives in a Canadian-made extruded line.

Despite technical merit, persistent supplier and manufacturing constraints—coupled with product-line streamlining as Winchester StaBALL expanded—led Hodgdon to **discontinue the entire IMR Enduron series in August 2022**, just two years after discontinuing legacy staples **Hodgdon H414** and **IMR 4320** in **2020**.[11]

Modern chemical-stability recalls (2015 and 2019)

Two high-profile commercial recalls reminded the industry that nitric ester decomposition (see Chapter 12) is not merely a nineteenth-century naval hazard:

- **IMR 4007 SSC (September 2, 2015):** Hodgdon issued a safety recall covering six lots of IMR 4007 SSC after identifying rapid chemical deterioration capable of causing self-heating and spontaneous combustion; the powder was subsequently discontinued.[12]
- **Accurate 2495, 4064, and 4350 (November 2019):** Western Powders and **GD-OTS Canada Valleyfield** recalled specific 1-pound and 8-pound lots manufactured prior to **October 1, 2016**, after a stabilizer/chemical processing defect caused accelerated propellant degradation—evidenced by lid deformation, discoloration, pungent acidic fumes, red-brown nitrogen dioxide dust, and spontaneous ignition risk.[13]

> **Safety**
> Smokeless propellants are energetic nitric esters that depend on finite sacrificial stabilizers to prevent autocatalytic breakdown. Any canister showing acrid acidic odor, reddish-brown dust or fumes, clumping, or unexplained warmth—or matching an active manufacturer recall notice—must be removed from service immediately and rendered inert according to manufacturer safety instructions (see Chapter 12).[14]

Corporate consolidation and defense-driven shortages

The commercial distribution landscape consolidated sharply at the start of the 2020s. In **October 2020**, **Hodgdon Powder Company** acquired **Western Powders**, bringing the **Accurate** and **Ramshot** rifle brands under the same corporate roof as **Hodgdon**, **IMR**, and the **Winchester** powder license.[15] Meanwhile, **Alliant Powder** moved through Vista Outdoor's corporate restructuring into **The Kinetic Group** in 2023–2024.

At the same time, surging global defense demand for nitrocellulose, nitroglycerin, and finished artillery and small-arms propellants during the 2020–2025 period exposed the structural fragility of civilian supply. Because the same eight primary industrial plants supply both national militaries and civilian canisters (see Chapter 9), wartime artillery procurement rapidly diverted plant capacity away from commercial packaging—leading to multi-year retail shortages of Alliant Reloder lines and European extruded propellants across North America and Europe alike.

Year	Event / Propellant	Organization / OEM	Significance
2008	Alliant Reloder 17	Alliant / Nitrochemie (Switzerland)	Commercial debut of Nitrochemie **EI®** impregnated extrusions
2010	IMR 8208 XBR & Vihtavuori N570	ADI Mulwala / Vihtavuori	Short-cut Extreme benchrest/match & ELR magnum milestones
2011–2021	AR-Comp, Reloder 23, Reloder 16, TS 15.5	Alliant / Eurenco Bofors (Sweden)	Swedish **TZ®** temperature-stabilized, decoppering rifle family
2012	Hodgdon CFE 223	Hodgdon / St. Marks Powder (USA)	Popularized commercial Copper Fouling Eraser spherical chemistry
2013	Reload Swiss launch (`RS60` et al.)	Nitrochemie Wimmis AG (Switzerland)	Direct Swiss consumer brand for EI® and single-base propellants
Sept 2015	IMR 4007 SSC recall	Hodgdon Powder Company	6 lots recalled for rapid chemical degradation / self-heating
2018	EU REACH enforcement (2,4-DNT / DBP)	European Chemicals Agency (ECHA)	Halted EU imports of ADI Extreme & legacy IMR; U.S./AU unaffected
2018–2021	Vihtavuori N565, N555, N568	Nammo Vihtavuori Oy (Finland)	Modern ELR and 6.5 Creedmoor / PRC high-energy competition wave
Nov 2019	Accurate 2495 / 4064 / 4350 recall	Western Powders / GD-OTS Valleyfield	Pre-Oct 2016 Valleyfield lots recalled for stabilizer degradation
2019 / 2020	Winchester StaBALL 6.5	Hodgdon / St. Marks Powder (USA)	First temperature-insensitive spherical rifle propellant
2020	Hodgdon acquires Western Powders; H414 & IMR 4320 discontinued	Hodgdon Powder Company	Consolidated Accurate & Ramshot alongside Hodgdon, IMR, Winchester
Aug 2022	IMR Enduron discontinued	Hodgdon / GD-OTS Valleyfield	Entire Enduron line (`4166`–`8133`) retired on supply constraints
Jan 2023	Winchester StaBALL Match & HD	Hodgdon / St. Marks Powder (USA)	Expanded temperature-stable spherical family across bottleneck range

III

Part III

Nomenclature, Manufacturers, and the Global Supply Chain

Commercial smokeless propellant labels rarely reveal where a powder was nitrated, which plant extruded or rolled it, or why four unrelated canisters carry the same four-digit number. Behind dozens of retail brands sits a surprisingly small network of industrial chemical plants on three continents, each operating under distinct naming conventions, military contracts, and regulatory frameworks. This part decodes commercial and military propellant nomenclature, profiles the eight primary manufacturing plants and the packagers they supply, and maps confirmed OEM equivalents, sister families, discontinuations, recalls, and regulatory replacements.

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Chapter 8

Why Powders Have Their Names: Nomenclature and Lineages

Key points

- DuPont's four-digit IMR codes began as internal laboratory specification numbers rather than a burn-rate scale; competing brands adopted famous numbers such as `4350`, `4895`, `4831`, and `4064` as shorthand for burn-rate niches.
- Four active commercial propellants carry the `4350` designation (`IMR 4350`, `Hodgdon H4350`, `Accurate 4350`, and `Shooters World SW4350`), representing four distinct formulations made across three continents.
- Military spherical propellants use Olin/St. Marks `WC` and `SMP` factory codes, while commercial retail lines translate those families into brand numbers and descriptive trademarks.
- Modern European makers—Vihtavuori, ADI Mulwala, Explosia Lovex, Nitrochemie Reload Swiss, and Eurenco Bofors—encode chemical base, burn-rate order, or factory heritage directly into their naming systems.

The DuPont IMR Four-Digit System

Modern rifle nomenclature owes its most persistent confusion to a single 1930s convention. When E. I. du Pont de Nemours and Company replaced its early two-digit Improved Military Rifle (`IMR`) formulations (`IMR 15½`, `IMR 17½`, and `IMR 25½`) with cleaner, coated single-base extrusions in the mid-1930s, the company assigned four-digit laboratory specification numbers to each commercial release.[1] `IMR 3031` arrived in 1934, followed by `IMR 4064`, `IMR 4198`, `IMR 4227`, and `IMR 4320` in 1935, and `IMR 4350` in 1940.[2]

Those four-digit numbers were never a burn-rate ladder. They originated as internal development and specification identifiers at DuPont's Carneys Point laboratories and plant.[3] Ordering the classic IMR series from fastest to slowest illustrates why the digits cannot be read numerically:

- **Fast rifle:** `IMR 4227` (fastest of the classic group), then `IMR 4198`.
- **Medium-fast to medium rifle:** `IMR 3031`, then `IMR 4895`, then `IMR 4064`, then `IMR 4320`.
- **Medium-slow to magnum rifle:** `IMR 4350`, then `IMR 4831`, then `IMR 7828`.

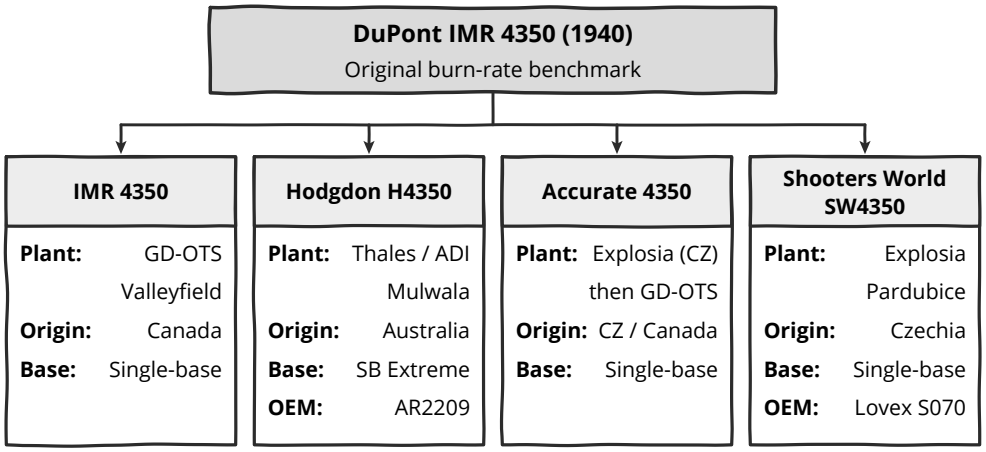
Notice the reversals. `IMR 4198` burns far faster than `IMR 3031`, even though its number is higher. `IMR 4895` burns faster than `IMR 4064` and dramatically faster than `IMR 4350`, yet its number is higher than both. Only at the slow end of the catalog (`4350`, `4831`, `7828`) do the digits happen to climb as burn rate slows.

Because DuPont's four-digit powders defined American rifle handloading for decades, their numbers entered the vocabulary as shorthand for cartridge applications rather than proprietary trademarks. When surplus salvagers and rival packagers introduced propellants targeting the same bottleneck niches after World War II, reusing the familiar four-digit number immediately signaled the intended burn-rate window to shooters. Over eighty years, that commercial shortcut produced overlapping naming families whose canisters look similar on a shelf but contain chemically distinct propellants.

The 4350 Family: Four Canisters, Three Continents

No number illustrates commercial naming overlap better than `4350`. Today, four widely distributed bottleneck rifle propellants carry `4350` on the label. They are not relabeled copies of one formula; they are four distinct propellants produced by three different industrial plants across North America, Australia, and Europe (Figure 8-1).

- **IMR 4350.** Introduced by DuPont in 1940 as a slow-burning, single-base extruded cylinder for cartridges such as the `.270 Winchester` and `.30-06 Springfield`.[4] Modern production takes place at General Dynamics Ordnance and Tactical Systems – Canada (GD-OTS Canada) in Valleyfield, Quebec, using legacy solvent-extruded nitrocellulose tooling.[5]
- **Hodgdon H4350.** Packaged by Hodgdon Powder Company as a flagship member of its Extreme extruded line, H4350 is manufactured in Mulwala, New South Wales, by Thales Australia (Australian Munitions) under the domestic code `ADI AR2209`.[6] It is a single-base extruded propellant engineered with ADI's temperature-insensitive surface treatment, giving it flatter thermal behavior across ambient temperature swings than traditional IMR 4350.[7]
- **Accurate 4350.** Introduced by Accurate Arms (later Western Powders, acquired by Hodgdon in 2020) as a shorter-cut competitor in the 4350 burn-rate band.[8] Historically, Accurate sourced its extruded rifle powders from Explosia a.s. in the Czech Republic before Western Powders shifted production of Accurate 4350 to GD-OTS Canada at Valleyfield to Accurate's own proprietary specifications.[9] Even when made under the same roof in Quebec, Accurate 4350 was blended to separate specifications and was never an identical twin of IMR 4350.
- **Shooters World SW4350.** Imported into North America by Shooters World and manufactured in Pardubice-Semtín, Czech Republic, by Explosia a.s. under its domestic designation `Lovex S070`.[10] It is a European single-base extruded cylinder targeting the same medium-slow bottleneck niche as the other three canisters.



Distinct OEM formulations across North America, Europe, and Australia — never interchange load data.

Figure 8-1. Lineage map of the 4350 naming family showing four distinct commercial propellants produced across three continents.

All four powders sit close together on empirical burn-rate charts and serve cartridges such as the `6.5 Creedmoor`, `.270 Winchester`, and `.30-06 Springfield`. Their bulk densities,

grain lengths, deterrent packages, and charge-pressure curves differ enough that load data for one `4350` canister never transfers directly to another.

Other Legacy Four-Digit Lineages: 4895, 4831, 4064, 4198, and 3031

The same post-war salvage history and burn-rate targeting multiplied other famous DuPont numbers across rival brands.

The 4895 lineage

DuPont developed `IMR 4895` as a military propellant for the `.30-06 Springfield` M2 Ball cartridge used in the M1 Garand during World War II.[3] In 1947, Bruce Hodgdon purchased 50,000 pounds of war-surplus 4895 and sold it to civilian shooters as `H4895`, launching the Hodgdon Powder Company.[4] When World War II surplus stockpiles ran dry, Hodgdon contracted new commercial manufacture first in Scotland (Nobel/ICI) and later with ADI in Mulwala, Australia. Modern `H4895` is manufactured at Mulwala as `ADI AR2206H`—a shorter-cut, temperature-insensitive Extreme single-base extrusion distinct from Valleyfield-made `IMR 4895`.[6] Accurate later echoed the number with `Accurate 2495` (retaining the `495` cadence with a `2` prefix), originally sourced from Explosia in the Czech Republic and later moved to GD-OTS Valleyfield to Accurate's own specifications.[9]

The 4831 lineage

Unlike `4895` and `4350`, the `4831` commercial name began with Hodgdon rather than DuPont. In 1950, Bruce Hodgdon salvaged war-surplus DuPont single-base extruded propellant originally manufactured for 20mm Oerlikon anti-aircraft cannons and marketed it as `H4831`.[4] Its slow burning profile proved ideal for overbore hunting cartridges such as the `.270 Winchester` and `.300 Winchester Magnum`. As surplus supplies dwindled, Hodgdon transitioned `H4831` to newly manufactured Scottish production and eventually to Thales/ADI Mulwala (`ADI AR2213`).[6] To improve metering through mechanical powder measures, ADI introduced a shorter grain cut—`ADI AR2213SC`, packaged in North America as `Hodgdon H4831SC` (`SC` for Short Cut)—engineered to match standard `H4831` ballistically while packing slightly denser.[11] DuPont answered Hodgdon's success in 1973 by releasing its own commercial canister `IMR 4831` (manufactured today at Valleyfield), which is slightly faster-burning than `H4831` and chemically distinct.

The 4064 and 4198 lineages

DuPont released `IMR 4064` and `IMR 4198` in 1935 as classic single-base extruded cylinders.[12] `IMR 4064` gained fame for its versatility in `.308 Winchester` and `.30-06 Springfield` despite its notoriously long, hard-to-meter tubular grains. Accurate targeted that market with `Accurate 4064`, a shorter-cut single-base extrusion historically sourced from Explosia and later produced at GD-OTS Valleyfield to independent specifications.[9] Similarly, `IMR 4198` (made at Valleyfield) gained a parallel Australian counterpart when Hodgdon sourced `H4198` from ADI Mulwala as `ADI AR2207`—a shorter, temperature-insensitive Extreme single-base extrusion in the fast bottleneck class.[6]

The 3031 lineage

IMR 3031 (1934) remained unique to the IMR catalog rather than spawning identically numbered rivals. Competitors instead targeted its medium-fast burn-rate slot under original names, including ADI's Benchmark (BM2), Accurate 2015, and Vihtavuori's N133 and N135. Even here, however, the legacy four-digit format shaped marketing expectations for decades; when IMR later released modern short-cut and Enduron lines (IMR 8208 XBR, IMR 4166, IMR 4451, IMR 4955, IMR 7977, IMR 8133), it preserved the four-digit numeric style even though IMR 8208 XBR was made in Australia by ADI rather than in Quebec.[6]

Military-to-Canister Codes: Olin and St. Marks (WC and SMP)

Spherical ("ball") propellants followed a completely different naming lineage anchored in U.S. military procurement. When Fred Olsen developed the water-slurry spherical propellant process for the Western Cartridge Company (later Olin Corporation) in the 1930s, factory formulations received WC prefixes (for **Western Cartridge**).[13] After Olin built its dedicated spherical plant in St. Marks, Florida, in 1970 (later acquired by General Dynamics as St. Marks Powder), modern commercial and military factory codes also adopted the SMP prefix (for **St. Marks Powder**).[14]

Two military WC designations shaped post-war commercial rifle propellants:

- **WC 844.** The standard military spherical propellant for 5.56x45mm NATO (M193 and M855) ammunition, whose commercial canister counterpart is Hodgdon H335.[15]
- **WC 846.** The standard military spherical propellant for 7.62x51mm NATO (M80) ammunition, closely related to the commercial lineage behind Hodgdon BL-C(2) and Winchester 748.[15]

Military WC propellants and commercial canister propellants differ in an important operational respect. Military procurement specifications optimize a lot for one fixed cartridge, projectile, primer, and weapon system, allowing wider lot-to-lot burn-rate swings because the arsenal adjusts charge weight per production lot. Commercial canister propellants (H335, BL-C(2), W748, W760) are blended to tight canister-grade repeatability across lots so published reloading tables remain valid from year to year.[16]

Under the SMP factory designation system, individual base blends map onto multiple retail brands packaged by Hodgdon (including the licensed Winchester brand) and Alliant:

- **Winchester numeric codes** such as W748, W760 (SMP 760, identical in OEM base to discontinued Hodgdon H414), Supreme 780, and magnum-handgun/300 Blackout boundary powder W296 (Hodgdon H110).[17]
- **Descriptive commercial families** introduced in the 2000s–2020s, where branding highlights a specific functional additive or engineering goal rather than a numeric code: Hodgdon's CFE (Copper Fouling Eraser: CFE 223, CFE BLK), Leverevolution, and SUPERFORMANCE; Winchester's temperature-insensitive StaBALL series (StaBALL Match, StaBALL 6.5, StaBALL HD); and Alliant's Power Pro spherical rifle line (1200-R, 2000-MR, 4000-MR, Varmint).[18]

European and Australian Systematic Numbering

While American nomenclature evolved through lab codes, surplus salvage, and marketing names, European and Australian plants built systematic codes that tell the reader far more about a powder's chemistry and burning speed.

Vihtavuori (`N100`, `N500`, and `20N29`/`24N41`)

Finland's Nammo Vihtavuori Oy uses one of the clearest numbering architectures in the industry.[19] Centerfire rifle propellants divide cleanly into two primary series by chemical base:

- **`N100` series (`N120`, `N130`, `N133`, `N135`, `N140`, `N150`, `N160`, `N165`, `N170`).** Single-base extruded nitrocellulose powders. Within the series, higher numbers correspond systematically to slower burning speeds—from fast small-bore `N120` and benchrest `N133` through mid-bore `N140`/`N150` to magnum `N160`, `N165`, and `N170`.[19]
- **`N500` series (`N530`, `N540`, `N550`, `N555`, `N560`, `N565`, `N568`, `N570`).** Nitroglycerin-infused high-energy double-base extruded propellants. The second and third digits intentionally mirror the burn-rate territory of the corresponding `N100` number: `N540` sits in the `N140` mid-bore class, `N550` and temperature-stabilized `N555` occupy the `N150`/4350 window, and `N560`, `N565`, `N568`, and `N570` step progressively slower through magnum and extreme-long-range cartridges.[19]
- **Heavy-caliber legacy codes (`20N29` and `24N41`).** Vihtavuori's ultra-slow `.50 BMG` and large-magnum single-base extrusions retain older factory nomenclature derived from 20mm-class and heavy-ordnance grain geometry codes rather than the `N100`/`N500` rifle grid.[19]

ADI Mulwala (`AR22xx` and `BM`)

Thales Australia's Mulwala plant labels its domestic Australian rifle catalog with two prefixes: `AR` (Australian Rifle) and `BM` (Bench Mark).[7] In the `AR22xx` series, the final two digits reflect development sequence rather than strict burn-rate order at the fast end (`AR2207` and `AR2219` both burn faster than `AR2206H`), whereas the medium-to-magnum sequence climbs cleanly from faster to slower: `AR2208` (`Varget`) → `AR2209` (`H4350`) → `AR2213SC` (`H4831SC`) → `AR2217` (`H1000`) → `AR2225` (`Retumbo`).[6]

Two suffixes carry specific technical meanings at Mulwala:

- `SC` denotes **Short Cut** (`AR2213SC` = `H4831SC`), signaling reduced grain length for smoother metering.[6]
- `H` in `AR2206H` (`H4895`) distinguishes the modern temperature-insensitive Hodgdon-specification formulation from the older, discontinued `AR2206`.[7]

The `BM` prefix covers short-cut precision extruded powders engineered for benchrest metering: `BM2` (packaged as `Hodgdon Benchmark`) and `BM8208` (packaged as `IMR 8208 XBR`, paying tribute to DuPont's famous experimental short-cut `8208` / `T32` benchrest propellant of the 1960s).[6]

Explosia Lovex versus Shooters World

Czech manufacturer Explosia a.s. uses an explicit chemistry-first code for its **Lovex** commercial line.[20] Every designation opens with a letter indicating chemical base:

- S = **Single-base** extruded nitrocellulose (S060, S062, S065, S070, S071).
- D = **Double-base** nitrocellulose/nitroglycerin (D060, D063, D073.04, D073.05, D073.06, D100). Note that D indicates double-base chemistry rather than grain shape alone: D060 is a double-base extruded tubular propellant, whereas the D073.0x family (D073.04, D073.05, D073.06) consists of double-base spherical ball propellants.[20]

Within both S and D rifle families, higher numeric codes generally indicate slower burning rates (S060 → S062 → S065 → S070; D073.04 → D073.05 → D073.06). When **Shooters World** packages Lovex propellants for North American retail, it replaces those technical codes with application-oriented English names—Precision Rifle (S062), Long Rifle (S065), SW4350 (S070), AR Plus (D073.04), Tactical Rifle (D073.05), and Match Rifle (D073.06)—so shooters can read the intended role straight off the canister.[21]

Nitrochemie Reload Swiss (RS30–RS80)

Launched in 2013 by Nitrochemie Wimmis AG, the **Reload Swiss** (RS) catalog uses a strictly monotonic numeric burn-rate ladder.[22] RS20 is a handgun propellant and RS30 sits at the magnum-pistol boundary, while bottleneck rifle grades step cleanly from fastest to slowest: RS36, RS40, RS50, RS52, RS60, RS62, RS70, RS76, and RS80.[22]

Adjacent mid-bore numbers also encode paired chemistries: RS50 and RS62 are traditional single-base extrusions, whereas RS52 and RS60 (twin to Alliant Reloder 17) are their **EI®** high-energy counterparts.[22]

Bofors RP, Norma, and Alliant Reloder

Sweden's Eurenco Bofors AB historically assigned RP (Swedish *Röksvagt Pulver*) internal factory codes—including the RP11 lineage behind medium-burn .308 Winchester grades—and supplies two major retail brands.[23]

Norma Precision pairs a 200-series (200, 201, 202, 203-B, 204, and slow magnum 217) with descriptive acronyms for its flagship high-energy lines: URP (Ultra Rifle Powder, 4350 band) and MRP (Magnum Rifle Powder).[24]

Alliant Powder markets its extruded rifle line under the legacy Hercules **Reloder** trademark (7, 10x, 15, TS 15.5, 16, 17, 19, 22, 23, 25, 26, 33, and 50), stepping generally from small-bore to .50 BMG, with TS denoting Temperature Stable.[25] Crucially, the sequence spans **two European OEMs**: Eurenco Bofors (Sweden) produces 7, 10x, 15, TS 15.5, 16, 19, 22, 23, 25, and AR-Comp, whereas Nitrochemie (Switzerland/Germany) produces the EI®-impregnated 17, 26, 33, and 50.[26]

Chapter 9

Global Manufacturers and Packagers

Key points

- Almost every commercial bottleneck rifle propellant sold worldwide originates in just **eight industrial OEM chemical plants** across North America, Europe, and Australia.
- Commercial canister brands act primarily as specification managers, ballistic laboratories, packagers, and retail distributors—often sourcing from three or four different OEM plants under one corporate umbrella.
- Because nitrocellulose nitration plants depend on defense ammunition contracts for capital scale, military demand surges directly tighten commercial canister availability.
- Two decades of consolidation—especially Hodgdon's acquisitions of IMR (2003), the Winchester powder license (2005), and Western Powders (2020)—concentrated North American retail distribution even while global chemical manufacturing stayed specialized.

OEM Chemical Plants Versus Commercial Packagers

A widespread misconception in handloading is that every brand name printed on a one-pound jug operates its own smokeless powder factory. In reality, the global propellant industry is sharply divided into two tiers: **industrial OEM (Original Equipment Manufacturer) chemical plants** and **commercial canister packagers** (Figure 9-1).

Manufacturing smokeless propellant from raw cellulose requires heavy chemical infrastructure: concentrated nitric and sulfuric acid plants, acid-recovery towers, remote-controlled nitration houses, high-pressure hydraulic extrusion presses or heated spherical-slurry reactors, solvent-recovery loops, and explosive-rated drying and blending magazines.[1] Environmental permitting, hazard-zone land buffers, and capital costs make building a new greenfield nitrocellulose plant virtually prohibitive for a purely civilian sporting brand. As a result, nearly all active smokeless rifle propellant plants were founded as state arsenals or defense-industrial energetics complexes between 1898 and 1970.

Commercial packagers sit downstream of those chemical plants. A packager defines target burn rates and ballistic acceptance windows, contracts bulk production runs from one or more OEMs, tests incoming master lots in pressure barrels, bottles the powder into retail canisters, publishes load manuals, and manages dealer distribution. Some OEMs—such as Nammo Vihtavuori and Nitrochemie (via Reload Swiss)—sell directly to consumers under their own factory brands, while major American packagers like Hodgdon and Alliant draw across multiple international plants to assemble complete catalogs.

That two-tier structure explains commercial supply cycles. Military small-arms and artillery contracts account for the primary tonnage at most OEM facilities. When defense procurement surges, extrusion presses and nitration lines prioritize government ammunition contracts, leaving commercial packagers queuing for bulk canister allocations.

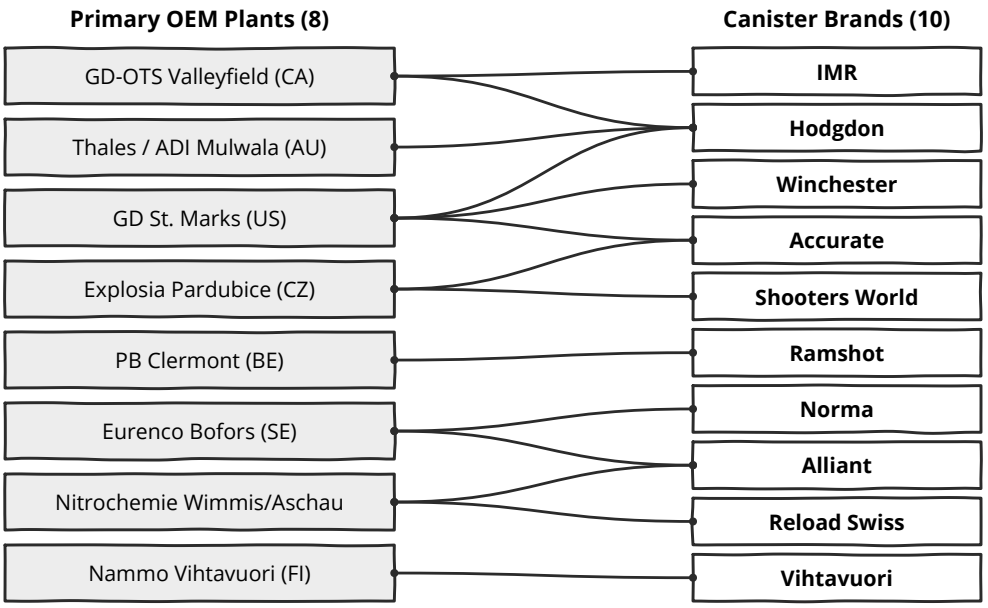


Figure 9-1. Global smokeless rifle propellant supply chain linking eight primary OEM manufacturing plants to ten commercial canister brands.

The Eight Primary Modern OEM Plants

1. General Dynamics Ordnance and Tactical Systems – Canada (Valleyfield, Quebec)

Originally established during World War II as a major Allied explosives complex and operated for decades under Canadian Industries Limited (CIL) and later Expro Chemical Products, the Valleyfield, Quebec facility is operated today as **General Dynamics Ordnance and Tactical Systems – Canada (GD-OTS Canada)**.[2] (Older handloading literature occasionally misidentifies the plant as "Explosives Ltd," a mangling of the former Expro name.)

Valleyfield is North America's primary solvent-extruded single-base nitrocellulose plant. After DuPont exited direct IMR manufacturing in the late 1980s, traditional **IMR** extruded rifle production (`IMR 3031`, `4064`, `4198`, `4227`, `4350`, `4831`, `4895`, `7828`, and `7828SSC`) consolidated at Valleyfield.[2] The plant also manufactured the copper-fouling-erasing **IMR Enduron** series (`4166`, `4451`, `4955`, `7977`, `8133`) prior to its August 2022 discontinuation and produced contracted single-base extruded formulations for Accurate (`Accurate 2015`, `2495`, `4064`, `4350`, `LT-30`, and `LT-32`).[3]

2. General Dynamics St. Marks Powder (St. Marks, Florida, USA)

Constructed by Olin Corporation in 1970 to succeed its original East Alton, Illinois ball-powder works—and acquired by General Dynamics in 1999—**St. Marks Powder** is the world's largest producer of spherical **BALL POWDER®** propellants.[4] Using Fred Olsen's water-slurry lacquer emulsion process, St. Marks forms nitrocellulose-nitroglycerin globules in heated water reactors, distills off solvent, applies deterrents, and mechanically rolls selected grades into flattened spheroids to control web thickness and burn progressivity.[5]

Alongside its core role supplying U.S. military 5.56mm (WC 844) and 7.62mm (WC 846) propellants, St. Marks manufactures a vast share of the North American spherical rifle market: **Winchester** (W748, W760, Supreme 780, StaBALL Match, StaBALL 6.5, StaBALL HD), **Hodgdon** spherical rifle lines (H335, BL-C(2), H380, CFE 223, CFE BLK, Leverevolution, SUPERFORMANCE, US 869), **Alliant Power Pro** rifle propellants (1200-R, 2000-MR, 4000-MR, Varmint), and select **Accurate** spherical grades.[6]

3. Thales Australia / Australian Munitions (Mulwala, New South Wales)

Built in 1943 as the Mulwala Explosives Factory to supply Commonwealth forces in the Pacific theater, the Mulwala plant transitioned through Australian Defence Industries (ADI) before Thales acquired full ownership in 2006 and commissioned a heavily modernized propellant facility in the 2010s.[7]

Mulwala is renowned for clean, tightly controlled single-base extruded rifle propellants incorporating temperature-insensitive surface coatings.[8] Sold domestically across Australia and New Zealand under the **ADI** label (AR2206H, AR2207, AR2208, AR2209, AR2213SC, AR2217, AR2219, AR2225, BM2, BM8208), those same formulations form the backbone of Hodgdon's **Extreme** extruded lineup (H4895, H4198, Varget, H4350, H4831/H4831SC, H1000, H322, Retumbo, Benchmark) as well as IMR 8208 XBR.[9] Because traditional ADI deterrent chemistry relied on compounds restricted under European Union REACH Annex XIV from 2018 onward, Mulwala powders disappeared from EU retail shelves while remaining dominant in North America and Australasia.[10]

4. Nammo Vihtavuori Oy (Vihtavuori / Laukaa, Finland)

Founded by the Finnish government in 1922 as the State Powder Factory (*Valtion Ruutitehdas*), the Vihtavuori plant began smokeless powder production in 1926 to supply Finland's military rifle ammunition.[11] After periods under Kemira and Eurenco ownership, the facility became part of Nordic defense group **Nammo** in 2014.[11]

Vihtavuori is one of the few vertically integrated commercial propellant makers, producing its own nitrocellulose from Scandinavian wood pulp and cotton linters alongside finished extruded rifle powders.[12] Its catalog spans the clean-burning **N100** single-base series (N120 through N170), the nitroglycerin-infused **N500** high-energy series (N530 through N570, including modern temperature-stabilized releases N555, N565, and N568), and .50 BMG-class 20N29 and 24N41.[13] Early transition to REACH-compliant deterrents made Vihtavuori a primary beneficiary of Europe's 2018 import restrictions on non-REACH extruded powders.[10]

5. Eurenco Bofors AB (Karlskoga, Sweden)

Tracing its lineage directly to **AB Bofors Nobelkrut**, established by Alfred Nobel's estate in Karlskoga in 1898, **Eurenco Bofors AB** operates today within the European Eurenco energetics group.[14] Bofors specializes in double-base and surface-deterred extruded small-arms and artillery propellants.

