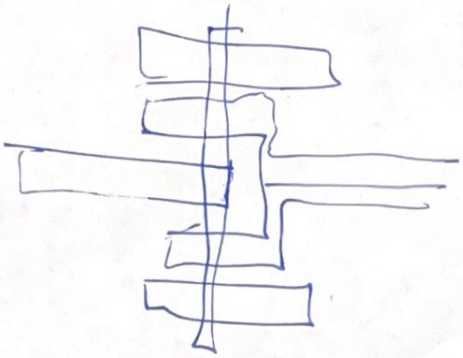
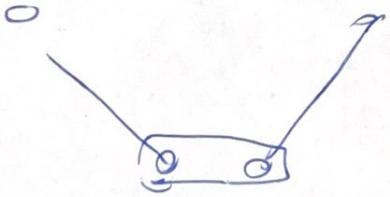
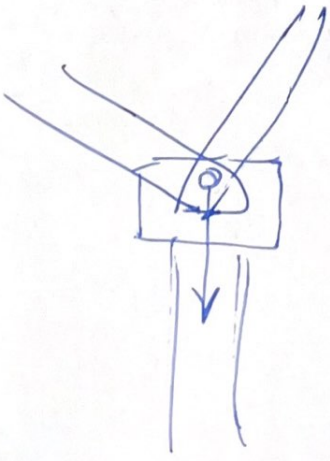






Trials: (5° angle from the base to the tip)

Joshua M.

Actuator (Repaired - slightly leaking)

