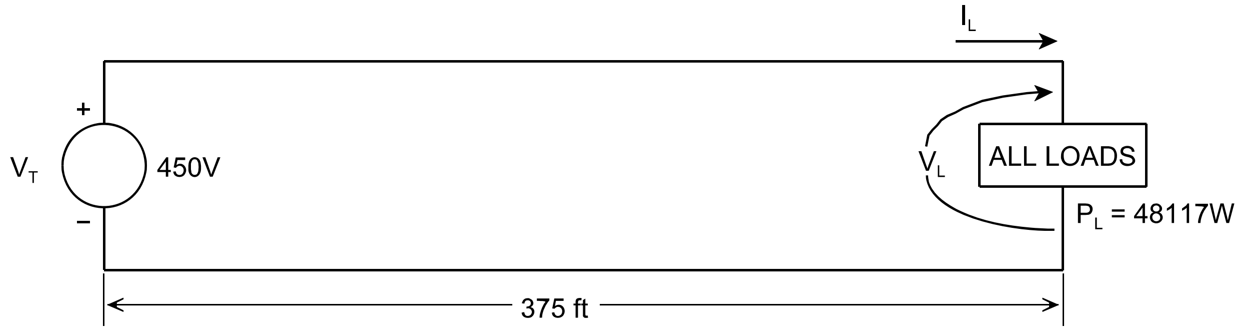
Assignment

ELECTROTECHNOLOGY
ELTK1100
QUIZ #7
SOLUTIONS

A 42hp motor and three 7.5hp motors are located 375ft away from their 450V source. If the maximum permissible voltage drop is 3% and the feeder uses aluminum conductors, what size of conductor should be used? What power is lost to the feeder?

How are the motors connected? Series or Parallel. Why?



$$P_L = 42hp * \frac{746W}{hp} + 3 * 7.5hp * \frac{746W}{hp} = 48{,}117W$$

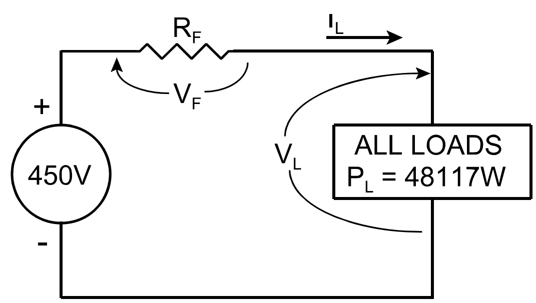
$$V_F \leq 3\% \ of \ V_T = 3\% * 450V = 13.5V \quad 1$$

$$V_L \geq 97\% \ of \ V_T = 97\% * 450V = 436.5V \quad 2$$

$$I_L = \frac{P_L}{V_L} = \frac{48117W}{436.5V} = 110A \quad 3$$

$$R_F = \frac{V_F}{I_L} = \frac{13.5V}{110A} = 0.122\Omega \ @ \ 20°C \quad 4$$

$$P_F = V_F I_L = 13.5V * 110A = 1{,}488W \quad 5$$



$$A = \frac{\rho * \ell}{R_F} = \frac{17.0 \frac{\Omega \cdot CM}{ft} * 2 * 375ft}{0.122\Omega} = 104{,}508CM$$

	P (W)	V (V)	I (A)	R (Ω)	
T		450	110 [3]		
F	1,488 [5]	13.5 [1]	110 [3]	0.122 [4]	3%
L	48,117	436.5 [2]	110 [3]		97%

$\#0 \ (Ans.) \quad A = 105{,}530CM$

$R \ \alpha \ \frac{1}{A}$. Since actual $A > 104{,}508CM$, then actual $P_F < 1488W$ (*Ans.*) and $\% voltage \ drop < 3\%$.

Motors and lights are connected in parallel, so that each can operate independently. *(Ans.)*
If they were connected in series, all would be on or off (like some Christmas lights).

