

1.1. CASING DESIGN

The casing houses the grains and has a bulkhead on the forward end and a nozzle on the rear. Combustion happens inside the casing and it is necessary to ensure it can withstand the high temperatures and pressures. Aluminium 6063 T5 was selected for the casing material as it has a higher strength-to-weight ratio than steel and is also available in tubular form from local vendors.

The wall thickness was designed based on the maximum expected operating pressure (MEOP) P_c , of 5 MPa based on past data.

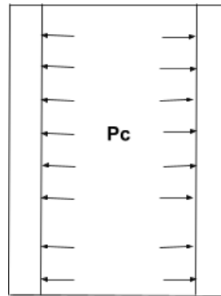


Figure 1: Casing design considerations

Problem Specifications		Al 6063 T5 Mechanical Properties	
Specification	Value	Property	Value
Length, L	725 mm	σ_{yp}	110 MPa
Inner Diameter, d	94 mm	σ_{UTS}	150 MPa
MEOP, P_c	4.26 MPa	E	70,000 MPa
Minimum S_f	2	μ	0.33

Minimum thickness

Considering the hoop stress,

$$t = \frac{P_c * d * S_f}{2\sigma_{yp}} = \frac{4.26 * 94 * 1.5}{2 * 110} = 2.7303 \text{ mm}$$

A thickness of 3 mm is selected to cater for tolerances during manufacturing.

Expected change in length

$$\Delta l = \frac{p_c * d * l}{4 * t * E} (1 - 2\mu) = \frac{5 * 94 * 725}{4 * 3 * 70000} (1 - 2 * 0.33) = 0.1379 \text{ mm}$$

Expected Change in diameter

$$\Delta d = \frac{p_c * d^2}{4 * t * E} (1 - \nu) = \frac{5 * 94^2}{4 * 3 * 70000} (1 - 0.33) = 0.03524 \text{ mm}$$

Burst Pressure

$$P_B = \frac{2 * t * \sigma_{UTS}}{d} = \frac{2 * 3 * 150}{94} = 9.5745 \text{ MPa}$$