1: 2.06 kg

2. 1.72 kg

3. 1.96 kg

4. 1.82 kg

5. 1.86 kg

6. 1.84 kg

Average: 1.8766 kg

Median: 1.85 kg

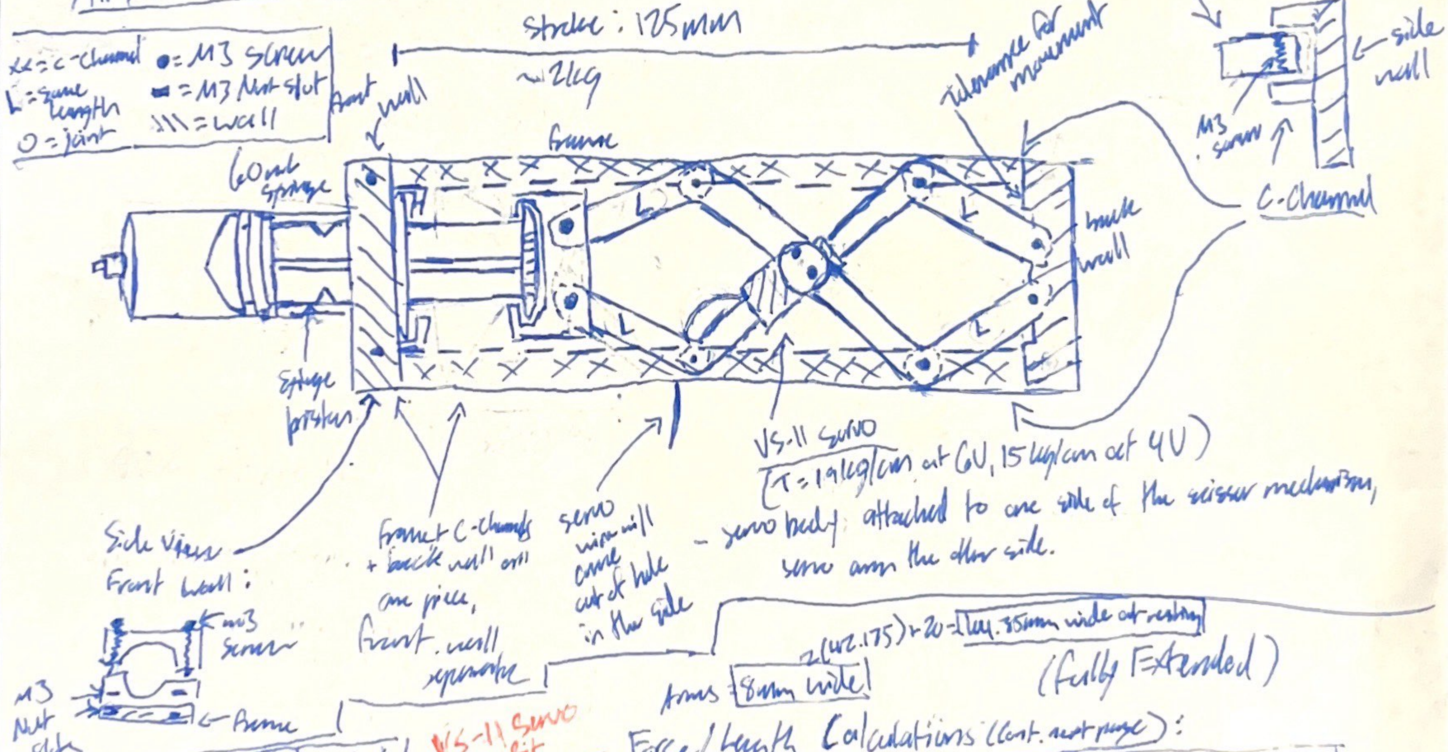
Standard Deviation: 0.108 kg

Actuator (New - no leaks)

1.

Top:

Air Actuator Activator:



- servo body attached to one side of the scissor mechanism, servo arm the other side.

$2(42.175)+20 =$ 104.35 mm wide at resting

Arms = 8 mm wide

(Fully Extended)

VS-11 Servo Doesn't Fit

Force/Length Calculations (Cont. next page):

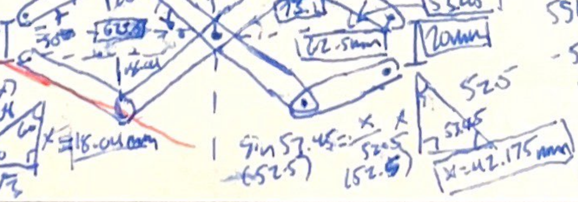
~~Law of Sines: $\frac{\sin a}{A} = \frac{\sin b}{B} = \frac{\sin c}{C}$~~

~~$\frac{\sin 120}{62.5} = \frac{\sin 30}{x}$~~

~~$x \sin 120 = \frac{62.5 \sin 30}{\sin 120}$~~

~~$x = 36.08$ mm~~

~~30°-60°-90° Right △ property~~



$\sin 53.45 = \frac{x}{52.5}$ (52.5)

Law of Cos(): $a^2 + b^2 - 2ab\cos C = c^2$

$52.5^2 + 52.5^2 - 2(52.5)(52.5)(\cos C) = 62.5^2$

$5512.5 - 5512.5 \cos C = 3906.25$

$-5512.5 \qquad -5512.5$

$\frac{5512.5}{\cdot -1} \qquad \frac{55125}{\cdot -1}$

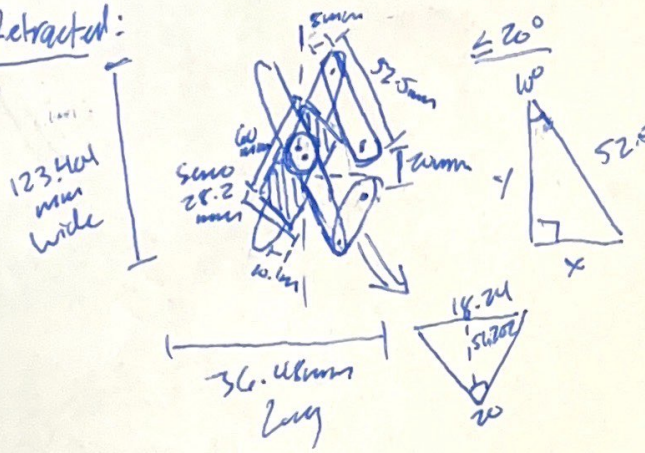
$\cos^{-1} \cos C = 0.29138 \cos^{-1}$

$C = 73.10$

Motor Force: (kg/cm) / 5.25cm = ~3.6 kg of force on piston (higher than we likely required). Not taking into account friction.

