Lab Write-up

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Our buckling load equation is

$$P = \frac{E\pi^3 D^3}{4L^2}$$

$$E = \frac{4PL^2}{\pi^3 D^4}$$

We can confirm the powers by plotting the data on log scales.

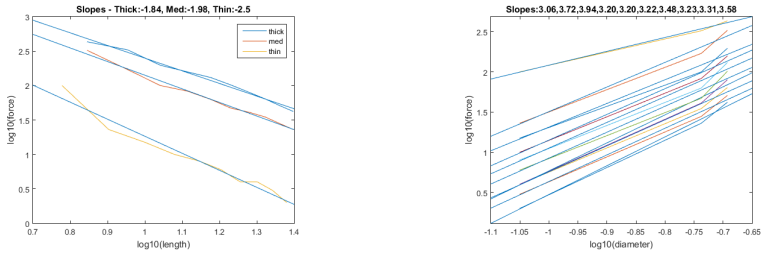

Figure 1: Averages for the slopes = -3.6 and 1.5

The ruler we used had an error of ± 0.5mm, and the scale had an error of ± 0.5g.

Calculating standard deviation of the length, radius, and pressure:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=i}^{N}(x_i - \mu)^2}$$

$$\sigma_{length} = 5.8624,\ \sigma_{diameter} = 0.4539,\ \sigma_{force} = 109.6030$$

Error propagation given by

$$\delta q = \sqrt{(\delta x^2) + (\delta z)^2 + (\delta \omega)^2}$$

$$\frac{\delta E}{E} = \frac{4}{\pi^3}\sqrt{(\frac{2\delta L}{L})^2 + (\frac{-4\delta R}{R})^2 + (\frac{\delta P}{P})^2}$$

$$\frac{\delta E}{E}$$

$$Mean(E) = 5.4534\frac{g}{cm * s^2} = 54.534\frac{kg}{m * s^2}$$

1 Appendix

Thick			
Length(cm)	Mass(g)	Force(N)	Diameter(cm)
25	42	412.02	0.203
23	51	500.31	
21	64	627.84	
19	80	784.80	
17	102	1000.62	
15	131	1285.11	
13	158	1549.98	
11	197	1932.57	
9	329	3227.49	
7	432	4237.92	

Medium			
Length(cm)	Mass(g)	Force(N)	Diameter(cm)
25	23	225.63	0.183
23	28	274.68	
21	35	343.35	
19	41	402.21	
17	47	461.07	
15	63	618.03	
13	83	814.23	
11	100	981.00	
9	170	1667.70	
7	325	3188.25	

Thin			
Length(cm)	Mass(g)	Force(N)	Diameter(cm)
24	2	19.62	0.089
22	3	29.43	
20	4	39.24	
18	4	39.24	
16	6	58.86	
14	8	78.48	
12	10	98.10	
10	15	147.15	
8	23	225.63	
6	100	981.00	