In the commercial bottleneck rifle market, Bofors manufactures the entire **Norma** rifle catalog (Norma 200, 201, 202, 203-B, 204, 217, URP, and MRP) as well as the Swedish-sourced core of the **Alliant Reloder** line (Reloder 7, 10x, 15, TS 15.5, 16, 19, 22, 23, 25, and AR-Comp).[15] Crucially, Eurenco Bofors is the developer and trademark owner of **TZ®**

(Temperature Zone) technology—a DNT-free, DBP-free, decoppering-capable chemical stabilization architecture used in `AR-Comp`, `Reloder 23`, `Reloder 16`, and `Reloder TS 15.5`.[16]

6. Nitrochemie Wimmis AG and Nitrochemie Aschau GmbH (Switzerland / Germany)

Formed in 1998 as a joint venture between Germany's **Rheinmetall** (55%) and Switzerland's **RUAG** (45%), **Nitrochemie** unites historic Swiss propellant works at Wimmis (established 1917) with German energetics facilities at Aschau.[17]

Nitrochemie pioneered **EI® (Extruded Impregnated)** propellant technology, which infuses nitroglycerin into extruded nitrocellulose grains with controlled radial concentration gradients so the charge delivers high energy density alongside progressive burning behavior.[18] In 2013, Nitrochemie launched its own factory-direct consumer brand, **Reload Swiss** (`RS36`–`RS80` for bottleneck rifles), while continuing to manufacture EI®-based contract propellants for Alliant Powder (`Reloder 17`, `Reloder 26`, `Reloder 33`, and `Reloder 50`).[19]

7. PB Clermont / Eurenco (Engis, Belgium)

Established in 1952 in Engis, Belgium (historically linked to Poudreries Réunies de Belgique) and now integrated within the Eurenco group, **PB Clermont** is Europe's premier specialist in spherical (ball) smokeless propellants.[20] Like St. Marks in the United States, Clermont produces water-emulsion double-base spherical grains and uses mechanical rolling mills to flatten spheres into precise web thicknesses for rifle burn-rate control.[20]

PB Clermont supplies the spherical rifle lines marketed in North America as **Ramshot** (`X-Terminator`, `TAC`, `Big Game`, `Hunter`, `Magnum`, `LRT`, and `Grand`) and **Accurate** spherical powders (`Accurate 1680`, `2200`, `2230`, `2460`, `2520`, `2700`, and `MagPro`), as well as the spherical `Sp` series sold in Europe under Nobel Sport's **Vectan** brand.[21]

8. Explosia a.s. (Pardubice-Semtín, Czech Republic)

Founded in 1920 at Pardubice-Semtín as a state-backed Czechoslovakian explosives manufacturer (historically operated within the Synthesia chemical complex), state-owned **Explosia a.s.** is one of the few European plants capable of producing both single-base extruded (`S`-series) and double-base extruded and spherical (`D`-series) small-arms propellants on one site.[22]

Explosia markets its commercial catalog in Europe under the **Lovex** brand and serves as the primary OEM supplier for **Shooters World** in North America.[23] Historically, Explosia also supplied Accurate Arms' early Czech extruded rifle propellants (including early versions of `Accurate 2015`, `2495`, `4064`, `4350`, and double-base extruded `Accurate 5744`) before Western Powders relocated several of those extruded contracts to North America.[24]

Historical Legacy Makers

Older manuals, vintage canisters, and archival ballistic literature frequently cite five historic manufacturers whose names no longer appear on new commercial rifle production or have been absorbed into modern groups:

- **DuPont (Carneys Point, New Jersey).** Founded in 1802 as a black powder mill on Brandywine Creek, DuPont built the Carneys Point smokeless works in the 1890s and engineered the entire classic IMR rifle lineage.[25] DuPont spun off its commercial IMR sporting powder business into the independent IMR Powder Company in 1986, with extrusion shifting permanently to Valleyfield, Quebec.[2]
- **Hercules Powder Company (Kenvil, New Jersey & Radford, Virginia).** Created in 1912 by the U.S. federal antitrust breakup of DuPont, Hercules inherited Laflin & Rand's double-base smokeless expertise (`Bullseye`, `Unique`, `HiVel`, `2400`) and operated the government-owned Radford Army Ammunition Plant from World War II onward.[26] In 1995, Alliant Techsystems (ATK) acquired Hercules Aerospace—including its sporting propellant division—rebranding the canister line as **Alliant Powder**.[27]
- **Olin Corporation / Western Cartridge Company (East Alton, Illinois).** Developed Fred Olsen's spherical Ball Powder process in 1933 and acquired Winchester Repeating Arms in 1931; Olin relocated commercial and military ball-powder production from East Alton to its new St. Marks, Florida facility in 1970 before divesting St. Marks to General Dynamics in 1999.[5]
- **Nobel / ICI (Ardeer, Scotland).** Founded by Alfred Nobel in 1871 as the British Dynamite Company (later Nobel Industries and Imperial Chemical Industries), the vast Ardeer complex manufactured commercial extruded propellants for Hodgdon—including post-surplus `H4831` and `H4895`—during the late 20th century before Hodgdon consolidated extruded sourcing at ADI Mulwala.[28]
- **SNPE / Nobel Sport (France — Vectan).** Descended from France's historic *Service des Poudres* (where Paul Vieille invented Poudre B in 1884), SNPE commercialized the **Vectan** `Tubal` single-base extruded rifle powders and `Ba`/`Sp` lines.[29] Today, Eurenco manages France's industrial energetics heritage while Nobel Sport distributes Vectan retail canisters, sourcing its spherical `Sp` powders from PB Clermont.[21]

Major Commercial Canister Brands and Packagers

Six commercial organizations account for almost the entire retail bottleneck rifle powder market across North America and Europe:

- **Hodgdon Powder Company (Shawnee, Kansas).** Founded in 1947 by Bruce Hodgdon on WWII surplus `4895`, Hodgdon transformed from a regional salvager into North America's dominant propellant packager through three strategic milestones: acquiring **IMR Powder Company** in **2003**, securing the license to market and distribute **Winchester** smokeless powders in **2005**, and acquiring **Western Powders** (bringing **Accurate** and **Ramshot** under its corporate roof) in **2020**.[30] Hodgdon operates no cellulose nitration plants of its own; instead, it sources across four primary OEMs—Thales/ADI Mulwala (Hodgdon Extreme, `IMR 8208 XBR`), GD-OTS Valleyfield (traditional IMR, contracted Accurate extruded), GD St. Marks Powder (Winchester, Hodgdon spherical), and PB Clermont (Ramshot, Accurate spherical).[31]

- **Alliant Powder (Anoka, Minnesota).** Descended from Hercules Powder Company via ATK (1995), Vista Outdoor (2015), and **The Kinetic Group** (2024), Alliant packages modern bottleneck rifle propellants sourced from three primary OEMs: Eurenco Bofors (Sweden), Nitrochemie (Switzerland/Germany), and GD St. Marks Powder (USA, `Power Pro` series).[32]
- **Norma Precision AB (Åmotfors, Sweden).** Founded in Norway in 1902 and established in Åmotfors in 1911 (later owned by RUAG Ammotec and acquired by Beretta Holding in 2022), Norma packages Bofors-manufactured extruded rifle propellants tailored to European and international precision cartridges.[33]
- **Shooters World (Charlotte, North Carolina).** Founded in 2013 as a North American propellant importer and packager, Shooters World partners directly with Czech OEM Explosia a.s. to distribute Lovex single-base and double-base rifle propellants under descriptive English retail names.[34]
- **Reload Swiss (Wimmis, Switzerland).** Launched in 2013 as Nitrochemie Wimmis AG's factory-direct commercial brand, Reload Swiss markets Swiss-made single-base and EI® impregnated propellants across Europe and export markets without an intermediary packager.[18]
- **Vihtavuori (Laukaa, Finland).** Operated directly by OEM Nammo Vihtavuori Oy, selling Finnish-made `N100`, `N500`, and heavy-caliber propellants globally (distributed in the United States through Capstone Precision Group).[12]

Chapter 10

OEM Cross-Reference: Twins, Sisters, and REACH Replacements

Key points

- Verified **OEM twins** originate from the same plant and base product code under two regional or retail brand names—most notably ADI Mulwala / Hodgdon Extreme, Explosia Lovex / Shooters World, Reload Swiss RS60 / Alliant Reloder 17, Winchester 760 / discontinued H414, and Ramshot X-Terminator / Accurate 2230.
- **Close OEM counterparts**—such as Bofors-made Norma 203-B / Alliant Reloder 15 and Norma MRP / Alliant Reloder 22—share a plant and burn-rate territory but follow independent packager specifications and are not identical twins.
- Lot-to-lot manufacturing tolerances, moisture equilibrium, and packager acceptance windows prohibit grain-for-grain substitution even between confirmed OEM twins without consulting published load data for the exact canister in hand.
- EU REACH Annex XIV restrictions on 2,4-DNT and DBP (effective ~2018), alongside the 2022 IMR Enduron discontinuation and historical stability recalls (2015 IMR 4007 SSC; 2019 Valleyfield Accurate lots), reshaped global propellant availability.

Three Tiers of Propellant Equivalence

Cross-reference charts often blur the line between true factory twins and powders that merely burn at similar speeds. Accurate technical reference requires separating cross-brand relationships into three strict tiers:

1. **Confirmed Direct OEM Equivalents ("Twins").** Propellants produced at the same OEM facility from the same base formulation and internal product code, packaged under two different regional or commercial labels (for example, ADI AR2208 in Australia and Hodgdon Varget in North America).
2. **Close OEM Counterparts and Sister Families.** Propellants made at the same plant—often sharing a base technology or historic factory lineage—that either carry independent commercial lot specifications (Norma 203-B versus Alliant Reloder 15) or represent stepped chemistry tiers (Vihtavuori N100 versus N500, or Reload Swiss RS50 versus RS52).
3. **Burn-Rate Neighbors from Different OEMs.** Chemically unrelated propellants that occupy the same relative burn-rate window (such as IMR 4350, Hodgdon H4350, Accurate 4350, and Shooters World SW4350). These are never OEM equivalents.

Confirmed Direct OEM Equivalents ("Twins")

Table 10-1 lists verified direct OEM twin pairs documented by manufacturer equivalency tables and technical records. Several persistent internet myths have been deliberately excluded: Hodgdon H1000 is ADI AR2217 (not AR2225), Hodgdon Retumbo is ADI AR2225 (not AR2217), Ramshot X-Terminator pairs with Accurate 2230 (not Accurate 2520), and neither Accurate 4350 nor Norma 203-B belongs in a direct-twin table.[1]

OEM Plant	OEM / Primary Code	Paired Retail Label	Class & Notes
Thales / ADI (Mulwala)	ADI AR2207	Hodgdon H4198	Single-base extruded (Extreme; fast rifle)[2]
Thales / ADI (Mulwala)	ADI AR2219	Hodgdon H322	Single-base extruded (Extreme; small-bore)[2]
Thales / ADI (Mulwala)	ADI BM2	Hodgdon Benchmark	Short-cut single-base extruded (Extreme)[2]
Thales / ADI (Mulwala)	ADI BM8208	IMR 8208 XBR	Short-cut single-base extruded (benchrest/mid-bore)[2]
Thales / ADI (Mulwala)	ADI AR2206H	Hodgdon H4895	Single-base extruded (Extreme; distinct from legacy AR2206)[2]
Thales / ADI (Mulwala)	ADI AR2208	Hodgdon Varget	Single-base extruded (Extreme; mid-bore standard)[2]
Thales / ADI (Mulwala)	ADI AR2209	Hodgdon H4350	Single-base extruded (Extreme; 4350 burn class)[2]
Thales / ADI (Mulwala)	ADI AR2213SC	Hodgdon H4831SC	Short-cut single-base extruded (Extreme; magnum)[2]
Thales / ADI (Mulwala)	ADI AR2217	Hodgdon H1000	Single-base extruded (Extreme; overbore magnum)[2]
Thales / ADI (Mulwala)	ADI AR2225	Hodgdon Retumbo	Single-base extruded (Extreme; ultra-overbore ELR)[2]
GD St. Marks Powder	Winchester 760 (SMP 760)	Hodgdon H414	Double-base spherical; H414 discontinued 2020, W760 active[3]
GD St. Marks Powder	Winchester 296	Hodgdon H110	Double-base spherical; magnum handgun / .300 Blackout boundary[4]
Explosia a.s. (Czech Rep.)	Lovex S062	Shooters World Precision Rifle	Single-base extruded (mid-bore / 4064–Varget class)[5]
Explosia a.s. (Czech Rep.)	Lovex S065	Shooters World Long Rifle	Single-base extruded (medium-slow rifle)[5]
Explosia a.s. (Czech Rep.)	Lovex S070	Shooters World SW4350	Single-base extruded (4350 burn class)[5]
Explosia a.s. (Czech Rep.)	Lovex D073.04	Shooters World AR Plus	Double-base spherical (fast .223 Rem / small-bore)[5]
Explosia a.s. (Czech Rep.)	Lovex D073.05	Shooters World Tactical Rifle	Double-base spherical (medium-fast .223 / .308 class)[5]
Explosia a.s. (Czech Rep.)	Lovex D073.06	Shooters World Match Rifle	Double-base spherical (heavy .223 / .308 class)[5]
Nitrochemie Wimmis AG	Reload Swiss RS60	Alliant Reloder 17	EI® nitroglycerin-impregnated extruded (4350 speed class)[6]
PB Clermont / Eurenco	Ramshot X-Terminator	Accurate 2230	Double-base rolled spherical (fast .223 Rem / varmint)[7]

Safety · Why Confirmed OEM Twins Are Not Grain-for-Grain Substitutes

Even when two canisters originate from the exact same OEM plant and base formulation, substituting one label for the other at a fixed charge weight risks unexpected chamber pressure spikes. Commercial lots vary within normal production tolerances for nitration level, deterrent penetration, residual solvent, and bulk density, and separate packagers may apply distinct lot-acceptance windows, drying histories, and storage conditions before retail bottling. Always verify current published data for the exact canister label in hand rather than copying a charge across twin brands.[8]

Close OEM Counterparts and Sister Families

Beyond confirmed twins, every major OEM plant produces closely related sister families and contract counterparts that share chemistry, grain morphology, or burn-rate lineage without being chemically identical across canisters. Table 10-2 maps those intra-plant relationships accurately.

OEM Plant	Propellant Pair / Family	Technical Relationship & Boundary Notes
Eurenco Bofors AB (Sweden)	Norma 203-B & Alliant Reloder 15	Close counterparts from the same Karlskoga plant and historic Bofors `RP11` extruded lineage; Norma and Alliant maintain independent lot specifications and blends, preventing blind 1:1 substitution.[9]
Eurenco Bofors AB (Sweden)	Norma 204 & Alliant Reloder 19	Close medium-slow counterparts manufactured at Bofors under separate packager specifications.[9]
Eurenco Bofors AB (Sweden)	Norma MRP & Alliant Reloder 22	Close high-energy magnum counterparts from Bofors; separate Norma and Alliant blending tolerances apply.[9]
Eurenco Bofors AB (Sweden)	Bofors TZ® Series (`AR-Comp`, `Reloder TS 15.5`, `Reloder 16`, `Reloder 23`)	Modern DNT-free, DBP-free temperature-stabilized Bofors extruded family using proprietary `TZ®` chemistry; chemically distinct from legacy `Reloder 15` and `Reloder 22`.[10]
Nammo Vihtavuori Oy (Finland)	`N100` Single-Base vs. `N500` High-Energy Series	Paired burn-rate tiers (`N130/N133` vs. `N530`; `N140` vs. `N540`; `N150` vs. `N550/N555`; `N160/N165` vs. `N560/N565/N568`). `N500` adds nitroglycerin infusion for higher specific energy and velocity; `N100` burns cooler with lower flame temperature.[11]
GD St. Marks Powder (USA)	Traditional `W`/Hodgdon Spherical vs. `CFE` vs. `StaBALL` vs. `Power Pro`	Shared St. Marks spherical architecture separated by additive packages: traditional ball (`W748`, `W760`, `H335`, `BL-C(2)`, `H380`), copper-fouling-eraser (`CFE 223`, `CFE BLK`), temperature-insensitive (`StaBALL Match`, `6.5`, `HD`), and Alliant contract `Power Pro` (`1200-R`, `2000-MR`, `4000-MR`, `Varmint`).[12]
PB Clermont / Eurenco (Belgium)	Ramshot & Accurate Rolled Spherical Series	Stepped double-base rolled-ball sisters spanning fast to ELR (`Accurate 1680` / `2200` / `2230` / `2460` / `2520` / `2700` / `MagPro` alongside `Ramshot X-Terminator` / `TAC` / `Big Game` / `Hunter` / `Magnum` / `LRT` / `Grand`). `Ramshot TAC` sits slower alongside `Accurate 2460/2520`, distinct from the `X-Terminator/Accurate 2230` twin pair.[7]

OEM Plant	Propellant Pair / Family	Technical Relationship & Boundary Notes
GD-OTS Canada (Valleyfield, QC)	Traditional IMR vs. IMR Enduron vs. Valleyfield Accurate Extruded	Traditional single-base IMR (3031, 4064, 4198, 4350, 4831, 4895, 7828) versus discontinued REACH-compliant decoppering IMR Enduron (4166–8133) versus independently specified Accurate extruded lines (2015, 2495, 4064, 4350, LT-30, LT-32).[13]
Nitrochemie (Switzerland / Germany)	Reload Swiss Single-Base vs. EI® Pairs & Reloder EI® Magnums	Paired mid-bore options (RS50 single-base vs. RS52 EI®; RS62 single-base vs. RS60 EI®), plus slow EI® magnum sister formulations (Reloder 26, 33, 50 alongside RS70, RS76, RS80 territory).[14]

Discontinued, Recalled, and REACH-Restricted Propellants

Long-term propellant stewardship requires tracking not only active canisters, but also formulations that have left the market, been subject to chemical-stability recalls, or faced cross-border regulatory bans. Table 10-3 summarizes the major discontinuations, safety recalls, and regulatory shocks affecting bottleneck rifle propellants.

Propellant / Family	Status & Date	OEM / Brand	Cause, Scope, and Market Impact
IMR Enduron Series (IMR 4166, 4451, 4955, 7977, 8133)	Discontinued (August 2022)	GD-OTS Canada / Hodgdon	Entire five-powder copper-fouling-erasing, temperature-stable extruded line discontinued due to supplier and manufacturing constraints.[15]
IMR 4320	Discontinued (2020)	GD-OTS Canada / Hodgdon	Classic 1935 mid-bore single-base extruded powder retired during portfolio rationalization.[3]
Hodgdon H414	Discontinued (2020)	GD St. Marks / Hodgdon	Retired as redundant with its identical St. Marks spherical twin, Winchester 760, which remained in production under Hodgdon's license.[3]
IMR 4007 SSC	Safety recall & discontinued (September 2015)	GD-OTS Canada / Hodgdon	Specific 2012–2013 lots recalled due to accelerated stabilizer depletion creating a spontaneous degradation and combustion hazard (see Chapter 12); formulation permanently discontinued.[16]
Accurate 2495, 4064, and 4350 (pre-Oct 2016 Valleyfield lots)	Lot-specific safety recall (November 2019)	GD-OTS Canada / Western Powders	Specific pre-October 1, 2016 Canadian-made lots recalled jointly by Western Powders and GD-OTS Valleyfield due to chemical degradation risk; post-October 2016 lots unaffected and product lines remained active.[17]
Norma MRP-2	Discontinued	Eurenco Bofors / Norma	Ultra-slow magnum extruded powder phased out; extreme-overbore roles transitioned toward Norma 217 and modern slow European grades.[18]
Winchester 680 (W680)	Discontinued	Olin / Winchester	Classic fast spherical propellant for small bottleneck cartridges (.22 Hornet, 7.62x39mm); superseded in its burn-rate niche by Accurate 1680 and Hodgdon CFE BLK.[4]

Propellant / Family	Status & Date	OEM / Brand	Cause, Scope, and Market Impact
EU REACH 2,4-DNT & DBP Restrictions (ADI / Hodgdon Extreme, legacy IMR, legacy Bofors blends)	EU import ban (~2018 onward)	ECHA Annex XIV (EU regulation)	European authorization restrictions on 2,4-dinitrotoluene (2,4-DNT) and dibutyl phthalate (DBP) halted EU commercial imports of ADI/Hodgdon Extreme (`Varget`, `H4350`, `H4895`, `H4831SC`, `H1000`, `Retumbo`, `IMR 8208 XBR`) and legacy IMR formulations, and constrained non-REACH legacy Bofors blends (`Reloder 15` / `22`) in Europe.[19]

Navigating EU REACH Replacements

No regulatory change in modern handloading altered regional propellant markets as abruptly as the European Union's **REACH** (Registration, Evaluation, Authorisation and Restriction of Chemicals) enforcement against **2,4-dinitrotoluene (2,4-DNT)** and **dibutyl phthalate (DBP)**.[19] Both chemicals served for decades as surface deterrents, plasticizers, and flash modifiers in traditional single-base extruded propellants—including the Thales/ADI Mulwala formulations sold globally as Hodgdon's Extreme series and legacy Valleyfield IMR powders.

Once Annex XIV sunset dates took effect in Europe around 2018 without commercial sporting exemptions, retail imports of `Varget`, `H4350`, `H4831SC`, `H1000`, `Retumbo`, `H4895`, `IMR 8208 XBR`, and classic `IMR` propellants ceased across EU member states (and subsequently impacted European supply chains broadly).[19] Meanwhile, those same powders remained fully legal and active in North America and Australia.

European riflemen responded not by seeking drop-in chemical clones—none existed for ADI's exact DNT-deterred surface architecture—but by migrating to REACH-compliant domestic European plants that had already reformulated around alternative deterrents:

- **Varget / H4895 / IMR 4064 mid-bore window:** Migrated toward `Vihtavuori N140` / `N150` / `N540`, `Reload Swiss RS50` / `RS52`, `Norma 203-B`, and `Explosia Lovex S062`.[20]
- **H4350 / IMR 4350 slow-medium window:** Migrated toward `Vihtavuori N555` (purpose-built in 2020 specifically for temperature-stable 6.5 Creedmoor and 4350-class roles) and `N550`, `Reload Swiss RS60` / `RS62`, `Norma URP`, and `Lovex S070`.[21]
- **H4831SC / H1000 / Retumbo magnum and ELR window:** Migrated toward `Vihtavuori N165`, `N560`, `N565`, `N568`, and `N570`, `Reload Swiss RS70` / `RS76` / `RS80`, and `Norma MRP` / `217`.[21]

Because REACH-compliant European replacements differ in specific energy (heat of explosion), bulk density, and grain geometry from the restricted Australian and Canadian formulas they replaced, each transition represents a fresh burn-rate-class selection using published data from the replacement manufacturer rather than a direct substitution.

IV

Part IV

Propellant Behavior, Lot Variance, and Stability

Understanding how a propellant is made and who makes it explains what sits inside the canister. Part IV examines how those formulations behave inside real bottleneck rifle cartridges and across years on the shelf. Chapter 11 links cartridge geometry, barrel length, and gas-system mechanics to burn-rate selection across four rifle classes, while Chapter 12 explains the chemistry of lot-to-lot variance, moisture equilibrium, and nitric ester aging.

Chapter 11. Bottleneck Cartridge Classes and Burn-Rate Matching 61
Chapter 12. Lot-to-Lot Variance, Chemical Aging, and Storage Stability 66

Chapter 11

Bottleneck Cartridge Classes and Burn-Rate Matching

Key points

- Bottleneck cartridge geometry—specifically the ratio of case capacity to bore cross-sectional area—sets the primary burn-rate window for a rifle propellant.
- Small-bore cartridges and gas-operated rifles place tight constraints on dwell time, volumetric metering, and gas-port pressure.
- Mid-bore cartridges span the broadest range of extruded and spherical formulations, rewarding propellants that achieve high, consistent loading density without heavy compression.
- Overbore magnum and extreme long-range cartridges require thick-webbed, progressive propellants and force a direct tradeoff between high-energy velocity and flame-temperature throat erosion.
- Relative burn-rate windows guide propellant class selection, never charge-weight substitution; published data for the exact cartridge, projectile, and canister always governs.

Geometry Before Chemistry: The Expansion Ratio

Two cartridges can fire bullets of identical weight at similar chamber pressures yet require completely different propellants. The reason is internal geometry. A bottleneck rifle cartridge mates a relatively wide powder reservoir to a narrower bore, and the proportion between that case volume and the bore's cross-sectional area controls how quickly the internal volume expands once the projectile starts moving.[1]

Internal ballisticians summarize that geometry with two closely related quantities: the overall expansion ratio of the rifle and the case-capacity-to-bore-area ratio (often called the overbore ratio).

```
Bore area (A_b)  = π × (bore diameter ÷ 2)²
Swept volume     = A_b × effective barrel travel (L_b)
Expansion ratio  = (case volume + swept volume) ÷ case volume
Overbore ratio   = case capacity ÷ A_b
```

When a cartridge has a small case relative to its bore—such as a `.308 Winchester` compared with a `.300 Winchester Magnum`—each inch of bullet travel opens a large percentage of additional volume behind the projectile base. Pressure falls rapidly unless the propellant generates gas early in the cycle. A faster-burning propellant matches that rapid volume expansion, reaching peak pressure close to the chamber and sustaining push before muzzle exit.[2]

When a cartridge has a large case relative to its bore, the reverse happens. Moving the bullet down the first several inches of rifling adds only a modest fraction to the initial combustion volume. A fast-burning powder would spike chamber pressure sharply while the bullet has barely cleared the throat, capping charge weight well below the case's physical capacity and leaving velocity on the table. A slower, more progressive propellant—with thicker grain web, deeper surface deterrence, or multi-perforated

geometry—holds early pressure in check while continuing to feed gas as the bullet accelerates down the bore.[3]

Two additional mechanical variables shift the optimal burn-rate window inside any given cartridge:

- **Projectile mass and bearing length.** Heavier bullets carry greater inertia and longer bearing surfaces, resisting initial acceleration and lingering longer in the throat. That extra residence time raises early chamber pressure, pushing optimal propellant selection slightly slower than for light-for-caliber projectiles in the same cartridge.[4]
- **Barrel length.** Slower, progressive propellants rely on barrel travel to convert late-burning gas into kinetic energy. As barrels shorten, unburned or late-burning gas exits the muzzle as blast and flash rather than projectile velocity, favoring slightly faster propellants that complete combustion earlier in the bore.[2]

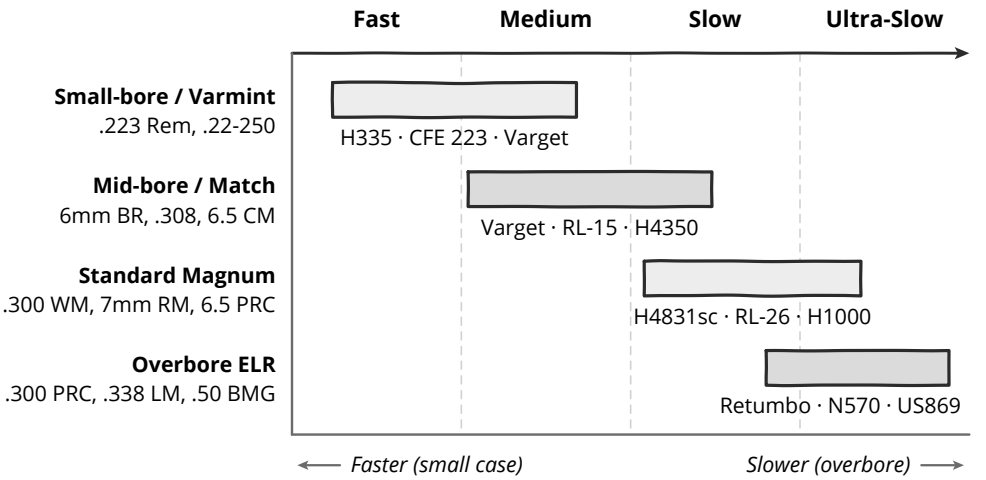


Figure 11-1. Relative burn-rate windows across four bottleneck cartridge classes from small-bore service rifles to overbore magnums.

Small-Bore Varmint and Service-Rifle Cartridges

Small-bore bottleneck cartridges—typified by the `.204 Ruger`, `.223 Remington` / `5.56×45mm NATO`, and `.222 Remington`—pair modest case capacities with narrow `.204`- to `.224`-inch bores. They sit toward the faster end of the rifle burn-rate spectrum, where thin-webbed single-base extrusions and fine-grained spherical powders dominate.[5]

Physical grain size matters disproportionately in small-bore cases. Narrow case necks bridge easily when fed long tubular sticks, creating irregular charge drops and air voids during high-volume loading. That mechanical reality explains why fine spherical propellants from St. Marks Powder and PB Clermont—such as `H335`, `BL-C(2)`, `CFE 223`, `Ramshot X-Terminator`, `Ramshot TAC`, and `Accurate 2230`—became staples in `.223 Remington` and `5.56mm NATO` production. Short-cut extruded formulations engineered specifically for small cases, including `H322`, `Benchmark`, `IMR 8208 XBR`, `Vihtavuori N133`, and `Alliant AR-Comp`, bridge the gap by pairing fine tubular metering with reduced thermal sensitivity.

Gas-Port Timing in Semi-Automatic Rifles

In bolt-action rifles, internal ballistics ends at muzzle exit. In gas-operated semi-automatic rifles—direct-impingement AR-15 and AR-10 platforms, M1 Garand and M14 actions, and gas-piston service rifles—propellant burn rate also drives the mechanical operating cycle. A small port drilled through the barrel wall taps high-pressure propellant gas at a fixed distance from the chamber to unlock the bolt and cycle the action.[3]

Gas-port pressure depends directly on the shape of the pressure-time curve at the exact millisecond the bullet passes the port:

- **Propellants matched to the gas system** reach peak pressure near the chamber and decay along a predictable slope, delivering enough impulse at the port to cycle reliably without excessive carrier speed.
- **Overly slow propellants** shift gas generation farther down the bore. Even when peak chamber pressure stays within safe SAAMI limits, residual bore pressure at the gas port remains elevated. In rifles with fixed gas ports and non-adjustable operating rods—most famously the long-stroke M1 Garand in `.30-06 Springfield`—excessive port pressure accelerates the operating rod, increases extraction stress while brass is still clinging to the chamber wall, and risks mechanical damage.[6]
- **Overly fast propellants** decay too steeply after peak pressure, leaving insufficient gas impulse at rifle-length ports and causing short-stroking or failure to lock open.

The `.22-250 Remington` illustrates how geometry overrides bullet diameter alone. Although it fires the same `.224`-inch projectiles as the `.223 Remington`, its substantially larger case capacity creates a much higher overbore ratio. As a result, its effective burn-rate window shifts noticeably slower—into the territory occupied by medium-fast to medium rifle powders such as `Varget`, `H380`, `IMR 4064`, `Vihtavuori N140`, and `Winchester 760`.

Mid-Bore Competition and Standard Hunting Cartridges

Mid-bore bottleneck cartridges form the center of gravity of the commercial rifle propellant market. They span compact benchrest cases (`6mm PPC`, `6mm BR Norma`), modern short-action competition and hunting standards (`6mm Creedmoor`, `6.5 Creedmoor`, `.308 Winchester`), and classic long-action cartridges (`.284 Winchester`, `.30-06 Springfield`). Because their overbore ratios sit in an efficient middle band, these cartridges accommodate the widest variety of propellant chemistries and grain geometries.

Within this broad class, internal geometry still carves out distinct burn-rate neighborhoods:

- **Compact high-efficiency benchrest cases** (`6mm PPC`, `6mm BR Norma`) have short powder columns and small capacities relative to their `6mm` bore. Fast-to-medium single-base extrusions such as `Vihtavuori N133`, `Benchmark`, `H322`, and `Accurate LT-32` fill the case cleanly and burn completely in match barrels.
- **Standard `.308`-class cases** (`.308 Winchester`, `7mm-08 Remington`) pair moderate capacity with wider `.284`- to `.308`-inch bores. Medium-rate extruded powders (`Varget`, `IMR 4064`, `IMR 4895`, `H4895`, `Vihtavuori N140`, `N150`, `Reloder 15`, `Norma 203-B`) and temperature-stabilized spherical grades (`Winchester StaBALL Match`, `CFE 223`) anchor this window.

- **Longer-column mid-bores** (6mm Creedmoor, 6.5 Creedmoor, .284 Winchester, .30-06 Springfield) carry higher case-capacity-to-bore-area ratios, especially with long, high-ballistic-coefficient match bullets seated deep into the case. Medium-slow propellants—the historic 4350 class (H4350, IMR 4350, SW4350), modern temperature-stabilized grades (Reloder 16, Vihtavuori N555, Winchester StaBALL 6.5), and Nitrochemie EI® formulations (RS60 / Reloder 17)—match their slower expansion curve.

Loading Density and Ignition Consistency

Mid-bore cartridges clearly demonstrate the role of **loading density**, the fraction of usable internal case volume occupied by the propellant charge. When a propellant's burn rate and bulk density match a cartridge well, working charges typically fill roughly 85 to 100 percent of the space below the seated bullet base. At high loading density, the primer's hot gas and incandescent particles traverse a uniform, tightly constrained bed of grains regardless of whether the rifle points uphill, level, or downhill.[7]

By contrast, selecting a propellant substantially faster than the case geometry calls for leaves excessive air space (ullage) above the powder bed. Depending on rifle orientation before firing, the charge can lie forward against the bullet base or back against the flash hole, altering ignition delay, flame-spread geometry, and shot-to-shot pressure uniformity. Conversely, choosing a powder far too slow for the case volume forces heavy compression before reaching useful operating pressure, risking crushed grains that fracture deterrent coatings and unpredictably alter burning surface area.

Overbore Magnum and Extreme Long-Range Cartridges

At the slow end of the bottleneck spectrum sit the overbore magnums and extreme long-range (ELR) cartridges: 6.5 PRC, 7mm PRC, .300 PRC, .300 Winchester Magnum, .338 Lapua Magnum, and .50 BMG. These cases hold massive propellant volumes behind relatively narrow bores, creating extreme overbore ratios that demand thick-webbed, deeply deterred, or multi-perforated progressive propellants.

Standard magnum cartridges (6.5 PRC, 7mm Remington Magnum, .300 Winchester Magnum) operate in the slow extruded and heavily deterred spherical window occupied by H4831 / H4831SC, H1000, IMR 7828, Vihtavuori N165, N565, Reloder 23, Reloder 26, Norma MRP, Winchester StaBALL HD, and Ramshot Magnum. Larger overbore and ELR designs (.300 PRC with heavy bullets, .338 Lapua Magnum, .375 CheyTac, .50 BMG) step even slower to ultra-thick-webbed grades such as Retumbo, Vihtavuori N568, N570, 20N29, 24N41, Reloder 33, Reloder 50, H50BMG, US 869, and Ramshot LRT.

Velocity Versus Throat Erosion: The Thermochemical Tradeoff

Overbore cartridges expose the central thermochemical tradeoff of modern rifle propellant design. Pushing heavy projectiles from large cases requires sustained high gas pressure, which manufacturers achieve through two distinct chemical philosophies:

- **Cooler-burning single-base extrusions** (such as H1000, Retumbo, and Vihtavuori N165) rely on nitrocellulose alone with thick webs and surface deterrents. Their lower adiabatic flame temperatures (T_v) reduce heat transfer into the barrel steel just ahead of the

chamber leade, moderating **throat erosion** and extending barrel service life at the cost of slightly lower peak muzzle velocity.[8]

- **High-energy double-base and infused propellants** (such as Vihtavuori's `N500` series and Nitrochemie's `EI®`-impregnated grades) incorporate nitroglycerin into the grain matrix to raise specific heat of explosion (`Q_ex`) and gas yield. That extra chemical energy delivers measurable velocity gains from the same case capacity, but higher flame temperatures accelerate thermal cracking (heat checking) and gas-wash erosion of the barrel throat.[9]

Barrel length also constrains overbore matching sharply. Slow progressive propellants need long barrels—commonly 24 to 30 inches in magnum and ELR rifles—to achieve high burn completion before bullet exit. Firing an ultra-slow magnum powder in a short sporting barrel wastes unconsumed energetic capacity at the muzzle, generating severe blast, flash, and recoil without realizing the propellant's velocity potential.

Cartridge Class	Representative Cartridges	Governing Mechanical Factors	Typical Propellant Families
Small-bore varmint & service	`.204 Ruger`, `.223 Rem` / `5.56 NATO`	Narrow necks, short dwell time, semi-auto gas-port pressure window	Fast spherical (`H335`, `TAC`, `CFE 223`, `AA2230`); short-cut extruded (`H322`, `Benchmark`, `8208 XBR`, `N133`, `AR-Comp`)
Compact & standard mid-bore	`6mm PPC/BR`, `.308 Win`, `7mm-08 Rem`	Moderate overbore ratio, high fill-ratio uniformity	Medium extruded (`Varget`, `N140`, `N150`, `IMR 4064`, `IMR 4895`, `RL-15`); stabilized ball (`StaBALL Match`)
Long-column mid-bore	`6mm/6.5mm Creedmoor`, `.284 Win`, `.30-06`	Higher overbore ratio with heavy bullets, thermal stability demand	Medium-slow extruded (`H4350`, `IMR 4350`, `N555`, `RL-16`, `RS60`); stabilized ball (`StaBALL 6.5`)
Overbore magnum & ELR	`6.5/7mm/300 PRC`, `.300 WM`, `.338 LM`, `.50 BMG`	Extreme overbore ratio, progressive burn, flame-temperature throat wear	Slow/very slow extruded (`H4831SC`, `H1000`, `Retumbo`, `N165`, `N565`, `N570`, `RL-26`, `RL-33`, `H50BMG`); slow ball (`StaBALL HD`, `LRT`, `US 869`)

Across every class, a burn-rate chart identifies the right physical neighborhood for a cartridge's geometry. It never establishes interchangeability between neighboring powders, because two formulations sitting side by side on a relative burn-rate list can differ markedly in bulk density, heat of explosion, progressivity, and pressure curve shape.

Chapter 12

Lot-to-Lot Variance, Chemical Aging, and Storage Stability

Key points

- Commercial canister propellants are blended to narrow tolerances, yet small shifts in nitration, residual volatiles, deterrent depth, web thickness, and bulk density still produce measurable lot-to-lot ballistic differences.
- Manufacturers and SAAMI warn against mixing different powders or combining separate lots because doing so destroys recall traceability, risks granular segregation, and can cross-contaminate fresh powder with aging decomposition gases.
- Nitrocellulose equilibrates with ambient relative humidity; moisture absorption depresses burn rate and pressure, whereas desiccation elevates both.
- All nitrate-ester propellants decompose slowly over time through `O-NO2` bond cleavage, relying on sacrificial stabilizers (such as diphenylamine, ethyl centralite, or Akardite II) to prevent autocatalytic self-heating.
- High storage heat accelerates stabilizer depletion exponentially under Arrhenius kinetics, as underscored by modern canister recalls such as IMR 4007 SSC (2015) and pre-October 2016 Valleyfield Accurate lots (2019).