52.5mm = 5.25cm

Fully Retracted:



$\leq 20°$

$\sin 40° = \frac{x}{52.5}(52.5)$ $x = 9.12mm$

$\cos 40° = \frac{y}{52.5}(52.5)$ $y = 51.702$

(kg/kg/cm) / 8.7cm = ~2.18 kg/cm

88.52mm Stroke

Parts:

- 4 M3x30
- 4 M3x25
- 2 M3x5
- 10 M3 Nuts
- 7 M4 Nuts
- 4 M4x15
- 3 M4L40
- 4 M6x8
- 4 T-Nuts

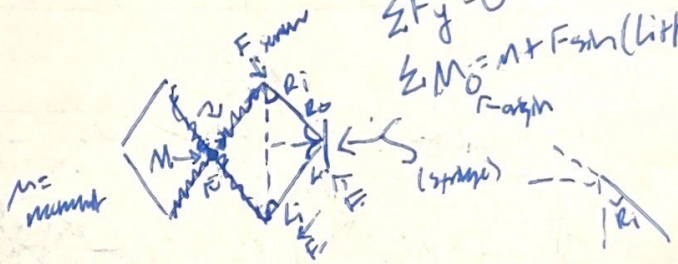
$F = \frac{S}{\sin(\Pi i)}$

Fully Retracted

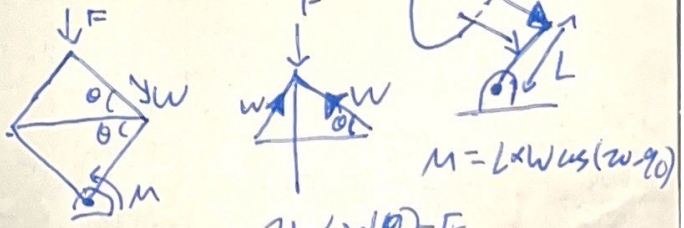
$\sum F_x = F\sin(\Pi i) - S = 0$

$\sum F_y = 0$

$\sum M_{O\text{-origin}} = M + F\sin(\Pi i + \Pi i)\,d = 0$ (distance)



