What is the Difference between Black, Pyrodex, Triple Seven, and Smokeless Powders?

That is a question that often comes up at this time of year, and understandably so. Though classified by the DOT as smokeless propellants, most muzzleloaders can be safely fired with black powder, Pyrodex, Triple Seven, Black Mag3, Pyrodex pellets, and Triple Seven Pellets. Only the Savage 10ML-II was designed to be used with all of these propellants, just like other muzzleloaders, plus certain recommended nitrocellulose (smokeless) powders. Smokeless powders are non-corrosive, offer less recoil, and leave very little residue. Here is a quick look at the basics.

**Black powder** is an old propellant, formed from a blend of natural ingredients: sulphur, potassium nitrate, and charcoal. Classified as an explosive, few muzzleloaders use true black powder these days because of limited availability. The energy produced by black powder in small arms use varies by manufacturer. "Swiss" black powder, for example, is considered a hotter propellant than "Goex" brand.

Black powder, Pyrodex, Black Mag3, and Triple Seven loose powder are all in the category of deflagrating powders. "Deflagrating" is just a fancy way of saying "fast-burning." These powders burn just as fast as they can as long as they can. Their grain size controls the burn rate. FFFF black powder is very, very easy to ignite; that is why the common application is as pan powder for flintlocks. FFF black powder is used often in .45 calibre or smaller bore muzzleloaders and side locks, FF is the standard for .50 calibre inline muzzleloaders. The "F" designation is just the screen size used in manufacture and the resultant grain size (coarseness).

In black powder the fuel is carbon; we are just burning charcoal. Black powder is horribly inefficient, as only about 50% of its mass turns into gas. The rest is solid residue that is forced out the muzzle as white smoke or left in the bore as corrosive fouling crud.

**Pyrodex** is the most common "black powder substitute." It is really the only synthetic black powder "performance" substitute in common use. By performance substitute, I refer to a charge of loose powder measure by volume. A 100 grain volumetric charge of Pyrodex RS (Rifle/Shotgun) is very close in performance to Goex FFg black powder.

There are differences, though, and this is where things get a bit convoluted. Pyrodex is bulkier, another way of saying "less dense." By weight, it is more powerful than Goex black powder. But, the traditional method of measuring black powder is indeed by volume, so in that sense it is a black powder performance substitute.

By actual weight, it is not the same. 100 grains measured by volume of Goex FFg is about 101.3 grains by weight. 100 grains measured by volume of Pyrodex RS is about 72.5 grains by weight. Pyrodex is where confusion can start to set in, as the standard "F" designations of powder coarseness start to go out the window.

Pyrodex "Select," formulated for use in muzzle loading rifles, is touted as an "extremely consistent" grade of Pyrodex, and has the largest grain size of them all. It is even farther away from black powder by actual weight; 100 grains volumetric equals about 63.9 grains by actual weight.
Pyrodex, though man-made and with a variety of additives, still has sulphur in it and is corrosive. It is classified as a smokeless powder by the DOT, and bears little resemblance to traditional black powder in actual weight or grain size. It is a bit harder to ignite than black powder, and is safer to handle, use, and store due to this fact. It is also not as impact-sensitive as is true black powder. Pyrodex is not classified as an explosive as is black powder, and is sold at many chain stores due to this fact.

**Triple Seven, Black Mag3, and Goex Clear Shot** get us into an area where the muzzle loading industry has drifted into double-talk, sidestepping, and confusion. These propellants have nothing in common with true black powder at all; chemically, neither sulphur nor charcoal is present. They are still carbon-burning propellants, though, of the deflagrating (fast-burning) type. They are measured volumetrically, but only Goex Clear Shot can be considered a black powder performance substitute.

Triple Seven and Black Mag3 are far hotter (or more energetic) than good old black powder, and produce higher velocities and pressures. Still burning carbon, the carbon-based fuel burned here is from the sugar family, not from wood (charcoal). These propellants are actually far more modern than nitrocellulose based powders. Triple Seven and Black Mag3 only become available in the 21st Century.

Referring to Triple Seven and Black Mag3, the only thing that they have in common with black powder is they can be volumetrically measured with old black powder measures. They are not as corrosive as black powder (Black Mag3 claims to be non-corrosive), have little in common chemically, and produce more pressure, heat, and velocity than black powder. They are considered smokeless powder by the DOT, and should be used with caution in older muzzleloaders, as there is no way that 100 grains volumetric charge of Triple Seven or Black Mag3 can be considered "the same" as traditional black powder. They are still relatively inefficient propellants, leaving behind close to 50% of their mass as non-combusted, solid residue.

