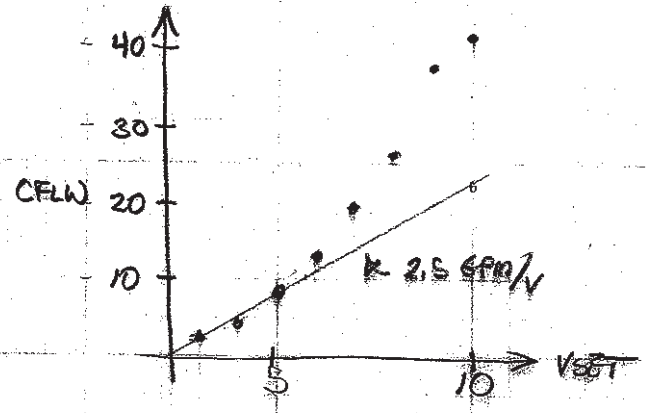


Aφ TEMP REGULATION

VSET	WACFLW
3	2.45 Gpm
4	4.52
5	8.26
6	13.34
7	19.5
8	26.1
9	37.6
10	41.3



FLOW LOOP BANDWIDTH $\omega_f = IFLW (2.5 \text{ GPM/V})$

FOR .01 Hz $IFLW = \frac{2\pi(.01)}{2.5} = .025$

[APPEARS STABLE FOR IFLW = .1]

Pump Power .435 WATTS / PSI-GPM 60% EFFICIENT

91.5 GPM (79.6-17 PSI) $.435 \frac{1}{.6} = 4.2 \text{ KW}$

REQUIRES 1.7 GPM CHILLED WATER TO MAINTAIN 28°C

1.7 GPM (25 - 15.4°C) $\frac{1}{3814} \frac{\text{KW}}{\text{°-GPM}} = 4.3 \text{ KW}$

HEAT CAPACITY

2 x 165' OF 2 1/8" OD ASSUME 2" ID COPPER PIPE

$12441 \text{ IN}^3 \frac{1 \text{ GAL}}{231 \text{ IN}^3} = 53.9 \text{ GAL WATER}$

$4.180 \frac{1}{\text{°C}} 3764 \frac{\text{g}}{\text{GAL}} 53.9 \text{ GAL} = .85 \text{ MJ / °C WATER}$

$\frac{1}{16} \text{ WALL} \Rightarrow 2\pi \frac{1}{16} 330 \text{ FT } 12 \frac{\text{IN}}{\text{FT}} \left(\frac{2.54 \text{ CM}}{\text{IN}} \right)^3 \frac{8.96 \text{ g}}{\text{CM}^3} = 228 \text{ kg}$

CAVITY $\approx 100 \text{ lbs} = 45 \text{ kg}$

$.3866 \frac{1}{\text{°C}} (45 + 228) 1000 = .11 \text{ MJ / °C COPPER}$

Loop GAWNS

$$\omega_0 = \frac{P}{\Delta T C}$$

$$C = 1 \text{ ms}/^\circ\text{C}$$

$$\Delta T = 15^\circ\text{C}$$

$$P = 5 \text{ kW}$$

$$\frac{\omega_0}{2\pi} = .000080 \text{ Hz}$$

$$\text{WANT } \frac{P_{\text{TMP}}}{I_{\text{TMP}}} = \frac{1}{\omega_0} = 2000$$

[COMPUTER DIVIDES I_{TMP} BY 1000]

$$\boxed{\frac{P_{\text{TMP}}}{I_{\text{TMP}}} = 2}$$

$$\text{WANT } P_{\text{TMP}} = \omega_T \frac{AC}{\Delta T}$$

$$A = 3.814 \frac{^\circ\text{C} \cdot \text{GPM}}{\text{KW}}$$

$$\omega_T = 2\pi \cdot 0.001 \text{ Hz}$$

$$\tau = 160 \text{ sec}$$

$$\boxed{\begin{aligned} P_{\text{TMP}} &= 1.6 \\ I_{\text{TMP}} &= .5 \end{aligned}}$$

$$\boxed{\frac{53.9 \text{ GAL}}{61 \text{ GPM}} = 53.0 \text{ SEC TO CIRCULATE}}$$