

# Simple Green Propellant

Slow and Fast Variations

Presented by 1020 Research Labs



## History

When AMW first came on the market I picked up the first K670 reload at a Blackrock launch. This motor sparked my interest in creating my own green EX motors. Simple Green is the end result of three years of research. It was just a pet project that I kept coming back to and changing it a little until I came up with a formula that worked for me. My first attempts at green were with Barium Carbonate. Results were good at one atmosphere but the flame turned pale yellow / green under pressure. The resulting propellants were hard to light and slow burning. Good results were finally had using Barium Nitrate. I am using the milled Barium Nitrate from Firefox and having good results. In both of these formulas I chose to go with a fairly low HTPB content to minimize color contamination. The burn rate was found to be fairly fast with just Barium Nitrate. To slow it down I chose to add in some Barium Carbonate. The burn rate reduced from 0.27 in/sec to 0.21 in/sec. A 22% reduction in burn rate! At this point I am happy with these propellants and how they fly. I have flown the Slow Green in 38mm, 54mm and 75mm motors all the way up to an 8000ns M3000. The Fast green has flown in 38mm and 54mm motors. The following are the formulas and numbers I currently use for this propellant. I run it with Kosdon cases and nozzles so a starting KN of 210 – 230 and a max KN of 250 - 270 will obtain similar results to what I have had. This is a fairly stiff propellant to mix so I would recommend machine mixing. Read the MSDS on Barium Nitrate and Barium Carbonate before trying this formula.

## Mixing Instructions

Measure out the R45 into your mixing bowl. Add the Tepanol and mix by hand until thoroughly combined. At this point I add the IDP or DOA but I don't mix it in yet. It will pool on top of the R45. Next I add the Magnesium to the bowl and let it rest for a moment. The liquid IDP or DOA will soak into the Mg and wet it out. Now I start mixing by hand until the mixture is smooth and thoroughly combined. The Barium Nitrate is screened and added next. Be sure to wear a respirator and avoid dusting. You don't want this stuff on your skin, in your eyes or be inhaled. Carefully mix in the Barium Nitrate and repeat the process with the Barium Carbonate if you are making the slow version. Measure and screen the AP next and add it to the bowl. I stir it in by hand before moving the bowl to the mixer. I like to use a timer. I mix for 15 minutes and scrape down the sides and bottom of the bowl every three minutes. At the end of 15 minutes I add the curative and mix again for 15 minutes scraping down every 3 minutes. At this point I vacuum the mixture for 2 – 3 minutes before packing. I can pack 4 54mm grains or 2 75mm grains by myself no problem but the curative starts to kick off after that. I clean the bowl and mixing equipment with Simple Green and finish off with acetone. Use paper towels to clean everything well and burn them when you are done. I pull my mandrels 4 – 6 hours after packing and you can burn the grains at 24 hours.

### Slow Green

<b>R45HTLO</b>	10.0%
<b>IDP or DOA</b>	2.4%
<b>Tepanol</b>	0.5%
<b>Mg 1000mesh</b>	3.0%
<b>Barium Nitrate</b>	15.0%
<b>Barium Carbonate</b>	5.0%
<b>AP200</b>	62.0%
<b>E744</b>	2.1%

BR Coefficient (a) : 0.0234  
BR Exponent (n) : 0.3666  
Burn Rate : 0.21 in/sec  
Density : 0.058 lb/in<sup>3</sup>  
ISP\* : 172 sec  
Spec. Heat Ratio : 1.229

### Fast Green

<b>R45HTLO</b>	10.0%
<b>IDP or DOA</b>	2.0%
<b>Tepanol</b>	0.5%
<b>Mg 1000mesh</b>	3.0%
<b>Barium Nitrate</b>	17.0%
<b>AP200</b>	65.4%
<b>E744</b>	2.1%

BR Coefficient (a) : 0.0476  
BR Exponent (n) : 0.2778  
Burn Rate : 0.27 in/sec  
Density : 0.059 lb/in<sup>3</sup>  
ISP\* : 179 sec  
Spec. Heat Ratio : 1.229



6 grain 38mm Fast Green