16.512, Rocket Propulsion
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Lecture 15: Selection of Propellant Mixtures

Solid Propellant Rocket Fundamentals

<u>Solid Propellants Rockets</u>

Read Sutton ch.11 $\rightarrow$ basic performance

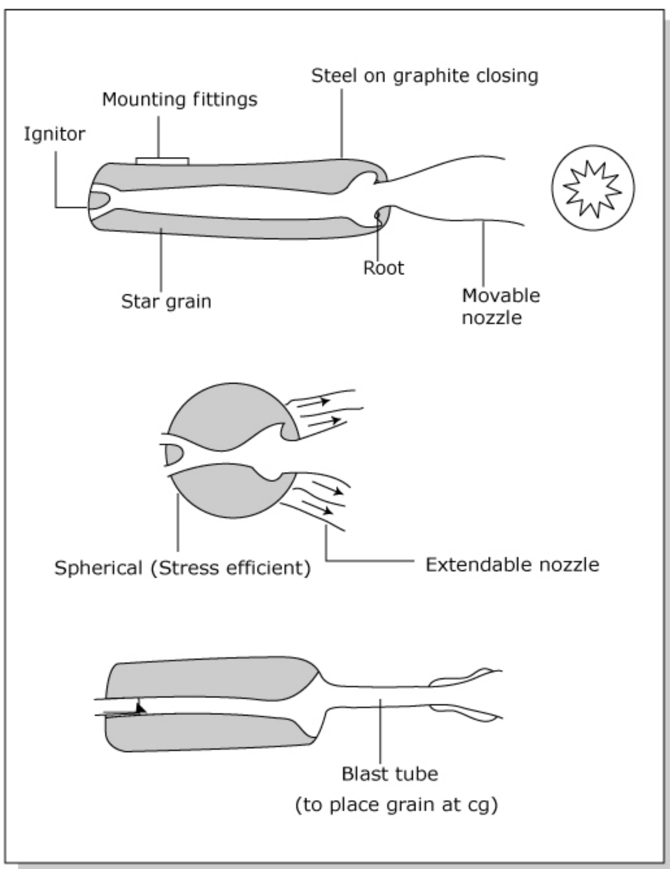
Surface regression rate $\left(\dot{r}\right)$, empirically correlated to gas pressure as

$$\dot{r} = a p_c^n \qquad (n < 1)$$

$$\dot{m} = \rho_p \, a \, P_c^n \, A_b = \frac{P_c A_t}{c^*}$$

$$\boxed{P_c = \left(\rho_p \, a c^* \, \frac{A_b}{A_d}\right)^{\frac{1}{1-n}}}$$

n<1 for stability



Booster motor

Space Engine (IUS)

Tactical motor

B. Double – bore propellants: Homogenous, Nitroglicerine/Nitrocellulose + additive

C. Composite propellants: Ammonium Per chlorate (AP) + Rubber binder (fuel) + Aluminum

Ex. Fig 11.7 Sutton. AP-CMDB 30% AP (150 μm) n ~ 0.4

$$r\ (100\ \text{atm}) \simeq 1\ \text{cm/s} \qquad r \simeq 0.01\left(\frac{P_c}{10^7}\right)^{0.4} \qquad a = 1.58 \times 10^{-5}$$

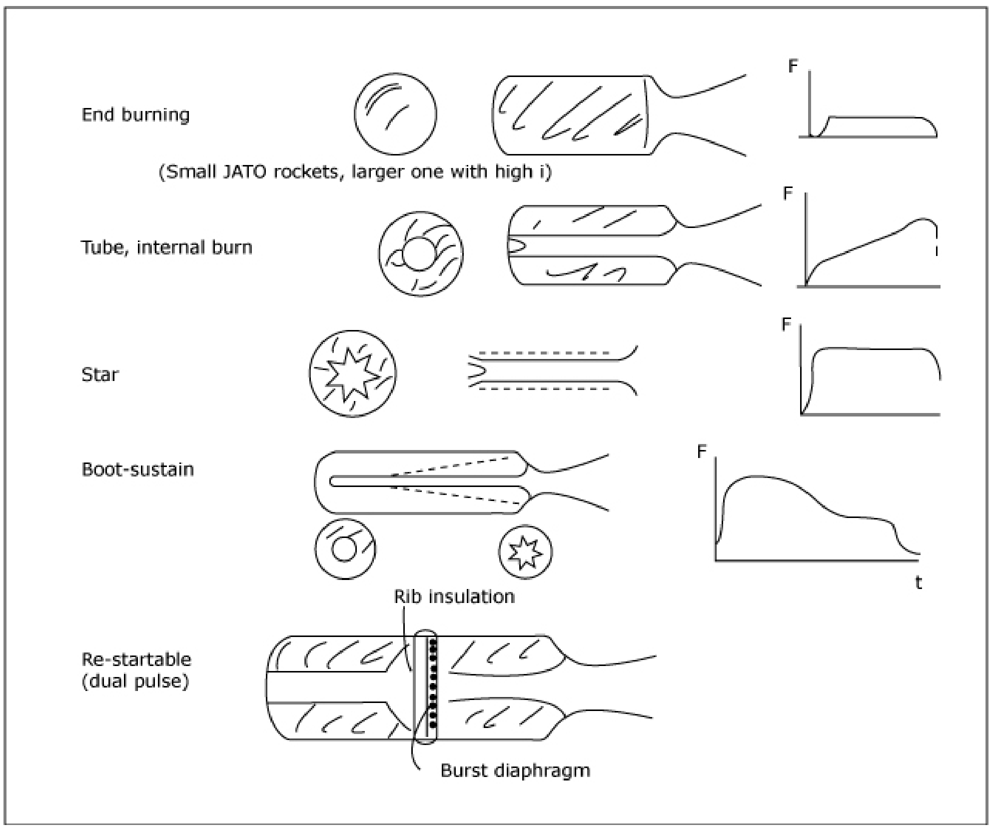
$C^* = 1600$ m/s $\quad \rho_p = 0.0636\ \text{lb/m}^2 = 1760\ \text{Kg/m}^2$

Want $P_c = 50\ \text{atm} \simeq 5 \times 10^6\ \text{N/m}^2$

$$\longrightarrow \frac{A_b}{A_t} = \frac{\left(5\times10^6\right)^{0.6}}{1760\times1.58\times10^{-5}\times1600} = 235$$

cannot use end – burn

Grain configuration



For Solid Rocket Components and Motor Design

Read Sutton, Chapter 14