Five Physical and Chemical Drivers of Lot-to-Lot Variance

Commercial smokeless propellant sold in retail canisters is known in the industry as **canister-grade powder**. Unlike bulk non-canister military propellants—where individual production lots can vary substantially and ammunition plants adjust charge weight for each lot during factory loading—canister propellants are blended and pressure-tested by the OEM and packager to hold internal ballistic performance within a specified tolerance window.[1]

Even within strict factory quality control, no two production campaigns are chemically or geometrically identical. Real-world lot-to-lot variance stems from five physical and chemical parameters in manufacturing:

1. **Nitration level and nitrogen content.** Nitrocellulose is synthesized from natural biological polymers—cotton linters or refined wood pulp—whose chain lengths and reactivity vary subtly from batch to batch. Small fluctuations in final nitrogen weight percent (typically controlled within the high-nitrogen propellant band around 12.6 to 13.4 percent nitrogen) directly alter specific heat of explosion (`Q_ex`), gas yield, and baseline burning speed.[2]
2. **Residual solvent and moisture equilibrium.** Solvent-extruded propellants use ether-alcohol, acetone, or ethyl acetate mixtures to gelatinize nitrocellulose before pressing. Water-leaching and thermal drying remove almost all solvent, yet a small fraction of residual volatile solvent and bound moisture remains trapped inside the polymer matrix. Minor differences in residual volatile content between drying runs shift the thermal energy absorbed during initial heating and modify the lot's effective burn rate.[3]

3. **Deterrent concentration and penetration depth.** Surface deterrents—such as dinitrotoluene (DNT), dibutyl phthalate (DBP), centralites, or modern polymeric coatings—are applied in tumbling drums or heated baths to slow early burning. Small variations in bath temperature, dwell time, coating concentration, or post-coating drying alter how deeply the deterrent diffuses into the grain exterior, changing the grain's progressivity profile.[4]
4. **Extrusion web thickness and die wear.** Under Piobert's law, the total burning duration of an extruded cylinder depends on its **web thickness** (`w`), the shortest distance the flame front must travel through solid propellant. For a single-perforated cylindrical grain:

```
w = (D − d) ÷ 2

w  web thickness (mm)
D  outer grain diameter (mm)
d  inner perforation diameter (mm)
```

Gradual abrasive wear on extrusion dies and cutter blades across long production runs subtly alters outer diameter, perforation concentricity, and grain length, shifting the ratio of burning surface area to propellant mass.[5]

5. **Bulk density and packing behavior.** Changes in grain cut length, flattening-roll compression on spherical powders, or the thickness of surface **graphite glazing** shift bulk packing density (in `g/L`). A bulk-density shift changes how a fixed mass fills a given cartridge case, modifying loading density and initial primer flame propagation through the powder bed.[6]

Evidence · Supported by data
Independent ballistic testing and manufacturer technical notices consistently confirm measurable velocity and chamber-pressure shifts between production lots of the same nominal canister powder—and between retail canisters packaged from the same OEM plant under different brand labels.[7] Because OEMs blend and certify each packager's lots to independent specifications, neither a new lot number nor a confirmed OEM twin guarantees identical pressure at the same charge weight.

Why Manufacturers Warn Against Mixing Lots or Formulations

Every major propellant manufacturer and the Sporting Arms and Ammunition Manufacturers' Institute (SAAMI) caution against combining different propellants—and against pouring separate production lots together into a single vessel.[8] Three physical and safety mechanisms explain why:

- **Incompatible combustion dynamics.** Mixing two different formulations—even powders with adjacent positions on a burn-rate chart—does not produce a clean average burn rate. Faster-burning grains ignite and raise chamber pressure early, accelerating the slower component along its pressure-exponent curve (`r = a × p^n`) and risking unpredictable pressure spikes.
- **Granular segregation.** Propellant grains differing even slightly in length, diameter, shape, or surface finish separate mechanically under vibration and pouring rather than remaining

uniformly distributed. A vessel shaken or carried can stratify into zones enriched in one component or lot.

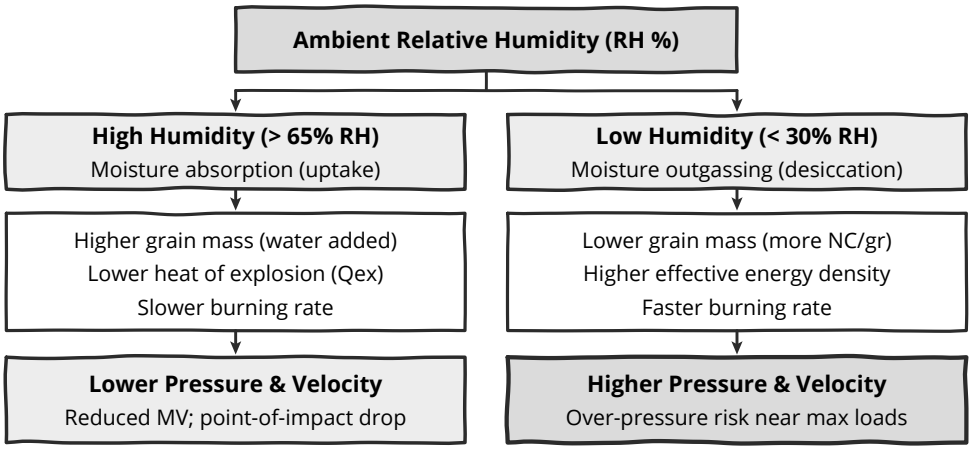
- **Loss of traceability and chemical cross-contamination.** Each factory container carries a stamped lot number tying that powder to specific manufacturing dates and stability surveillance records. Mixing lots destroys traceability during a safety recall. Worse, if one older lot has already begun releasing acidic nitrogen oxides, blending it with fresh powder exposes the entire batch to catalytic degradation gases.[9]

Moisture Equilibrium and Environmental Exposure

Nitrocellulose is mildly hygroscopic: exposed propellant continuously exchanges water vapor with the surrounding air until it reaches **moisture equilibrium** with ambient relative humidity (RH). Sealed factory containers slow this exchange dramatically, whereas open hoppers, loosely capped jugs, or containers opened repeatedly in extreme climates allow measurable moisture drift.[10]

Moisture acts as a thermal sink inside the combustion chamber, producing two opposite ballistic pathways:

- **High relative humidity (moisture absorption).** Water absorbed into the polymer matrix adds inert mass to every weighed grain of propellant. During ignition and burning, heat that would otherwise raise gas temperature and pressure must first vaporize that bound water. Effective heat of explosion (`Q_ex`) drops, burn rate slows, and both chamber pressure and muzzle velocity fall.[11]
- **Low relative humidity (desiccation).** Conversely, prolonged exposure to very dry air—such as heated winter indoor spaces or arid climates—draws equilibrium moisture out of the grains. Each unit of weighed propellant now contains a higher fraction of active nitrocellulose and less water vaporizing load. Effective `Q_ex` rises, burning accelerates, and peak chamber pressure climbs.[8]



Factory equilibrium baseline: ~50% RH at 21 °C (70 °F). Keep canisters tightly sealed.

Figure 12-1. Ambient relative humidity equilibrium pathways showing how moisture absorption and desiccation shift grain mass, heat of explosion, burn rate, and chamber pressure.

Because moisture transfer is reversible when chemical decomposition has not yet occurred, keeping factory canisters tightly sealed between uses and storing them in a stable, moderate-humidity environment prevents most environmental burn-rate drift.

Nitric Ester Decomposition Kinetics and Stabilizer Chemistry

Unlike inert metals or simple inorganic salts, every smokeless propellant is thermodynamically metastable. The nitrate-ester functional group (`R–O–NO2`) present in both nitrocellulose and nitroglycerin contains a relatively weak oxygen-nitrogen bond. Even at room temperature, slow thermal cleavage continuously breaks a tiny fraction of those bonds, liberating reactive nitrogen dioxide (`NO2`) and nitric oxide (`NO`) gases.[12]

If those nitrogen oxides remain free inside the propellant grain, they react with trace moisture to form nitric acid (`HNO3`) and nitrous acid (`HNO2`). Those acids attack adjacent nitrate-ester bonds directly, generating still more nitrogen oxides and releasing heat. Left unchecked, this self-reinforcing **autocatalysis** accelerates exponentially—degrading grain structure, destroying ballistic predictability, and eventually generating enough internal heat to trigger spontaneous combustion (thermal runaway or cook-off).[13]

Sacrificial Stabilizers

Modern smokeless propellants achieve multi-decade shelf life through **sacrificial stabilizers** incorporated at roughly 0.5 to 2.0 percent by weight during manufacture. Rather than halting initial `O–NO2` bond cleavage, stabilizers act as chemical traps that react preferentially with free `NO2` and acidic byproducts, neutralizing them into stable nitrated compounds before they can catalyze further nitrocellulose breakdown:[2]

- **Diphenylamine (DPA)** is the classic stabilizer for single-base nitrocellulose propellants. As DPA absorbs nitrogen oxides over decades, it converts sequentially through *N*-nitrosodiphenylamine to mono- and dinitro-diphenylamine derivatives—each step still offering residual stabilizing capacity until the chemical reserve nears exhaustion.
- **Ethyl centralite, methyl centralite, and Akardite II** are urea-derivative stabilizers standard in double-base and nitroglycerin-infused propellants. Traditional DPA is too basic for high-nitroglycerin formulations and can attack nitroglycerin ester linkages directly; centralites and Akardite II provide effective `NO2` scavenging without hydrolyzing nitroglycerin.[3]

Stabilizers are strictly consumable. Once a propellant's effective stabilizer reserve drops below a critical threshold, autocatalytic decomposition begins rapidly and cannot be reversed.

Arrhenius Thermal Acceleration

The rate of nitric ester decomposition obeys the **Arrhenius equation**, rising exponentially with absolute storage temperature:

```
k = A × exp(−Ea ÷ (R × T))

k   decomposition rate constant
A   pre-exponential frequency factor
Ea  activation energy (J/mol)
R   universal gas constant (8.314 J/(mol·K))
T   absolute storage temperature (K = °C + 273.15)
```

Under standard NATO and military propellant surveillance models (such as STANAG 4582 heat-flow calorimetry), nitric ester decomposition rates roughly triple to quadruple for every 10 °C (18 °F) increase in continuous storage temperature.[14] That exponential penalty governs practical shelf life far more than calendar age alone. A well-stabilized rifle propellant stored continuously in a cool, dry room near 20 °C (68 °F) can remain chemically sound for several decades. The same canister left in an unconditioned garage, attic, or metal shed cycling daily to 45–55 °C (113–131 °F) burns through its stabilizer reserve many times faster, compressing decades of safe service life into just a few years.[15]

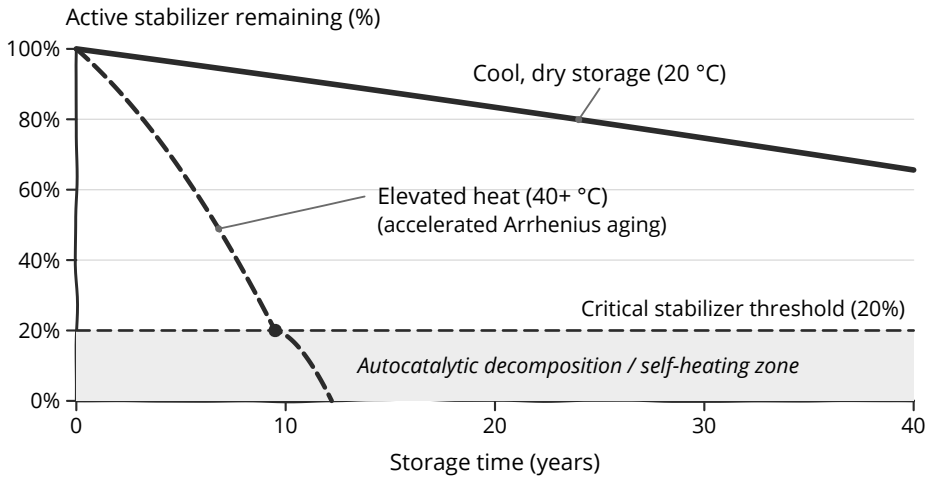


Figure 12-2. Stabilizer depletion and nitric ester autocatalytic decomposition curve showing safe service life versus accelerated thermal aging.

Lessons from Modern Stability Recalls

Although nineteenth- and early twentieth-century warship magazine disasters drove the invention of modern stabilizer chemistry, accelerated chemical aging is not purely historical. Two major twenty-first-century commercial recalls demonstrated why lot traceability and routine inspection remain essential:

- **September 2015 — IMR 4007 SSC recall.** Hodgdon Powder Company issued an immediate recall covering all lots of IMR 4007 SSC in both 1-pound and 8-pound containers after testing confirmed rapid chemical deterioration in specific lots. The company warned that degraded canisters could undergo spontaneous combustion or fire, and permanently discontinued the formulation.[16]

- **November 2019 — Accurate 2495, 4064, and 4350 recall.** Western Powders issued a safety recall covering designated pre-October 2016 lots of Accurate 2495, Accurate 4064, and Accurate 4350 produced in Canada (at the GD-OTS Valleyfield plant) after stability surveillance detected accelerated degradation capable of spontaneous ignition.[17]

Both events involved modern, factory-sealed commercial canister propellants from established manufacturing lines. Keeping powder in its original labeled container—with its factory lot number intact—is what makes it possible to check a shelf against a manufacturer recall notice years after purchase.

Field Inspection and Storage Principles

Smokeless propellant gives clear physical and sensory warnings before reaching the late stages of autocatalytic decomposition. Inspecting stored canisters periodically—especially older stock or containers exposed to warm climates—catches failing powder early.[8]

> **Safety**
> Degraded smokeless propellant is an active fire and pressure hazard—never load, shoot, or ignore deteriorating powder. Four classic warning signs indicate advanced nitric ester decomposition:
>
> 1. **Acrid, acidic odor.** Fresh smokeless powder has a faint, sweet-to-neutral ether, acetone, or solvent smell (or almost no odor at all). Failing powder emits a sharp, pungent, biting acidic or nitrous odor that irritates the nostrils.
> 2. **Rust-colored dust or fumes.** Visible reddish-brown, orange, or rust-tinted dust coating the grains or container walls—or brownish `NO2` vapor when opened—confirms active decomposition.
> 3. **Clumping or grain distortion.** Grains that cake together into hard lumps, soften, crumble into sticky residue, or lose their crisp surface finish are chemically breaking down.
> 4. **Container heat or deformation.** A canister that feels warm to the touch, bulges from trapped gas, or shows brittle, discolored plastic signals active exothermic reaction.
>
> If any of these signs appear, immediately submerge or thoroughly douse the propellant in clean water to arrest self-heating, keep it away from ignition sources, and contact the manufacturer or local fire authority for safe disposal instructions.[8]

Sound storage practices extend safe service life directly from the underlying chemistry:

- **Control temperature first.** Store propellants in a cool, dry indoor location with stable ambient temperature, away from furnaces, water heaters, attics, garages, and direct sunlight.[8]
- **Keep original containers sealed.** Factory plastic and lined fiber canisters are engineered to resist static buildup, vent safely rather than fragmenting in a fire, and preserve product identity and lot numbers. Never transfer smokeless powder into heavy-walled airtight metal vessels, glass jars, or unlabeled containers.[8]
- **Inspect older stock on a schedule.** Checking odor and grain appearance whenever opening an older container—and checking lot numbers against manufacturer safety bulletins—catches isolated stability failures long before they become a bench or storage hazard.

V

Part V

Empirical Burn Rate Reference and Propellant Compendium

This reference part brings together the empirical burn-rate hierarchy derived across 143 smokeless propellants and a 135-entry Propellant Compendium covering four foundational historical milestones plus every bottleneck rifle propellant in the database.

Use the Empirical Burn Rate Table below to locate propellants by relative speed and jump directly to each powder's Compendium entry by page number. In the Compendium itself, entries are grouped by retail brand with right-edge thumb tabs for rapid lookup; every modern database entry pairs historical and technical commentary with a verified specification card and a scannable QR link to its live technical record.

ONLINE REFERENCE · EMPIRICAL BURN RATE CHART

View the live, searchable empirical burn-rate chart—updated continuously from published rifle load data—at empiricalprecision.com/burn-chart.

empiricalprecision.com/burn-chart

Empirical Burn Rate Table **73**
Accurate **77**
Alliant **85**
Hodgdon **94**
IMR **106**
Norma **119**
Ramshot **127**
Reload Swiss **131**
Shooters World **139**
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Empirical Burn Rate Table

Propellants are ordered from fastest (#001) to slowest (#143) by relative maximum charge weight fitted across shared published rifle tests. Density and heat of explosion (Qex) come from the database reference catalog. Page numbers point directly to each bottleneck rifle powder's Compendium entry; a dash (—) marks fast handgun or subsonic-only powders kept in the table solely to preserve the complete burn-rate scale. Never treat neighboring powders on any burn-rate chart as interchangeable.

Rank	Powder	Brand	OEM Plant	Grain	g/L	kJ/kg	Page
#001	**Trail Boss**	Hodgdon	—	Ext. 1-perf	310	3,500	—
#002	**N105**	Vihtavuori	—	Ext. 1-perf	730	3,950	—
#003	**No. 9**	Accurate	—	Spherical	970	4,000	—
#004	**R123**	Norma	—	Ext. 1-perf	920	4,000	—
#005	**2400**	Alliant	—	Extruded	905	3,780	—
#006	**N110**	Vihtavuori	—	Ext. 1-perf	800	3,950	—
#007	**4100**	Accurate	—	Spherical	950	4,087	—
#008	**H4227**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	870	3,880	**100**
#009	**RS30**	Reload Swiss	—	Extruded	820	4,000	—
#010	**H110**	Hodgdon	—	Spherical	970	4,300	—
#011	**No. 11FS**	Accurate	—	Spherical	990	3,950	—
#012	**4227**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	880	4,020	**111**
#013	**Power Pro 300-MP**	Alliant	—	Spherical	950	3,600	—
#014	**5744**	Accurate	GD-OTS Canada (CA)	Ext. 1-perf	860	4,310	**83**
#015	**Lil'Gun**	Hodgdon	—	Spherical	890	3,752	—
#016	**SBR-SOCOM**	Shooters World	Explosia (CZ)	Spherical	970	4,100	**144**
#017	**N120**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	860	3,620	**150**
#018	**RS36**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	910	3,950	**131**
#019	**4198**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	830	4,024	**110**
#020	**H4198**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	870	3,680	**99**
#021	**Reloder 7**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	940	3,600	**87**
#022	**Blackout**	Shooters World	Explosia (CZ)	Spherical	980	3,950	**140**
#023	**LT-30**	Accurate	GD-OTS Canada (CA)	Ext. 1-perf	992	3,620	**83**
#024	**N130**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	870	3,700	**151**
#025	**1680**	Accurate	GD St. Marks (US)	Spherical	970	3,900	**77**
#026	**CFE BLK**	Hodgdon	GD St. Marks (US)	Spherical	970	3,800	**96**
#027	**Reloder 10x**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	885	3,850	**88**
#028	**200**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	920	3,940	**119**
#029	**LT-32**	Accurate	GD-OTS Canada (CA)	Extruded	906	3,800	**84**
#030	**Power Pro 1200-R**	Alliant	GD St. Marks (US)	Spherical	980	3,950	**85**
#031	**2200**	Accurate	GD St. Marks (US)	Spherical	880	4,000	**78**
#032	**N133**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	870	3,600	**151**
#033	**2015**	Accurate	GD-OTS Canada (CA)	Ext. 1-perf	962	3,650	**78**
#034	**H322**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	940	3,650	**97**
#035	**N530**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	930	3,950	**157**
#036	**RS40**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	940	3,950	**132**
#037	**The Patriot**	Shooters World	RDM / Somchem (ZA)	Spherical	975	3,667	**148**
#038	**3031**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	935	3,620	**106**
#039	**N135**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	870	3,550	**152**
#040	**Benchmark**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	906	3,620	**94**
#041	**AR-Comp**	Alliant	Eurenco Bofors (SE)	Extruded	932	3,620	**85**

Empirical Burn Rate Table (continued)

Rank	Powder	Brand	OEM Plant	Grain	g/L	kJ/kg	Page
#042	**AR Plus**	Shooters World	Explosia (CZ)	Spherical	986	3,600	**139**
#043	**2230**	Accurate	PB Clermont (BE)	Spherical	986	3,710	**79**
#044	**X-Terminator**	Ramshot	PB Clermont (BE)	Spherical	986	4,000	**130**
#045	**8208 XBR**	IMR	Thales / ADI (AU)	Ext. 1-perf	920	3,720	**118**
#046	**H335**	Hodgdon	GD St. Marks (US)	Spherical	1010	3,800	**97**
#047	**H4895**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	964	3,670	**102**
#048	**2460**	Accurate	PB Clermont (BE)	Spherical	996	3,680	**79**
#049	**201**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	900	3,980	**120**
#050	**2495**	Accurate	GD-OTS Canada (CA)	Ext. 1-perf	992	3,750	**80**
#051	**4166**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	900	3,640	**109**
#052	**202**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	920	3,760	**121**
#053	**Tactical Rifle**	Shooters World	Explosia (CZ)	Spherical	970	3,950	**146**
#054	**4895**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	966	3,640	**115**
#055	**TAC**	Ramshot	PB Clermont (BE)	Spherical	938	3,750	**130**
#056	**4064**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	933	3,790	**108**
#057	**N140**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	910	3,700	**153**
#058	**RS50**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	950	3,750	**133**
#059	**Varget**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	960	3,620	**105**
#060	**RS52**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	950	3,900	**133**
#061	**Power Pro Varmint**	Alliant	GD St. Marks (US)	Spherical	945	3,680	**87**
#062	**N150**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	910	3,750	**154**
#063	**4320**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	992	3,600	**111**
#064	**Precision Rifle**	Shooters World	Explosia (CZ)	Ext. 1-perf	900	3,600	**143**
#065	**4064**	Accurate	GD-OTS Canada (CA)	Ext. 1-perf	900	3,750	**82**
#066	**203B**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	920	3,910	**122**
#067	**2520**	Accurate	PB Clermont (BE)	Spherical	970	3,730	**80**
#068	**Reloder 15**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	935	3,990	**88**
#069	**N540**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	940	3,980	**158**
#070	**Match Rifle**	Shooters World	Explosia (CZ)	Spherical	970	4,100	**142**
#071	**748**	Winchester	GD St. Marks (US)	Spherical	971	3,700	**164**
#072	**The Creed**	Shooters World	RDM / Somchem (ZA)	Spherical	983	3,568	**147**
#073	**StaBALL Match**	Winchester	GD St. Marks (US)	Spherical	960	3,850	**168**
#074	**BL-C(2)**	Hodgdon	GD St. Marks (US)	Spherical	995	3,800	**95**
#075	**Reloder TS 15.5**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	890	3,650	**93**
#076	**Leverevolution**	Hodgdon	GD St. Marks (US)	Spherical	1045	4,000	**103**
#077	**CFE 223**	Hodgdon	GD St. Marks (US)	Spherical	980	3,800	**95**
#078	**Long Rifle**	Shooters World	Explosia (CZ)	Ext. 1-perf	910	3,600	**141**
#079	**RS60**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	970	4,000	**134**
#080	**H380**	Hodgdon	GD St. Marks (US)	Spherical	940	4,000	**98**
#081	**Power Pro 2000-MR**	Alliant	GD St. Marks (US)	Spherical	950	4,000	**86**
#082	**N550**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	950	3,990	**159**
#083	**Big Game**	Ramshot	PB Clermont (BE)	Spherical	980	4,000	**127**
#084	**4007 SSC**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	932	3,580	**107**
#085	**2700**	Accurate	GD St. Marks (US)	Spherical	980	4,200	**81**
#086	**H414**	Hodgdon	GD St. Marks (US)	Spherical	980	4,100	**98**
#087	**RS62**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	960	3,750	**135**
#088	**Reloder 17**	Alliant	Nitrochemie (CH/DE)	Ext. 1-perf	970	4,000	**89**
#089	**760**	Winchester	GD St. Marks (US)	Spherical	971	4,050	**165**
#090	**4451**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	960	3,580	**113**

Empirical Burn Rate Table (continued)

Rank	Powder	Brand	OEM Plant	Grain	g/L	kJ/kg	Page
#091	**H4350**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	990	3,590	**100**
#092	**Hybrid 100V**	Hodgdon	GD St. Marks (US)	Extruded	890	3,620	**102**
#093	**Reloder 16**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	900	3,800	**89**
#094	**4350**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	930	3,580	**112**
#095	**URP**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	910	4,017	**126**
#096	**4350**	Accurate	GD-OTS Canada (CA)	Ext. 1-perf	955	3,590	**82**
#097	**204**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	950	3,950	**123**
#098	**RS70**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	990	3,900	**136**
#099	**N160**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	920	3,560	**155**
#100	**StaBALL 6.5**	Winchester	GD St. Marks (US)	Spherical	990	3,820	**166**
#101	**4831**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	930	3,575	**114**
#102	**4955**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	992	3,560	**115**
#103	**SW4350**	Shooters World	Explosia (CZ)	Ext. 1-perf	920	3,580	**145**
#104	**Hunter**	Ramshot	PB Clermont (BE)	Spherical	940	3,800	**128**
#105	**N555**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	900	3,700	**160**
#106	**Power Pro 4000-MR**	Alliant	GD St. Marks (US)	Spherical	980	4,100	**86**
#107	**Reloder 19**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	940	3,900	**90**
#108	**3100**	Accurate	Explosia / Lovex (CZ)	Ext. 1-perf	920	3,600	**81**
#109	**Reloder 23**	Alliant	Eurenco Bofors (SE)	Ext. multi	920	3,800	**91**
#110	**SUPERFORMANCE**	Hodgdon	GD St. Marks (US)	Spherical	1020	4,300	**104**
#111	**H4831**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	930	3,570	**101**
#112	**H4831SC**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	992	3,570	**101**
#113	**Reloder 22**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	940	3,980	**90**
#114	**7828SSC**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	960	3,900	**116**
#115	**7828**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	992	3,550	**116**
#116	**MRP**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	960	3,873	**125**
#117	**N560**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	955	3,970	**160**
#118	**N165**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	930	3,560	**156**
#119	**RS76**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	990	3,850	**137**
#120	**Supreme 780**	Winchester	GD St. Marks (US)	Spherical	992	3,600	**169**
#121	**Reloder 26**	Alliant	Nitrochemie (CH/DE)	Ext. multi	994	4,200	**92**
#122	**7977**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	920	3,827	**117**
#123	**RS80**	Reload Swiss	Nitrochemie (CH)	Ext. 1-perf	1000	3,850	**138**
#124	**N565**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	950	3,960	**161**
#125	**Reloder 25**	Alliant	Eurenco Bofors (SE)	Ext. 1-perf	915	3,990	**91**
#126	**H1000**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	920	3,441	**99**
#127	**MagPro**	Accurate	GD St. Marks (US)	Spherical	978	3,900	**84**
#128	**N170**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	960	3,700	**157**
#129	**Retumbo**	Hodgdon	Thales/ADI (AU)	Ext. multi	960	3,444	**103**
#130	**Grand**	Ramshot	GD St. Marks (US)	Spherical	980	4,000	**128**
#131	**217**	Norma	Eurenco Bofors (SE)	Ext. 1-perf	920	3,766	**124**
#132	**Magnum**	Ramshot	PB Clermont (BE)	Spherical	995	4,000	**129**
#133	**8133**	IMR	GD-OTS Canada (CA)	Ext. 1-perf	960	3,703	**117**
#134	**StaBALL HD**	Winchester	GD St. Marks (US)	Spherical	980	3,800	**167**
#135	**N570**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	970	3,930	**163**
#136	**N568**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	960	3,850	**162**
#137	**24N41**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	970	3,700	**150**
#138	**Reloder 33**	Alliant	Nitrochemie (CH/DE)	Ext. 1-perf	920	3,900	**92**
#139	**Reloder 50**	Alliant	Nitrochemie (CH/DE)	Ext. 1-perf	890	3,800	**93**

Empirical Burn Rate Table (continued)

Rank	Powder	Brand	OEM Plant	Grain	g/L	kJ/kg	Page
#140	**H50BMG**	Hodgdon	Thales/ADI (AU)	Ext. 1-perf	980	3,205	**96**
#141	**LRT**	Ramshot	PB Clermont (BE)	Spherical	980	3,605	**129**
#142	**US 869**	Hodgdon	GD St. Marks (US)	Spherical	970	4,200	**104**
#143	**20N29**	Vihtavuori	Vihtavuori (FI)	Ext. 1-perf	960	3,600	**149**

Accurate

Accurate 1680

Proprietary (ex-D063) · Burn Rank #025

Accurate 1680 entered the commercial catalog during the Accurate Arms era of the 1990s, originally sourced from Explosia in the Czech Republic alongside the Lovex D063 formulation. Following Western Powders' acquisition of Accurate in 2004 and Hodgdon's purchase of Western Powders in 2020, modern spherical production transitioned into North American and allied ball-powder supply lines led by General Dynamics St. Marks Powder in Florida. Its numeric designation places it among Accurate's fastest bottleneck rifle propellants.

Engineered as a fast-burning, fine-grained double-base ball propellant, Accurate 1680 meters smoothly through progressive measures and generates ample gas volume at moderate chamber pressures. That combustion profile made it a benchmark choice for cycling gas-operated rifles in 7.62x39mm and .300 AAC Blackout, particularly with heavy subsonic projectiles, as well as classic small-case cartridges like the .22 Hornet. Because OEM sourcing shifted over decades, handloaders must always verify data for the exact canister lot in hand.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (ex-D063)**
Introduced	**1990s**
Class	**DB spherical (ball)**
Burn Rank	**#025 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**3,900 kJ/kg**
Role	**Small-capacity & subsonic carbine**
Status	**Active**

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Accurate 2015

Proprietary · Burn Rank #033

Accurate Arms launched this propellant in the 1980s under the name 2015 BR to court short-range benchrest competitors seeking fine-grained extruded consistency. Early commercial lots were imported from Explosia in the Czech Republic, sharing burn-rate heritage with the Lovex S060 family before Western Powders later moved manufacture to General Dynamics Ordnance and Tactical Systems Canada in Valleyfield, Quebec. After Hodgdon acquired Western Powders in 2020, the simplified Accurate 2015 label remained an active mainstay.

As a fast-medium single-base extruded powder cut into short cylindrical kernels, Accurate 2015 bridges the gap between very fast carbine propellants and standard .223-class stick powders. Its compact geometry meters more uniformly than traditional long-grain extruded sticks while burning cleanly across broad pressure bands. It fits small-to-medium bottleneck cartridges including .222 Remington, .223 Remington, .204 Ruger, 6mm PPC, and light-bullet .308 Winchester, though older Czech and modern Canadian lots should never be treated as interchangeable.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD-OTS Canada (CA)**
OEM / Twin	**Proprietary**
Introduced	**1980s (as 2015 BR)**
Class	**SB extruded (short)**
Burn Rank	**#033 of 143**
Bulk Density	**962 g/L**
Heat (Qex)	**3,650 kJ/kg**
Role	**Small-bore varmint & benchrest**
Status	**Active**

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Accurate 2200

Proprietary (ex-DP2200) · Burn Rank #031

Accurate 2200 first appeared in the 1990s as Data Powder 2200 (DP-2200), a military-surplus bulk spherical propellant sold in economy jugs by Accurate Arms until surplus stocks ran dry. Recognizing persistent demand from high-volume small-bore shooters, Western Powders reintroduced Accurate 2200 as a newly manufactured canister propellant around 2009 through General Dynamics St. Marks Powder in Crawfordville, Florida. Hodgdon retained the powder in its Accurate catalog following the 2020 acquisition.

Formulated as a fast double-base spherical powder sitting just faster than Accurate 2230, Accurate 2200 delivers brisk velocity and clean volumetric metering in compact bottleneck cases. Its high energy density and free-flowing ball geometry suit progressive presses loading .223 Remington with lighter varmint bullets, as well as modern intermediate AR-15 cartridges such as 6.8 Remington SPC, 6.5 Grendel, and .22 Nosler. Legacy surplus DP-2200 data must never be applied to current commercial canisters.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (ex-DP2200)**
Introduced	**1990s (commercial 2009)**
Class	**DB spherical (ball)**
Burn Rank	**#031 of 143**
Bulk Density	**880 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**Small-bore & intermediate AR carbines**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 2230

PB Clermont (X-Term twin) · Burn Rank #043

Accurate 2230 takes its name directly from the .223 Remington cartridge it was brought to market to serve during the early Accurate Arms years in the 1980s. Early canisters originated from Explosia in the Czech Republic, but after Western Powders consolidated Accurate alongside its Ramshot brand in 2004, production aligned with PB Clermont in Engis, Belgium. Hodgdon continues to market Accurate 2230 under the Accurate label following its 2020 acquisition of Western Powders.

A double-base spherical propellant, Accurate 2230 flows effortlessly through progressive powder measures and packs densely into compact cases. It is the confirmed PB Clermont counterpart to Ramshot X-Terminator—not Accurate 2520, which sits notably slower—yet lot-to-lot variance and separate packager testing preclude grain-for-grain substitution without consulting published data for the exact canister in hand. Its burn rate excels in .223 Remington, 5.56x45mm NATO, .204 Ruger, .222 Remington, and light-bullet .308 Winchester.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**PB Clermont (X-Term twin)**
Introduced	**1980s**
Class	**DB spherical (ball)**
Burn Rank	**#043 of 143**
Bulk Density	**986 g/L**
Heat (Qex)	**3,710 kJ/kg**
Role	**Small-bore & .223/5.56 progressive**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 2460

Proprietary · Burn Rank #048

Introduced by Accurate Arms in the 1980s as a slightly slower companion to Accurate 2230, Accurate 2460 bridged small-bore varmint rounds and standard .308-class cartridges. Early Accurate Arms canisters were sourced from Explosia in the Czech Republic before Western Powders transitioned spherical production to PB Clermont in Engis, Belgium, with select domestic supply channels also utilizing St. Marks Powder over time. Hodgdon kept Accurate 2460 in active distribution after buying Western Powders in 2020.

Accurate 2460 is a dense, free-flowing double-base spherical propellant sitting in the same medium burn-rate corridor as Ramshot TAC and just faster than Accurate 2520. Its high bulk density permits generous case fill without compression in mid-capacity bottleneck cartridges, making it well suited to progressive loading in heavy-bullet .223 Remington, 6.5 Grendel, .308 Winchester, and .30-30 Winchester. As with all multi-era spherical imports, handloaders must consult current published data matching their canister.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**Proprietary**
Introduced	**1980s**
Class	**DB spherical (ball)**
Burn Rank	**#048 of 143**
Bulk Density	**996 g/L**
Heat (Qex)	**3,680 kJ/kg**
Role	**Small-bore heavy & mid-bore rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 2495

Proprietary · Burn Rank #050

Accurate Arms introduced Accurate 2495 in the 1980s, deliberately echoing the classic 4895 numbering to signal its suitability for military service rifles and versatile mid-bore cartridges. Originally manufactured by Explosia in the Czech Republic, production later moved under Western Powders to General Dynamics Ordnance and Tactical Systems Canada in Valleyfield, Quebec, built to Accurate's independent specification rather than duplicating IMR 4895. Hodgdon assumed the brand in October 2020.

As a medium-burning single-base extruded propellant, Accurate 2495 delivers steady port pressures compatible with semi-automatic gas systems such as the M1 Garand and M14 alongside bolt-action .308 Winchester, .30-06 Springfield, and heavy-bullet .223 Remington rifles. In November 2019, Western Powders issued a safety recall covering specific Valleyfield-manufactured lots of Accurate 2495 produced prior to October 2016 after accelerated-aging tests identified potential nitric-ester degradation; affected lots should be destroyed rather than fired.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD-OTS Canada (CA)**
OEM / Twin	**Proprietary**
Introduced	**1980s**
Class	**SB extruded**
Burn Rank	**#050 of 143**
Bulk Density	**992 g/L**
Heat (Qex)	**3,750 kJ/kg**
Role	**Service rifle & mid-bore standard**
Status	**Active (2019 pre-2016 lot recall)**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 2520

Proprietary · Burn Rank #067

Accurate 2520 earned the nickname 'Camp Perry powder' during the 1980s and 1990s for its strong showing in High Power service-rifle competition with M14 and AR-15 rifles. Originally imported by Accurate Arms from Explosia in the Czech Republic, its manufacture later transitioned under Western Powders to Belgian spherical production at PB Clermont in Engis, Belgium, with St. Marks Powder also supplying domestic Accurate ball lines across shifting eras. Hodgdon retained the line after 2020.