$\sin(\Pi i + \Pi i) = \frac{x}{F}$ $M = -F\sin(\Pi i + \Pi i)$

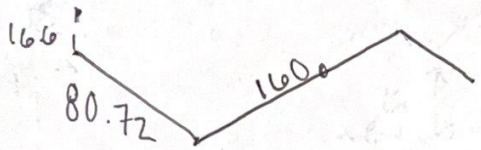


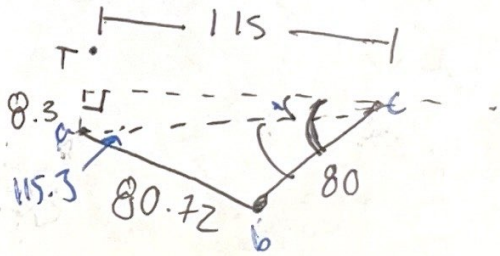
$2W\sin(\Theta) = F$

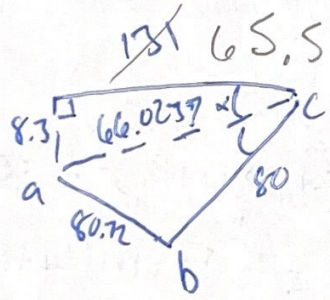
plunger fully retracted, Find M

280.842mm

230







$\tan^{-1}\tan x = \frac{8.3}{115}\tan^{-1}$

$x = 4.128^\circ$

$80.72^2 = 80^2 + 115.3^2 - 2(80)(115.3)\cos(C)$

$-13178.37 = -18448\cos C$

$\frac{-13178.37}{-18448} = \frac{-18448\cos C}{-18448}$

$0.71435 = \cos C$

$\cos^{-1}$ $\cos^{-1}$

$C = 44.41^\circ$

$\tan^{-1}\tan A = \frac{8.3}{65.5}\tan^{-1}$

$A = 7.222^\circ$

$48.538^\circ \angle x$

$80.72^2 = 80^2 + 66.0237^2 - 2(80)(66.0237)\cos C$

$-4243.41 = -10563.742\cos C$

$\frac{-4243.41}{-10563.742} = \frac{-10563.742\cos C}{-10563.742}$

$\cos C = 0.40164$ $x = 73.54^\circ$

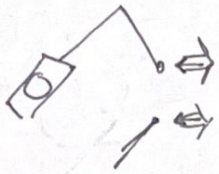
$\cos^{-1}$ $\cos^{-1}$

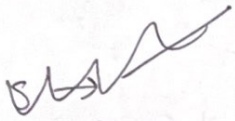
$C = 66.32^\circ$

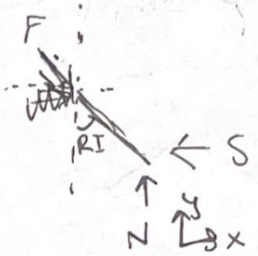
$\sum F_x = 0$

$\sum F_y = 0$

$\sum M = 0$

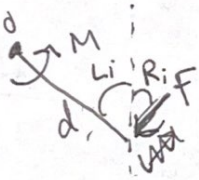






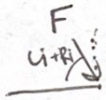
$\sum F_x = F \sin(R_i) - S = 0$

$F = \frac{S}{\sin(R_i)}$



$\sum M_0 = M + F \sin(L_i + R_i) \cdot d = 0$

$M = - F \sin(L_i + R_i) \cdot 8\,cm$



$\sin(L_i + R_i) = \frac{x}{F}$

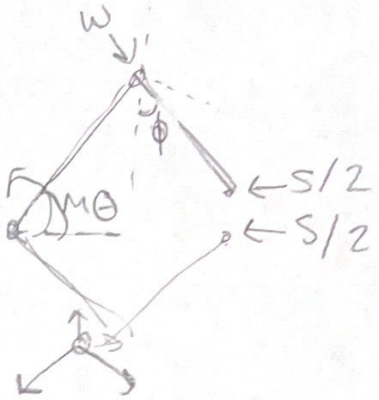
$M = \frac{S \cdot \sin(L_i + R_i)}{\sin(R_i)}$

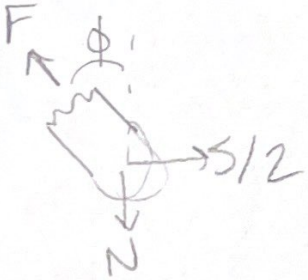
$$Li = 90 - \theta \qquad Ly = 80\sin(\theta) - 8.3$$

$$\cos(Ri) = \frac{80\sin(\theta) - 8.3}{80.72}$$

$$Ri = \cos^{-1}\left(\frac{80\sin(\theta) - 8.3}{80.72}\right)$$

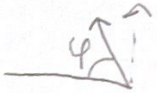
$$M = \frac{1.87\,kg \cdot 8cm \cdot \sin\left(90 - \theta + \cos^{-1}\left(\frac{80\sin(\theta) - 8.3}{80.72}\right)\right)}{\sin(90 - \theta)}$$





$$\Sigma F_x = S/2 - F\sin(\phi) = 0$$

$$F = \frac{S}{2\sin(\phi)}$$



$$\Sigma M = M - F\sin(\phi + 90 - \theta)\cdot d$$

$$M = \frac{S\sin(\phi + 90 - \theta)\cdot d}{2\sin(\phi)}$$

$h = 80.27$

$h_y = 80\sin(\theta) - 8.3$ $\quad \phi = \cos^{-1}\left(\frac{80\sin(\theta) - 8.3}{80.27}\right)$