## CHAPTER 1 - INTRODUCTION

**1.5-1**

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

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

$F_u = 120$ ksi

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

$e = 13.3\%$

(c)

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

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

Reduction = 38.9%

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**1.5-2**

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

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

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

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

$E = 29{,}500$ ksi

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**1.5-3**

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

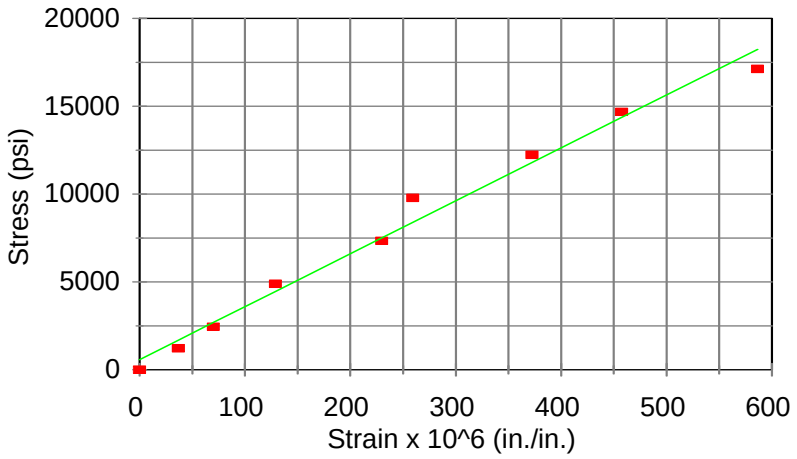
For $P = 250$ lb, $f = \frac{P}{A} = \frac{250}{0.2043} = 1224$ psi

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) $E$ = slope = 30,100 ksi

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**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 ksi

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**1.5-5**

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

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

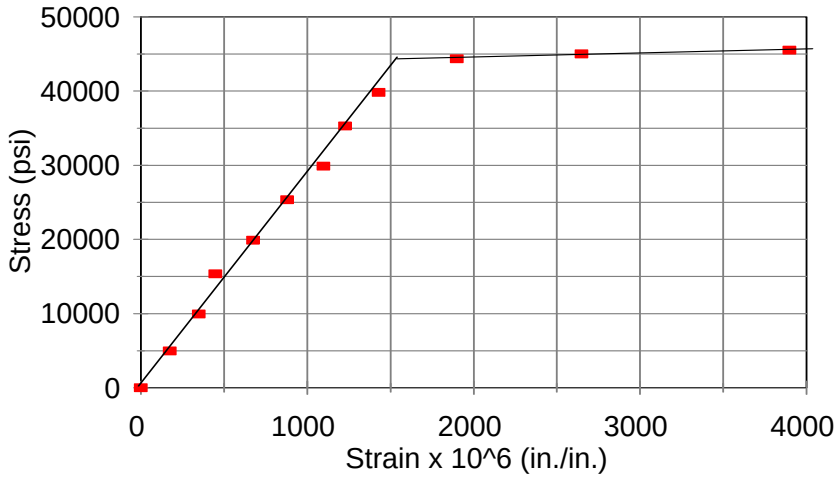
$$\varepsilon = \frac{\Delta L}{L} = \frac{350 \times 10^{-6}}{2} = 175 \times 10^{-6}$$

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

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

(d) $$\underline{F_y \approx 44{,}000 \text{ psi}}$$

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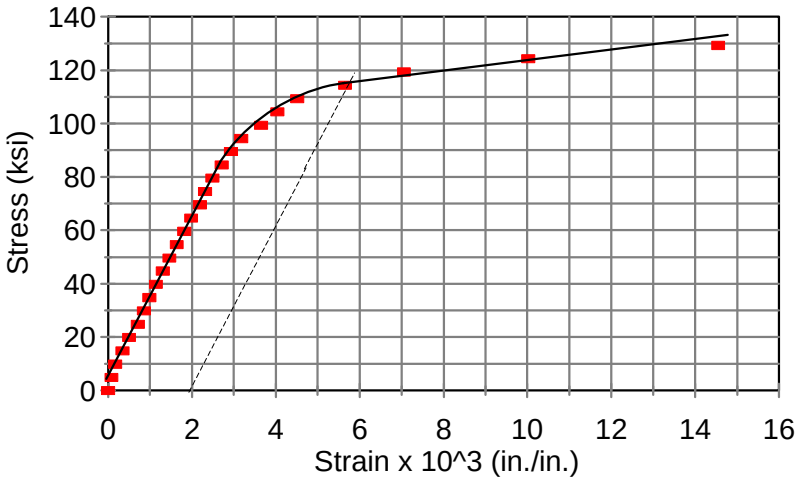
**1.5-6**

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

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

(d) $$F_{p\ell} \approx 85 \text{ ksi}$$

(e) $$F_y \approx 116 \text{ ksi}$$