Sitting slightly slower than Accurate 2460 and Ramshot TAC, Accurate 2520 is a dense double-base ball powder distinct from Ramshot X-Terminator, which pairs instead with faster Accurate 2230. Its uniform spherical granules meter reliably for high-volume match preparation while generating competitive velocities in .308 Winchester, heavy-bullet .223 Remington, 6.5 Grendel, and 6mm ARC. Because double-base spherical lots can vary across OEM transitions, separate published data must always be used for each brand and era.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**Proprietary**
Introduced	**1980s**
Class	**DB spherical (ball)**
Burn Rank	**#067 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**3,730 kJ/kg**
Role	**Match service rifle & .308 class**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 2700

Proprietary · Burn Rank #085

Accurate Arms introduced Accurate 2700 in the 1980s as a medium-slow double-base spherical rifle propellant aimed squarely at standard North American big-game cartridges such as the .270 Winchester. Manufactured domestically by General Dynamics St. Marks Powder in Crawfordville, Florida, it remained a fixture through Western Powders' ownership from 2004 onward and entered Hodgdon's portfolio in October 2020. Its numbering reflects its classic placement just above the 2520 medium-rifle tier.

Positioned in the burn-rate corridor near Winchester 760 and the discontinued Hodgdon H414, Accurate 2700 combines high bulk density with the smooth metering expected of double-base ball propellants. Its higher heat of explosion supports strong velocities across mid-capacity and standard bottleneck cartridges including .22-250 Remington, .243 Winchester, 7mm-08 Remington, .270 Winchester, and .30-06 Springfield. Although it shares St. Marks manufacturing heritage with other spherical lines, independent specifications prevent blind substitution.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary**
Introduced	**1980s**
Class	**DB spherical (ball)**
Burn Rank	**#085 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**4,200 kJ/kg**
Role	**Mid-bore & standard hunting rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 3100

Lovex S071 (legacy) · Burn Rank #108

Accurate 3100 served as Accurate Arms' flagship slow-burning extruded rifle powder during the 1980s and 1990s, filling the 4831-class magnum niche alongside classic American stick propellants. Sourced from Explosia in Pardubice, Czech Republic—associated with the legacy Lovex S071 formulation—it earned a loyal following among hunters loading long-action and belted-magnum cartridges. After Western Powders acquired Accurate in 2004, rising overseas supply costs and sourcing changes ended commercial production, and Accurate 3100 was formally discontinued.

Formulated as a single-base cylindrical extruded propellant with a moderate heat of explosion, Accurate 3100 delivered gentle pressure curves and full case fill in overbore bottleneck cases such as .25-06 Remington, .270 Winchester, 7mm Remington Magnum, and .300 Winchester Magnum. Remaining canisters in private hands should be inspected carefully for acidic odor or reddish-brown dust before use, and modern handloaders looking for a similar burn rate must start fresh with current published data for active replacements.

Propellant specifications

Packager	**Accurate Arms / Western Powders**
OEM Plant	**Explosia / Lovex (CZ)**
OEM / Twin	**Lovex S071 (legacy)**
Introduced	**1980s**
Class	**SB extruded**
Burn Rank	**#108 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Overbore standard & belted magnum**
Status	**Discontinued**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 4064

Proprietary · Burn Rank #065

Western Powders introduced Accurate 4064 in the 2000s, adopting the iconic 4064 designation to signal a versatile medium-burning extruded propellant positioned alongside classic .308 and .30-06 sticks. Early European sourcing drew on Explosia in the Czech Republic (parallel to Lovex S062 era lines) before production shifted to General Dynamics Ordnance and Tactical Systems Canada in Valleyfield, Quebec, built to Accurate's own specification. Despite sharing the Valleyfield plant with IMR 4064, the two were never identical twins.

A single-base extruded powder cut slightly shorter than legacy DuPont-pattern 4064 sticks, Accurate 4064 improves metering while covering .22-250 Remington, .308 Winchester, 7mm-08 Remington, and .30-06 Springfield. In November 2019, Western Powders recalled specific Valleyfield lots manufactured prior to October 2016 due to stabilizer depletion risks that could cause autocatalytic degradation. Handloaders must verify lot codes against the official recall list and never substitute IMR 4064 charge tables for Accurate 4064.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD-OTS Canada (CA)**
OEM / Twin	**Proprietary**
Introduced	**2000s**
Class	**SB extruded**
Burn Rank	**#065 of 143**
Bulk Density	**900 g/L**
Heat (Qex)	**3,750 kJ/kg**
Role	**Mid-bore & .30-caliber standard**
Status	**Active (2019 pre-2016 lot recall)**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 4350

Proprietary · Burn Rank #096

Accurate 4350 joined the famous 4350 naming lineage during the 1990s to give handloaders an Accurate-branded extruded option in the industry's most popular medium-slow burn band. Originally imported from Explosia in the Czech Republic (historically associated with the Lovex S070 era), manufacture moved under Western Powders to General Dynamics Ordnance and Tactical Systems Canada in Valleyfield, Quebec, engineered to Accurate's own specifications. Although produced at the same Quebec plant as IMR 4350, Accurate 4350 is not an identical twin.

Cut into short single-base extruded grains for cleaner volumetric throwing, Accurate 4350 serves 6.5 Creedmoor, .243 Winchester, .270 Winchester, .280 Remington, and .30-06 Springfield with smooth pressure curves and high loading density. Specific pre-October 2016 Valleyfield lots were included in Western Powders' November 2019 stability recall and must be checked before use. Independent chemistry and lot tolerances mean IMR 4350 or Hodgdon H4350 data can never be substituted directly.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD-OTS Canada (CA)**
OEM / Twin	**Proprietary**
Introduced	**1990s**
Class	**SB extruded**
Burn Rank	**#096 of 143**
Bulk Density	**955 g/L**
Heat (Qex)	**3,590 kJ/kg**
Role	**Mid-bore & long-action standard**
Status	**Active (2019 pre-2016 lot recall)**

Live spec card
empiricalprecision.com
Components · Powders

Accurate 5744

Proprietary (ex-D060) · Burn Rank #014

Originally marketed by Accurate Arms in the 1990s as XMR 5744 (for Extruded Magnum Rifle), Accurate 5744 filled a specialized niche for very fast, easy-igniting stick propellants. Early lots were manufactured by Explosia in the Czech Republic in the Lovex D060 double-base lineage—where the D prefix denotes double-base chemistry—before Western Powders transferred production to General Dynamics Ordnance and Tactical Systems Canada in Valleyfield, Quebec. Hodgdon kept Accurate 5744 active after acquiring Western Powders in 2020.

Unlike most single-base extruded rifle powders, Accurate 5744 incorporates nitroglycerin in a short, bulky extruded grain that ignites cleanly even at low loading densities. That low position sensitivity made it a favorite for black-powder-era bottleneck and straight-wall cartridges, heavy-for-caliber subsonic work, and reduced-recoil rifle loads in standard cases such as .30-30 Winchester, .308 Winchester, and .30-06 Springfield. Its elevated heat of explosion reflects its double-base formulation.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD-OTS Canada (CA)**
OEM / Twin	**Proprietary (ex-D060)**
Introduced	**1990s (as XMR 5744)**
Class	**DB extruded**
Burn Rank	**#014 of 143**
Bulk Density	**860 g/L**
Heat (Qex)	**4,310 kJ/kg**
Role	**Reduced-load & large-case fast rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate LT-30

Proprietary · Burn Rank #023

Western Powders launched Accurate LT-30 in 2014 as a faster sibling to LT-32, with the ‘LT’ prefix denoting Light Target competition propellants and ‘30' nodding to the .30 BR benchrest cartridge. Manufactured for the Accurate line by General Dynamics Ordnance and Tactical Systems Canada in Valleyfield, Quebec, LT-30 was developed with direct input from score-shooting competitors who needed a clean, consistent extruded alternative to erratic surplus lots. Hodgdon retained it in the Accurate catalog after 2020.

Formulated as an ultra-fine single-base extruded propellant, Accurate LT-30 meters through precision benchrest powder throwers with minimal kernel bridging and delivers uniform ignition in short, efficient bottleneck cases. Beyond its flagship role in the .30 BR, its fast burn rate suits .221 Fireball, .222 Remington, and light-bullet .223 Remington varmint loads where crisp combustion and low velocity dispersion take priority over maximum heavy-bullet velocity.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD-OTS Canada (CA)**
OEM / Twin	**Proprietary**
Introduced	**2014**
Class	**SB extruded (micro)**
Burn Rank	**#023 of 143**
Bulk Density	**992 g/L**
Heat (Qex)	**3,620 kJ/kg**
Role	**Short-range benchrest & small-bore**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate LT-32

Proprietary · Burn Rank #029

Western Powders introduced Accurate LT-32 in 2012 to answer short-range group benchrest shooters lamenting the exhaustion of legendary surplus Thunderbird T-32 and early IMR 8208 lots. Produced in Canada by General Dynamics Ordnance and Tactical Systems at its Valleyfield, Quebec facility, LT-32 ('Light Target 32') was specifically engineered to replicate the fast, flat-burning ballistic signature prized in 6mm PPC competition rifles. Hodgdon continued offering LT-32 after acquiring Western Powders in October 2020.

Built as a fine-grained single-base extruded propellant, Accurate LT-32 sits just slower than LT-30 and slightly faster than Hodgdon H322, pairing smooth volumetric metering with low extreme velocity spreads. Although tailored first for the 6mm PPC, it also performs cleanly in .222 Remington, .223 Remington, .204 Ruger, and light-bullet .308 Winchester target cartridges. Its production in small specialty runs means lot consistency should still be verified whenever opening a new canister.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD-OTS Canada (CA)**
OEM / Twin	**Proprietary**
Introduced	**2012**
Class	**SB extruded (micro)**
Burn Rank	**#029 of 143**
Bulk Density	**906 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**Benchrest 6mm PPC & small-bore**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Accurate MagPro

Proprietary · Burn Rank #127

Accurate Arms introduced MagPro around 2001 to coincide with the rapid rise of Winchester Short Magnum (WSM) cartridges and high-capacity belted magnums. Its name—short for Magnum Propellant—signaled a dedicated slow-burning spherical powder capable of filling large cases efficiently without the metering drag of long extruded sticks. Manufactured domestically by General Dynamics St. Marks Powder in Crawfordville, Florida, MagPro passed through Western Powders in 2004 and joined Hodgdon's Accurate lineup in 2020.

As a high-density double-base spherical propellant positioned near the H1000 and Reloder 25 burn-rate bracket, MagPro maximizes case fill and velocity in overbore cartridges including .270 WSM, 7mm WSM, 7mm Remington Magnum, .300 WSM, and .300 Winchester Magnum. Like most heavily deterred slow ball powders, it benefits from magnum rifle primers to guarantee prompt, uniform ignition across cold hunting weather. Always follow published Accurate MagPro data rather than extrapolating from extruded magnum powders.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary**
Introduced	**2001**
Class	**DB spherical (ball)**
Burn Rank	**#127 of 143**
Bulk Density	**978 g/L**
Heat (Qex)	**3,900 kJ/kg**
Role	**Magnum & short-magnum rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Alliant

Alliant AR-Comp

Bofors TZ (proprietary) · Burn Rank #041

Alliant Powder introduced AR-Comp in June 2011 specifically for competitive AR-15 and AR-10 shooters demanding extruded match precision across wide seasonal temperature swings. Manufactured by Eurenco Bofors AB in Karlskoga, Sweden, AR-Comp evolved from the proven Reloder 15 design while adopting Bofors' proprietary TZ (Temperature Zone) chemistry and a noticeably faster burn rate tailored to semi-automatic gas systems. Like other Alliant canister lines, retail availability has been heavily constrained since 2024 by global defense propellant demand.

Cut into short double-base extruded grains, AR-Comp meters cleanly for an extruded powder and holds consistent chamber pressures from freezing winter matches to hot summer firing lines. Its burn rate sits in the versatile H4895-to-Benchmark corridor, shining with heavy match projectiles in 5.56x45mm NATO and .223 Remington as well as 6.5 Grendel, 6mm ARC, and .308 Winchester. Its Bofors TZ formulation is free of EU REACH-restricted 2,4-DNT.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors TZ (proprietary)**
Introduced	**2011**
Class	**DB extruded (TZ)**
Burn Rank	**#041 of 143**
Bulk Density	**932 g/L**
Heat (Qex)	**3,620 kJ/kg**
Role	**Gas-gun match & .223/.308 class**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Power Pro 1200-R

Proprietary (OEM ball) · Burn Rank #030

Alliant Powder launched Power Pro 1200-R in 2010 as the fastest bottleneck rifle entry in its new Power Pro commercial canister line. Rather than sourcing from European extruded plants, Alliant partnered with General Dynamics St. Marks Powder in Crawfordville, Florida, adapting proven OEM factory-ammunition spherical propellants for retail handloaders. The numeric prefix indicates its position at the brisk end of the Power Pro rifle progression, ahead of Power Pro Varmint and 2000-MR.

Engineered as a dense, fine-grained double-base ball powder, Power Pro 1200-R delivers high velocities and rapid, uniform volumetric metering on progressive presses. Its fast burn rate and compact grain density target small-capacity bottleneck cartridges including .204 Ruger, .222 Remington, .223 Remington with light varmint projectiles, and 7.62x39mm. As a conventional double-base spherical propellant, it prioritizes velocity and metering economy over extreme cold-to-hot temperature flatness.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (OEM ball)**
Introduced	**2010**
Class	**DB spherical (ball)**
Burn Rank	**#030 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**3,950 kJ/kg**
Role	**Small-bore varmint & carbine**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Power Pro 2000-MR

Proprietary (OEM ball) · Burn Rank #081

Introduced by Alliant Powder in mid-2010 as the 'Medium Rifle' (MR) flagship of the Power Pro series, Power Pro 2000-MR brought a high-performance factory-ammunition spherical blend directly to the canister market. Manufactured in the United States by General Dynamics St. Marks Powder in Crawfordville, Florida, it quickly gained fame among F-T/R and precision riflemen for extracting exceptional velocities from standard .308 Winchester and heavy-bullet .223 Remington chambers.

Power Pro 2000-MR is a high-energy double-base spherical propellant incorporating chemical flash suppressants and progressive deterrent coatings tailored to mid-capacity bottleneck cases. Its dense ball grains throw accurately from volumetric measures and fill .308 Winchester, .22-250 Remington, 6.5 Grendel, and heavy-bullet .223 Remington cases efficiently. Because it is a high-energy double-base spherical blend, velocities can climb noticeably in hot ambient temperatures, rewarding careful seasonal verification.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (OEM ball)**
Introduced	**2010**
Class	**DB spherical (ball)**
Burn Rank	**#081 of 143**
Bulk Density	**950 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**High-velocity .223 heavy & .308 class**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Power Pro 4000-MR

Proprietary (OEM ball) · Burn Rank #106

Alliant Powder released Power Pro 4000-MR in 2010 as the slowest rifle propellant in its St. Marks-manufactured Power Pro commercial family, with 'MR' denoting Magnum Rifle capability. Built by General Dynamics St. Marks Powder in Crawfordville, Florida from commercial OEM ball-powder technology, 4000-MR extended the line's high-velocity spherical concept into long-action hunting and short-magnum cartridges. Retail supply has fluctuated sharply alongside broader Alliant canister restrictions since 2024.

Formulated as a dense, high-energy double-base spherical propellant, Power Pro 4000-MR sits in the medium-slow burn-rate neighborhood between the 4350 and 4831 extruded classes. Its free-flowing ball geometry meters smoothly and achieves high loading densities in .243 Winchester, .270 Winchester, .30-06 Springfield, .270 WSM, .300 WSM, and 7mm Remington Magnum. Like other slow double-base ball propellants, it pairs well with hotter rifle primers to assure reliable cold-weather ignition.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (OEM ball)**
Introduced	**2010**
Class	**DB spherical (ball)**
Burn Rank	**#106 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**4,100 kJ/kg**
Role	**Standard & short-magnum rifle**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Power Pro Varmint

Proprietary (OEM ball) · Burn Rank #061

Released alongside the initial Power Pro rifle lineup in 2010, Alliant Power Pro Varmint was positioned directly between faster Power Pro 1200-R and slower Power Pro 2000-MR. Manufactured by General Dynamics St. Marks Powder in Crawfordville, Florida, it adapted commercial factory-loading spherical technology for handloaders turning out large batches of prairie-dog and predator ammunition where effortless volumetric metering matters as much as flat trajectories.

Power Pro Varmint is a double-base spherical propellant with a moderate heat of explosion and a medium-fast burn rate placing it near the Varget and IMR 4064 extruded zone. Its uniform ball grains flow cleanly through rotary measures and deliver crisp velocities across .204 Ruger, .223 Remington, .22-250 Remington, light-bullet .243 Winchester, and .308 Winchester. Because its spherical chemistry differs fundamentally from extruded neighbors, published Power Pro Varmint data must always be followed.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (OEM ball)**
Introduced	**2010**
Class	**DB spherical (ball)**
Burn Rank	**#061 of 143**
Bulk Density	**945 g/L**
Heat (Qex)	**3,680 kJ/kg**
Role	**High-volume varmint & mid-bore**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 7

Bofors (proprietary) · Burn Rank #021

Reloder 7 is the sole surviving number from Hercules Powder Company's original 1960s Reloder rifle series (which initially comprised Reloder 7, 11, and 21). While early American-era production took place domestically, modern Alliant Reloder 7 is manufactured in Karlskoga, Sweden by Eurenco Bofors AB—not at the Radford Army Ammunition Plant in Virginia, a common misconception in older reference notes. Alliant retained the historic 'Reloder' spelling created by Hercules over half a century ago.

Built as a fast-burning, short-grained double-base extruded propellant, Reloder 7 ignites briskly and burns cleanly across low-to-moderate operating pressures. Its burn rate sits in the H4198 and IMR 4198 class, serving small-capacity bottleneck cartridges such as .222 Remington, light-bullet .223 Remington, 6mm PPC, and 7.62x39mm, as well as classic lever-action rounds like .30-30 Winchester. Modern Swedish-made canisters use updated specifications and should never be loaded from antique Hercules tables.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors (proprietary)**
Introduced	**1960s (modern Bofors era)**
Class	**DB extruded (Bofors)**
Burn Rank	**#021 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Small-bore, carbine & lever-action**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 10x

Bofors (proprietary) · Burn Rank #027

Alliant Powder introduced Reloder 10x around 1999–2000 to bridge the gap between fast Reloder 7 and medium-burning Reloder 15 for small-bore varmint and precision benchrest rifles. Manufactured in Karlskoga, Sweden by Eurenco Bofors AB, the '10x' designation nodded to the tight ten-ring center of competitive target faces as well as its numeric place in the Reloder burn-rate ladder. Later Swedish production refined grain uniformity and combustion cleanliness.

Formulated as a fine-grained double-base extruded propellant with single-perforated cylindrical kernels, Reloder 10x meters more consistently than coarser stick powders while delivering high energy in compact cases. Its burn rate occupies the brisk H322 and Vihtavuori N133 neighborhood, making it well suited to .204 Ruger, .222 Remington, .223 Remington, 6mm PPC, and light-bullet .22-250 Remington. As with all Bofors double-base propellants, ambient temperature shifts warrant attention during seasonal workups.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors (proprietary)**
Introduced	**1999–2000**
Class	**DB extruded (Bofors)**
Burn Rank	**#027 of 143**
Bulk Density	**885 g/L**
Heat (Qex)	**3,850 kJ/kg**
Role	**Small-bore varmint & benchrest**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 15

Bofors RP11 (lineage) · Burn Rank #068

Hercules Powder Company introduced Reloder 15 in the late 1980s as part of a revamped Swedish-made extruded line produced by Bofors (now Eurenco Bofors AB) in Karlskoga, Sweden. Rooted in the Bofors RP11 propellant family, Reloder 15 achieved lasting prominence after selection for U.S. military M118LR 7.62x51mm NATO long-range sniper ammunition and decades of National Match competition. Legacy Reloder 15 contains ingredients restricted under EU REACH rules, which spurred Alliant's later TZ-series successors.

Reloder 15 is a medium-burning double-base extruded propellant delivering high energy and consistent ignition across a broad range of mid-capacity bottleneck cartridges including .308 Winchester, heavy-bullet .223 Remington, 6mm BR, and .30-06 Springfield. Although it shares Karlskoga manufacturing heritage and close burn-rate territory with Norma 203-B, both packagers maintain independent lot specifications and blending tolerances, so grain-for-grain substitution between the two without consulting exact canister data is unsafe.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors RP11 (lineage)**
Introduced	**Late 1980s**
Class	**DB extruded (Bofors)**
Burn Rank	**#068 of 143**
Bulk Density	**935 g/L**
Heat (Qex)	**3,990 kJ/kg**
Role	**Match service rifle & .308 class**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 16

Bofors TZ (proprietary) · Burn Rank #093

Alliant Powder launched Reloder 16 in August 2016 to compete head-to-head in the intensely popular 4350 burn-rate class dominated by 6.5 Creedmoor and mid-bore precision rifles. Manufactured by Eurenco Bofors AB in Karlskoga, Sweden—frequently misattributed to Nitrochemie in informal summaries—Reloder 16 employs Bofors' TZ (Temperature Zone) chemistry rather than Swiss EI impregnation. Its numeric name slots it neatly between Reloder 15 and faster-energy Reloder 17.

Formulated without EU REACH-restricted 2,4-DNT and enhanced with a bismuth-based decoppering additive, Reloder 16 combines low velocity drift across hot and cold extremes with reduced barrel copper accumulation. Its relatively bulky single-perforated extruded grains fill medium-capacity bottleneck cases thoroughly, promoting uniform ignition in 6.5 Creedmoor, 6mm Creedmoor, .243 Winchester, .260 Remington, and .30-06 Springfield. Despite sitting alongside Hodgdon H4350 on burn-rate charts, independent charge tables must always be used.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors TZ (proprietary)**
Introduced	**2016**
Class	**Extruded (TZ/decop.)**
Burn Rank	**#093 of 143**
Bulk Density	**900 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**Mid-bore match & 6.5 Creedmoor**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 17

Nitrochemie EI (RS60 kin) · Burn Rank #088

Alliant Powder introduced Reloder 17 in February 2008 as its first canister propellant produced by Nitrochemie (operating in Wimmis, Switzerland and Aschau, Germany), breaking from the Swedish Bofors lineage of earlier Reloder numbers. Built with Nitrochemie's patented EI (Extruded Impregnated) process, it debuted to wide attention for generating notably higher velocities than conventional single-base powders in the 4350 burn-rate bracket. In Europe, Nitrochemie markets a closely related EI sibling as Reload Swiss RS60.

Rather than coating deterrents solely on the exterior of each grain, Nitrochemie's EI process infuses nitroglycerin and burn-rate modifiers deeply into the extruded matrix, sustaining gas generation further down the bore without excessive early peak pressure. Reloder 17 excels in .243 Winchester, 6.5 Creedmoor, .270 Winchester, .270 WSM, and .300 WSM. Even though it shares OEM ancestry with Reload Swiss RS60, separate packager lot specifications forbid blind 1:1 charge substitution.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Nitrochemie (CH/DE)**
OEM / Twin	**Nitrochemie EI (RS60 kin)**
Introduced	**2008**
Class	**DB extruded (EI)**
Burn Rank	**#088 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**High-velocity mid-bore & WSM**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 19

Bofors (proprietary) · Burn Rank #107

Introduced by Hercules Powder Company in the late 1980s alongside Reloder 15 and Reloder 22, Reloder 19 filled the broad slow-medium hunting corridor between 4350 and 4831 burn rates. Manufactured in Karlskoga, Sweden by Eurenco Bofors AB, it quickly became an American sporting staple for flat-shooting long-action cartridges. Like other legacy Bofors formulations containing restricted plasticizers or stabilizers, older Reloder 19 fell under European REACH import limits after 2018.

Reloder 19 is a single-perforated double-base extruded propellant whose elevated energy content yields strong hunting velocities in .25-06 Remington, .270 Winchester, heavy-bullet .30-06 Springfield, .300 WSM, and 7mm Remington Magnum. It occupies a close Karlskoga production neighborhood to Norma 204, yet independent blending specifications and lot variance mean Norma and Alliant load manuals are never interchangeable. Standard seasonal pressure checks remain wise across wide hunting temperature swings.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors (proprietary)**
Introduced	**Late 1980s**
Class	**DB extruded (Bofors)**
Burn Rank	**#107 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**3,900 kJ/kg**
Role	**Standard long-action & hunting magnum**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 22

Bofors (MRP kin) · Burn Rank #113

Hercules Powder Company introduced Reloder 22 in the late 1980s as the flagship magnum propellant of its Swedish-made Bofors extruded trio. Manufactured by Eurenco Bofors AB in Karlskoga, Sweden, Reloder 22 gained a formidable reputation in both big-game hunting and long-range military sniping, having powered early U.S. Mk 248 Mod 0 .300 Winchester Magnum ammunition before temperature-stabilized replacements arrived. Its legacy chemical formulation is subject to EU REACH restrictions in Europe.

A slow-burning, high-energy double-base extruded propellant, Reloder 22 sits near Hodgdon H4831 in burn speed while offering higher chemical energy for extra velocity in overbore cases such as .25-06 Remington, 7mm Remington Magnum, .300 Winchester Magnum, and .300 Weatherby Magnum. It shares close Karlskoga OEM heritage with Norma MRP, but both packagers maintain distinct lot specifications and explicitly advise against grain-for-grain substitution without consulting canister-specific data.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors (MRP kin)**
Introduced	**Late 1980s**
Class	**DB extruded (Bofors)**
Burn Rank	**#113 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**3,980 kJ/kg**
Role	**Belted magnum & long-action heavy**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 23

Bofors TZ (proprietary) · Burn Rank #109

Alliant Powder announced Reloder 23 in 2014 alongside Reloder 26, offering precision long-range shooters a modern, temperature-stabilized counterpart to the classic Reloder 22 and H4831 burn-rate bracket. Manufactured by Eurenco Bofors AB in Karlskoga, Sweden, Reloder 23 builds on Bofors' TZ (Temperature Zone) chemistry rather than Nitrochemie's EI system. Its '23' designation placed it directly beside Reloder 22 while signaling a next-generation REACH-compliant additive package.

Featuring a multi-perforated extruded grain geometry paired with a bismuth-based decoppering agent, Reloder 23 was engineered to combine progressive combustion, reduced bore fouling, and flat velocity stability across extreme temperature swings. It thrives in long-action and standard magnum bottleneck cartridges including .270 Winchester, .280 Ackley Improved, 7mm Remington Magnum, and .300 Winchester Magnum. Despite overlapping burn territory with Reloder 22, separate published load data is strictly required.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors TZ (proprietary)**
Introduced	**2014**
Class	**Extruded (TZ/decop.)**
Burn Rank	**#109 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**Long-action & magnum precision**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 25

Bofors (proprietary) · Burn Rank #125

Alliant Powder introduced Reloder 25 around 2004–2005 as Remington Ultra Magnum and large Weatherby cartridges pushed case capacities beyond the ideal range of Reloder 22. Manufactured by Eurenco Bofors AB in Karlskoga, Sweden, Reloder 25 extended the traditional Swedish double-base extruded family into the H1000 and Retumbo burn-rate neighborhood. Like other Alliant extruded imports, retail canister availability has been severely limited since 2024 due to defense-sector nitrocellulose demand.

Formulated as a very slow, high-energy double-base extruded propellant, Reloder 25 fills cavernous magnum cases cleanly and produces high velocities behind heavy, high-ballistic-coefficient bullets. It became a favored hunting and long-range choice for 7mm Remington Ultra Magnum, .300 Winchester Magnum with heavy projectiles, .300 Weatherby Magnum, and .338 Lapua Magnum. Because its conventional double-base chemistry responds to wide ambient temperature shifts, hunters should verify cold- and hot-weather performance.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors (proprietary)**
Introduced	**2004–2005**
Class	**DB extruded (Bofors)**
Burn Rank	**#125 of 143**
Bulk Density	**915 g/L**
Heat (Qex)	**3,990 kJ/kg**
Role	**Overbore magnum & ultra-magnum**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 26

Nitrochemie EI (proprietary) · Burn Rank #121

Alliant Powder introduced Reloder 26 in 2014 as a high-energy magnum companion to Reloder 17, manufactured by Nitrochemie in Wimmis, Switzerland and Aschau, Germany. Utilizing Nitrochemie's Extruded Impregnated (EI) process, Reloder 26 quickly gained an almost legendary reputation among long-range competitors and hunters for producing standout velocities across overbore cartridges without spikes in pressure. Its high demand combined with 2024 canister supply constraints made it one of the hardest-to-find rifle powders on the market.

Combining a dense, multi-perforated extruded grain with deep nitroglycerin and deterrent impregnation, Reloder 26 packs unusually high bulk density and chemical energy into the H1000-to-Reloder 25 burn-rate bracket. It also incorporates a decoppering additive and temperature-stabilizing chemistry, shining in 6.5 PRC, 6.5-284 Norma, 7mm Remington Magnum, .300 Winchester Magnum, and .300 PRC. Never assume interchangeability with Reload Swiss EI powders; always use published Reloder 26 data.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Nitrochemie (CH/DE)**
OEM / Twin	**Nitrochemie EI (proprietary)**
Introduced	**2014**
Class	**DB extruded (EI)**
Burn Rank	**#121 of 143**
Bulk Density	**994 g/L**
Heat (Qex)	**4,200 kJ/kg**
Role	**High-velocity magnum & PRC class**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 33

Nitrochemie EI (proprietary) · Burn Rank #138

Alliant Powder introduced Reloder 33 in 2012, naming it directly for the .338 Lapua Magnum class it was engineered to propel. Produced by Nitrochemie (Wimmis, Switzerland and Aschau, Germany) using its Extruded Impregnated (EI) process, Reloder 33 bridged the wide burn-rate gap between conventional magnum powders like Reloder 25 and dedicated .50 BMG propellants like Reloder 50. It arrived just as extreme-long-range (ELR) shooting expanded rapidly beyond one mile.

Built around large, deeply deterred double-base impregnated kernels, Reloder 33 sustains progressive pressure curves behind heavy long-range projectiles in extreme-capacity cases. Beyond its namesake .338 Lapua Magnum, it excels in .300 Remington Ultra Magnum, .30-378 Weatherby Magnum, .338 Edge, and .375 CheyTac, delivering high velocities with full case density. As with all ultra-slow propellants, magnum primers and careful attention to lot-specific published data are essential.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Nitrochemie (CH/DE)**
OEM / Twin	**Nitrochemie EI (proprietary)**
Introduced	**2012**
Class	**DB extruded (EI)**
Burn Rank	**#138 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,900 kJ/kg**
Role	**Extreme overbore & .338 Lapua**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder 50

Nitrochemie EI (proprietary) · Burn Rank #139

Alliant Powder launched Reloder 50 in 2011 as its first ultra-slow canister propellant explicitly named and formulated for the .50 BMG cartridge. Manufactured by Nitrochemie in Wimmis, Switzerland and Aschau, Germany via the Extruded Impregnated (EI) process, Reloder 50 gave civilian heavy-rifle shooters a purpose-built commercial alternative to variable military surplus .50-caliber cannon powders. Retail supply has tightened sharply alongside broader Alliant canister availability constraints.

Extruded into large, thick-webbed single-perforated grains infused with burn-moderating deterrents, Reloder 50 sits at the very slowest frontier of rifle propellants alongside Hodgdon H50BMG and Vihtavuori 24N41. Its progressive burn rate controls peak chamber pressure while pushing heavy projectiles efficiently down long barrels in .50 BMG, .416 Barrett, .408 CheyTac, and ultra-heavy .338 Lapua Magnum rifles. Dedicated .50-class primers and strict adherence to published data are mandatory.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Nitrochemie (CH/DE)**
OEM / Twin	**Nitrochemie EI (proprietary)**
Introduced	**2011**
Class	**DB extruded (EI)**
Burn Rank	**#139 of 143**
Bulk Density	**890 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**.50 BMG & extreme-long-range rifle**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Alliant Reloder TS 15.5

Bofors TZ (proprietary) · Burn Rank #075

Alliant Powder unveiled Reloder TS 15.5 in early 2021 as a modern, REACH-compliant, temperature-stable evolution of the classic Reloder 15 niche. Manufactured in Karlskoga, Sweden by Eurenco Bofors AB—not Nitrochemie in Switzerland—the powder uses Bofors' proprietary TZ (Temperature Zone) technology, with 'TS' standing for Temperature Stable and '15.5' marking its burn rate just slower than legacy Reloder 15. Supply has been tight since Alliant curtailed commercial canister shipments in 2024.

Designed specifically for competitive precision riflemen, Reloder TS 15.5 incorporates a copper-fouling reducer and eliminates EU-restricted 2,4-DNT while holding flat velocity behavior across wide ambient temperature swings. Its burn rate sits comfortably between Reloder 15 and Reloder 16, targeting heavy-bullet .223 Remington, 6mm BR, 6mm Dasher, 6mm GT, 6.5x47 Lapua, and .308 Winchester. Because its chemistry and slightly slower burn profile differ from legacy Reloder 15, dedicated TS 15.5 data is mandatory.

Propellant specifications

Packager	**Alliant Powder**
OEM Plant	**Eurenco Bofors (SE)**
OEM / Twin	**Bofors TZ (proprietary)**
Introduced	**2021**
Class	**Extruded (TZ/decop.)**
Burn Rank	**#075 of 143**
Bulk Density	**890 g/L**
Heat (Qex)	**3,650 kJ/kg**
Role	**Precision mid-bore & match rifle**
Status	**Active (supply-constrained)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon

Hodgdon Benchmark

ADI BM2 · Burn Rank #040

Hodgdon Powder Company introduced Benchmark around 2000 as an early addition to its temperature-insensitive Extreme Extruded line, targeting benchrest and small-bore varmint shooters who wanted crisp metering in an extruded powder. Manufactured at the Mulwala plant in New South Wales, Australia by Thales/ADI, it is marketed in Australia as ADI BM2. Like other ADI Mulwala Extreme powders containing regulated additives, Benchmark has been restricted from European Union import under REACH enforcement since 2018.

Cut into notably short single-base extruded kernels, Benchmark throws far more uniformly through volumetric powder measures than traditional long-stick propellants while delivering stable velocities across wide temperature ranges. Positioned just slower than H322 and slightly faster than H4895, it excels in .204 Ruger, .222 Remington, .223 Remington, 6mm PPC, and light-bullet .308 Winchester. Even though it shares its OEM source with ADI BM2, lot-to-lot variance always warrants consulting canister-specific published data.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI BM2**
Introduced	**2000**
Class	**SB extruded (Extreme)**
Burn Rank	**#040 of 143**
Bulk Density	**906 g/L**
Heat (Qex)	**3,620 kJ/kg**
Role	**Small-bore varmint & benchrest**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon BL-C(2)

Proprietary (ball) · Burn Rank #074

The BL-C lineage began in 1949 when founder Bruce Hodgdon acquired military-surplus Ball Powder Lot C, which benchrest and varmint shooters prized in small-bore rifles. When that original surplus supply was exhausted, Hodgdon introduced newly manufactured BL-C(2) in 1961—adding the '(2)' to mark the second-generation commercial specification—produced using Olin's spherical ball process now operated by General Dynamics St. Marks Powder in Crawfordville, Florida. It remains one of Hodgdon's longest-running commercial propellants.

BL-C(2) is a dense, free-flowing double-base spherical propellant sitting in the medium burn-rate corridor near Hodgdon CFE 223 and slightly slower than H335. Its fine ball geometry meters with high repeatability on progressive presses and fills .223 Remington, .22-250 Remington, .308 Winchester, and .30-30 Winchester cases efficiently. As a traditional double-base spherical powder, it benefits from magnum or hotter rifle primers in cold weather and merits seasonal velocity checks.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (ball)**
Introduced	**1961 (BL-C in 1949)**
Class	**DB spherical (ball)**
Burn Rank	**#074 of 143**
Bulk Density	**995 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**Service rifle & mid-bore progressive**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon CFE 223

Proprietary (CFE ball) · Burn Rank #077

Hodgdon Powder Company launched CFE 223 in 2012 as the inaugural entry in its Copper Fouling Eraser (CFE) canister series. Manufactured in Crawfordville, Florida by General Dynamics St. Marks Powder, the propellant adapted military decoppering additive technology originally developed to extend barrel life and cleaning intervals in rapid-fire service weapons. Although named for the ubiquitous .223 Remington, its versatile burn rate immediately attracted shooters across a wide span of medium-capacity bottleneck cartridges.

