SRM_2014 TIP SHEET Rev.2020-12-21

1. It is highly recommended to type in a descriptive Title (*Data and Kn* worksheet). This will be beneficial when opening the file at a later date. Example:

   Title: Impulser Rocket Motor
   as configured for flight Z-28.

2. To directly convert inches to millimetres (*Data and Kn* worksheet), type in the cell
   =25.4**inch measurement*
   For example, to convert 2.5 inches, type in the cell:
   =25.4*2.5
   63.5 will be displayed, which is the millimetre equivalent

3. There are several factors that can affect burn rate of a propellant in a rocket motor. Since burn rate influences chamber pressure (and therefore thrust and overall burn time), the performance of a motor may differ from that predicted, and may vary from one propellant batch to another. Propellant factors that affect burn rate, in order of influence:

   a. Oxidizer particle size

   b. Moisture content

   c. Purity of oxidizer and fuel

   d. Blending of oxidizer and fuel

For potassium nitrate, particle size does not have a profound effect on burn rate (compared to AP), but nevertheless can be significant. Two choices are given for oxidizer particle size for the sugar propellants listed in SRM: **coarse** and **fine**. *Coarse* refers to granular, similar to table salt in appearance. *Fine* refers to milled, typically in a grinder for about 30 seconds, similar to *flour* in appearance. Particle sizes are approximately as follows:

Coarse	100-800 micron range (approximate)
Fine	25-200 micron range (approximate)

The following table gives typical sieve analysis for coarse and fine oxidizer grind.

Particle size range *microns*	Pass sieve	Retained by sieve	**COARSE OXIDIZER**	**FINE OXIDIZER**
1840 to 800	#10	#20	**10%**	**-**
800 to 440	#20	#35	**40%**	**-**
440 to 235	#35	#60	**40%**	**5%**
235 to 120	#60	#120	**10%**	**25%**
120 to 75	#120	#230	-	**25%**
less than 75	#230	pan	-	**45%**
			100%	100%

Typical sieve analysis for COARSE and FINE oxidizer

Moisture content has a significant effect on burn rate. Moisture acts as a burn rate suppressant. For consistent results, both oxidizer and fuel should be desiccated *after grinding* and prior to blending. Calcium chloride serves well as an excellent desiccant.

Purity of the ingredients, particularly the oxidizer, can affect burn rate significantly. For example, fertilizer grade potassium nitrate can contain anti-caking agents. Such additives can have either an enhancing or suppressing effect on burn rate.

Thorough blending of oxidizer and fuel prior to melting is important mainly for combustion efficiency, however, burn rate is slightly affected as well.

SRM is designed to be *conservative* with regard to motor design, in its prediction of chamber pressure. In other words, the predicted chamber pressure will represent an *upper limit*, as the burn rate parameters used in the calculations assumes oxidizer and fuel are well blended, constituents are fully desiccated and of high purity.

4. Erosive burning parameters should typically be left at the default values:

G*	6	Propellant erosive burning area ratio threshold
kv	0	Propellant erosive burning velocity coefficient

Sugar propellants do not exhibit erosive burning if the core diameter is a minimum of 1.25× nozzle throat diameter and the total grain length to throat diameter ratio is 35 or less:

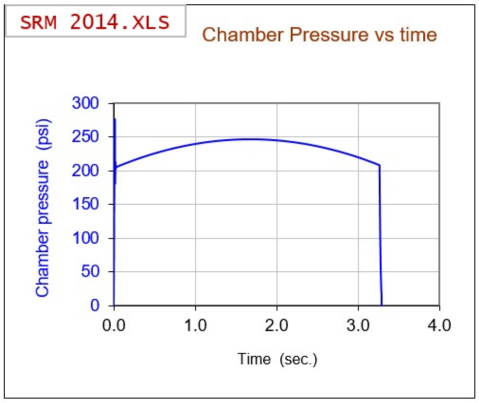
$\mathbf{D_{core} \geq 1.25 \times D_{throat}}$

$\mathbf{L_{grain} \leq 35 \times D_{throat}}$

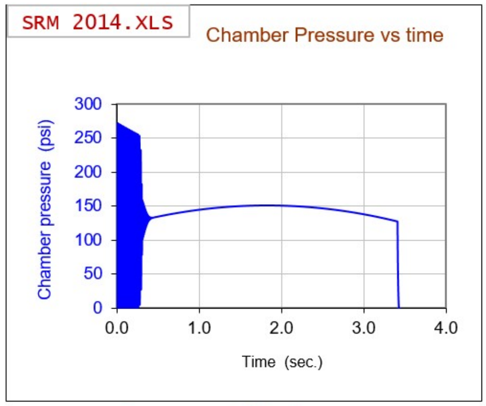
Motors should therefore be designed using these criteria.

5. A word of caution when using SRM to design a motor that operates at low chamber pressure. Version 2014.1 fixed an issue that caused #NUM to appear in the calculation of Chamber Pressure when a low “Target MEOP” pressure was selected. Although the

calculation error was fixed, the resulting Chamber Pressure versus time graph (as well as Thrust versus time) may exhibit oscillatory start-up behaviour. This is shown in examples below:



Pmax =	272 psi
t burn =	3.269 s.
t thrust =	3.294 s.



Pmax =	272 psi
t burn =	3.415 s.
t thrust =	3.432 s.

As such, the values of “Pmax” and “Fmax” may not correspond to the true (steady-state) maximums. This oscillatory start-up behaviour is not strictly a calculation oddity. In fact, this may occur in real life. With many propellants, a low Kn (ratio of burning area to throat area) can result in start-up instability known as “chuffing”. The chamber pressure will oscillate in a distinct manner immediately upon ignition, and may, or may not, transition to a stable steady-state burn.