BOLTS CALCULATION

The maximum pressure (P_{Max})as simulated in open motor was **8.02Mpa**.

$$P_{Max} = 8.02Mpa$$

The pressure force (F_P):

$$F_P = P_{Max} \times Cross\ sectional\ area$$

Inside diameter(d)=68mm

$$F_P = 8.02 \times \frac{\pi}{4} \times 68^2 = 29126.08N$$

The shear stress (τ) acting on each bolt

$$\tau = \frac{F_B}{bolt\ x{-}area}$$

M8 Bolt x-area= 50.265mm^2

Force acting on each bolt:

$F_B = \frac{F_P}{n}$, *Where n= number of bolts*

Using **8** M8 Bolts:

$$F_B = \frac{29126.08}{8} = 3640.76N$$

$$\therefore\ \tau = \frac{3640.76N}{50.265mm^2} = 72.431\ N/mm^2$$

The **yield strength** of mild steel bolt is 250N/mm^2.

Using **von misses yield criterion** to calculate the maximum shear stress:

$$\tau_{Max} = 0.58\sigma_{yield}$$

$$\tau_{Max=0.58\times250=145N/mm^2}$$

Using a safety factor of 1.5:

$$Maximum\ allowable\ shear\ stress = \frac{145}{1.5} = \mathbf{96.67N/mm^2}$$

72.431 < 96.67

$$\therefore \tau_{bolt} < \tau_{yield}$$

Hence the design using 8 M8 bolts is safe.

Below is an excel sheet showing variations of the bolts and comparing with the maximum allowable stress to obtain an optimum design:

BOLTS SHEAR STRESS CALCULATIONS

	Bolt diameter	No. of bolts	CSA (per bolt)	Force per bolt	Shear stress(per bolt)
M6	6	6	28.27433388	4854.34708	171.6874074
		8		3640.76031	128.7655556
M8	8	6	50.272	4854.34708	96.56164625
		8		3640.76031	72.42123469
M10	10	6	78.55	4854.34708	61.7994536
		8		3640.76031	46.3495902

Pipe diameter	68
Tube Pressure(Max)	8.02
Yield stress(Mild steel)	250
Safety factor	1.5
CSA(tube)	3631.681108
Force on tube(max)	29126.08248
shear stress(Max)	145
Bolt Shear stress(allowable)	96.66666667

NB: CSA means cross section area
RESULTS: 72.4212Pa < 96.67Pa
INFERENCE: MINIMUM BOLT DIAMETER = M8
NO. OF BOLTS = 8