Formulated as a dense double-base spherical powder containing a bismuth-based copper-fouling reducer, CFE 223 meters smoothly through progressive measures and produces brisk velocities with noticeably reduced jacket fouling over long firing strings. Sitting near BL-C(2) and slightly slower than Varget, it performs strongly in heavy-bullet .223 Remington, .204 Ruger, .22-250 Remington, 6.5 Grendel, and .308 Winchester. Unlike Hodgdon's Extreme extruded series, CFE 223 is a conventional double-base ball powder sensitive to temperature extremes.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (CFE ball)**
Introduced	**2012**
Class	**DB ball (decoppering)**
Burn Rank	**#077 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**High-volume .223, .308 & mid-bore**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon CFE BLK

Proprietary (CFE ball) · Burn Rank #026

Announced in late 2016 and officially released in January 2017, Hodgdon CFE BLK extended the Copper Fouling Eraser additive family into the fast-burning carbine bracket. Manufactured by General Dynamics St. Marks Powder in Crawfordville, Florida, its 'BLK' suffix explicitly signals its primary target: the .300 AAC Blackout, which had surged in popularity for suppressed semi-automatic rifles requiring clean gas-system operation across both supersonic and heavy subsonic projectile weights.

Sitting right beside Accurate 1680 on empirical burn-rate charts, CFE BLK is a fine-grained double-base spherical propellant incorporating Hodgdon's decoppering agent to minimize bore and suppressor fouling. Its brisk combustion generates ample port pressure to cycle short-barreled AR-15 gas systems reliably in .300 AAC Blackout while also serving 7.62x39mm, 6.8 SPC, and small bottleneck rounds such as .22 Hornet. Despite close burn-rate proximity to Accurate 1680, dedicated CFE BLK data must always be used.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (CFE ball)**
Introduced	**2017**
Class	**DB ball (decoppering)**
Burn Rank	**#026 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**.300 Blackout & small carbine**
Status	**Active**



Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H50BMG

ADI AR2218 · Burn Rank #140

Hodgdon introduced H50BMG in the late 1990s (entering Hodgdon manuals by 1999) as the company's first purpose-built, temperature-stabilized canister propellant for the .50 BMG cartridge. Manufactured in Mulwala, Australia by Thales/ADI—where it carries the domestic designation ADI AR2218—H50BMG gave civilian fifty-caliber match and long-range shooters a uniform commercial extruded powder rather than erratic surplus military lots. Like all ADI Mulwala Extreme powders, it has been restricted in the EU under REACH since 2018.

Extruded into large, thick-webbed single-base cylindrical grains with a notably cool heat of explosion, H50BMG minimizes throat erosion while keeping velocity dispersion tight across desert heat and freezing alpine temperatures. Sitting at the ultra-slow frontier alongside Alliant Reloder 50 and Hodgdon US 869, it excels in .50 BMG, .416 Barrett, .408 CheyTac, and .375 CheyTac. Because H50BMG and ADI AR2218 are packaged independently, always verify current data for the exact canister.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2218**
Introduced	**1999**
Class	**SB extruded (Extreme)**
Burn Rank	**#140 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**3,205 kJ/kg**
Role	**.50 BMG & extreme-capacity rifle**
Status	**Active (EU REACH-restricted)**



Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H322

ADI AR2219 · Burn Rank #034

Hodgdon H322 traces its origins to post-war military-derived small-bore propellants adopted by benchrest pioneers, entering commercial Hodgdon distribution in the 1970s before moving to Thales/ADI in Mulwala, Australia during the 1990s rollout of Hodgdon's Extreme Extruded line. In Australia, ADI markets the equivalent propellant as AR2219. Over decades of short-range benchrest competition, H322 earned a storied record in .222 Remington and 6mm PPC rifles, though EU REACH rules have restricted European imports since 2018.

Extruded into fine, short single-base kernels, H322 bridges the burn-rate gap between H4198 and Benchmark with crisp volumetric metering and low thermal velocity drift. Its clean combustion and uniform ignition suit small-capacity bottleneck cartridges including .222 Remington, .223 Remington, .204 Ruger, 6mm PPC, and 6.8 SPC, as well as light-bullet .308 Winchester target loads. Although H322 matches ADI AR2219 in OEM lineage, lot variance requires verifying published data for the exact canister.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2219**
Introduced	**1970s (ADI Extreme 1990s)**
Class	**SB extruded (Extreme)**
Burn Rank	**#034 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**3,650 kJ/kg**
Role	**Small-bore benchrest & varmint**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H335

Proprietary (WC844 lineage) · Burn Rank #046

Hodgdon H335 entered the commercial reloading market during the 1960s wave of military-derived spherical propellants, tracing its ballistic lineage to the 5.56x45mm NATO ball powders (historically associated with the WC844 specification) developed for the M16 rifle program. Today it is manufactured as a commercial canister propellant by General Dynamics St. Marks Powder in Crawfordville, Florida. Its high bulk density and economical metering made it a multi-decade staple for high-volume .223 Remington handloaders.

As a fine-grained double-base spherical powder sitting directly alongside H4895 and Accurate 2460 in burn speed, H335 drops with exceptional weight uniformity from progressive powder measures. It excels in .223 Remington and 5.56x45mm NATO with standard-weight projectiles, as well as .204 Ruger, .222 Remington, and .30-30 Winchester. Because surplus military WC844 lots vary widely from canister H335 specifications, military pull-down data and commercial H335 tables are never interchangeable.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (WC844 lineage)**
Introduced	**1960s**
Class	**DB spherical (ball)**
Burn Rank	**#046 of 143**
Bulk Density	**1010 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**.223/5.56 progressive & small-bore**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H380

Proprietary (ball) · Burn Rank #080

Hodgdon H380 carries one of the best-known naming stories in American handloading. During the 1960s, Bruce Hodgdon tested an unnamed spherical propellant in his custom .22-caliber wildcat—soon standardized as the .22-250 Remington—and named the powder H380 after the favorite test charge weight that repeatedly produced tiny groups in that rifle. Manufactured in Crawfordville, Florida by General Dynamics St. Marks Powder, H380 has remained continuously in Hodgdon's spherical rifle catalog for over six decades.

Positioned in the medium-to-medium-slow burn corridor between CFE 223 and Winchester 760, H380 is a double-base spherical propellant offering smooth volumetric metering and high chemical energy. Its classic niche remains the .22-250 Remington, though it also serves .220 Swift, .243 Winchester, 7mm-08 Remington, and .30-06 Springfield reliably. As a conventional double-base ball powder without Extreme temperature stabilization, H380 performs best with magnum primers in cold weather and careful seasonal pressure monitoring.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (ball)**
Introduced	**1960s**
Class	**DB spherical (ball)**
Burn Rank	**#080 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**High-velocity .22-250 & mid-bore**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H414

St. Marks (W760 twin) · Burn Rank #086

Hodgdon introduced H414 in the 1970s as a versatile medium-slow double-base spherical propellant manufactured by Olin's St. Marks plant in Florida (now General Dynamics St. Marks Powder). After Hodgdon acquired the Winchester smokeless powder license in 2005, both H414 and Winchester 760 were marketed under the same corporate roof as confirmed OEM twins from St. Marks. In 2020, Hodgdon formally discontinued H414 to streamline overlapping SKUs, leaving Winchester 760 as the continuing label.

Formulated as a dense, high-energy double-base ball propellant sitting just faster than the 4350 extruded class, H414 delivered effortless volumetric metering and brisk velocities in .22-250 Remington, .243 Winchester, 6.5x55 Swedish, .270 Winchester, 7mm-08 Remington, and .30-06 Springfield. Although H414 and Winchester 760 shared identical St. Marks manufacturing specifications, lot-to-lot variance still requires starting conservatively from current published Winchester 760 data when transitioning off legacy H414 canisters.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**St. Marks (W760 twin)**
Introduced	**1970s (discontinued 2020)**
Class	**DB spherical (ball)**
Burn Rank	**#086 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**4,100 kJ/kg**
Role	**Mid-bore & standard hunting rifle**
Status	**Discontinued (2020; see W760)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H1000

ADI AR2217 · Burn Rank #126

Hodgdon introduced H1000 in the late 1990s—its name nodding to 1,000-yard long-range competition—as an ultra-consistent slow extruded powder within the Extreme Extruded family. Manufactured by Thales/ADI in Mulwala, Australia, H1000 is the official counterpart to ADI AR2217 (not AR2225, which corresponds to slower Retumbo—a swap that occasionally appears in careless reference tables). Since 2018, EU REACH restrictions on 2,4-DNT and DBP have halted European imports of H1000.

Formulated as a very slow single-base extruded propellant with a comparatively low heat of explosion, H1000 pairs gentle barrel wear with outstanding cold-to-hot thermal stability. It became an iconic standard for heavy-for-caliber long-range cartridges including 6.5 PRC, 7mm Remington Magnum, 7mm PRC, .300 Winchester Magnum, .300 PRC, and .338 Lapua Magnum. Although H1000 shares Mulwala production with ADI AR2217, lot-to-lot variance dictates following published data for the exact container on hand.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2217**
Introduced	**Late 1990s (ca. 1998)**
Class	**SB extruded (Extreme)**
Burn Rank	**#126 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,441 kJ/kg**
Role	**Heavy-bullet magnum & ELR rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H4198

ADI AR2207 · Burn Rank #020

Hodgdon H4198 originated in the post-World War II surplus wave of the late 1940s and early 1950s, carrying the 'H' prefix to distinguish Bruce Hodgdon's offerings from DuPont's commercial IMR 4198. As surplus ran dry, Hodgdon transitioned H4198 to new commercial production and eventually partnered with Thales/ADI in Mulwala, Australia—where it is sold domestically as ADI AR2207—as part of the temperature-insensitive Extreme Extruded line. EU REACH rules have barred its European import since 2018.

Cut into short single-base extruded grains that meter cleanly compared with longer IMR 4198 sticks, H4198 sits near Reloder 7 at the brisk end of bottleneck rifle propellants. It shines in .222 Remington, light-bullet .223 Remington, .221 Fireball, 7.62x39mm, and efficient short-range cartridges such as the .30 BR, while also serving reduced-velocity and straight-wall lever-action roles. Because H4198 and IMR 4198 come from different plants and formulations, their published data are never interchangeable.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2207**
Introduced	**Late 1940s / 1950s (Extreme 1990s)**
Class	**SB extruded (Extreme)**
Burn Rank	**#020 of 143**
Bulk Density	**870 g/L**
Heat (Qex)	**3,680 kJ/kg**
Role	**Small-bore, .222 & fast rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H4227

ADI AR2205 · Burn Rank #008

Hodgdon H4227 began alongside H4198 and H4895 in the post-World War II military-surplus era, using the 'H' prefix to parallel DuPont's classic IMR 4227 burn rate. Decades later, Hodgdon contracted Thales/ADI in Mulwala, Australia to manufacture H4227 as the counterpart to ADI AR2205. After acquiring the IMR brand in 2003, Hodgdon found both 4227 labels competing for the same niche and eventually discontinued H4227, consolidating Australian AR2205 production under the stronger-selling IMR 4227 banner.

Positioned at the very fastest boundary of bottleneck rifle propellants, H4227 is a fine-grained single-base extruded powder suited to tiny rifle cases such as .22 Hornet, .218 Bee, and .300 AAC Blackout as well as magnum revolver cartridges. Although modern IMR 4227 shares its ADI Mulwala AR2205 heritage, handloaders moving from legacy H4227 canisters to IMR 4227 must never transfer charge weights blindly and should always consult current published data.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2205**
Introduced	**Late 1940s / 1950s**
Class	**SB extruded**
Burn Rank	**#008 of 143**
Bulk Density	**870 g/L**
Heat (Qex)	**3,880 kJ/kg**
Role	**.22 Hornet, .300 BLK & small cases**
Status	**Discontinued (consolidated into IMR 4227)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H4350

ADI AR2209 · Burn Rank #091

Hodgdon introduced H4350 in the 1970s to parallel DuPont's landmark 1940 IMR 4350 burn rate, initially sourcing commercial manufacture in Scotland before moving production to Thales/ADI in Mulwala, Australia during the 1990s launch of the Extreme Extruded series. Known in Australia as ADI AR2209, H4350 became the defining benchmark propellant of modern 6.5mm and 6mm precision rifle competition. European Union REACH enforcement against 2,4-DNT and DBP halted EU imports of H4350 in 2018.

Engineered as a medium-slow single-base extruded propellant with temperature-stabilized surface coatings, H4350 delivers remarkably flat velocity consistency from freezing winter ranges to summer matches. It dominates 6.5 Creedmoor, 6mm Creedmoor, .243 Winchester, .260 Remington, .270 Winchester, and .30-06 Springfield, combining moderate flame temperature with forgiving pressure curves. While H4350 is the confirmed OEM twin of ADI AR2209, it differs substantially from IMR 4350 and Accurate 4350 and requires canister-specific data.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2209**
Introduced	**1970s (ADI Extreme 1990s)**
Class	**SB extruded (Extreme)**
Burn Rank	**#091 of 143**
Bulk Density	**990 g/L**
Heat (Qex)	**3,590 kJ/kg**
Role	**Mid-bore match & standard rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H4831

ADI AR2213 · Burn Rank #111

Bruce Hodgdon introduced H4831 in 1950 after purchasing massive lots of World War II DuPont surplus propellant originally manufactured for 20mm Oerlikon anti-aircraft cannons—not from an Australian plant in 1941, as some erroneous summaries claim. When surplus stocks finally ran out decades later, Hodgdon contracted new manufacture first in Scotland (ICI/Nobel) and later with Thales/ADI in Mulwala, Australia, where it corresponds to ADI AR2213 in the Extreme Extruded line. EU REACH restrictions have barred European imports since 2018.

A slow-burning single-base extruded propellant with relatively long cylindrical kernels, H4831 became synonymous with .270 Winchester, .25-06 Remington, .280 Remington, 7mm Remington Magnum, and .300 Winchester Magnum accuracy. Its low flame temperature and temperature-insensitive Extreme formulation promote predictable internal ballistics and moderate throat erosion across seasonal extremes. H4831 shares identical chemistry with short-cut H4831SC, yet differences in bulk density and independent IMR 4831 specifications require separate published data.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2213**
Introduced	**1950 (WWII surplus; ADI 1990s)**
Class	**SB extruded (Extreme)**
Burn Rank	**#111 of 143**
Bulk Density	**930 g/L**
Heat (Qex)	**3,570 kJ/kg**
Role	**Overbore long-action & belted magnum**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H4831SC

ADI AR2213SC · Burn Rank #112

Hodgdon Powder Company introduced H4831SC—'Short Cut'—around 1999 to solve the one persistent complaint about classic H4831: its long extruded kernels bridged frequently inside powder measures and packed loosely in compact magnum necks. Manufactured by Thales/ADI in Mulwala, Australia as the counterpart to ADI AR2213SC, it joined the temperature-insensitive Extreme Extruded catalog and quickly became a staple of F-Open and long-range hunting rifles. Like H4831, it has been EU REACH-restricted since 2018.

Chemically matched to standard H4831 as a slow single-base extruded propellant, H4831SC uses a shorter cut that raises bulk loading density and meters markedly smoother through dispensers and tricklers. That denser packing makes it particularly valuable in 6.5-284 Norma, .284 Winchester, .270 Winchester, 7mm Remington Magnum, and .300 Winchester Magnum where case volume is at a premium. Although Hodgdon publishes shared H4831/H4831SC load data, lot-to-lot checks remain essential when switching canisters.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2213SC**
Introduced	**1999**
Class	**SB extruded (Extreme)**
Burn Rank	**#112 of 143**
Bulk Density	**992 g/L**
Heat (Qex)	**3,570 kJ/kg**
Role	**Long-range & magnum precision**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon H4895

ADI AR2206H · Burn Rank #047

H4895 is the foundational propellant that launched the Hodgdon Powder Company in 1947, when Bruce Hodgdon bought fifty thousand pounds of World War II surplus IMR 4895 originally blended for .30-06 Springfield M2 Ball ammunition. Decades after surplus ran dry, commercial production moved first to Scotland and then to Thales/ADI in Mulwala, Australia, where it is sold domestically as ADI AR2206H within the temperature-insensitive Extreme Extruded series. EU REACH rules halted European imports in 2018.

A fast-medium single-base extruded propellant sitting slightly faster than Varget and IMR 4895, H4895 is celebrated for exceptional versatility across .223 Remington, .22-250 Remington, .308 Winchester, and .30-06 Springfield, including gas-operated M1 Garand rifles. It is also uniquely approved by Hodgdon for published youth and reduced-recoil loads in many standard rifle cartridges due to its clean, dependable ignition at lower charge densities. Independent manufacturing separates H4895 data strictly from IMR 4895.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2206H**
Introduced	**1947 (WWII surplus; ADI 1990s)**
Class	**SB extruded (Extreme)**
Burn Rank	**#047 of 143**
Bulk Density	**964 g/L**
Heat (Qex)	**3,670 kJ/kg**
Role	**Versatile mid-bore & reduced-load rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon Hybrid 100V

Proprietary (hybrid) · Burn Rank #092

Announced in late 2007 and released to handloaders in early 2008, Hodgdon Hybrid 100V represented an unusual manufacturing crossover produced domestically by General Dynamics St. Marks Powder in Crawfordville, Florida. Its 'Hybrid' name reflects its dual heritage—combining St. Marks' double-base spherical propellant chemistry with a super-short extruded stick geometry—while '100V' signaled Hodgdon's claim of added velocity in standard hunting chambers. It remains an active, distinctively manufactured member of Hodgdon's catalog.

Positioned directly in the 4350 burn-rate corridor between H4350 and H4831, Hybrid 100V uses compact cylindrical kernels that meter markedly smoother than conventional long-stick propellants while delivering brisk velocities across .243 Winchester, 6.5 Creedmoor, .270 Winchester, .270 WSM, .30-06 Springfield, and 7mm Remington Magnum. Because its double-base spherical chemistry differs from Hodgdon's single-base Australian Extreme series, it is not part of the Extreme line and requires dedicated Hybrid 100V load tables.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (hybrid)**
Introduced	**2008**
Class	**DB hybrid extruded**
Burn Rank	**#092 of 143**
Bulk Density	**890 g/L**
Heat (Qex)	**3,620 kJ/kg**
Role	**Mid-bore & magnum hunting rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon Leverevolution

Proprietary (OEM ball) · Burn Rank #076

Introduced to handloaders in January 2011 alongside Superformance, Hodgdon Leverevolution brought a specialized factory-ammunition spherical blend developed with Hornady directly to the commercial canister market. Manufactured in Crawfordville, Florida by General Dynamics St. Marks Powder, the powder carries the trademark of Hornady's elastomer-tipped LEVERevolution ammunition line. It was created to boost velocity safely in classic tubular-magazine lever-action cartridges operating under conservative SAAMI chamber pressure ceilings.

Engineered as an unusually dense double-base spherical propellant sitting near CFE 223 and BL-C(2) in burn rate, Leverevolution delivers progressive gas generation that pushes extra speed out of .30-30 Winchester, .35 Remington, .308 Marlin Express, and .338 Marlin Express. Modern handloaders also discovered its strong performance in compact intermediate bottleneck cases such as 6.5 Grendel, 6mm ARC, and .22 ARC. Because its tailored pressure curve is cartridge-sensitive, only published Leverevolution applications should be used.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (OEM ball)**
Introduced	**2011**
Class	**DB spherical (ball)**
Burn Rank	**#076 of 143**
Bulk Density	**1045 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**Lever-action & intermediate bottleneck**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon Retumbo

ADI AR2225 · Burn Rank #129

Hodgdon introduced Retumbo around 2004—borrowing the Spanish word for a deep reverberating boom—specifically to feed the surging wave of Remington Ultra Magnums and large Weatherby cartridges. Manufactured in Mulwala, Australia by Thales/ADI within the Extreme Extruded series, Retumbo is the official counterpart to ADI AR2225 (never AR2217, which corresponds to faster H1000). Like other ADI Mulwala Extreme powders, Retumbo has been restricted from European Union import under REACH since 2018.

Formulated as an ultra-consistent, very slow single-base extruded propellant with multi-perforated grains and a cool heat of explosion, Retumbo pairs progressive burn control with standout cold-to-hot thermal stability. It thrives in heavily overbore bottleneck cartridges including 7mm Remington Ultra Magnum, .28 Nosler, .300 Remington Ultra Magnum, .300 Weatherby Magnum, and .338 Lapua Magnum. Even though Retumbo shares Mulwala origin with ADI AR2225, lot variance requires consulting data for the exact canister.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2225**
Introduced	**2004**
Class	**SB extruded (Extreme)**
Burn Rank	**#129 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,444 kJ/kg**
Role	**Overbore ultra-magnum & ELR rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon SUPERFORMANCE

Proprietary (OEM ball) · Burn Rank #110

Released to handloaders in January 2011 in partnership with Hornady, Hodgdon SUPERFORMANCE brought one specific spherical formulation from Hornady's high-velocity Superformance factory ammunition program into commercial one-pound canisters. Manufactured by General Dynamics St. Marks Powder in Crawfordville, Florida, it is styled in all-capitals to mirror Hornady's ammunition branding. Rather than serving as a universal powder, it was marketed strictly for select cartridges where its unique burn progression excels.

Built as a very dense, high-energy double-base spherical propellant sitting in the slow-medium burn corridor near Hodgdon H4831, SUPERFORMANCE achieves standout velocities in specific overbore mid-caliber cartridges including .22-250 Remington, .243 Winchester, 6.5 Creedmoor, .300 WSM, and .270 WSM. Its specialized pressure curve can behave unpredictably outside tested chambers—particularly in gas-operated rifles or unapproved calibers—so handloaders must restrict SUPERFORMANCE strictly to cartridges with published Hodgdon data.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (OEM ball)**
Introduced	**2011**
Class	**DB spherical (ball)**
Burn Rank	**#110 of 143**
Bulk Density	**1020 g/L**
Heat (Qex)	**4,300 kJ/kg**
Role	**Select high-velocity hunting rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon US 869

Proprietary (.50 ball) · Burn Rank #142

Announced in late 2005 and shipped to dealers in spring 2006, Hodgdon US 869 filled the slowest spherical niche in Hodgdon's catalog. Manufactured in Crawfordville, Florida by General Dynamics St. Marks Powder, US 869 grew out of U.S. military .50 BMG ball-propellant technology—its 'US' prefix emphasizing domestic American production and its numeric code reflecting its ultra-slow burn tier. It gave magnum and fifty-caliber reloaders a clean-metering spherical alternative to bulky extruded sticks.

Sitting slower than H50BMG and Alliant Reloder 50 on empirical burn-rate rankings, US 869 is a dense, high-energy double-base spherical propellant designed for massive case volumes. Beyond .50 BMG, it delivers high velocities in extreme overbore hunting cartridges such as 7mm Remington Ultra Magnum, .300 Remington Ultra Magnum, .30-378 Weatherby Magnum, and .338-378 Weatherby Magnum. Because heavily deterred ultra-slow ball powders resist ignition, magnum primers and full case fill are vital for clean combustion.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (.50 ball)**
Introduced	**2006**
Class	**DB spherical (ball)**
Burn Rank	**#142 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**4,200 kJ/kg**
Role	**.50 BMG & extreme overbore magnum**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Hodgdon Varget

ADI AR2208 · Burn Rank #059

Hodgdon introduced Varget in 1995 (not 1996, as sometimes misstated) as the flagship launch of its temperature-insensitive Extreme Extruded line, combining the words 'Varmint' and 'Target' into one of the most recognizable names in modern ballistics. Manufactured by Thales/ADI in Mulwala, Australia—where it is sold domestically as ADI AR2208—Varget rapidly became the gold standard for F-T/R, High Power, and precision varmint rifles. EU REACH enforcement against 2,4-DNT and DBP barred European imports starting in 2018.

A medium-burning single-base extruded propellant cut into short cylindrical kernels, Varget balances moderate flame temperature, clean combustion, and exceptional cold-to-hot thermal stability. Its versatile burn rate sits squarely between H4895 and H4350, dominating .308 Winchester, heavy-bullet .223 Remington, 6mm BR, 6mm Dasher, 6mm GT, and .22-250 Remington. Although Varget and ADI AR2208 are confirmed OEM twins, independent lot blending means published data should always be verified for the exact canister in hand.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**Thales/ADI (AU)**
OEM / Twin	**ADI AR2208**
Introduced	**1995**
Class	**SB extruded (Extreme)**
Burn Rank	**#059 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,620 kJ/kg**
Role	**Benchmark .223 heavy & .308 match**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR

IMR 3031

Burn Rank #038

DuPont introduced IMR 3031 in 1934 as one of the earliest civilian-marketed Improved Military Rifle propellants, replacing the older IMR 17 1/2 series with a cleaner, more progressive single-base formulation. After DuPont exited smokeless powder manufacturing and transferred its extruded canister lines northward, production moved to the Valleyfield, Quebec facility now operated by General Dynamics Ordnance and Tactical Systems – Canada (GD-OTS Canada). Hodgdon acquired the IMR brand in 2003 and continues distributing IMR 3031 worldwide where regulatory rules allow.

IMR 3031 consists of medium-length, single-perforated tubular grains coated with dinitrotoluene (DNT) deterrent and graphite glaze. Because its formulation retains DNT, European Union REACH enforcement halted commercial imports into the EU in 2018, though North American production remains active. Long stick kernels can bridge slightly in volumetric powder measures, yet the powder delivers consistent ignition across mid-capacity sporting cartridges, notably the .30-30 Winchester, .308 Winchester, .223 Remington with heavier bullets, and classic medium-bore lever-action and bolt-action rifles.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1934 (DuPont)**
Class	**Single-base extruded**
Burn Rank	**#038 of 143**
Bulk Density	**935 g/L**
Heat (Qex)	**3,620 kJ/kg**
Role	**Fast-medium rifle & lever-action**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4007 SSC

Burn Rank #084

Hodgdon introduced IMR 4007 SSC in 2007 under the IMR banner to bridge the burn-rate gap between IMR 4064 and IMR 4350 while improving metering through a Super Short Cut (SSC) extruded geometry. Manufactured at the GD-OTS Canada plant in Valleyfield, Quebec, the propellant was aimed at high-efficiency short-action cartridges such as the .22-250 Remington, .243 Winchester, and early short magnums. Its commercial tenure proved brief: Hodgdon phased it out of production in 2014 before issuing a formal product safety recall in September 2015.

The September 2015 recall—followed by subsequent safety reminders covering remaining lots—stemmed from accelerated chemical instability in affected canisters, where stabilizer depletion could lead to autocatalytic decomposition and spontaneous ignition in storage. Any remaining containers of IMR 4007 SSC must never be used or retained; owners are instructed to follow manufacturer destruction guidance rather than load it. Historically, its short-cut single-base grain design served as an important stepping stone toward later compact Valleyfield extrusions.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**2007 (Hodgdon / IMR)**
Class	**Single-base extruded**
Burn Rank	**#084 of 143**
Bulk Density	**932 g/L**
Heat (Qex)	**3,580 kJ/kg**
Role	**Medium-slow short-action rifle**
Status	**Recalled (Sept 2015) & discontinued**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4064

Burn Rank #056

Introduced by DuPont in 1935 as part of the landmark 1930s expansion of the Improved Military Rifle family, IMR 4064 quickly became one of North America's benchmark medium-rate rifle propellants. Its numerical designation later inspired competitive look-alike labels such as Accurate 4064, though those rivals were formulated independently—first in Czechia and later to separate Valleyfield specifications—and are not identical twins. Today IMR 4064 is manufactured at GD-OTS Canada in Valleyfield, Quebec, and distributed by Hodgdon Powder Company.

IMR 4064 is a single-base, single-perforated tubular propellant notable for relatively long extruded sticks coated with a DNT deterrent and graphite. While the long kernels resist uniform volumetric throwing and typically favor trickle-weighing, the powder's predictable pressure curve earned decades of military and match-grade service, including factory U.S. M118LR 7.62 NATO sniper ammunition. Restricted in the European Union under REACH rules since 2018, it remains a mainstay across .22-250 Remington, .308 Winchester, .30-06 Springfield, and medium-capacity hunting and target cartridges.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1935 (DuPont)**
Class	**Single-base extruded**
Burn Rank	**#056 of 143**
Bulk Density	**933 g/L**
Heat (Qex)	**3,790 kJ/kg**
Role	**Versatile medium rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4166

Burn Rank #051

Hodgdon launched IMR 4166 in 2015 as the fastest member of the IMR Enduron series, manufactured by GD-OTS Canada in Valleyfield, Quebec. The Enduron family was engineered to deliver modern temperature stability, reduced copper fouling, and European REACH compliance without relying on Australian ADI supply. Positioned directly in the .308 Winchester and Varget burn-rate corridor, IMR 4166 gained rapid acceptance among precision riflemen before Hodgdon discontinued the entire Enduron line in August 2022 due to supplier and manufacturing constraints.

Built as a short-cut, single-base extruded propellant free of DNT and phthalate plasticizers, IMR 4166 incorporated a bismuth-based decoppering additive intended to curb jacket-metal buildup in rifle bores over extended strings of fire. Its clean-burning chemistry and compact grain length improved metering compared to legacy IMR 4064 while targeting high load density in .223 Remington heavy-bullet, 6mm BR, .243 Winchester, and .308 Winchester chambers. Although factory production has ended, existing canisters remain fully usable under standard storage precautions.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**2015 (IMR Enduron line)**
Class	**Single-base extruded**
Burn Rank	**#051 of 143**
Bulk Density	**900 g/L**
Heat (Qex)	**3,640 kJ/kg**
Role	**Medium match & tactical rifle**
Status	**Discontinued (August 2022)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4198

Burn Rank #019

DuPont introduced IMR 4198 in the mid-1930s alongside IMR 3031 and IMR 4064 to serve small-capacity varmint cartridges and historic black-powder rifle cases converted to smokeless operation. Now produced at GD-OTS Canada in Valleyfield, Quebec, and marketed by Hodgdon, IMR 4198 shares a historical number—but not a manufacturing plant or identical burn curve—with Hodgdon H4198, which is produced by Thales / ADI in Mulwala, Australia. Because their grain lengths and pressure curves differ, published data for one must never be substituted for the other.

Formulated as a fast-burning, single-base extruded stick propellant coated with DNT deterrent, IMR 4198 features comparatively slender, elongated kernels that burn crisply at moderate operating pressures. Its DNT content places it outside European Union REACH import eligibility since 2018, while keeping it a staple in North America. Handloaders pair IMR 4198 with compact bottleneck cartridges such as the .222 Remington, .223 Remington with light bullets, 7.62x39mm, and .221 Fireball, as well as classic big-bore straight-wall cartridges like the .45-70 Government.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1935 (DuPont)**
Class	**Single-base extruded**
Burn Rank	**#019 of 143**
Bulk Density	**830 g/L**
Heat (Qex)	**4,024 kJ/kg**
Role	**Fast small-bore & straight-wall rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4227

Burn Rank #012

DuPont introduced IMR 4227 in the mid-1930s as the fastest-burning rifle propellant in the classic IMR lineup, specifically targeting tiny bottleneck cartridges such as the .22 Hornet and .218 Bee that bridged handgun and rifle case volumes. After Hodgdon acquired the IMR brand in 2003, it retained IMR 4227 from GD-OTS Canada in Valleyfield, Quebec, and eventually consolidated the overlapping Australian-made Hodgdon H4227 out of the North American catalog. The two shared a legacy designation but were distinct factory products with separate data.

IMR 4227 uses very fine, short-cut single-base tubular grains that meter unusually well for an extruded stick powder and pack cleanly into restricted case capacities. Containing DNT deterrent under the legacy DuPont recipe, it is restricted under European Union REACH regulations enforced in 2018. Within the bottleneck rifle domain, IMR 4227 sits at the fast boundary alongside magnum handgun propellants, serving .22 Hornet, .17 Hornet, .218 Bee, .300 AAC Blackout, and cast-bullet reduced-velocity loads in larger military cases.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1935 (DuPont)**
Class	**Single-base extruded**
Burn Rank	**#012 of 143**
Bulk Density	**880 g/L**
Heat (Qex)	**4,020 kJ/kg**
Role	**Very fast micro-rifle & magnum carbine**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4320

Burn Rank #063

DuPont introduced IMR 4320 in the mid-1930s as a finer-grained, better-metering companion to IMR 4064 in the medium rifle burn-rate band. Manufactured for decades on the legacy IMR extrusion lines at Valleyfield, Quebec (now GD-OTS Canada) and distributed by Hodgdon following the 2003 IMR acquisition, IMR 4320 remained continuously available for more than eight decades. In 2020, Hodgdon discontinued IMR 4320 alongside Hodgdon H414 to streamline production capacity toward higher-demand propellants.

Unlike the longer tubular sticks of IMR 4064, IMR 4320 used shorter, single-perforated single-base grains treated with DNT deterrent, yielding noticeably smoother volumetric metering in mechanical powder measures. Its burn speed sat immediately adjacent to IMR 4064 and Hodgdon Varget, making it a historical favorite in .22-250 Remington, .220 Swift, .257 Roberts, .308 Winchester, and .30-06 Springfield rifles. Prior to its 2020 discontinuation, its DNT formulation had also placed it under European Union REACH import restrictions.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1935 (DuPont)**
Class	**Single-base extruded**
Burn Rank	**#063 of 143**
Bulk Density	**992 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Medium short-grain rifle**
Status	**Discontinued (2020)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4350

Burn Rank #094

DuPont introduced IMR 4350 in 1940 to give handloaders and ammunition makers a slower-burning, progressive single-base propellant suited to overbore cartridges like the .270 Winchester, .300 H&H Magnum, and wildcat heavy-bullet designs. Its numerical code became one of the most imitated benchmarks in smokeless history, spawning distinct 4350-labeled powders from Hodgdon (Australian ADI AR2209), Accurate, and Shooters World (Czech Lovex S070). Original IMR 4350 is manufactured at GD-OTS Canada in Valleyfield, Quebec, and marketed by Hodgdon.

IMR 4350 is a classic single-perforated, tubular single-base propellant deterred with DNT and glazed with graphite. While its legacy Valleyfield chemistry exhibits greater ambient-temperature sensitivity than temperature-stabilized Australian H4350, IMR 4350 delivers crisp ignition and uniform internal ballistics across an extraordinarily broad range of bottleneck cartridges. Restricted in the European Union under REACH since 2018, it remains a foundational propellant for .243 Winchester, 6.5 Creedmoor, .270 Winchester, .30-06 Springfield, and .300 Winchester Magnum. Never substitute load data across different brands bearing the 4350 designation.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1940 (DuPont)**
Class	**Single-base extruded**
Burn Rank	**#094 of 143**
Bulk Density	**930 g/L**
Heat (Qex)	**3,580 kJ/kg**
Role	**Mid-bore & standard magnum rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4451

Burn Rank #090

Introduced by Hodgdon in 2015 as the centerpiece mid-slow member of the IMR Enduron series, IMR 4451 was manufactured at GD-OTS Canada in Valleyfield, Quebec, to compete directly in the coveted 4350 burn-rate bracket. Conceived during chronic North American shortages of Australian-made H4350, IMR 4451 offered a domestically produced North American extruded alternative with modern thermal stability and REACH-compatible chemistry. Hodgdon discontinued IMR 4451 along with all other Enduron propellants in August 2022 due to plant supply constraints.

