

CHAPTER 1 - INTRODUCTION

1.5-1

(a) $A = \pi(0.550)^2 / 4 = 0.2376 \text{ in.}^2$

$$F_u = \frac{P_u}{A} = \frac{28,500}{0.2376} = 120,000 \text{ psi} = 120 \text{ ksi}$$

$$\underline{F_u = 120 \text{ ksi}}$$

(b) $e = \frac{2.300 - 2.030}{2.030} \times 100 = 13.3\%$

$$\underline{e = 13.3\%}$$

(c)

$$A_f = \pi(0.430)^2 / 4 = 0.1452 \text{ in.}^2$$

$$\text{Change} = \frac{A_f - A_o}{A_o} \times 100 = \frac{0.1452 - 0.2376}{0.2376} \times 100 = -38.9\%$$

$$\underline{\text{Reduction} = 38.9\%}$$

1.5-2

$$A = \pi(0.5)^2 / 4 = 0.1963 \text{ in.}^2$$

$$f = \frac{P}{A} = \frac{13.5}{0.1963} = 68.77 \text{ ksi}$$

$$\varepsilon = \frac{\Delta L}{L} = \frac{4.66 \times 10^{-3}}{2} = 2.33 \times 10^{-3}$$

$$E = \frac{f}{\varepsilon} = \frac{68.77}{2.33 \times 10^{-3}} = 29,500 \text{ ksi}$$

$$\underline{E = 29,500 \text{ ksi}}$$

1.5-3

$$A = \pi(0.510)^2 / 4 = 0.2043 \text{ in.}^2$$

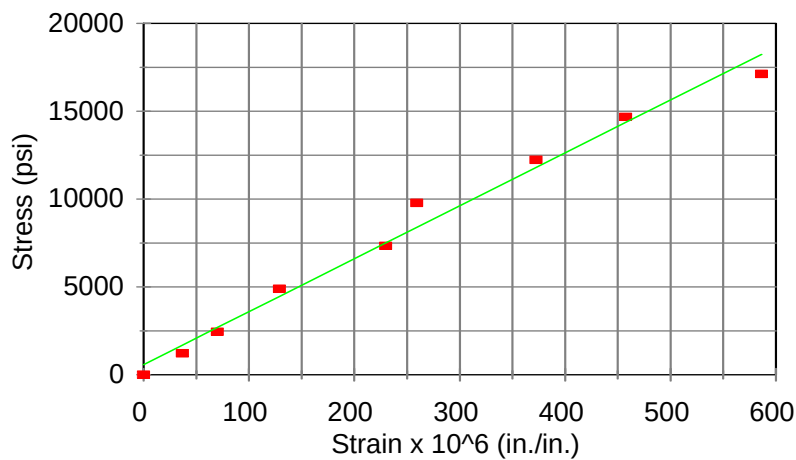
$$\text{For } P = 250 \text{ lb, } f = \frac{P}{A} = \frac{250}{0.2043} = 1224 \text{ psi}$$

Spreadsheet results:

(a)

Load (lb)	Stress (psi)	Strain x 10 ⁶ (in./in.)
0	0	0
250	1224	37.1
500	2447	70.3
1000	4895	129.1
1500	7342	230.1
2000	9790	259.4
2500	12237	372.4
3000	14684	457.7
3500	17132	586.5

(b)



(c)

$$E = \text{slope} = 30,100 \text{ ksi}$$

1.5-4

$$A = \pi(0.5)^2 / 4 = 0.1963 \text{ in.}^2$$

$$E = \frac{f}{\varepsilon} = \frac{P / A}{\Delta L / L} = \frac{P}{\Delta L} \cdot \frac{L}{A} = 1392(4 / 0.1963) = 28,400 \text{ ksi}$$

$$E = 28,400 \text{ ksi}$$

1.5-5

$$A = \pi(3/8)^2 / 4 = 0.1104 \text{ in.}^2$$

$$\text{For } P = 550 \text{ lb, } f = \frac{P}{A} = \frac{550}{0.1104} = 4982 \text{ psi}$$