Referring to Triple Seven, that 50% unburned material is substantially less fouling than black powder for the simple reason that a 100 grain volumetric charge of Triple Seven, though it produces more energy than black powder, is far less by actual weight. More directly stated, you still have about 50% of the garbage left, but you start with less garbage to burn in the first place.

**Pyrodex and Triple Seven pellets** are the area where the snake oil sales pitch starts to sizzle. Sold as black powder equivalents of "pelletized powder," they have nothing to do with traditional black powder. The pelletized powder lingo is wishful thinking, as pellets are just pellets. This type of tortured language adds more confusion to the mix. If you take two tablets of aspirin and call me in the morning, you have taken two aspirin tablets, not "tabletised acetylsalicylic acid." Sometimes pellets are just pellets, ask any rabbit, and a cigar is just a cigar. Let's talk about what they really are, and what they do.

Pyrodex pellets are a sophisticated rocket fuel type propellant, more related to an Este’s rocket engine than black powder. They consist of a black igniter portion on one side of the base; although called an "ignition accelerant," this is nothing more than good old black powder. They are, of course, not volumetrically measured, and they do not burn at all like loose powder. A Pyrodex pellet burns progressively down the bore, from the base in, from the outside in, and--due to the hole in the centre--from the inside out.
Though not recommended by Hodgdon, most inline manufacturers currently allow and promote the use of "three pellet loads" for velocities far in excess of what loose black powder or Pyrodex can possibly achieve. How fast? One load out of the 2004 Knight catalogue shows a muzzle velocity of 2417 fps, another is 2639 fps! These velocities can actually be bettered in a longer barrelled gun, like the Thompson/Centre Omega.

Triple Seven pellets, used in three-pellet configuration, actually produce a bit more muzzle velocity. Where Pyrodex pellets are pressed into shape from black powder and Pyrodex RS, Triple Seven pellets are made from straight Triple Seven, and are harder to ignite. For what it is worth, I've personally found Pyrodex pellet loads to be more consistent, and more accurate.

A word of caution is in order. Hodgdon does not condone the use of more than 100 grains of their Pyrodex or Triple Seven pellets in .45 or .50 calibre muzzleloaders, and they clearly, loudly proclaim that warning with every box of pellets sold. Several people have asked, "What pressures do three pellets produce?" Well, there is no finite answer. Much is necessarily contingent on projectile weight, type, and calibre of rifle.

I shoot a few flaming pellets into the air on the 4th of July. The kids get a kick out of it, but as there is no projectile there is little pressure. Lyman Ballistic Laboratories has published three Pyrodex pellet-powered saboted bullet loads that develop 27,000 psi out of a 22" test barrel; Triple Seven pellets can produce more pressure than that.

Not all inline muzzleloaders have been tested with Triple Seven pellets, and it is a matter of public record that the casual take "three pellets and call me in the morning" approach can lead to an immediate trip to the emergency room. There are a few makes and models of inline muzzleloaders that have been extensively tested with three pellet loads, and I'll mention them right here: current production Knight Disc Rifles, Thompson Omega and Encore rifles, and the Savage 10ML-II.

**Smokeless Powder**, the original black powder substitute, became commercially available in the last decade of the 19th Century. As you've read above, the path to "black powder substitutes" is a convoluted, twisty one. What is called a "black powder substitute" has very little to do with the actual and factual, and a lot more to do with who has what to sell.

Only the Savage 10ML-II has been proven safe with nitrocellulose based smokeless powder, as opposed to solid fuel or deflagrating style DOT classified smokeless black powder substitutes like Triple 7 or Black Mag3 mentioned above. Folks are a bit confused about smokeless powder use in the Savage 10ML-II, but not nearly as bewildered as they are about the black powder / pellet / synthetic black powder substitute mess already described.
There is a myth that "smokeless powder" means "high pressure." That statement is sheer nonsense, borne out of complete ignorance. Most all shot shells today, of course, are powered by nitrocellulose based smokeless powder. Shot shells are mentioned as the current plastic wads used in today's shotshell ammo serve the same function as a sabot in a muzzleloader, that being of taking up windage in the bore and providing an effective gas seal. Note that these pressures, all nitrocellulose smokeless powder generated, are but a fraction of the pressures generated in today's inline muzzleloaders.