IMR 4451 utilized a short-cut, single-base extruded grain free of DNT and DBP, paired with a bismuth-based copper-fouling eliminator and high-density loading characteristics. Although its burn speed closely shadowed IMR 4350 and Hodgdon H4350, its independent deterred chemistry required dedicated load tables rather than cross-brand substitution. Before its discontinuation, IMR 4451 earned wide adoption in 6mm and 6.5mm Creedmoor, .260 Remington, .270 Winchester, .280 Remington, and .30-06 Springfield rifles.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**2015 (IMR Enduron line)**
Class	**Single-base extruded**
Burn Rank	**#090 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,580 kJ/kg**
Role	**Mid-bore precision & hunting rifle**
Status	**Discontinued (August 2022)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4831

Burn Rank #101

Although World War II DuPont 20mm Oerlikon surplus propellant popularized the 4831 number through Bruce Hodgdon beginning in 1950, DuPont did not release commercial canister IMR 4831 until 1973, after military surplus stocks were nearly exhausted. Rather than duplicating Hodgdon's slower Scottish and later Australian H4831 lots, DuPont engineered commercial IMR 4831 to its own slightly faster burn-rate specification. Produced today at GD-OTS Canada in Valleyfield, Quebec, and distributed by Hodgdon, IMR 4831 remains distinct from Hodgdon H4831 and H4831SC.

IMR 4831 is a classic single-perforated, single-base tubular propellant coated with DNT deterrent and graphite. Its burn rate sits noticeably faster than Australian-made H4831, bridging the gap between 4350-class powders and true slow magnum propellants; because of this gap, IMR 4831 and H4831 data are never interchangeable. Restricted from European Union import under 2018 REACH enforcement, IMR 4831 remains an active North American standby for .270 Winchester, .25-06 Remington, 7mm Remington Magnum, and .300 Winchester Magnum.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1973 (DuPont commercial)**
Class	**Single-base extruded**
Burn Rank	**#101 of 143**
Bulk Density	**930 g/L**
Heat (Qex)	**3,575 kJ/kg**
Role	**Overbore hunting & magnum rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4895

Burn Rank #054

DuPont developed IMR 4895 during World War II as the primary military rifle propellant for U.S. .30-06 M2 Ball ammunition fired in the M1 Garand, producing hundreds of millions of pounds before surplus lots launched Bruce Hodgdon's postwar powder business. DuPont later introduced fresh commercial canister IMR 4895 to match that legendary military burn rate. Manufactured at GD-OTS Canada in Valleyfield, Quebec, and distributed by Hodgdon since 2003, IMR 4895 is a separate product from Australian-made Hodgdon H4895.

Formulated as a single-perforated, single-base tubular stick powder with DNT deterrent, IMR 4895 burns cleanly and generates port pressures well matched to gas-operated service rifles such as the M1 Garand and M14/M1A. Its DNT deterrent precludes European Union import under 2018 REACH enforcement, though it remains in steady North American production. Beyond military service cartridges, IMR 4895 spans an unusually wide range of bottleneck cases from .222 Remington and .223 Remington through .308 Winchester and .30-06 Springfield, always using IMR-specific data rather than H4895 tables.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1941–1945 (WWII DuPont; commercial…**
Class	**Single-base extruded**
Burn Rank	**#054 of 143**
Bulk Density	**966 g/L**
Heat (Qex)	**3,640 kJ/kg**
Role	**Service-rifle & general medium rifle**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 4955

Burn Rank #102

Hodgdon expanded the IMR Enduron family in 2017 by introducing IMR 4955, manufactured at GD-OTS Canada in Valleyfield, Quebec, to occupy the slow-medium hunting corridor between IMR 4451 and IMR 7977. Positioned directly alongside IMR 4831 and Hodgdon H4831, IMR 4955 completed the core big-game progression of the Enduron lineup. Like its four Enduron siblings, IMR 4955 was discontinued by Hodgdon in August 2022 when Valleyfield manufacturing constraints ended the series.

IMR 4955 combined a REACH-compliant, DNT-free single-base extruded matrix with short-cut grain geometry, low temperature sensitivity across hunting climates, and a bismuth-based copper-fouling eliminator. Its high bulk density allowed efficient case fill in long-action overbore cartridges without excessive compression. During its five-year production run, IMR 4955 served .25-06 Remington, .270 Winchester, .280 Ackley Improved, 7mm Remington Magnum, and .300 Winchester Magnum rifles, providing stable velocity and cleaner bores between cleanings.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**2017 (IMR Enduron line)**
Class	**Single-base extruded**
Burn Rank	**#102 of 143**
Bulk Density	**992 g/L**
Heat (Qex)	**3,560 kJ/kg**
Role	**Overbore big-game & magnum rifle**
Status	**Discontinued (August 2022)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 7828

Burn Rank #115

Originally developed by DuPont as a factory ammunition propellant for heavy belted magnums, IMR 7828 entered the commercial handloading canister market in 1986 as the slowest-burning member of the legacy IMR line. Produced at GD-OTS Canada in Valleyfield, Quebec, and distributed by Hodgdon since 2003, IMR 7828 filled a long-standing need for a slow, progressive single-base stick powder slower than IMR 4831. Its long-grain geometry later prompted the 2005 introduction of a shorter-cut companion, IMR 7828SSC.

IMR 7828 uses large, long-cut single-perforated single-base grains surface-deterred with DNT and coated with graphite. Because its lengthy kernels bridge easily in mechanical measures and limit charge packing in smaller necks, careful weighing and slow pouring are routine practice. Restricted in the European Union under 2018 REACH rules, it remains an active North American magnum workhorse for 7mm Remington Magnum, .300 Winchester Magnum, .300 Weatherby Magnum, and .300 Remington Ultra Magnum with heavy projectiles.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**1986 (DuPont / IMR)**
Class	**Single-base extruded**
Burn Rank	**#115 of 143**
Bulk Density	**992 g/L**
Heat (Qex)	**3,550 kJ/kg**
Role	**Slow belted & large-capacity magnum**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 7828SSC

Burn Rank #114

Hodgdon introduced IMR 7828SSC (Super Short Cut) in 2005 shortly after acquiring the IMR line, answering handloader complaints that original long-stick IMR 7828 bridged in powder measures and overflowed narrow-necked magnum cases. Manufactured at GD-OTS Canada in Valleyfield, Quebec, IMR 7828SSC retains the same general burn-rate class as standard IMR 7828 while trimming kernel length to improve flow and packing efficiency. Both variants share the Valleyfield IMR heritage and remain in Hodgdon's North American catalog.

IMR 7828SSC is a single-base, single-perforated extruded propellant using a DNT deterrent package that makes it ineligible for European Union import under REACH enforcement since 2018. Although Hodgdon publishes closely aligned load data for 7828 and 7828SSC, their differing bulk densities and kernel geometry mean handloaders should consult data specific to the exact canister in hand rather than blindly swapping charges across lots. It excels in high-capacity bottleneck magnums such as .264 Winchester Magnum, 7mm Remington Magnum, .300 Winchester Magnum, and .300 Weatherby Magnum.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**2005 (Hodgdon / IMR)**
Class	**Single-base extruded**
Burn Rank	**#114 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,900 kJ/kg**
Role	**Slow belted & large-capacity magnum**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 7977

Burn Rank #122

Launched in 2015 as the magnum flagship of the initial three-powder IMR Enduron release alongside IMR 4166 and IMR 4451, IMR 7977 was manufactured by GD-OTS Canada in Valleyfield, Quebec, for Hodgdon Powder Company. Engineered to stand alongside Hodgdon H1000 in burn rate while remaining free of DNT and phthalate additives, it targeted long-range magnum shooters seeking thermally stable domestic extrusion. Hodgdon discontinued IMR 7977 with the rest of the Enduron line in August 2022 due to supplier constraints.

IMR 7977 was formulated as a slow-burning, single-base extruded propellant incorporating a bismuth-based copper-fouling eliminator and high-density short-cut grains. Its progressive burn profile and reduced ambient temperature drift suited extended-range hunting and target shooting across wide seasonal swings. Prior to discontinuation, it served high-volume bottleneck magnums including the 7mm Remington Magnum, .300 Winchester Magnum, .300 PRC, .300 Remington Ultra Magnum, and .338 Lapua Magnum.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**2015 (IMR Enduron line)**
Class	**Single-base extruded**
Burn Rank	**#122 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,827 kJ/kg**
Role	**Slow magnum & long-range rifle**
Status	**Discontinued (August 2022)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 8133

Burn Rank #133

Hodgdon introduced IMR 8133 in 2018 as the fifth and slowest-burning member of the IMR Enduron series, manufactured by GD-OTS Canada in Valleyfield, Quebec. Developed specifically for extreme overbore magnums that outgrew IMR 7977—such as the 6.5-300 Weatherby Magnum, 28 Nosler, and .300 Remington Ultra Magnum—IMR 8133 positioned itself alongside Hodgdon Retumbo and Vihtavuori N570. Its commercial run proved short-lived, ending when Hodgdon discontinued the entire Enduron family in August 2022.

Like its Enduron siblings, IMR 8133 employed a REACH-compliant, DNT-free single-base extruded formulation with a copper-fouling eliminator and temperature-insensitive surface deterrent package. Its compact extruded grains packed densely into cavernous magnum cases while sustaining progressive pressure curves behind heavy, high-ballistic-coefficient bullets. Although no longer manufactured, IMR 8133 demonstrated the upper burn-rate limit achievable on GD-OTS Canada's commercial Enduron lines for ultra-overbore cartridges like 26 Nosler, 28 Nosler, .30-378 Weatherby, and .338 Lapua Magnum.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**GD-OTS Canada (CA)**
Introduced	**2018 (IMR Enduron line)**
Class	**Single-base extruded**
Burn Rank	**#133 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,703 kJ/kg**
Role	**Ultra-slow overbore magnum rifle**
Status	**Discontinued (August 2022)**

Live spec card
empiricalprecision.com
Components · Powders

IMR 8208 XBR

ADI BM8208 · Burn Rank #045

Unlike traditional Canadian-made IMR powders, IMR 8208 XBR is manufactured by Thales / ADI at Mulwala, Australia—where it is sold domestically as ADI BM8208—and was introduced to North America by Hodgdon in 2010 under the IMR label. Its designation honors the legendary DuPont Thunderbird T-8208 experimental military lot prized by benchrest competitors decades earlier, while the XBR suffix denotes Extreme Benchrest. It brought ADI's temperature-insensitive single-base extrusion technology into the fast-medium match corridor between Benchmark and Varget.

IMR 8208 XBR features very fine, short-cut single-perforated tubular grains that meter with near-spherical uniformity while retaining the thermal stability of ADI's Extreme-class single-base chemistry. Because its Australian formulation contains DNT deterrent, European Union REACH rules halted EU imports in 2018, though North American and Australian distribution continues. Even though IMR 8208 XBR and ADI BM8208 share the same Mulwala OEM recipe, lot variance demands using canister-specific data. It excels in 6mm PPC, .223 Remington heavy-bullet service loads, 6.5 Grendel, 6mm ARC, and .308 Winchester with mid-weight match projectiles.

Propellant specifications

Packager	**IMR / Hodgdon**
OEM Plant	**Thales / ADI (AU)**
OEM / Twin	**ADI BM8208**
Introduced	**2010 (Hodgdon / ADI)**
Class	**Single-base extruded**
Burn Rank	**#045 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,720 kJ/kg**
Role	**Benchrest, service-rifle & fast-medium**
Status	**Active (EU REACH-restricted)**

Live spec card
empiricalprecision.com
Components · Powders

Norma

Norma 200

Burn Rank #028

Norma 200 anchors the fastest end of Norma Precision AB's numbered 200-series rifle propellants, originally assembled during Norma's post-World War II expansion into commercial sporting ammunition and canister components. Produced in Karlskoga, Sweden, by Eurenco Bofors AB—the historic Swedish energetics plant once owned by Alfred Nobel—Norma 200 reflects decades of Scandinavian extruded rifle propellant development. Its simple three-digit designation signals its place at the rapid-burning entry point of the Norma rifle progression.

Formulated as a fine-grained, single-perforated double-base extruded propellant combining nitrocellulose with a moderate nitroglycerin content, Norma 200 delivers brisk ignition and high energy density across compact powder columns. Fully compliant with European Union REACH regulations, it provides European and international handloaders an extruded alternative to fast North American powders. Norma 200 is tailored to small-capacity bottleneck cartridges such as the .222 Remington, .223 Remington with lightweight varmint bullets, .221 Fireball, and 7.62x39mm, as well as light-bullet loads in compact short-action cases.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**1950s (Norma / Bofors)**
Class	**Double-base extruded**
Burn Rank	**#028 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,940 kJ/kg**
Role	**Fast small-bore & varmint rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Norma 201

Burn Rank #049

Norma 201 occupies the second rung of Norma Precision AB's classic 200-series rifle progression, manufactured at Eurenco Bofors AB in Karlskoga, Sweden. Introduced alongside Norma 200 and 202 during Norma's mid-twentieth-century rollout of commercial reloading components, Norma 201 bridged the gap between small-case varmint propellants and full-sized military-caliber powders. Its continued production for more than half a century reflects steady Scandinavian demand for clean-burning, medium-fast hunting propellants suited to short-barreled forest rifles.

Built on Bofors' high-energy double-base extruded chemistry with single-perforated cylindrical grains, Norma 201 balances crisp ignition with moderate pressure progression across wide bore-to-capacity ratios. Compliant with European Union REACH chemical mandates, it has remained unaffected by the 2018 restrictions that curtailed DNT-deterred imports across Europe. Typical bottleneck applications span the .223 Remington with medium bullets, .308 Winchester with lighter hunting projectiles, 8x57mm JS, 9.3x62mm, and classic large-bore African and European dangerous-game cartridges.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**1950s (Norma / Bofors)**
Class	**Double-base extruded**
Burn Rank	**#049 of 143**
Bulk Density	**900 g/L**
Heat (Qex)	**3,980 kJ/kg**
Role	**Fast-medium hunting & big-bore rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Norma 202

Burn Rank #052

Norma 202 was specifically tailored by Norma Precision AB and Eurenco Bofors AB in Karlskoga, Sweden, to serve the .308 Winchester and similarly proportioned medium-capacity European rifle cartridges. Emerging from the core mid-century 200-series canister lineup, Norma 202 became one of Scandinavia's most widely loaded general-purpose rifle propellants, spanning both sporting ammunition assembly and civilian handloading. Its burn speed slots neatly between faster Norma 201 and slightly slower Norma 203B.

Manufactured as a single-perforated, double-base extruded stick propellant, Norma 202 offers clean combustion, high lot uniformity, and full compliance with European Union REACH regulations. Its compact cylindrical grains deliver reliable ignition in cold Nordic hunting conditions and consistent velocity curves across short-action cases. Beyond its flagship pairing with the .308 Winchester across light and medium bullet weights, Norma 202 performs well in the 6mm BR, .22-250 Remington, 7.62x54mmR, 8x57mm JS, and 9.3x62mm.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**1950s (Norma / Bofors)**
Class	**Double-base extruded**
Burn Rank	**#052 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,760 kJ/kg**
Role	**Medium short-action & .308-class rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Norma 203B

Burn Rank #066

Norma 203B evolved in the late twentieth century as an updated refinement of the earlier Norma 203 rifle propellant, manufactured at Eurenco Bofors AB in Karlskoga, Sweden, for Norma Precision AB. Positioned squarely in the most versatile medium burn-rate band of bottleneck rifle shooting, 203B quickly won a reputation among both European hunters and North American precision competitors. It comes off the same Karlskoga production complex as Alliant Reloder 15, sharing historical Bofors RP11 lineage.

Formulated as a single-perforated, double-base extruded propellant with moderate nitroglycerin infusion, Norma 203B produces high velocity efficiency alongside predictable chamber pressures and REACH-compliant European availability. Although Norma 203B and Alliant Reloder 15 occupy nearly identical burn-rate territory, Norma and Alliant maintain independent lot blending specifications and explicitly caution against grain-for-grain substitution without consulting canister-specific data. Norma 203B shines in 6mm Dasher, 6mm BR, .22-250 Remington, .308 Winchester with heavier match projectiles, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**1990s (Norma / Bofors; replaced Nor…**
Class	**Double-base extruded**
Burn Rank	**#066 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,910 kJ/kg**
Role	**Medium match & all-around rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Norma 204

Burn Rank #097

Norma 204 has served for decades as the classic slow-medium backbone of Norma Precision AB's 200-series canister lineup, manufactured at Eurenco Bofors AB in Karlskoga, Sweden. Originally introduced to support classic European long-action cartridges such as the 6.5x55mm Swedish Mauser and 7x64mm Brenneke, Norma 204 bridges the transition between mid-range propellants like URP and full magnum grades like MRP. It shares Karlskoga production ancestry and burn-rate neighborhood with Alliant Reloder 19.

Produced as a dense, single-perforated double-base extruded propellant, Norma 204 is fully compliant with European Union REACH rules and offers progressive gas generation suited to heavier bullets in standard-capacity cases. While closely aligned in burn speed with Bofors-made Alliant Reloder 19, independent packager specifications and lot tolerances prohibit blind cross-substitution between the two brands. Typical bottleneck rifle applications include the 6.5x55mm Swedish, .243 Winchester with heavy bullets, .270 Winchester, .280 Remington, .30-06 Springfield, and lighter magnum bullet weights.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**1950s (Norma / Bofors)**
Class	**Double-base extruded**
Burn Rank	**#097 of 143**
Bulk Density	**950 g/L**
Heat (Qex)	**3,950 kJ/kg**
Role	**Slow-medium standard & overbore rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Norma 217

Burn Rank #131

Norma 217 represents the slowest-burning propellant in Norma Precision AB's commercial rifle catalog, manufactured by Eurenco Bofors AB in Karlskoga, Sweden. Introduced in the 2010s to succeed the slow-magnum niche previously occupied by the discontinued Norma MRP-2, Norma 217 was developed as modern extreme long-range cartridges pushed case capacities well beyond conventional belted magnums. Its designation breaks from the older 200–204 sequence to distinguish its ultra-progressive magnum burn profile.

Engineered as a large-web, single-perforated double-base extruded propellant that meets European Union REACH requirements, Norma 217 delivers sustained pressure curves behind heavy, high-ballistic-coefficient projectiles in severely overbore chambers. Its high energy density and controlled surface deterrents prevent premature pressure spikes when filling cavernous magnum cases. Primary bottleneck rifle applications include the .300 Norma Magnum, .338 Norma Magnum, .338 Lapua Magnum, .300 Remington Ultra Magnum, 28 Nosler, and 7mm Remington Ultra Magnum.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**2010s (Norma / Bofors; succeeded MR…**
Class	**Double-base extruded**
Burn Rank	**#131 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,766 kJ/kg**
Role	**Ultra-slow ELR & super-magnum rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Norma MRP

Burn Rank #116

Norma MRP—an acronym for Magnum Rifle Powder—was introduced in the 1960s during Norma Precision AB's historic collaboration with Roy Weatherby to produce factory Weatherby Magnum ammunition in Sweden. Manufactured by Eurenco Bofors AB in Karlskoga, Sweden, MRP became one of the most celebrated slow-burning sporting propellants in Europe and North America. It occupies the same Karlskoga Bofors lineage and burn-rate class as Alliant Reloder 22.

Formulated as a high-energy, single-perforated double-base extruded propellant complying with European Union REACH mandates, Norma MRP packs substantial bulk density and energetic output into overbore magnum cases. Although Norma MRP and Bofors-made Alliant Reloder 22 are closely related counterparts, Norma and Alliant maintain independent lot tolerances and specifications, so handloaders must never substitute charges 1:1 across labels. Norma MRP excels in 6.5x55mm Swedish with heavy bullets, .270 Weatherby Magnum, 7mm Remington Magnum, .300 Winchester Magnum, and .300 Weatherby Magnum.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**1960s (Norma / Bofors)**
Class	**Double-base extruded**
Burn Rank	**#116 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,873 kJ/kg**
Role	**Slow belted & long-action magnum**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Norma URP

Burn Rank #095

Norma URP—standing for Universal Rifle Powder—was introduced by Norma Precision AB in the mid-2000s to fill the important burn-rate gap between Norma 203B and Norma 204. Manufactured by Eurenco Bofors AB in Karlskoga, Sweden, URP targeted the immensely popular 4350 burn-rate corridor that had previously been underserved in Norma's canister catalog. Its name reflects its breadth across standard short- and long-action sporting cartridges rather than single-caliber specialization.

Produced as a REACH-compliant, single-perforated double-base extruded propellant, Norma URP offers brisk energy release and high velocity efficiency while maintaining clean combustion across seasonal hunting temperatures. Its burn speed aligns closely with Hodgdon H4350 and IMR 4350, giving European shooters a domestic Scandinavian equivalent after 2018 EU REACH restrictions removed DNT-deterred North American and Australian 4350 powders from European shelves. Typical bottleneck applications span the .243 Winchester, 6.5 Creedmoor, 6.5x55mm Swedish, .270 Winchester, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Norma Precision AB**
OEM Plant	**Eurenco Bofors (SE)**
Introduced	**2005 (Norma / Bofors)**
Class	**Double-base extruded**
Burn Rank	**#095 of 143**
Bulk Density	**910 g/L**
Heat (Qex)	**4,017 kJ/kg**
Role	**Mid-slow versatile hunting & match**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Ramshot

Ramshot Big Game

PB Clermont (proprietary) · Burn Rank #083

Western Powders launched Ramshot Big Game in 1998 as part of the original Ramshot spherical rifle lineup out of Miles City, Montana, contracting manufacture with PB Clermont in Engis, Belgium—a historic European propellant maker dating back to 1850 and now part of Eurenco. Named plainly for North American deer and elk cartridges, Big Game joined Hodgdon Powder Company's catalog when Hodgdon acquired Western Powders in October 2020.

Formulated as a high-energy, free-flowing double-base spherical propellant, Ramshot Big Game sits in the medium-to-medium-slow burn-rate neighborhood alongside Hodgdon H380 and just faster than Winchester 760. Its dense spherical geometry meters cleanly and delivers strong velocities in mid-capacity bottleneck hunting rounds including .22-250 Remington, .243 Winchester, 6.5 Creedmoor, 7mm-08 Remington, .308 Winchester with heavy bullets, and .30-06 Springfield. Like all Belgian ball propellants, it remains compliant with modern European chemical standards.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**PB Clermont (proprietary)**
Introduced	**1998**
Class	**DB spherical (ball)**
Burn Rank	**#083 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**Mid-bore & standard hunting rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Ramshot Grand

Proprietary (ball) · Burn Rank #130

Hodgdon Powder Company formally unveiled Ramshot Grand in January 2024 following late-2023 manual previews, expanding the Ramshot brand with its first major post-acquisition rifle release. Unlike traditional Belgian-made Ramshot propellants from PB Clermont, Ramshot Grand is manufactured domestically in the United States by General Dynamics St. Marks Powder in Crawfordville, Florida. Its name evokes big-game magnum reach in modern long-range hunting chambers.

Engineered as a very slow, high-density double-base spherical propellant, Ramshot Grand occupies the Retumbo-to-Ramshot Magnum burn-rate tier while incorporating modern temperature-stabilizing and decoppering technology. Its smooth-metering ball kernels maximize case fill and velocity in heavy-bullet magnums such as 6.5 PRC, 7mm Remington Magnum, 7mm PRC, .28 Nosler, .300 Winchester Magnum, and .300 PRC. Because its domestic St. Marks formulation differs completely from Belgian Ramshot Magnum, separate published data must be followed.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**GD St. Marks (US)**
OEM / Twin	**Proprietary (ball)**
Introduced	**2024**
Class	**DB ball (temp-stable)**
Burn Rank	**#130 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**Heavy-bullet magnum & PRC rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Ramshot Hunter

PB Clermont (proprietary) · Burn Rank #104

Introduced by Western Powders in 1998 alongside Big Game and TAC, Ramshot Hunter was manufactured in Engis, Belgium by PB Clermont to bridge standard mid-bore rifle cartridges and belted magnums with a smooth-metering spherical alternative to 4350- and 4831-class stick powders. Following Hodgdon Powder Company's October 2020 acquisition of Western Powders, Ramshot Hunter remained an active cornerstone of the Ramshot hunting catalog.

Positioned between Accurate 4350 and Hodgdon H4831 on empirical burn-rate charts, Ramshot Hunter is a fine-grained double-base ball propellant whose clean-burning PB Clermont chemistry delivers full case fill and consistent ignition. It shines in .243 Winchester, 6.5 Creedmoor, 6.5x55 Swedish, .270 Winchester, .270 WSM, .30-06 Springfield, and .300 WSM. As a double-base spherical powder without Extreme temperature coatings, it pairs well with magnum primers in freezing hunting weather.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**PB Clermont (proprietary)**
Introduced	**1998**
Class	**DB spherical (ball)**
Burn Rank	**#104 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**Long-action & short-magnum hunting**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Ramshot LRT

PB Clermont (proprietary) · Burn Rank #141

Western Powders announced Ramshot LRT—standing for Long Range Tactical—in May 2018 to give extreme-long-range shooters an ultra-slow, free-flowing Belgian spherical propellant slower than Ramshot Magnum. Manufactured by PB Clermont in Engis, Belgium, LRT (occasionally misprinted as 'LRC' in informal lists) filled the extreme-overbore tier previously dominated by bulky extruded powders. Hodgdon kept LRT in active distribution after acquiring Western Powders in 2020.

Sitting alongside Hodgdon H50BMG and US 869 at the slowest edge of commercial rifle propellants, Ramshot LRT features dense, heavily deterred double-base ball grains that pour effortlessly through scales and automated dispensers. Its progressive burn rate excels behind heavy, high-BC projectiles in .338 Lapua Magnum, .300 Remington Ultra Magnum, .30-378 Weatherby Magnum, .28 Nosler, and .375 CheyTac. Magnum rifle primers and high case fill help guarantee clean, consistent ignition.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**PB Clermont (proprietary)**
Introduced	**2018**
Class	**DB spherical (ball)**
Burn Rank	**#141 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**3,605 kJ/kg**
Role	**Extreme overbore & ELR magnum**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Ramshot Magnum

PB Clermont (proprietary) · Burn Rank #132

Western Powders originally introduced this Belgian-made magnum spherical propellant in 1998 under the name 'Big Boy' before renaming it Ramshot Magnum in 2001 to align with the rest of the Ramshot hunting lineup. Manufactured by PB Clermont in Engis, Belgium, Ramshot Magnum became a longtime favorite for high-capacity hunting cartridges needing heavy charges without the metering friction of coarse magnum sticks. Hodgdon assumed distribution in October 2020.

Ramshot Magnum is a very slow, high-density double-base spherical propellant sitting just slower than Hodgdon Retumbo and Ramshot Grand. Its elevated chemical energy and dense packing support top-end velocities in overbore cartridges including 7mm Remington Magnum, 7mm Remington Ultra Magnum, .28 Nosler, .300 Winchester Magnum, .300 Weatherby Magnum, and .338 Lapua Magnum. Magnum primers are strongly recommended to ensure prompt, even ignition across cold mountain hunting temperatures.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**PB Clermont (proprietary)**
Introduced	**1998 (as Big Boy; renamed 2001)**
Class	**DB spherical (ball)**
Burn Rank	**#132 of 143**
Bulk Density	**995 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**Belted magnum & ultra-magnum rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Ramshot TAC

PB Clermont (proprietary) · Burn Rank #055

Launched by Western Powders in 1998 as the tactical and service-rifle flagship of the Ramshot brand, Ramshot TAC was named directly for its primary role in military-pattern 5.56x45mm NATO and 7.62x51mm NATO rifles. Manufactured in Engis, Belgium by PB Clermont, TAC rapidly earned a reputation for crisp progressive-press metering and dependable accuracy across both gas-operated AR platforms and bolt-action rifles. Hodgdon retained it as a core offering after acquiring Western Powders in 2020.

Formulated as a fine-grained double-base spherical propellant sitting near IMR 4895 and Accurate 2460—distinct from faster Ramshot X-Terminator and Accurate 2230—Ramshot TAC excels with heavy match projectiles in .223 Remington and 5.56x45mm NATO as well as .308 Winchester, 6.5 Grendel, and .22-250 Remington. Its smooth ball flow and clean PB Clermont combustion make it ideal for high-volume match loading, though published TAC data must never be cross-substituted with Accurate spherical powders.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**PB Clermont (proprietary)**
Introduced	**1998**
Class	**DB spherical (ball)**
Burn Rank	**#055 of 143**
Bulk Density	**938 g/L**
Heat (Qex)	**3,750 kJ/kg**
Role	**Tactical 5.56/7.62 & progressive match**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Ramshot X-Terminator

PB Clermont (AA2230 twin) · Burn Rank #044

Western Powders launched Ramshot X-Terminator in 1998 as the fastest bottleneck rifle powder in its Belgian-sourced Ramshot catalog, coining the playful varmint-hunting name for high-volume prairie-dog and predator shooters. Manufactured by PB Clermont in Engis, Belgium, it entered Hodgdon Powder Company's lineup in October 2020 alongside the rest of the Western Powders portfolio. Informal references occasionally duplicate its name as 'Exterminator,' though X-Terminator is the sole official product.

X-Terminator is a dense, fine-grained double-base spherical propellant that meters with exceptional uniformity on progressive presses and fills small-bore cases cleanly. It is the confirmed PB Clermont counterpart to Accurate 2230 (not Accurate 2520, which sits markedly slower), yet lot-to-lot variance and independent packager quality control preclude blind 1:1 charge substitution without consulting data for the exact canister. Its brisk burn rate excels in .204 Ruger, .222 Remington, .223 Remington, and 6.8 SPC.

Propellant specifications

Packager	**Hodgdon Powder Co.**
OEM Plant	**PB Clermont (BE)**
OEM / Twin	**PB Clermont (AA2230 twin)**
Introduced	**1998**
Class	**DB spherical (ball)**
Burn Rank	**#044 of 143**
Bulk Density	**986 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**Small-bore varmint & .223 progressive**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss

Reload Swiss RS36

Burn Rank #018

Nitrochemie Wimmis AG introduced Reload Swiss RS36 in 2016 to expand its civilian Reload Swiss brand—originally launched in 2013—into the fast-burning rifle corridor between magnum-pistol RS30 and small-bore RS40. Manufactured directly at Nitrochemie's historic Swiss energetics works in Wimmis (a joint venture of Rheinmetall and RUAG), RS36 was developed specifically for compact intermediate rifle cartridges and classic lever-action cases that require brisk, complete combustion in shorter barrels.

RS36 is a pure single-base, single-perforated extruded nitrocellulose propellant finished with a camphor-based surface treatment engineered to stabilize burn behavior across ambient temperatures. Free of DNT and phthalate plasticizers, it is fully compliant with European Union REACH regulations and burns cleanly without heavy flame temperatures. Its primary bottleneck and sporting rifle applications include the 7.62x39mm, .222 Remington, .22 Hornet, .223 Remington with lightweight projectiles, .300 AAC Blackout supersonic loads, and classic .30-30 Winchester and .45-70 Government rifles.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2016 (Reload Swiss)**
Class	**Single-base extruded**
Burn Rank	**#018 of 143**
Bulk Density	**910 g/L**
Heat (Qex)	**3,950 kJ/kg**
Role	**Fast intermediate & lever-action rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS40

Burn Rank #036

Reload Swiss RS40 debuted in 2013 as part of Nitrochemie Wimmis AG's founding civilian Reload Swiss propellant catalog. Manufactured in Wimmis, Switzerland, RS40 draws directly from Nitrochemie's military small-arms propellant expertise—specifically the 5.56x45mm NATO and GP90 Swiss service-cartridge manufacturing heritage. Launching RS40 under the Reload Swiss canister label gave European handloaders direct retail access to Swiss military-grade fast-medium extrusion.

RS40 is built on Nitrochemie's proprietary EI® (Extruded Impregnated) process, in which an extruded, single-perforated nitrocellulose matrix is impregnated with nitroglycerin and modern deterrents to achieve high energetic output alongside controlled pressure progression. Fully REACH-compliant and containing a lead-free decoppering additive, RS40 delivers fine grain geometry that meters consistently for high-volume loading. It excels in .223 Remington / 5.56x45mm NATO across medium and heavy bullets, .222 Remington, 6mm PPC, 6mm BR, and lightweight-bullet .308 Winchester target loads.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2013 (Reload Swiss launch)**
Class	**EI double-base extruded**
Burn Rank	**#036 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**3,950 kJ/kg**
Role	**Fast-medium small-bore & service rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS50

Burn Rank #058

Launched in 2013 as one of the foundational rifle grades in Nitrochemie Wimmis AG's Reload Swiss line, RS50 brings classic Swiss military single-base extrusion into the civilian reloading market. Produced at Wimmis, Switzerland, RS50 shares design roots with propellants manufactured for standard 7.62x51mm NATO and Swiss 7.5x55mm GP11 service ammunition. It pairs directly alongside higher-energy RS52, offering target shooters a cooler-burning single-base option in the same medium burn-rate class.

RS50 is a pure single-base, single-perforated extruded nitrocellulose propellant treated with a camphor surface coating for smooth pressure progression and predictable thermal behavior. Compliant with European Union REACH regulations, it avoids the higher flame temperatures of nitroglycerin-impregnated propellants, appealing to competitive high-round-count shooters concerned with throat erosion. Primary bottleneck rifle applications include the .308 Winchester, 7.5x55mm Swiss, .223 Remington with heavy target bullets, 6mm BR, and classic 8x57mm JS and .30-06 Springfield sporting loads.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2013 (Reload Swiss launch)**
Class	**Single-base extruded**
Burn Rank	**#058 of 143**
Bulk Density	**950 g/L**
Heat (Qex)	**3,750 kJ/kg**
Role	**Medium military & match rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS52

Burn Rank #060

Reload Swiss RS52 launched in 2013 alongside single-base RS50 as Nitrochemie Wimmis AG's high-energy medium-rate rifle propellant. Produced in Wimmis, Switzerland, RS52 was engineered specifically for competitive long-range .308 Winchester and F-TR shooters seeking maximum velocity from restricted case capacities without crossing into slower mid-bore powders. Following 2018 EU REACH restrictions on DNT-deterred Australian Varget, RS52 became one of Europe's premier replacements in the medium match corridor.

Manufactured through Nitrochemie's EI® (Extruded Impregnated) process, RS52 infuses nitroglycerin into an extruded, single-perforated nitrocellulose grain structure together with a REACH-compliant deterrent system and lead-free decoppering agent. This combination raises available specific energy above single-base RS50 while keeping bulk density high enough for efficient case fill. RS52 excels in .308 Winchester with heavy long-range match bullets, .223 Remington heavy-for-caliber loads, 6mm BR, 7.5x55mm Swiss, and 7mm-08 Remington.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2013 (Reload Swiss launch)**
Class	**EI double-base extruded**
Burn Rank	**#060 of 143**
Bulk Density	**950 g/L**
Heat (Qex)	**3,900 kJ/kg**
Role	**High-energy medium match & tactical**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS60

Burn Rank #079

Reload Swiss RS60 was introduced in 2013 as the high-energy mid-bore flagship of Nitrochemie Wimmis AG's civilian canister line in Wimmis, Switzerland. Well before the Reload Swiss retail brand existed, Nitrochemie had developed this EI®-impregnated burn class for OEM commercial export, making RS60 the Swiss factory counterpart to Alliant Reloder 17. Its release gave European handloaders direct access to a progressive, high-velocity 4350-class propellant built under strict Swiss lot-control standards.

Constructed via Nitrochemie's EI® (Extruded Impregnated) double-base technology—penetrating an extruded single-perforated nitrocellulose grain with nitroglycerin and depth-graded deterrents—RS60 sustains a broader, flatter pressure curve that yields notable velocity gains in medium-overbore cases. It is fully REACH-compliant and includes a lead-free decoppering additive. Despite its shared OEM heritage with Alliant Reloder 17, independent commercial lot tolerances prohibit blind 1:1 charge substitution. RS60 shines in 6.5 Creedmoor, 6.5x47 Lapua, .243 Winchester, .270 Winchester, .284 Winchester, and .30-06 Springfield.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2013 (Reload Swiss launch)**
Class	**EI double-base extruded**
Burn Rank	**#079 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**4,000 kJ/kg**
Role	**High-energy mid-slow rifle & 6.5mm**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS62

Burn Rank #087

Nitrochemie Wimmis AG launched Reload Swiss RS62 in 2013 as the pure single-base partner to nitroglycerin-impregnated RS60, giving European precision shooters a cooler-burning alternative in the critical 4350 burn-rate bracket. Manufactured in Wimmis, Switzerland, RS62 gained rapid popularity after 2018 EU REACH restrictions cut off European imports of Hodgdon H4350 and IMR 4350. Its naming intentionally pairs with RS60 to signify matching burn-rate territory achieved through lower-flame-temperature single-base chemistry.