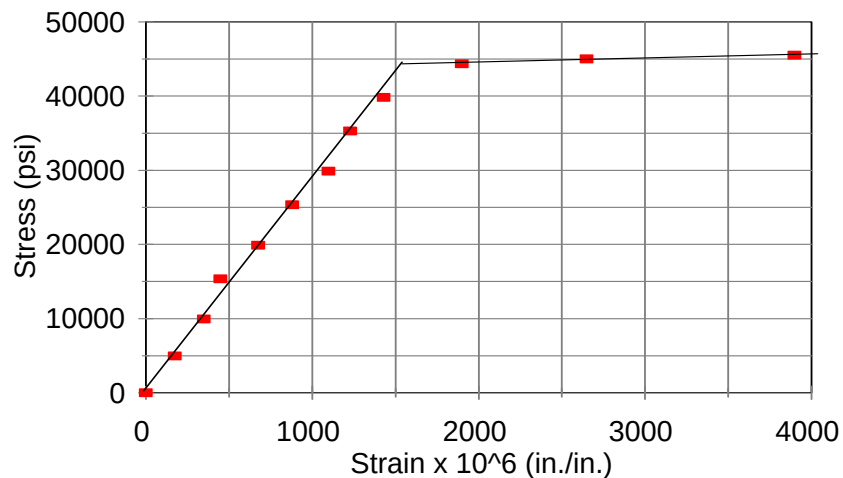
$$\varepsilon = \frac{\Delta L}{L} = \frac{350 \times 10^{-6}}{2} = 175 \times 10^{-6}$$

Spreadsheet results:

(a)

Load (lb)	Elongation x 10 ⁶ (in.)	Stress (psi)	Strain x 10 ⁶ (in./in.)
0	0	0	0
550	350	4982	175
1100	700	9964	350
1700	900	15399	450
2200	1350	19928	675
2800	1760	25362	880
3300	2200	29891	1100
3900	2460	35326	1230
4400	2860	39855	1430
4900	3800	44384	1900
4970	5300	45018	2650
5025	7800	45516	3900

(b)



$$(c) \quad E = \text{slope} = \frac{15,000}{500 \times 10^{-6}} = 30,000,000 \text{ psi}$$

$$E = 30,000,000 \text{ psi}$$

(d)

$$F_y \approx 44,000 \text{ psi}$$

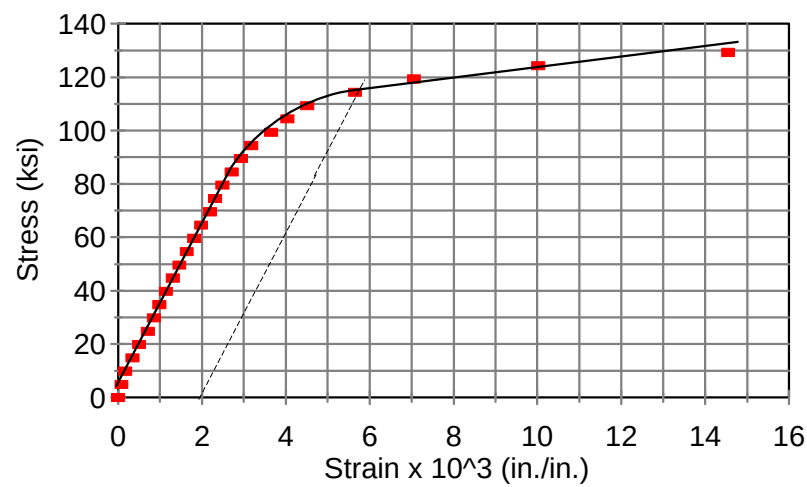
1.5-6

Spreadsheet results:

(a)

Load (kips)	Elongation x 10 ³ (in.)	Stress (ksi)	Strain x 10 ³ (in./in.)
0	0	0	0
1	0.16	4.973	0.080
2	0.352	9.945	0.176
3	0.706	14.92	0.353
4	1.012	19.89	0.506
5	1.434	24.86	0.717
6	1.712	29.84	0.856
7	1.986	34.81	0.993
8	2.286	39.78	1.143
9	2.612	44.75	1.306
10	2.938	49.73	1.469
11	3.274	54.70	1.637
12	3.632	59.67	1.816
13	3.976	64.64	1.988
14	4.386	69.62	2.193
15	4.64	74.59	2.320
16	4.988	79.56	2.494
17	5.432	84.54	2.716
18	5.862	89.51	2.931
19	6.362	94.48	3.181
20	7.304	99.45	3.652
21	8.072	104.4	4.036
22	9.044	109.4	4.522
23	11.31	114.4	5.655
24	14.12	119.3	7.060
25	20.044	124.3	10.02
26	29.106	129.3	14.55

(b)



(c) $E = \text{slope} = \frac{80 - 50}{0.0025 - 0.0015} = 30,000 \text{ ksi}$

$$\underline{E = 30,000 \text{ ksi}}$$

(d)

$$\underline{F_{p\ell} \approx 85 \text{ ksi}}$$

(e)

$$\underline{F_y \approx 116 \text{ ksi}}$$