For comparison, please note that Lyman Ballistic Laboratories independent data shows that just 100 grains of Pyrodex RS fired by a CCI #11 cap produces 22,600 PSI when pushing a saboted 240 grain Hornady XTP bullet through a 22" test barrel.

The Savage 10ML-II is the only significant muzzleloader on the market that can use all the black powder substitutes mentioned. It was designed to use nitrocellulose-based powders from its inception.

The benefits are easy enough for even me to understand: a propellant such as Accurate Arms 5744 is economical, non-corrosive, and extremely clean burning compared to all the other "substitutes" mentioned. It offers far less recoil for a given sabotted projectile and muzzle velocity than does Pyrodex or Triple Seven powder or pellets.
Many people have asked why that is. The reason is simple, and two fold.

First, deflagrating propellants burn as fast as they can as quick as they can, resulting in a very sharp jolt of a primary recoil pulse. Accurate Arms 5744 burns progressively, a far smoother pressure curve. This results in a push to the shoulder, rather than a punch.

Second, as we previously mentioned, roughly half of the carbon-based propellant mass is left behind as solid residue. This inert residue must necessarily be pushed out of the bore by gas. From a recoil standpoint, this solid unburned residue is considered part of the ejecta. Approximately half of the carbon-based powder charge can be added to the bullet and sabot weight to calculate free recoil. With Accurate Arms 5744, there is no such mass of fouling, as virtually all the propellant converts to gas. Therefore, there is much less weight of additional ejecta to push out the barrel, and less recoil as a result.

I'm taking the liberty of mentioning Accurate Arms 5744 smokeless powder for a reason. It is the favourite propellant of the inventor of the Savage 10ML-II, Henry Ball, and is currently my favourite as well. It actually has more things in common with black powder from a usage standpoint than do Pyrodex or Triple Seven pellets. It can easily be volumetrically measured with great accuracy. (Not using a black powder measure, but using a Lee 3.4 cc smokeless powder measure.) It also is a powder, not a solid fuel.

The smokeless powder myth of "high pressure" has been disproved, and the notion that smokeless powder cannot be volumetrically measured is also wrong. All commercial smokeless ammunition is loaded by volume, not by weight, and anyone that has ever seen or used any of the popular MEC shotshell reloading presses knows that the powder is dropped by volume, not by weight.

Richard Lee, of course, has known the convenience of smokeless powder volumetric loading for decades, and has made it available to the masses with his "Lee Dipper Set." Perhaps I am being a bit redundant, but I must mention again that the Savage 10ML-II is the only muzzleloader in which you can safely use Accurate Arms 5744, or any other smokeless powder.

The fracas over smokeless powder in muzzle loading is silly. Perhaps it is due to the hyperbole driven marketing of smoke poles, but "smokeless" absolutely does not mean any type of smokeless in the Savage, either, nor just any charge. There are only four powders approved by Savage Arms, as of this writing, for use in the 10ML-II. Do not be confused just because some 200 different nitrocellulose powders are currently available. You don't use just any smokeless powder in a shotshell or rifle cartridge application, either.

The message is simple: use propellants approved by a quality muzzle loading arms manufacturer and you'll have no problems, provided you follow the rules of good reloading practices. If you are a muzzleloader, let there be no mistake, you are a reloader. All the freedom and all the responsibility that goes with reloading goes with muzzle loading.

In conclusion I'll just mention what "black powder substitutes" I've had the best luck with during the testing of some fifty different muzzleloaders over the last couple of years alone. 100 grains of Triple 7 FFg by volume has more or less been my preferred load for most quality inlines to date, including Austin & Halleck, Knight, and Thompson rifles. Pyrodex pellets have shown themselves to be more accurate than their Triple 7 counterparts. The Savage 10ML-II does well with both Hodgdon products, but Accurate Arms 5744 has been an easy choice due
to delightfully soft recoil, extreme accuracy, and no necessity for immediate maintenance.

Whatever your choice, Pyrodex, Black Mag3, Triple Seven, or smokeless powder (in the Savage 10ML-II only), just let your gun tell you what combination it likes. Hopefully, this article has shed a little light on what today’s inline muzzle loading propellants are really all about.

Congratulate yourself! If you've hung in there this long with me you've demonstrated far more interest and caring about your sport than most would be bothered with, and I thank you.