RS62 is a single-perforated, pure single-base extruded nitrocellulose propellant finished with a REACH-compliant camphor surface deterrent rather than nitroglycerin impregnation. While its specific energy is lower than double-base RS60, the cooler combustion profile reduces throat erosion in long-string target rifles and preserves consistent velocity behavior across ambient temperature shifts. RS62 is widely used in 6mm Creedmoor, 6.5 Creedmoor, .260 Remington, 6.5x55mm Swedish, .270 Winchester, .284 Winchester, and .30-06 Springfield.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2013 (Reload Swiss launch)**
Class	**Single-base extruded**
Burn Rank	**#087 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,750 kJ/kg**
Role	**Cool-burning mid-slow precision rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS70

Burn Rank #098

Introduced in 2013 with the inaugural Reload Swiss portfolio, RS70 was developed by Nitrochemie Wimmis AG in Wimmis, Switzerland, to serve classic overbore long-action cartridges and standard belted magnums. Sitting squarely between mid-bore RS60/RS62 and heavier magnum grades RS76 and RS80, RS70 was formulated as a high-bulk-density magnum propellant capable of delivering brisk velocities without requiring extreme charge compression. Its clean European manufacture made it a natural substitute when REACH enforcement curtailed imported North American 4831-class powders.

RS70 utilizes Nitrochemie's EI® (Extruded Impregnated) process, combining a single-perforated nitrocellulose extrusion with nitroglycerin impregnation, progressive surface deterrents, and a lead-free decoppering additive. Fully EU REACH-compliant, its high bulk density allows generous energetic payload inside long-action hunting and target chambers while maintaining crisp ignition. Typical bottleneck applications include the .270 Winchester, .280 Remington, 7mm Remington Magnum, 7mm WSM, .300 Winchester Magnum, and 6.5x55mm Swedish with heavy target projectiles.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2013 (Reload Swiss launch)**
Class	**EI double-base extruded**
Burn Rank	**#098 of 143**
Bulk Density	**990 g/L**
Heat (Qex)	**3,900 kJ/kg**
Role	**Slow hunting & standard magnum rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS76

Burn Rank #119

Nitrochemie Wimmis AG released Reload Swiss RS76 in 2019 to close the substantial burn-rate gap between RS70 and ultra-slow RS80. Developed at Wimmis, Switzerland, in response to the rapid proliferation of modern long-range magnum cartridges—particularly the .300 Norma Magnum, .300 PRC, and .338 Lapua Magnum—RS76 targeted the high-energy slow-magnum slot populated by Hodgdon H1000 and Alliant Reloder 26. Its arrival strengthened Nitrochemie's standing among European extreme long-range competitors.

RS76 is produced using Nitrochemie's EI® (Extruded Impregnated) manufacturing method, in which an extruded, single-perforated nitrocellulose base is surface-impregnated with nitroglycerin alongside progressive deterrents and a lead-free decoppering additive. Fully REACH-compliant and formulated for high bulk density, RS76 maximizes propellant weight in large magnum cases while maintaining progressive pressure delivery behind long, heavy match bullets. Primary bottleneck rifle applications span the 7mm Remington Magnum, .300 Winchester Magnum, .300 PRC, .300 Norma Magnum, and .338 Lapua Magnum.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2019 (Reload Swiss)**
Class	**EI double-base extruded**
Burn Rank	**#119 of 143**
Bulk Density	**990 g/L**
Heat (Qex)	**3,850 kJ/kg**
Role	**Slow magnum & long-range precision**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Reload Swiss RS80

Burn Rank #123

Reload Swiss RS80 debuted in 2013 as the slowest-burning magnum rifle propellant in Nitrochemie Wimmis AG's original Reload Swiss retail catalog. Manufactured in Wimmis, Switzerland, RS80 leveraged Nitrochemie's military heavy-sniper and medium-caliber energetics programs to serve extreme long-range civilian rifles. It stands at the upper end of Nitrochemie's commercial canister line, addressing overbore magnum chambers where faster double-base powders peak prematurely before achieving full velocity potential.

Built via Nitrochemie's EI® (Extruded Impregnated) process—impregnating a heavy-web, single-perforated extruded nitrocellulose kernel with nitroglycerin and depth-tailored deterrents—RS80 achieves exceptionally high bulk density and sustained late-barrel acceleration while remaining fully EU REACH-compliant. Its additive package incorporates a lead-free decoppering agent to ease barrel maintenance during long-range match strings. RS80 is ideally matched to ultra-overbore bottleneck cartridges such as the .338 Lapua Magnum, .338 Norma Magnum, .300 Remington Ultra Magnum, 28 Nosler, and .375 CheyTac.

Propellant specifications

Packager	**Nitrochemie Wimmis AG**
OEM Plant	**Nitrochemie (CH)**
Introduced	**2013 (Reload Swiss launch)**
Class	**EI double-base extruded**
Burn Rank	**#123 of 143**
Bulk Density	**1000 g/L**
Heat (Qex)	**3,850 kJ/kg**
Role	**Ultra-slow ELR & super-magnum rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World

Shooters World AR Plus

Lovex D073.04 · Burn Rank #042

Shooters World LLC—founded in 2012 in the United States to import and package European propellants under descriptive American market names—introduced AR Plus as its primary spherical propellant for autoloading .223 Remington rifles. Manufactured by Explosia a.s. in Pardubice, Czechia, AR Plus is the American canister counterpart to Lovex D073.04, part of Explosia's well-known D073 double-base ball series. The brand's naming replaces European alphanumeric codes with immediate application cues while preserving direct traceability to Czech OEM production.

Formulated as a fine, free-flowing double-base spherical propellant, AR Plus meters with exceptional uniformity through progressive presses and volumetric measures, making it well suited to high-volume autoloader loading. In Explosia's nomenclature, the 'D' prefix denotes double-base nitrocellulose-nitroglycerin chemistry, and the formulation meets European Union REACH requirements. Although AR Plus corresponds directly to Lovex D073.04, normal lot-to-lot variance means handloaders should rely on published data for the exact canister in hand. Primary bottleneck cartridges include .223 Remington / 5.56x45mm NATO, 6.5 Grendel, .204 Ruger, and lighter-bullet .308 Winchester loads.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex D073.04**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Double-base spherical**
Burn Rank	**#042 of 143**
Bulk Density	**986 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Fast-medium AR & service rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World Blackout

Lovex D063-02 · Burn Rank #022

Shooters World LLC introduced Blackout during the 2010s surge in suppressed .300 AAC Blackout and compact intermediate-cartridge shooting, packaging Czech-manufactured spherical propellant from Explosia a.s. in Pardubice, Czechia. Blackout is the North American canister equivalent of Explosia's Lovex D063-02, sitting slightly slower than its close sibling SBR-SOCOM (Lovex D063-01). Its marketing name directly announces its central mission: reliable gas-port cycling and clean combustion in short-barreled .300 Blackout rifles.

Manufactured as a fine-grained, double-base spherical ball powder conforming to European Union REACH chemical standards, Blackout flows smoothly through automated powder dispensers and ignites cleanly across both supersonic and heavy-bullet subsonic pressure regimes. Its burn rate places it directly alongside Accurate 1680 and Hodgdon CFE BLK, though independent formulations and lot tolerances require dedicated load tables for the exact canister in hand. Beyond .300 AAC Blackout, typical bottleneck applications include 7.62x39mm, .22 Hornet, .218 Bee, and compact straight-wall carbines.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex D063-02**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Double-base spherical**
Burn Rank	**#022 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**3,950 kJ/kg**
Role	**Fast subsonic & compact tactical rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World Long Rifle

Lovex S065 · Burn Rank #078

Shooters World LLC introduced Long Rifle in the 2010s as the intermediate extruded bridge between Precision Rifle and SW4350 in its Czech-sourced rifle catalog. Produced by Explosia a.s. at Pardubice, Czechia, Long Rifle is the American canister counterpart to Lovex S065, a classic European single-base sporting propellant long favored on the continent for standard military and hunting cartridges. Its descriptive title highlights its suitability for medium-to-long-action hunting rifles requiring a slightly slower burn curve than .308-class sticks.

True to the 'S' designation in Lovex S065, Long Rifle is a pure single-base, single-perforated extruded nitrocellulose propellant meeting European Union REACH regulations. Its moderately cut tubular grains burn cleanly at lower flame temperatures than double-base ball powders while delivering dependable ignition across seasonal temperature ranges. Although Long Rifle maps directly to Lovex S065, handloaders should always verify published data for the specific canister label and lot in hand. Typical bottleneck rifle cartridges include .243 Winchester, 6.5x55mm Swedish, 7x57mm Mauser, .270 Winchester, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex S065**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Single-base extruded**
Burn Rank	**#078 of 143**
Bulk Density	**910 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Medium-slow standard hunting rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World Match Rifle

Lovex D073.06 · Burn Rank #070

Shooters World LLC introduced Match Rifle as the slowest and highest-energy member of its Czech-manufactured D073 spherical rifle trio, sitting slower than AR Plus and Tactical Rifle. Produced by Explosia a.s. in Pardubice, Czechia, Match Rifle is the North American retail packaging of Lovex D073.06. Historically, this Explosia spherical lineage also underpinned several well-known American ball-powder equivalents in the Accurate 2520 class, making Match Rifle immediately familiar to high-volume service-rifle and across-the-course competitors.

Formulated as a dense, double-base spherical propellant fully compliant with European Union REACH regulations, Match Rifle combines high specific energy with smooth volumetric metering suited to progressive loading presses. Its progressive surface deterrent package supports brisk velocities with heavier match projectiles in medium-capacity cases, though its double-base chemistry requires attentive lot verification and canister-specific data rather than blind cross-substitution with Lovex D073.06 or other brands. Primary bottleneck rifle applications include .223 Remington with heavy long-range bullets, 6mm ARC, 6.5 Grendel, .308 Winchester, and .30-06 Springfield.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex D073.06**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Double-base spherical**
Burn Rank	**#070 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**4,100 kJ/kg**
Role	**Medium match & heavy-bullet service rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World Precision Rifle

Lovex S062 · Burn Rank #064

Shooters World LLC brought Precision Rifle to the North American market in the 2010s as its premier single-base extruded stick powder for medium-capacity match rifles. Manufactured by Explosia a.s. at Pardubice, Czechia, Precision Rifle is the U.S. canister counterpart to Lovex S062—a long-established European single-base formulation that also shared historical roots with early Czech-sourced Accurate 4064 production prior to Accurate's shift to Canadian extrusion. It gained rapid North American traction during recurring shortages of Australian Hodgdon Varget.

Precision Rifle consists of clean-burning, single-perforated single-base extruded nitrocellulose grains conforming to European Union REACH chemical rules. Positioned in the heart of the Varget and IMR 4064 burn-rate corridor, it delivers consistent ignition, moderate flame temperature, and low lot-to-lot drift when weighed carefully. Because independent packager lots can vary slightly, handloaders should always consult canister-specific data rather than substituting Lovex S062 or Varget tables directly. Typical bottleneck applications span .223 Remington heavy-bullet match loads, 6mm BR, 6mm Dasher, .22-250 Remington, .308 Winchester, and .30-06 Springfield.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex S062**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Single-base extruded**
Burn Rank	**#064 of 143**
Bulk Density	**900 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Medium precision & .308-class rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World SBR-SOCOM

Lovex D063-01 · Burn Rank #016

Shooters World LLC introduced SBR-SOCOM to address the growing segment of short-barreled rifles (SBRs) and big-bore AR-15 cartridges that demand brisk combustion before the projectile clears a short muzzle. Manufactured by Explosia a.s. in Pardubice, Czechia, SBR-SOCOM is the American canister counterpart to Lovex D063-01, standing just faster than its sibling Shooters World Blackout (Lovex D063-02). Its designation reflects its dual emphasis on short-barrel tactical carbines and large-caliber subsonic or heavy-bullet autoloaders.

Formulated as a fine, high-energy double-base spherical ball propellant meeting European Union REACH rules, SBR-SOCOM meters evenly through volumetric measures and reaches high burn completeness even in compact barrels, minimizing unburned powder residue and muzzle flash. Despite sharing the Lovex D063 family with Shooters World Blackout, its faster burn profile requires strictly separate published load tables for the exact canister on the bench. Primary rifle applications include .458 SOCOM, .450 Bushmaster, .350 Legend, .300 AAC Blackout, and .22 Hornet.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex D063-01**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Double-base spherical**
Burn Rank	**#016 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**4,100 kJ/kg**
Role	**Very fast short-barrel & big-bore AR**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World SW4350

Lovex S070 · Burn Rank #103

Shooters World LLC launched SW4350 in the 2010s to participate in the crowded 4350 burn-rate category, importing single-base extruded propellant from Explosia a.s. in Pardubice, Czechia. SW4350 is the North American retail counterpart to Lovex S070, a long-running Czech sporting powder that earlier formed the historical baseline for Czech-sourced Accurate 4350 before Western Powders relocated Accurate's extrusion to Canada. The 4350 number indicates its burn-rate neighborhood rather than a common plant or recipe with IMR 4350 or Hodgdon H4350.

SW4350 is a pure single-base, single-perforated tubular nitrocellulose propellant that meets European Union REACH chemical mandates, avoiding DNT and phthalate plasticizers. Its progressive burn rate actually trends slightly slower than Australian H4350 in empirical testing, making independent SW4350 load data essential and ruling out 1:1 charge swapping across any other 4350-labeled brand or Lovex lot. Typical bottleneck applications span the 6.5 Creedmoor, 6.5x55mm Swedish, .243 Winchester, .270 Winchester, .280 Remington, .30-06 Springfield, and medium-weight .300 Winchester Magnum loads.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex S070**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Single-base extruded**
Burn Rank	**#103 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,580 kJ/kg**
Role	**Mid-slow standard & 6.5mm rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World Tactical Rifle

Lovex D073.05 · Burn Rank #053

Shooters World LLC introduced Tactical Rifle as the middle burn-rate anchor of its Explosia-made D073 spherical rifle family, positioned directly between faster AR Plus and slower Match Rifle. Manufactured by Explosia a.s. in Pardubice, Czechia, Tactical Rifle is the American canister counterpart to Lovex D073.05, a double-base spherical propellant originally engineered to support NATO 5.56x45mm and 7.62x51mm military ammunition specifications. Its accessible commercial name highlights its service-rifle and multi-gun competition focus.

Produced as a fine, high-bulk-density double-base spherical ball powder complying with European Union REACH regulations, Tactical Rifle flows cleanly through progressive presses and generates dependable gas-system pressures in semi-automatic rifles. Its burn speed sits directly alongside Ramshot TAC and Hodgdon H4895, offering strong velocity potential across standard military calibers; however, lot-to-lot variance precludes blind substitution with Lovex D073.05 or rival brands. Core bottleneck rifle cartridges include .223 Remington / 5.56x45mm NATO, .308 Winchester / 7.62x51mm NATO, .204 Ruger, and .22-250 Remington.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**Explosia (CZ)**
OEM / Twin	**Lovex D073.05**
Introduced	**2010s (Shooters World; Explosia OEM)**
Class	**Double-base spherical**
Burn Rank	**#053 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**3,950 kJ/kg**
Role	**Fast-medium 5.56mm & .308 tactical**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World The Creed

Somchem S341 · Burn Rank #072

Unlike the majority of Shooters World propellants sourced from Explosia in Czechia, The Creed is an import exception manufactured in South Africa by Rheinmetall Denel Munition (formerly Somchem) at Somerset West. Introduced by Shooters World LLC in the early 2020s to expand spherical rifle supply during global powder shortages, The Creed is the U.S. canister packaging of Somchem S341—a long-established South African medium-rate rifle ball powder. Its name references modern 6mm and 6.5mm Creedmoor-class rifles alongside traditional medium bottleneck cartridges.

Formulated as a dense, double-base spherical propellant rather than a Lovex Czech extrusion, The Creed delivers smooth volumetric metering and high packing efficiency across medium-capacity rifle cases. Its empirical burn speed sits in the medium rifle band near Alliant Reloder 15, Winchester 748, and Shooters World Match Rifle, yet its distinct South African chemical baseline prohibits cross-loading Lovex or other brands' tables without using Shooters World's dedicated data. Typical bottleneck applications span .308 Winchester, 6mm and 6.5mm Creedmoor, .243 Winchester, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**RDM / Somchem (ZA)**
OEM / Twin	**Somchem S341**
Introduced	**2020s (Shooters World; Somchem OEM)**
Class	**Double-base spherical**
Burn Rank	**#072 of 143**
Bulk Density	**983 g/L**
Heat (Qex)	**3,568 kJ/kg**
Role	**Medium spherical match & hunting rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Shooters World The Patriot

Somchem S321 · Burn Rank #037

Introduced alongside The Creed in the early 2020s as part of Shooters World LLC's supply diversification beyond Czech Explosia lines, The Patriot is manufactured in South Africa by Rheinmetall Denel Munition (Somchem) at Somerset West. It represents the North American canister form of Somchem S321, a proven South African spherical military and sporting rifle propellant originally developed for 5.56mm and 7.62mm service ammunition. Its patriotic branding targets American AR-15 and service-rifle shooters loading in high volume.

The Patriot is a fine-grained, double-base spherical ball propellant incorporating flash-suppressing additives to curb muzzle signature in carbine-length barrels while maintaining effortless volumetric metering on progressive presses. Sitting in the fast-medium burn corridor close to Hodgdon H335 and Accurate 2230, it carries a distinct South African chemical recipe and must be loaded strictly from published Shooters World data rather than Lovex or Hodgdon charge tables. Primary bottleneck applications include .223 Remington / 5.56x45mm NATO, 6mm ARC, 6.5 Grendel, .204 Ruger, and lighter-bullet .308 Winchester loads.

Propellant specifications

Packager	**Shooters World LLC**
OEM Plant	**RDM / Somchem (ZA)**
OEM / Twin	**Somchem S321**
Introduced	**2020s (Shooters World; Somchem OEM)**
Class	**Double-base spherical**
Burn Rank	**#037 of 143**
Bulk Density	**975 g/L**
Heat (Qex)	**3,667 kJ/kg**
Role	**Fast-medium spherical service rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori

Vihtavuori 20N29

Burn Rank #143

Vihtavuori 20N29 stands as the slowest-burning commercial rifle propellant manufactured by Nammo Vihtavuori Oy at its historic Vihtavuori, Finland facility—founded in 1922 with nitrocellulose production starting in 1926. Unlike the commercial N100 and N500 retail naming conventions, the 20N29 designation reflects Finnish military ordnance nomenclature originally developed for heavy-caliber anti-materiel and 20mm-class energetics before entering civilian canister sales for extreme long-range rifles.

Formulated as a large-grain, single-perforated pure single-base nitrocellulose extrusion with progressive surface treatment, 20N29 complies fully with European Union REACH regulations and burns substantially cooler than nitroglycerin-infused magnum propellants. Its slow gas generation and massive kernel web are specifically proportioned to push very heavy projectiles down long barrels without premature chamber pressure peaks. Primary bottleneck applications are the .50 BMG with heavy match bullets, .375 and .408 CheyTac, .416 Barrett, and select ultra-overbore .338-caliber wildcats.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1990s (Vihtavuori; Finnish military lin…**
Class	**Single-base extruded**
Burn Rank	**#143 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Ultra-slow .50 BMG & ELR cannon-class**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori 24N41

Burn Rank #137

Developed at Nammo Vihtavuori Oy in Vihtavuori, Finland—where smokeless production began in 1926 after the plant's 1922 founding—24N41 shares the same military-coded naming tradition as slower 20N29. Originally engineered for large-caliber defense cartridges and later brought to commercial canister distribution, 24N41 sits immediately faster than 20N29 and slower than the N100 retail series, bridging ultra-overbore sporting magnums and true .50 BMG anti-materiel chambers.

Vihtavuori 24N41 is a pure single-base, single-perforated tubular nitrocellulose propellant featuring progressive surface deterrents and full European Union REACH compliance. Because it contains no nitroglycerin, 24N41 delivers lower flame temperatures than high-energy double-base alternatives, helping preserve barrel throats in large-volume long-range rifles fired under sustained strings. Typical bottleneck applications include .50 BMG with mid-weight projectiles, .338 Lapua Magnum with heavy match bullets, .338-378 Weatherby Magnum, .30-378 Weatherby Magnum, and .375 CheyTac.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1990s (Vihtavuori; Finnish military lin…**
Class	**Single-base extruded**
Burn Rank	**#137 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**3,700 kJ/kg**
Role	**Ultra-slow .50 BMG & super-magnum**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N120

Burn Rank #017

Vihtavuori N120 anchors the fastest dedicated bottleneck rifle tier of Nammo Vihtavuori Oy's long-running N100 single-base series, produced at Vihtavuori, Finland, where the state-founded propellant works began operations in 1926. Originally developed to support the 7.62x39mm Finnish service cartridge adopted by the Finnish Defence Forces in the RK 62 assault rifle, N120 transitioned smoothly into commercial reloading canisters as an exceptionally clean-burning small-case rifle powder.

Formulated as a fine-grained, single-perforated pure single-base nitrocellulose extrusion, N120 complies fully with European Union REACH regulations and burns cleanly with minimal soot even in shorter carbine barrels. Its compact tubular geometry meters predictably through volumetric throwers and offers reliable ignition across sub-freezing Nordic winter temperatures. Beyond its military roots in 7.62x39mm, N120 excels in .221 Fireball, .222 Remington, .223 Remington with light varmint bullets, .300 AAC Blackout, and classic .45-70 Government loads.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1970s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#017 of 143**
Bulk Density	**860 g/L**
Heat (Qex)	**3,620 kJ/kg**
Role	**Fast small-bore & intermediate rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N130

Burn Rank #024

Manufactured by Nammo Vihtavuori Oy in Vihtavuori, Finland—at a plant established in 1922 and active in propellant manufacture since 1926—Vihtavuori N130 occupies the classic fast small-bore slot between N120 and benchrest icon N133. Developed originally for light-bullet .22-caliber sporting cartridges and Nordic target shooting, N130 earned international prominence in the 1980s and 1990s as short-range benchrest competitors adopted Finnish single-base extrusions for their strict lot uniformity.

N130 is a pure single-base, single-perforated extruded nitrocellulose propellant meeting European Union REACH rules, prized for clean combustion, low residue, and modest flame temperatures that extend barrel life in fast-firing varmint and match rifles. Its small cylindrical kernels flow evenly through precision volumetric measures without excessive shearing. Core bottleneck rifle cartridges include .222 Remington, .223 Remington with lighter varmint projectiles, .204 Ruger, 6mm PPC with lightweight bullets, 7.62x39mm, and .30-30 Winchester.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1970s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#024 of 143**
Bulk Density	**870 g/L**
Heat (Qex)	**3,700 kJ/kg**
Role	**Fast varmint & benchrest small-bore**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N133

Burn Rank #032

Vihtavuori N133 is arguably the single most celebrated short-range benchrest propellant in modern history, manufactured by Nammo Vihtavuori Oy in Vihtavuori, Finland (founded 1922; production since 1926). Originally formulated for 5.56x45mm NATO ammunition specifications, N133 was discovered by North American and European 100- and 200-yard benchrest shooters pairing it with the 6mm PPC, where its clean burning and narrow pressure variance helped set countless world records.

Built as a pure single-base, single-perforated extruded nitrocellulose propellant fully compliant with European Union REACH regulations, N133 combines brisk ignition with cool combustion and remarkably little carbon fouling between cleanings. Its fine tubular grains meter reliably in precision benchrest click-measures while filling compact cases to optimal loading density. Beyond its legendary dominance in 6mm PPC, N133 performs superbly in .222 Remington, .223 Remington, .204 Ruger, .22 PPC, and light-bullet .308 Winchester target cartridges.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1980s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#032 of 143**
Bulk Density	**870 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Short-range benchrest & .223 varmint**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N135

Burn Rank #039

Produced by Nammo Vihtavuori Oy at its historic Vihtavuori, Finland complex (founded 1922, operating since 1926), Vihtavuori N135 bridges the gap between benchrest-focused N133 and general-purpose N140. Originally developed for European match cartridges and lighter-bullet 7.62x51mm NATO target loads, N135 became a staple across both European hunting circuits and North American precision rifle disciplines seeking a slightly faster, lower-bulk-density counterpart to N140.

N135 is a pure single-base, single-perforated extruded nitrocellulose propellant compliant with European Union REACH regulations, offering clean burning, low flame temperature, and uniform ballistic behavior across wide ambient swings. Its relatively generous kernel volume fills mid-capacity short-action cases efficiently behind light-to-medium projectiles without excessive air space. Typical bottleneck applications span .223 Remington with mid-weight bullets, 6mm BR, 6mm PPC heavy-bullet loads, .22-250 Remington, .308 Winchester with lighter target and hunting bullets, and .30-30 Winchester.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1980s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#039 of 143**
Bulk Density	**870 g/L**
Heat (Qex)	**3,550 kJ/kg**
Role	**Fast-medium target & .308 light-bullet**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N140

Burn Rank #057

Vihtavuori N140 is the cornerstone all-around rifle propellant of Nammo Vihtavuori Oy in Vihtavuori, Finland—a plant founded in 1922 that has produced smokeless propellants continuously since 1926. Originally engineered for 7.62x53mmR Finnish service and 7.62x51mm NATO rifle ammunition, N140 became Europe's quintessential medium-rate stick powder. After 2018 EU REACH enforcement halted European imports of DNT-deterred Hodgdon Varget and IMR 4064, N140 experienced an enormous surge across European F-TR, PRS, and hunting communities.

Formulated as a pure single-base, single-perforated tubular nitrocellulose propellant complying fully with European Union REACH regulations, N140 pairs low flame temperature with exceptional cleanliness, tight lot-to-lot consistency, and modern decoppering additives in current production. Its burn rate sits directly beside Hodgdon Varget and IMR 4064, making it a first-choice benchmark across an unmatched span of cartridges including .223 Remington heavy-bullet match loads, 6mm BR, 6mm Dasher, .22-250 Remington, .308 Winchester, .30-06 Springfield, and 8x57mm JS.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1970s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#057 of 143**
Bulk Density	**910 g/L**
Heat (Qex)	**3,700 kJ/kg**
Role	**Versatile medium match & all-around rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N150

Burn Rank #062

Manufactured by Nammo Vihtavuori Oy in Vihtavuori, Finland—where smokeless production began in 1926 following the plant's 1922 founding—Vihtavuori N150 sits just slower than N140 in the single-base N100 family. Developed to bridge standard military-caliber burn rates and heavier-bullet long-range target loads, N150 has earned a devoted global following among F-TR, Palma, and 600-to-1,000-yard benchrest shooters who prize cool combustion and low extreme velocity spreads.

Vihtavuori N150 is a pure single-base, single-perforated extruded nitrocellulose propellant that complies with European Union REACH regulations and incorporates Vihtavuori's clean-burning surface treatment without nitroglycerin. Its slightly slower burn progression than N140 yields generous case fill and smooth pressure delivery behind heavy match projectiles while minimizing throat erosion over long barrel lives. Core bottleneck applications include .308 Winchester with heavy long-range match bullets, 6mm BR and 6mm Dasher, 6.5x47 Lapua, 6.5 Creedmoor, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1980s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#062 of 143**
Bulk Density	**910 g/L**
Heat (Qex)	**3,750 kJ/kg**
Role	**Medium-slow precision & F-Class rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N160

Burn Rank #099

Vihtavuori N160 has long served as the primary slow-medium single-base hunting and target propellant of Nammo Vihtavuori Oy in Vihtavuori, Finland, where commercial and defense smokeless production dates back to 1926 (plant founded 1922). Sitting cleanly between medium-slow N150 and magnum-focused N165, N160 established itself across Europe as the classic Scandinavian single-base propellant for 6.5x55mm Swedish and traditional long-action sporting rifles, while also seeing widespread international adoption in overbore target cartridges.

Manufactured as a pure single-base, single-perforated tubular nitrocellulose extrusion compliant with European Union REACH chemical rules, N160 burns cleanly at moderate flame temperatures that help protect rifle throats in overbore calibers. Its burn rate places it directly in the 4350-to-4831 transition zone, giving European shooters a reliable domestic staple unaffected by 2018 REACH import bans on DNT-deterred propellants. Typical bottleneck rifle cartridges include .243 Winchester, 6.5x55mm Swedish, 6.5 Creedmoor, .25-06 Remington, .270 Winchester, .284 Winchester, 7mm Remington Magnum, and .300 Winchester Magnum.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1970s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#099 of 143**
Bulk Density	**920 g/L**
Heat (Qex)	**3,560 kJ/kg**
Role	**Slow-medium hunting & magnum rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N165

Burn Rank #118

Introduced by Nammo Vihtavuori Oy at Vihtavuori, Finland (founded 1922; production since 1926) to expand the N100 single-base series deeper into slow belted-magnum territory, Vihtavuori N165 slots between N160 and N170. Originally adopted for heavy-bullet European hunting magnums and early .338 Lapua Magnum military development, N165 later achieved enduring fame in international 1,000-yard F-Open competition, especially in .284 Winchester and 7mm short-magnum target rifles.

Formulated as a pure single-base, single-perforated extruded nitrocellulose propellant fully compliant with European Union REACH regulations, N165 delivers substantially cooler flame temperatures than double-base magnum powders such as N560 or N565, noticeably prolonging barrel life in overbore target rigs. Its progressive burn rate aligns closely with Hodgdon H4831 and IMR 7828 while maintaining clean carbon signatures across long match strings. Core bottleneck applications include .284 Winchester with heavy bullets, 6.5-284 Norma, 7mm Remington Magnum, .300 Winchester Magnum, and .338 Lapua Magnum with lighter projectiles.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1980s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#118 of 143**
Bulk Density	**930 g/L**
Heat (Qex)	**3,560 kJ/kg**
Role	**Slow magnum & long-range F-Open**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N170

Burn Rank #128

Vihtavuori N170 represents the slowest-burning member of Nammo Vihtavuori Oy's retail N100 single-base rifle family, manufactured in Vihtavuori, Finland, where the company's smokeless powder heritage stretches back to 1922 (production begun 1926). Developed specifically to meet the needs of extreme overbore hunting and military sniper cartridges—most notably the .338 Lapua Magnum—N170 sits slower than N165 while remaining faster than specialized .50 BMG grades 24N41 and 20N29.

Constructed as a large-web, single-perforated pure single-base nitrocellulose extrusion meeting European Union REACH standards, N170 trades the peak velocity of nitroglycerin-infused N570 for noticeably lower combustion temperatures and reduced throat erosion in high-capacity magnums. Its burn speed occupies the Hodgdon H1000 and Retumbo tier, delivering progressive pressure curves and high case fill behind heavy long-range projectiles. Typical bottleneck rifle cartridges include .338 Lapua Magnum, .300 Remington Ultra Magnum, .300 Weatherby Magnum, 7mm Remington Ultra Magnum, and .300 PRC.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**1990s (Vihtavuori N100 rifle series)**
Class	**Single-base extruded**
Burn Rank	**#128 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,700 kJ/kg**
Role	**Very slow single-base magnum rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N530

Burn Rank #035

Vihtavuori N530 anchors the fastest end of Nammo Vihtavuori Oy's high-energy N500 rifle propellant line, originally introduced in the late 1990s from the historic Vihtavuori, Finland works (founded 1922; production since 1926). Created as a higher-energy counterpart to single-base N133 and N135, N530 was specifically engineered to extract greater muzzle velocity from compact 5.56x45mm NATO and .223 Remington chambers while retaining the tight ballistic uniformity of Finnish extrusion.

Built via Vihtavuori's high-energy process—infusing nitroglycerin into an extruded, single-perforated nitrocellulose matrix alongside REACH-compliant stabilizers and deterrents—N530 packs higher bulk density and specific energy into small case volumes than pure single-base sticks. Its fine cylindrical grains meter cleanly and deliver crisp ignition across winter and summer match conditions. Primary bottleneck rifle applications span .223 Remington / 5.56x45mm NATO, .222 Remington, 6mm PPC, 6.5 Grendel, and light-to-medium bullet .308 Winchester loads.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**Late 1990s (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#035 of 143**
Bulk Density	**930 g/L**
Heat (Qex)	**3,950 kJ/kg**
Role	**Fast-medium high-energy small-bore**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N540

Burn Rank #069

Introduced in the late 1990s as a founding member of Nammo Vihtavuori Oy's high-energy N500 series at Vihtavuori, Finland (plant founded 1922; production since 1926), Vihtavuori N540 serves as the nitroglycerin-enhanced counterpart to single-base N140. Developed to maximize velocity in standard 5.56mm heavy-bullet and 7.62x51mm NATO / .308 Winchester loads without exceeding chamber pressure limits, N540 became an enduring staple among European and North American F-TR, High Power, and tactical precision shooters.

N540 is a single-perforated, nitroglycerin-infused high-energy double-base extruded propellant that complies fully with European Union REACH regulations and incorporates decoppering additives in modern production. Compared with N140, N540's higher specific energy and bulk density deliver noticeably higher velocities behind heavy projectiles in medium cases, albeit with somewhat higher combustion temperatures. Core bottleneck rifle applications include .223 Remington with heavy long-range match bullets, 6mm BR, 6.5x47 Lapua, .308 Winchester, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**Late 1990s (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#069 of 143**
Bulk Density	**940 g/L**
Heat (Qex)	**3,980 kJ/kg**
Role	**High-energy medium match & service rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N550

Burn Rank #082

Vihtavuori N550 was developed by Nammo Vihtavuori Oy at Vihtavuori, Finland (founded 1922; production since 1926) in the late 1990s as an anchor of the original N500 High Energy rifle lineup. Conceived specifically to deliver elevated velocities in classic .308 Winchester heavy-bullet and .30-06 Springfield hunting and target rifles, N550 slots cleanly between faster N540 and later-introduced N555. Its high energetic output quickly made it a favored European choice for Scandinavian big-game and long-range cartridges.

Manufactured as a REACH-compliant, nitroglycerin-infused high-energy double-base extruded propellant with single-perforated cylindrical grains, N550 combines strong specific energy with high bulk density for efficient case fill in medium-to-long-action chambers. Its burn rate sits slightly faster than the 4350 corridor, delivering crisp ignition and brisk acceleration behind medium-heavy projectiles across .308 Winchester, 6.5 Creedmoor, 6.5x55mm Swedish, .243 Winchester, .270 Winchester, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**Late 1990s (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#082 of 143**
Bulk Density	**950 g/L**
Heat (Qex)	**3,990 kJ/kg**
Role	**High-energy medium-slow sporting & target**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N555

Burn Rank #105

Nammo Vihtavuori Oy introduced Vihtavuori N555 in 2020 from its Vihtavuori, Finland plant (founded 1922; production since 1926) specifically to fill the critical 4350 burn-rate gap between N550 and N560. Developed in direct response to global precision-rifle demand in the 6.5 Creedmoor—and accelerated by 2018 EU REACH restrictions that removed Australian H4350 from European shelves—N555 was engineered from the ground up for precision match consistency rather than sheer maximum velocity alone.

Although numbered inside the nitroglycerin-infused N500 High Energy family, N555 uses a moderated energetic balance with exceptional ambient-temperature stability, full European Union REACH compliance, and Vihtavuori's built-in anti-copper-fouling additive. Its relatively light bulk density achieves near-100% case fill in medium short-action precision cartridges without heavy compression, yielding low velocity spreads across seasonal extremes. Primary bottleneck rifle applications include 6mm Creedmoor, 6.5 Creedmoor, .260 Remington, 6.5x55mm Swedish, .284 Winchester, and .30-06 Springfield.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**2020 (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#105 of 143**
Bulk Density	**900 g/L**
Heat (Qex)	**3,700 kJ/kg**
Role	**Precision 6.5mm & mid-slow match rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N560

Burn Rank #117

Vihtavuori N560 debuted in the late 1990s as the original slow-magnum flagship of Nammo Vihtavuori Oy's high-energy N500 line, manufactured at Vihtavuori, Finland (plant founded 1922; production since 1926). Designed as the nitroglycerin-infused counterpart to single-base N160 and N165, N560 quickly gained a reputation across Europe and North America for unlocking top-tier velocities in standard belted magnums and overbore long-action hunting rifles.

