NZAR ID A20 BLACK POWDER GRADES courtesy Geox USA August 2011

Compiled by John Osborne Many thanks to several contributors

Black powder is a granular mixture of

- a nitrate, typically potassium nitrate (KNO_3), which supplies oxygen for the reaction;
- charcoal, which provides carbon and other fuel for the reaction, simplified as carbon (C);
- sulfur (S), which, while also serving as a fuel, lowers the temperature required to ignite the mixture, thereby increasing the rate of combustion.

Potassium nitrate is the most important ingredient in terms of both bulk and function because the combustion process releases oxygen from the potassium nitrate, promoting the rapid burning of the other ingredients. To reduce the likelihood of accidental ignition by static electricity, the granules of modern black powder are typically coated with graphite, which prevents the build-up of electrostatic charge.

Charcoal does not consist of pure carbon; rather, it consists of partially pyrolyzed cellulose, in which the wood is not completely decomposed.

The current standard composition for the black powders that are manufactured by pyrotechnicians was adopted as long ago as 1780. Proportions by weight are 75% potassium nitrate (known as saltpeter or saltpetre), 15% softwood charcoal, and 10% sulfur.[9] These ratios have varied over the centuries and by country, and can be altered somewhat depending on the purpose of the powder. For instance, power grades of black powder, unsuitable for use in firearms but adequate for blasting rock in quarrying operations, is called blasting powder rather than gunpowder with standard proportions of 70% nitrate, 14% charcoal, and 16% sulfur; blasting powder may be made with the cheaper sodium nitrate substituted for potassium nitrate and proportions may be as low as 40% nitrate, 30% charcoal, and 30% sulfur.[10] The British Government in 1635 used the ratio 75% Saltpetre, 12.5% Charcoal, 12.5% Sulfur.

Black powder types are purchased and described by 'grades'. The grades carry numbers or designations to declare their granule sizes, and their relative speeds of burning. Those numbers are familiar to pyrotechnicians - the famous 'F' numbers. Powders come in two broad basic grades, 'a' grade, or blasting powder, and 'g' grade, or 'sporting' (shooter's) powder.

The more "F"s in a number, the smaller the granule size, and thus, the faster the powder will burn. So, FFa powder is slower, with a larger granule size than FFFa, and FFFg is faster than Fg.

The primary difference between 'a' and 'g' grades is processing. Both powders begin as milled 'meal' powder. The potassium nitrate, charcoal and sulfur are milled into an extremely fine powder. This milling process takes many hours and is usually done by remotely operated equipment due to the inherent danger of the process. The meal powder is consolidated under high pressure into a 'mill cake' or 'press cake' of solid Black Powder by hydraulic press. The cake is dried, and crushed into grains. Both types are then screened to remove fines, and to grade the grain sizes.

Subsequent polishing of the powders may be done in a tumbler. Blasting "a" type powders are not usually tumbled. If they are tumbled, it is just for a short time to knock off any sharp and long projections. Sporting "g" type powders are tumbled with a tiny amount of graphite to polish the grains. The base formula is the same. The graphite is not part of the basic Black Powder formula.

The graphite does act as a burn rate modifier, slowing the burn rate slightly. But primarily, the graphite serves as a surface lubricant to make the powder flow more easily when loading guns. It also serves the cosmetic purpose of making the powder shiny and pretty. The grain sizes are different for sporting and blasting Black Powder.

Note, as shown in the tables below, that it is conventional to express 'g' type powder types with multiple 'F's followed by a lower-case 'g', while 'a' grade powders wear a number before one 'F', and a capital "A". So, "three F g" powder is written as "FFFg", while "three F a" powder is written as "3FA". This convention is thought to have b een instituted so that less confusion would exist between powder types. For a given number of Fs, 'a' grade powder is coarser and slower-burning than 'g' grades, notwithstanding the graphite polish on the 'g' types. Sporting Grade Black Powder -- "g" type powders

Powder Grade	pass screen,	holding,	stays on,	passing
Whaling	32/64" mesh	3%	4 mesh	12%
Lifesaving	6 mesh	3%	12 mesh	12%
Cannon	6 mesh	3%	12 mesh	12%
Saluting	10 mesh	3%	20 mesh	12%
Fg	12 mesh	3%	16 mesh	12%
FFg	16 mesh	3%	30 mesh	12%
FFFg	20 mesh	3%	50 mesh	12%
FFFFg	40 mesh	3%	100 mesh	12%
FFFFFg	(no longer manufactured by Goex)			

"A" Blasting Powder used mostly by pyrotechnicians and for some specialized quarry work

Powder Grade	pass screen,	holding,	stays on,	passing
FA	20/64" mesh	3%	5 mesh	12%
2FA	4 mesh	3%	12 mesh	12%
3FA& nbsp;	10 mesh	3%	16 mesh	12%
4FA	12 mesh	3%	20 mesh	12%
5FA	20 mesh	3%	50 mesh	12%
6FA	30 mesh	3%	50 mesh	12%
7FA	40 mesh	3%	100 mesh	12%
Meal D	40 mesh	3%		
Meal F	100 mesh	3%		
Meal XF	140 mesh	3%		

*** Shows maximum percentages held or passed by the sizing screens.

Except where noted in inches, the screen sizes are in wires per inch. The higher the mesh number the smaller the opening size. Note that, for any given number of "F"s, that the blasting powder is much coarser.

Reference: AMCP 706-175 Engineering Design Handbook - Explosives Series- Solid Propellants Part One. Thanks to Bill Nelson and Murr Rhame for collating most of this data.

If you ignore the 'F' numbers, for a given measured grain size, the blasting powder burns faster than the graphite-inhibited sporting powder; That's partly because of the inhibiting action of the graphite, and partly because of the geometry of the grains.

Blasting powder is less dense because the grains are more irregularly shaped; they take up more volume for a given weight of powder. Blasting powder grains also have a lot of rough edges. Rough edges both inhibit packing of grains, and offer lots of easy-to-ignite sites on each grain. The combination of more air space between grains, and the rougher surfaces of the grains promotes faster burning.

Image by John Osborne August 2011