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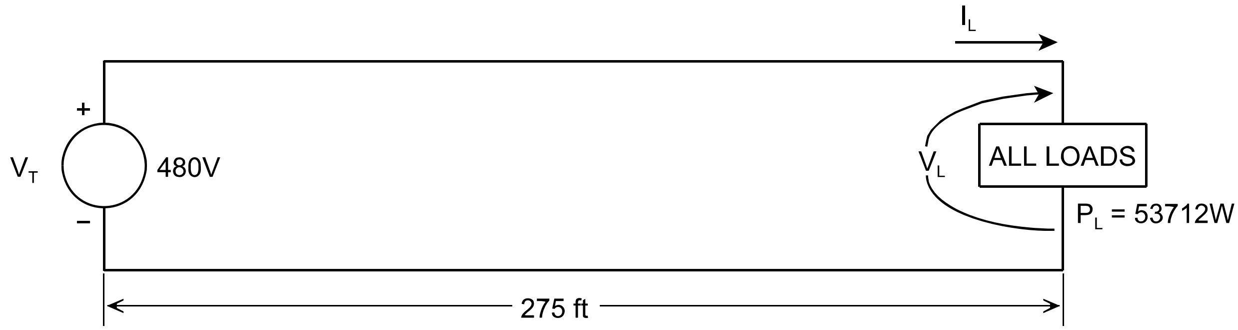
A 42hp motor and four 7.5hp motors are located 275ft away from their 480V source. If the maximum permissible voltage drop is 3% and the feeder uses aluminum conductors, what size of conductor should be used? What power is lost to the feeder?

Why is the actual feeder voltage drop less than 3%?



$$P_L = 42\,hp * \frac{746\,W}{hp} + 4 * 7.5\,hp * \frac{746\,W}{hp} = 53{,}712\,W$$

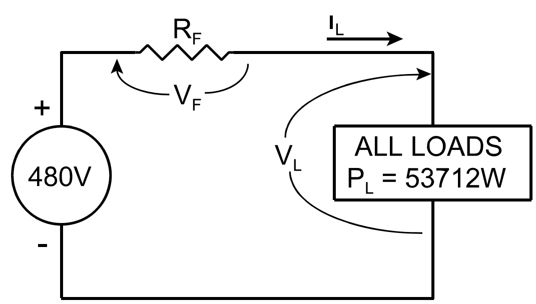
$$V_F \le 3\% \text{ of } V_T = 3\% * 480\,V = 14.4\,V \quad {}^{1}$$

$$V_L \ge 97\% \text{ of } V_T = 97\% * 480\,V = 465.6\,V \quad {}^{2}$$

$$I_L = \frac{P_L}{V_L} = \frac{53{,}712\,W}{465.6\,V} = 115\,A \quad {}^{3}$$

$$R_F = \frac{V_F}{I_L} = \frac{14.4\,V}{115\,A} = 0.125\,\Omega \text{ @ } 20^\circ C \quad {}^{4}$$

$$P_F = V_F\,I_L = 14.4\,V * 115\,A = 1{,}661\,W \quad {}^{5}$$



$$A = \frac{\rho * \ell}{R_F} = \frac{17.0\,\frac{\Omega - CM}{ft} * 2 * 275\,ft}{0.125\,\Omega} = 74{,}800\,CM$$

#1 (*Ans.*) $A = 83{,}694\,CM$

	P (W)	V (V)	I (A)	R (Ω)	
T		480	115 [3]		
F	1,661 [5]	14.4 [1]	115 [3]	0.125 [4]	3%
L	53,712	465.6 [2]	115 [3]		97%

$R \propto \frac{1}{A}$. The actual area of #1 wire, ($A > 74{,}800\,CM$), is greater than the 3% design, which means the resistance of the feeder, $R_F < 0.125\,\Omega$ *(Ans.)*, $\%\,voltage\ drop < 3\%$ and $P_F < 1661\,W$ (*Ans.*).