Formulated as a REACH-compliant, nitroglycerin-infused high-energy double-base extruded propellant with single-perforated cylindrical grains, N560 pairs high bulk density with strong energetic output. Its progressive pressure profile makes it particularly effective behind heavy projectiles in cartridges where single-base powders run out of case capacity before reaching peak safe velocity. Typical bottleneck applications span 6.5 PRC, 6.5-284 Norma, .270 Winchester, 7mm Remington Magnum, 7mm WSM, .300 Winchester Magnum, and .338 Winchester Magnum.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**Late 1990s (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#117 of 143**
Bulk Density	**955 g/L**
Heat (Qex)	**3,970 kJ/kg**
Role	**High-energy slow magnum & hunting**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N565

Burn Rank #124

Nammo Vihtavuori Oy released Vihtavuori N565 in 2018 from its Vihtavuori, Finland facility (founded 1922; production since 1926) to bridge the burn-rate space between N560 and N570. Originally developed for demanding military sniper applications in the .338 Lapua Magnum—requiring consistent ballistic behavior across extreme cold and desert heat—N565 rapidly became one of the most sought-after commercial propellants for modern long-range magnum rifles in the Hodgdon H1000 burn-rate bracket.

Manufactured as a REACH-compliant, nitroglycerin-infused high-energy double-base extruded propellant incorporating Vihtavuori's decoppering additive and enhanced thermal stabilization, N565 achieves noticeably tighter grain length than larger-kerneled N570, improving flow into magnum case necks. Its progressive combustion curve delivers strong muzzle velocities with uniform extreme spreads across wide environmental swings. Primary bottleneck rifle applications include 6.5 PRC, 7mm PRC, 7mm Remington Magnum, .300 Winchester Magnum, .300 PRC, .300 Norma Magnum, and .338 Lapua Magnum.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**2018 (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#124 of 143**
Bulk Density	**950 g/L**
Heat (Qex)	**3,960 kJ/kg**
Role	**Slow magnum & long-range sniper**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N568

Burn Rank #136

Introduced by Nammo Vihtavuori Oy in 2021 from Vihtavuori, Finland (plant founded 1922; production since 1926), Vihtavuori N568 was engineered specifically for the rising generation of long-range precision magnums such as the 6.5 PRC, .300 PRC, and .338 Lapua Magnum. Though numbered numerically between N565 and N570, N568 sits at the very slowest end of Vihtavuori's commercial N500 family in empirical testing, offering short-cut grain flow that addressed handloader complaints about N570's bulky kernels.

Formulated as a REACH-compliant, nitroglycerin-infused high-energy double-base extruded propellant with Vihtavuori's copper-fouling-reduction additive and temperature-stabilized burn profile, N568 delivers exceptionally gentle pressure progression and high case fill behind heavy high-BC projectiles. Its shorter extruded grains pour cleanly through drop tubes and trickle smoothly on automated precision scales without bridging. Core bottleneck applications include 6.5 PRC, 7mm PRC, 28 Nosler, .300 PRC, .300 Norma Magnum, .300 Remington Ultra Magnum, and .338 Lapua Magnum.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**2021 (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#136 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,850 kJ/kg**
Role	**Ultra-slow precision magnum & ELR**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Vihtavuori N570

Burn Rank #135

Nammo Vihtavuori Oy introduced Vihtavuori N570 in 2010 from its Vihtavuori, Finland complex (founded 1922; production since 1926) as the ultra-slow high-energy counterpart to single-base N170. Created for extreme long-range shooting and large-capacity magnum cartridges pushing heavy, low-drag projectiles past a mile, N570 quickly became an international benchmark in extreme long-range (ELR) competition for delivering top-of-class muzzle velocity.

N570 is a REACH-compliant, nitroglycerin-infused high-energy double-base extruded propellant distinguished by visibly large, coarse single-perforated cylindrical kernels that require careful weighing or drop-tubing rather than volumetric throwing. Its high specific energy and slow, progressive burn rate unlock exceptional ballistic efficiency in heavily overbore chambers, though its energetic double-base chemistry demands mindful cadence management to limit barrel-throat heating. Primary bottleneck cartridges include 28 Nosler, .300 PRC, .300 Norma Magnum, .300 Remington Ultra Magnum, .338 Lapua Magnum, .338 Norma Magnum, and .338 Edge.

Propellant specifications

Packager	**Nammo Vihtavuori Oy**
OEM Plant	**Vihtavuori (FI)**
Introduced	**2010 (Vihtavuori N500 series)**
Class	**NG-infused double-base**
Burn Rank	**#135 of 143**
Bulk Density	**970 g/L**
Heat (Qex)	**3,930 kJ/kg**
Role	**Ultra-slow high-energy ELR magnum**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Winchester

Winchester 748

Burn Rank #071

Olin Corporation introduced Winchester 748 to commercial handloaders in 1968 under the designation 748BR (Ball Rifle), dropping the suffix in 1973 to establish the enduring Winchester 748 name. Manufactured using the classic Olin Ball Powder process at St. Marks, Florida—now operated as General Dynamics Ordnance and Tactical Systems St. Marks Powder—Winchester 748 grew directly out of commercial and military 7.62x51mm NATO and 5.56x45mm spherical propellant programs. Hodgdon Powder Company has marketed and distributed the Winchester canister powder line under license since 2005.

Winchester 748 is a flattened, double-base spherical propellant coated with surface deterrents and graphite glaze, offering high bulk density and ultra-consistent volumetric metering across mechanical measures. Like most traditional St. Marks ball propellants, it benefits from robust magnum-strength or consistent standard rifle primers in cold weather and exhibits greater ambient temperature sensitivity than modern StaBALL formulations. Its versatile medium burn speed serves .222 Remington, .223 Remington, .22-250 Remington, .30-30 Winchester, .308 Winchester, and medium-bore classic hunting cartridges.

Propellant specifications

Packager	**Hodgdon (Winchester license)**
OEM Plant	**GD St. Marks (US)**
Introduced	**1968 (as 748BR; 1973 as 748)**
Class	**Double-base spherical**
Burn Rank	**#071 of 143**
Bulk Density	**971 g/L**
Heat (Qex)	**3,700 kJ/kg**
Role	**Medium spherical service & sporting**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Winchester 760

Burn Rank #089

Olin Corporation introduced Winchester 760 in 1968 alongside 748BR as 760BR (Ball Rifle), simplifying the label to Winchester 760 in 1973. Manufactured at General Dynamics St. Marks Powder in St. Marks, Florida, and marketed by Hodgdon under the Winchester license since 2005, Winchester 760 served for decades as the confirmed St. Marks OEM twin of Hodgdon H414. When Hodgdon discontinued H414 in 2020 to eliminate redundant canister SKUs, Winchester 760 remained in active production as the sole survivor of that classic spherical specification.

Formulated as a high-energy, double-base spherical propellant, Winchester 760 meters smoothly through progressive and volumetric measures and packs densely into standard hunting cases. Its burn rate occupies the 4350-class spherical corridor, yielding high muzzle velocities in mid-bore cartridges, though it retains conventional double-base temperature sensitivity compared to newer StaBALL 6.5. Even though Winchester 760 and discontinued H414 shared the same St. Marks recipe, lot-to-lot variance requires following published data for the exact canister on hand. Key bottleneck cartridges include .243 Winchester, .25-06 Remington, .270 Winchester, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Hodgdon (Winchester license)**
OEM Plant	**GD St. Marks (US)**
Introduced	**1968 (as 760BR; 1973 as 760)**
Class	**Double-base spherical**
Burn Rank	**#089 of 143**
Bulk Density	**971 g/L**
Heat (Qex)	**4,050 kJ/kg**
Role	**Mid-slow spherical hunting rifle**
Status	**Active**

Live spec card
empiricalprecision.com
Components · Powders

Winchester StaBALL 6.5

Burn Rank #100

Announced by Hodgdon Powder Company in October 2019 and reaching retail shelves in early 2020 under the licensed Winchester banner, StaBALL 6.5 marked a milestone in spherical propellant engineering at General Dynamics St. Marks Powder in St. Marks, Florida. Marketed as the world's first temperature-insensitive commercial ball powder, StaBALL 6.5 was developed directly for the 4350 burn-rate bracket dominated by extruded sticks like H4350. Its launch founded a three-powder StaBALL family later joined by StaBALL Match and StaBALL HD in 2023.

StaBALL 6.5 is a REACH-compliant, double-base spherical propellant incorporating specialized thermal-stabilization chemistry and a copper-fouling-reduction additive to keep rifle bores cleaner across long strings of fire. Its smooth spherical grains meter effortlessly through volumetric throwers while achieving high load density and velocity efficiency rivaling slower extruded powders across wide ambient temperature swings. Primary bottleneck rifle applications include 6mm Creedmoor, 6.5 Creedmoor, .260 Remington, .243 Winchester, .270 Winchester, 7mm-08 Remington, and .30-06 Springfield.

Propellant specifications

Packager	**Hodgdon (Winchester license)**
OEM Plant	**GD St. Marks (US)**
Introduced	**2019 (announced Oct 2019; retail 2020)**
Class	**Double-base spherical**
Burn Rank	**#100 of 143**
Bulk Density	**990 g/L**
Heat (Qex)	**3,820 kJ/kg**
Role	**Mid-slow precision & 6.5mm rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Winchester StaBALL HD

Burn Rank #134

Hodgdon unveiled Winchester StaBALL HD alongside StaBALL Match at SHOT Show in January 2023, extending General Dynamics St. Marks Powder's temperature-stabilized spherical platform into the heavy-magnum burn-rate tier. Manufactured in St. Marks, Florida, and distributed under the licensed Winchester name, StaBALL HD—where HD stands for Heavy Duty—was engineered to compete directly in the H1000 and Retumbo magnum corridor while providing American spherical production independent of offshore extruded supply chains.

Formulated as a REACH-compliant, double-base spherical propellant featuring thermal-stabilizing deterrent chemistry and a copper-fouling-eliminator additive, StaBALL HD combines high bulk density with progressive pressure delivery behind long, heavy magnum projectiles. Its spherical grains flow smoothly into narrow-necked overbore cases without bridging, maximizing usable propellant mass in large magnum chambers. Primary bottleneck applications include 6.5 PRC, 7mm PRC, 7mm Remington Magnum, 28 Nosler, .300 Winchester Magnum, .300 PRC, and .338 Lapua Magnum.

Propellant specifications

Packager	**Hodgdon (Winchester license)**
OEM Plant	**GD St. Marks (US)**
Introduced	**2023 (SHOT Show Jan 2023)**
Class	**Double-base spherical**
Burn Rank	**#134 of 143**
Bulk Density	**980 g/L**
Heat (Qex)	**3,800 kJ/kg**
Role	**Slow & ultra-slow magnum rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Winchester StaBALL Match

Burn Rank #073

Introduced by Hodgdon Powder Company at SHOT Show in January 2023 alongside StaBALL HD, Winchester StaBALL Match extended the St. Marks Powder temperature-stabilized ball platform into the core medium-rate match corridor. Manufactured at General Dynamics St. Marks Powder in St. Marks, Florida, under the licensed Winchester brand, StaBALL Match filled the faster burn-rate bracket below StaBALL 6.5, giving high-volume target and tactical handloaders a domestic, thermally stabilized spherical alternative to classic Varget and Winchester 748.

Built as a REACH-compliant, double-base spherical propellant incorporating thermal-stabilization chemistry and a copper-fouling-reduction additive, StaBALL Match meters cleanly on progressive presses while maintaining steady velocities across cold and hot match conditions. Its burn rate aligns directly with Winchester 748, Hodgdon BL-C(2), and Hodgdon CFE 223, pairing high packing density with crisp ignition behind heavy-for-caliber match bullets. Key bottleneck applications include .223 Remington with heavy long-range projectiles, 6mm ARC, 6.5 Grendel, .22-250 Remington, and .308 Winchester.

Propellant specifications

Packager	**Hodgdon (Winchester license)**
OEM Plant	**GD St. Marks (US)**
Introduced	**2023 (SHOT Show Jan 2023)**
Class	**Double-base spherical**
Burn Rank	**#073 of 143**
Bulk Density	**960 g/L**
Heat (Qex)	**3,850 kJ/kg**
Role	**Medium spherical match & service rifle**
Status	**Active (EU REACH-compliant)**

Live spec card
empiricalprecision.com
Components · Powders

Winchester Supreme 780

Burn Rank #120

Hodgdon Powder Company introduced Winchester Supreme 780 to the commercial canister market in spring 2008 under its licensed Winchester propellant agreement, drawing from spherical ball propellants produced by General Dynamics St. Marks Powder in St. Marks, Florida, for Winchester's factory Supreme ammunition line. Positioned slower than Winchester 760 in the H4831 and Magnum spherical class, Supreme 780 offered handloaders an easy-metering magnum ball powder. Facing sluggish retail demand, Hodgdon announced its discontinuation in early 2014 and phased it out by year's end.

Formulated as a dense, double-base spherical propellant, Supreme 780 delivered smooth volumetric flow and generous case packing in long-action hunting and belted magnum cartridges. Unlike newer temperature-stabilized StaBALL HD, Supreme 780 belonged to the traditional St. Marks ball-powder generation requiring attentive primer selection in cold hunting climates. During its six-year canister run, it served .243 Winchester with heavy bullets, .25-06 Remington, .270 Winchester, .270 WSM, 7mm Remington Magnum, and .300 Winchester Magnum.

Propellant specifications

Packager	**Hodgdon (Winchester license)**
OEM Plant	**GD St. Marks (US)**
Introduced	**2008 (Hodgdon / Winchester)**
Class	**Double-base spherical**
Burn Rank	**#120 of 143**
Bulk Density	**992 g/L**
Heat (Qex)	**3,600 kJ/kg**
Role	**Slow spherical magnum & hunting rifle**
Status	**Discontinued (2014)**

Live spec card
empiricalprecision.com
Components · Powders

Other

Poudre B

Poudre B (Vieille) · 1884 (service 1886)

French chemist Paul Vieille created Poudre B in 1884 at the state powder laboratory in Moulin-Blanc, near Brest. Originally dubbed Poudre V and officially renamed Poudre B for Poudre Blanche or General Boulanger, it became the world's first practical smokeless military rifle propellant. France adopted it in 1886 for the 8mm Lebel rifle, instantly rendering black-powder service arms obsolete by delivering flatter trajectories, far less fouling, and minimal smoke on the battlefield.

Vieille solved fibrous guncotton's violent detonation problem by dissolving nitrocellulose in an ether-alcohol solvent, rolling the colloid into dense sheets, and cutting uniform flakes that burned strictly in parallel layers. Early lots used amyl alcohol as a stabilizer and suffered severe autocatalytic decomposition in warm naval magazines, contributing to the battleship disasters of Iéna in 1907 and Liberté in 1911. Adding diphenylamine later stabilized single-base extruded and flake rifle propellants worldwide.

Propellant specifications

Packager	**Service des Poudres et Salpêtres**
OEM Plant	**Moulin-Blanc (FR)**
OEM / Twin	**Poudre B (Vieille)**
Introduced	**1884 (service 1886)**
Class	**SB gelatinized flake**
Burn Rank	**Historical**
Role	**Historical military rifle milestone**
Status	**Historical (obsolete)**

Ballistite

Ballistite / Filite · 1887 (service 1889)

Alfred Nobel patented Ballistite in 1887 after discovering that soluble nitrocellulose could be gelatinized directly with liquid nitroglycerin, creating the first successful double-base smokeless propellant. Produced commercially at Nobel's works in Ardeer, Scotland, and Avigliana, Italy, Ballistite entered Italian military service in 1889 in both square-cut flake and extruded Filite cord forms for the 6.5x52mm Carcano rifle. Its commercial lineage shaped European double-base military and sporting propellants for more than a century.

Nobel's original formula blended near-equal parts of collodion cotton and nitroglycerin with camphor as a gelatinizer and stabilizer. Because camphor evaporated in storage and altered ballistic behavior, later manufacturing replaced it with diphenylamine and non-volatile deterrents. Compared with single-base Poudre B, Ballistite packed substantially greater chemical energy and resisted atmospheric moisture better, but its higher flame temperature accelerated throat erosion in nineteenth-century steel rifle barrels.

Propellant specifications	
Packager	**Nobel Dynamite / Italian State**
OEM Plant	**Nobel Ardeer/Avig.**
OEM / Twin	**Ballistite / Filite**
Introduced	**1887 (service 1889)**
Class	**DB flake / cube**
Burn Rank	**Historical**
Role	**Historical double-base rifle milestone**
Status	**Historical (obsolete)**

Cordite

Cordite Mk I / MD · 1889 (service 1891)

Sir Frederick Abel and Sir James Dewar patented Cordite in 1889 at the Royal Gunpowder Factory in Waltham Abbey after Britain's Explosives Committee sought an alternative to Nobel's Ballistite. Named for the long spaghetti-like strands extruded through dies, Cordite entered British service in 1891 for the .303 British Lee-Metford rifle. Nobel unsuccessfully sued for patent infringement because Cordite used insoluble guncotton gelatinized with acetone rather than Nobel's soluble collodion cotton.

Original Cordite Mk I combined high-nitroglycerin double-base chemistry with mineral jelly, which lubricated extrusion dies and inadvertently stabilized the nitric esters. Its intense flame temperature eroded .303 rifle throats quickly during the Second Boer War, prompting Britain to introduce Cordite MD (Modified) in 1901 with substantially reduced nitroglycerin content. Later solventless Cordite SC and triple-base NQ variants extended the cordite family through World War II.

Propellant specifications	
Packager	**British War Office**
OEM Plant	**Waltham Abbey (UK)**
OEM / Twin	**Cordite Mk I / MD**
Introduced	**1889 (service 1891)**
Class	**DB extruded cord**
Burn Rank	**Historical**
Role	**Historical British rifle & ordnance milestone**
Status	**Historical (obsolete)**

Bullseye

Developed in 1898 by the Laflin & Rand Powder Company and released for commercial canister sale in 1904, Bullseye is one of the longest continuously manufactured smokeless propellants in history. After DuPont acquired Laflin & Rand, the 1912 federal antitrust breakup transferred Bullseye to the newly formed Hercules Powder Company, which later became Alliant Powder. It served the U.S. military in .45 ACP M1911 service ammunition for decades.

Although Bullseye is a fast handgun propellant rather than a bottleneck rifle powder, it earns a historical place alongside early rifle milestones for pioneering standardized American double-base flake manufacture. Its high nitroglycerin content and thin graphite-coated flakes ignite cleanly at modest pressures and meter consistently in high-volume production. Bullseye helped establish commercial canister quality control, published ballistic testing, and retail handloading distribution across North America.

Propellant specifications	
Packager	**Laflin & Rand / Hercules / Alliant**
OEM Plant	**Laflin & Rand / US**
OEM / Twin	**Bullseye**
Introduced	**1898 (canister 1904)**
Class	**DB flake (pistol)**
Burn Rank	**Historical**
Role	**Historical commercial smokeless milestone**
Status	**Active (handgun milestone)**

Appendix A

Master Chronological Timeline (1884–Present)

Major chemical inventions, military adoptions, commercial canister introductions, corporate consolidations, stability recalls, and regulatory milestones shaping modern smokeless rifle propellants.[1]

Year	Event & Significance
1884	Paul Vieille invents Poudre B at Poudrerie du Moulin-Blanc (France), the first practical colloided single-base smokeless propellant; adopted for the 8×50mmR Lebel rifle in 1886.
1887	Alfred Nobel patents Ballistite, the first double-base smokeless propellant combining nitrocellulose and nitroglycerin.
1889	Sir Frederick Abel and Sir James Dewar patent Cordite in Britain; adopted for the .303 British military service cartridge.
1898	Laflin & Rand develops Bullseye, an early porous-flake double-base smokeless powder (released commercially in 1904; later manufactured by Hercules and Alliant).
1909–1910	U.S. Ordnance adopts Pyro DG single-base extruded rifle propellant for the .30-06 Springfield; DuPont introduces its Military Rifle (MR) and Improved Military Rifle (IMR) lines.
1922	Finnish state gunpowder factory founded at Vihtavuori (Laukaa, Finland); industrial propellant production commences in 1926.
1933–1934	Fred Olsen and Western Cartridge Company (Olin) patent the water-slurry spherical Ball Powder process at East Alton, Illinois; DuPont introduces IMR 3031 (1934).
1935	DuPont introduces IMR 4064 alongside the core 1930s four-digit classic IMR extruded series (IMR 4198, IMR 4227, IMR 4320).
1940	DuPont introduces IMR 4350; IMR 4895 enters mass wartime production as the primary .30-06 M2 Ball propellant for the M1 Garand.
1947	Bruce Hodgdon purchases 50,000 lb of WWII surplus 4895 powder and founds Hodgdon Powder Company in Kansas.
1949	Hodgdon purchases 80 tons of WWII surplus .303 British spherical powder and markets it as BL-C (replaced by newly manufactured BL-C(2) in 1961).
1950	Hodgdon salvages WWII DuPont 20mm Oerlikon anti-aircraft cannon propellant and introduces it commercially as H4831.
1952	PB Clermont begins spherical ball propellant manufacturing in Engis, Belgium (later supplying Ramshot, Accurate spherical, and Vectan Sp commercial lines).
1960s	Olin's St. Marks, Florida plant (now GD-OTS St. Marks Powder) expands military WC 844 (5.56mm NATO) and WC 846 (7.62mm NATO) lines, spawning commercial staples including H335, BL-C(2), W748, and W760 / H414.
1970s–1980s	Commercial canister market transitions from WWII surplus salvage to purpose-built OEM contracts; Vihtavuori N100 single-base powders and Bofors/Norma 200-series gain precision match adoption.
1990s	Hodgdon partners with Thales / ADI Mulwala (Australia) to launch the temperature-insensitive Extreme extruded line—including Varget (1995), H4350, H4831SC, H1000, and Retumbo; Vihtavuori launches its nitroglycerin-infused N500 high-energy series.
2003	Hodgdon Powder Company acquires the IMR Powder Company brand.
2005	Hodgdon acquires the commercial license to market and distribute Winchester smokeless propellants.
2008	Alliant introduces Reloder 17, bringing Nitrochemie's EI® (extruded impregnated) high-energy technology to commercial rifle canisters.
2010	IMR introduces IMR 8208 XBR (manufactured by Thales / ADI Mulwala); Vihtavuori introduces N570 for magnum and extreme long-range cartridges.
2012	Hodgdon introduces CFE 223, incorporating bismuth-based copper-fouling-eraser (CFE) decoppering chemistry into a spherical rifle propellant.
2013	Nitrochemie launches the Reload Swiss commercial brand in Europe, including RS60 (the commercial counterpart to Reloder 17).
2015	Hodgdon issues a full recall of IMR 4007 SSC in September due to rapid chemical deterioration in certain lots and permanently retires the product; IMR launches the Enduron extruded series.
2016	Alliant introduces Reloder 16 using Eurenco Bofors TZ® (Temperature Zone) chemical stabilization, joining AR-Comp, Reloder 23, and later Reloder TS 15.5.
2018	European Union REACH enforcement against 2,4-DNT and DBP halts EU imports of Thales / ADI (Hodgdon Extreme) and legacy IMR lines; Vihtavuori releases N565.

Year	Event & Significance
2019	Western Powders recalls specific pre-October 2016 GD-OTS Valleyfield lots of Accurate 2495, 4064, and 4350 in November; Winchester announces StaBALL 6.5 (October; retail 2020), launching its temperature-insensitive ball-powder family.
2020	Hodgdon acquires Western Powders (Accurate and Ramshot brands); Hodgdon discontinues H414 and IMR 4320; Vihtavuori introduces N555 (followed by N568 in 2021).
2022	Hodgdon discontinues the entire IMR Enduron series (4166, 4451, 4955, 7977, 8133) in August due to supplier and manufacturing constraints.
2023	Winchester expands its temperature-insensitive ball-powder line at SHOT Show (January) with StaBALL Match and StaBALL HD.

Propellant Storage and Handling Safety Card

Keep this reference card posted wherever smokeless propellant is stored or inspected.

Storage and handling

1. Keep every propellant in its original factory container with the label and lot number intact.
2. Store canisters in a cool, dry, well-ventilated space away from heat sources, sunlight, sparks, and open flames.
3. Never lock smokeless propellant inside a tightly sealed metal vault or pressure vessel; store it only in containers designed to vent safely in a fire, following local codes.
4. Keep primers, black powder, solvents, and flammable liquids separated from smokeless propellants.
5. Never allow open flame, smoking, vaping, or static-generating clutter near open containers.
6. Handle one propellant canister at a time and return unused powder to its original container immediately.

Identification and degradation

7. Never mix different propellants, brands, or production lots—even confirmed OEM twins.
8. Never substitute propellants by burn-rate chart rank, visual appearance, or OEM cross-reference without consulting published data for the exact canister in hand.
9. Inspect older canisters periodically for an acrid acidic odor, reddish-brown fumes, rust-colored dust, clumping, or container swelling.
10. Do not use, tightly seal, or place degraded powder in household trash; wet it thoroughly with water and follow manufacturer and local hazardous-waste guidance.
11. Check manufacturer safety bulletins for active stability recalls before using legacy or second-hand canisters.

Reference

Units and Thermochemical Conversions

Factors marked exact are exact by definition; all other conversion factors are rounded to six significant figures, and worked examples are rounded further.[1]

Mass. 1 gr = 0.06479891 g (exact); 1 g = 15.4324 gr; 1 kg = 15,432.4 gr; 1 lb = 7,000 gr (exact) = 453.592 g; 1 oz = 437.5 gr (exact).

Density. 1 g/L = 1 kg/m³ (exact) = 0.001 g/cm³ (exact); 1 g/cm³ = 1,000 g/L = 1,000 kg/m³. Propellant bulk density is reported in g/L (numerically identical to kg/m³), whereas solid grain density is commonly stated in g/cm³.

Energy and heat of explosion. 1 kJ/kg = 1 J/g (exact) = 0.239006 cal/g (thermochemical calorie, 1 cal = 4.184 J exact); 1 cal/g = 4.184 kJ/kg = 4.184 J/g; 1 BTU/lb = 2.326 kJ/kg. So a specific heat of explosion of 4,000 kJ/kg equals 4,000 J/g, or about 956.0 cal/g.

Pressure. 1 psi = 0.0689476 bar = 0.00689476 MPa; 1 bar = 14.5038 psi = 0.1 MPa (exact); 1 MPa = 10 bar (exact) = 145.038 psi. So 62,000 psi is about 4,275 bar, or 427.5 MPa. Units convert, whereas measurement standards do not: C.I.P. limits in bar and SAAMI limits in psi rely on distinct test-barrel and transducer protocols, and legacy copper units of pressure (CUP) do not convert mathematically to psi.[2]

Length. 1 inch = 25.4 mm (exact); 1 mm = 0.0393701 inch. So a propellant web thickness of 0.40 mm is about .0157 inch, and a 24-inch barrel is 609.6 mm.

Temperature. °F = °C × 9/5 + 32; °C = (°F − 32) × 5/9; K = °C + 273.15 (exact). A 10 °C rise equals an 18 °F rise. Standard ballistic conditioning temperature is 70 °F (21.1 °C), while the ICAO standard atmosphere temperature is 59 °F (15 °C).

Velocity. 1 fps = 0.3048 m/s (exact); 1 m/s = 3.28084 fps. So 2,800 fps is 853.4 m/s.

Notes

Notes

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Glossary

Akardite II. A urea-derivative chemical stabilizer widely used in modern double-base and nitroglycerin-infused propellants to scavenge nitrogen oxides without attacking nitroglycerin esters. *pp. 7 and 66*

Arrhenius equation. The exponential rate law relating chemical reaction speed to absolute temperature, used to model accelerated thermal aging and stabilizer depletion in stored propellants. *p. 70*

Autocatalysis. A self-accelerating decomposition reaction in which acidic nitrogen oxides released by aging nitrate esters catalyze further bond cleavage, raising temperature until ignition if unchecked. *p. 69*

Ball Powder. A trademarked family of spherical and flattened-sphere smokeless propellants manufactured by the water-slurry lacquer process pioneered by Fred Olsen at Olin. *pp. 8 and 26*

Ballistite. The first practical double-base smokeless propellant, patented by Alfred Nobel in 1887 from a gelatinized blend of nitrocellulose and nitroglycerin. *pp. 2 and 21*

Black powder. A mechanical mixture of potassium nitrate, charcoal, and sulfur that preceded smokeless propellants, characterized by heavy solid fouling, dense smoke, and lower energy density. *p. 2*

Bulk density. The mass of loose propellant occupying a unit volume, expressed in grams per liter (g/L, numerically equal to kg/m³), governing how a charge fills a cartridge case. *pp. 14 and 66*

Burn rate. The speed at which a propellant flame front consumes grain web thickness under pressure, determined by chemical formulation, surface deterrence, and geometry. *pp. 18 and 63*

Canister powder. Commercial smokeless propellant blended by the manufacturer or packager to hold consistent ballistic tolerances across retail lots for published reference data. *pp. 28 and 67*

Case capacity. The internal volume of a cartridge case, commonly measured in grains of water, which together with bore cross-sectional area determines the cartridge's expansion ratio. *pp. 14 and 61*

Centralite. A class of dialkyl-diphenylurea compounds—most commonly ethyl centralite—used in double-base and extruded propellants as both chemical stabilizer and surface deterrent. *pp. 7 and 9*

CFE. Copper Fouling Eraser, a commercial designation for propellants incorporating bismuth or tin-based decoppering additives that reduce jacket metal buildup in rifle bores. *pp. 12 and 36*

Cordite. A British double-base smokeless propellant developed by Abel and Dewar in 1889, originally extruded as thin cords of nitrocellulose, nitroglycerin, and mineral jelly. *pp. 2 and 21*

Covolume. The excluded volume occupied by propellant combustion gas molecules themselves at extreme chamber pressures, correcting the ideal gas law in internal ballistics equations. *p. 14*

Decoppering additive. A metallic compound—typically containing bismuth, tin, or zinc—incorporated into modern rifle propellants to embrittle and help clear copper jacket fouling from the bore. *p. 8*

Degressive burning. A combustion profile in which burning surface area shrinks continuously as the grain consumes from the outside inward, typical of unperforated flakes and spheres. *pp. 2 and 16*

Deterrent. A less-energetic chemical coating diffused into the outer surface of propellant grains to slow initial burning and promote progressive gas generation. *pp. 8 and 66*

Diphenylamine (DPA). The classic sacrificial chemical stabilizer added to single-base nitrocellulose propellants to absorb nitrogen dioxide and halt autocatalytic degradation. *pp. 3 and 66*

Double-base propellant. A smokeless propellant formulated from both nitrocellulose and a liquid nitrate-ester plasticizer, typically nitroglycerin or diethylene glycol dinitrate. *p. 4*

EI. Extruded Impregnated, Nitrochemie's trademarked manufacturing process in which nitroglycerin is diffused into an extruded nitrocellulose grain to combine high energy density with progressive burning. *pp. 8 and 36*

Expansion ratio. The ratio of total internal volume at bullet exit (case volume plus swept bore volume) to initial case capacity, a primary geometric driver of burn-rate matching. *pp. 14 and 61*

Extruded propellant. Smokeless propellant pressed through mechanical dies into cylindrical rods or tubes and cut to length, commonly perforated with one or more axial holes. *p. 9*

Flame temperature. The peak combustion gas temperature reached by a burning propellant at constant volume, a major driver of barrel throat erosion in overbore cartridges. *pp. 14 and 64*

Flash suppressant. An inorganic salt, often a potassium compound, added in small amounts to disrupt secondary muzzle-gas combustion and reduce visible muzzle flash. *p. 8*

Form function. The mathematical relationship describing how a propellant grain's burning surface area changes as a function of the fraction of grain mass consumed. *p. 16*

Gas-port pressure. The bore gas pressure acting at the gas port of a semi-automatic rifle as the bullet passes, governing action timing and bolt-carrier velocity. *p. 61*

Graphite glazing. A microscopic conductive coating of powdered graphite tumbled onto finished propellant grains to dissipate static electricity and improve volumetric flow. *pp. 8 and 67*

Heat of explosion. The total thermal energy released per unit mass of propellant during constant-volume combustion, expressed in kJ/kg (equivalent to J/g). *pp. 14 and 66*

Impetus. Also called force constant, the work potential per unit mass of propellant gas, proportional to the product of gas yield and adiabatic flame temperature. *p. 14*

IMR. Improved Military Rifle, DuPont's historic line of tubular single-base extruded propellants whose four-digit laboratory specification numbers shaped commercial rifle powder naming. *pp. 21 and 43*

Loading density. The ratio of propellant charge mass to available internal case volume, or the percentage of usable case space filled by the charge. *pp. 15 and 61*

Lot variance. Measurable ballistic differences between separate production batches of the same nominal propellant caused by small shifts in nitration, moisture, web thickness, deterrence, and bulk density. *p. 66*

Moisture equilibrium. The balance point at which hygroscopic nitrocellulose neither gains nor loses water vapor relative to ambient humidity, shifting grain mass, energy content, and burn rate. *p. 66*

Neutral burning. A combustion profile in which burning surface area stays nearly constant as the grain burns simultaneously from its outer wall and central perforation, typical of single-perforated cylinders. *p. 16*

Nitrocellulose (NC). Nitrated cellulose polymer derived from cotton linters or refined wood pulp, serving as the primary energetic binder in all modern smokeless rifle propellants. *p. 2*

Nitroglycerin (NG). A high-energy liquid nitrate ester used with nitrocellulose in double-base and infused propellants to raise specific energy and gas generation. *p. 2*

Nomenclature. The numbering and naming conventions used by OEMs and retail packagers, ranging from legacy DuPont laboratory codes to systematic European burn-rate scales. *p. 43*

OEM. Original Equipment Manufacturer; one of the small number of industrial chemical plants that actually nitrate, extrude, or form propellant sold under retail canister brands. *pp. 49 and 55*

Overbore. A bottleneck cartridge with a large case capacity relative to its bore cross-sectional area, requiring slower, more progressive propellants and generating higher throat erosion. *p. 61*

Piobert's law. The fundamental combustion principle stating that homogeneous solid propellants burn in parallel layers perpendicular to every exposed surface at a uniform linear rate. *p. 16*

Poudre B. Paul Vieille's 1884 gelatinized nitrocellulose rifle propellant, the first practical smokeless powder adopted for military service. *pp. 2 and 21*

Progressive burning. A combustion profile in which effective gas generation increases during the burn, achieved through multi-perforated grain geometry or surface deterrence. *pp. 16 and 61*

REACH. The European Union's Registration, Evaluation, Authorisation and Restriction of Chemicals regulation, whose 2018 enforcement against 2,4-DNT and DBP restricted imports of several legacy rifle powders into Europe. *pp. 36 and 55*

Single-base propellant. A smokeless propellant whose sole primary energetic ingredient is nitrocellulose, generally burning cooler than comparable double-base formulations. *p. 5*

Spherical propellant. Propellant formed as tiny globes or flattened spheres via a water-slurry solvent-distillation process, prized for high bulk density and uniform metering. *p. 8*

Stabilizer. A sacrificial chemical additive incorporated into smokeless propellant to neutralize acidic nitrogen oxides generated during aging and prevent autocatalytic decomposition. *pp. 2 and 66*

Temperature sensitivity. The degree to which a propellant's burn rate, chamber pressure, and muzzle velocity shift as ambient cartridge temperature rises or falls. *pp. 17 and 31*

Throat erosion. Thermal and mechanical wear of the barrel steel immediately ahead of the chamber leade, driven primarily by peak flame temperature, gas velocity, and charge mass. *pp. 14 and 61*

TZ. Temperature Zone, Eurenco Bofors' trademarked chemical stabilization technology engineered to keep rifle propellant burn rates consistent across wide ambient temperature swings. *pp. 8 and 36*

Vieille's law. The empirical power law relating linear propellant burning rate to ambient chamber pressure, named after Paul Vieille. *p. 16*

Web thickness. The minimum solid thickness a flame front must burn through to consume a propellant grain, measured as half the difference between outer diameter and inner perforation in a single-perforated cylinder. *pp. 8 and 66*

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