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MET 330 Professor Ayala August 5th, 2023

13.2. $Q = 750\ L/min$ or $198\ gal/min$
$T = 80°C$

Commercial steel pipe because water won't corrode.

$Q = V \cdot A$ using criterion $V = 3\ m/s$

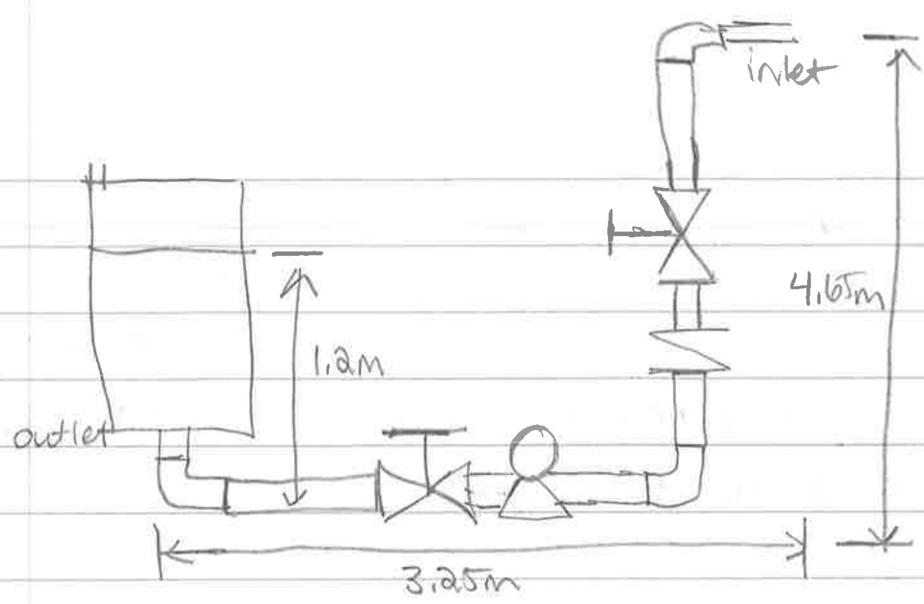
$\frac{Q}{V} = A$ $\quad \frac{750\ L/\cancel{min}}{3\ m/s} \cdot \frac{1\ m^3/s}{60000\ L/\cancel{min}}$ $\quad A = 0.00417\ m^2$

$= 4.17 \times 10^{-3}$

3" NPS steel pipe $= 4.768 \times 10^{-3}\ m^2$

Real velocity $= \frac{Q}{A} = \frac{750 \cdot \frac{1}{60000}}{4.768 \times 10^{-3}} = 2.62\ m/s$
meets criteria

13.2



$$H_A = H_L + \Delta z + \frac{v_2^2}{2g}$$

3 elbows, 2 gate valves, 1 check valve

water @ 80°C ν (kinematic) $= 3.60 \times 10^{-7}\ m^2/s$
velocity $v = 2.62\ m/s$
$D = 77.9mm = 0.0779m$

$$N_R = \frac{(2.62)(0.0779)}{3.60 \times 10^{-7}} = 566939$$

5.67×10^5

$\varepsilon = 4.6 \times 10^{-5}$

$$\frac{D}{\varepsilon} = \frac{0.0779m}{4.6 \times 10^{-5}} = 1693.48$$

$$f = \frac{0.25}{\left[\log\left(\frac{1}{3.7(1693.48} + \frac{5.74}{(5.67 \times 10^5)^{0.9}}\right)\right]^2}$$

$$\left[\log\left(0.000159 + 0.000038\right)\right]^2$$

$f = 0.018$

13.2 Total length of pipe = 7.9m

4.65m + 3.25m = 7.9m

$\frac{v_2^2}{2g} = \frac{2.62^2}{2 \cdot 9.81}$

$= 0.3499$

$= 0.350$

gate valve = $8 f_T = 8(0.018) = 0.144$

QTY 2 = $2 \times 0.144 = 0.288$

elbows = $30 f_T = 30(0.018) = 0.54$

QTY 3 = $3 \times 0.54 = 1.62$

1 check valve (swing) = $100 f_T = 100 \times 0.018 = 1.8$

entrance loss assume square edged inlet = K = 0.5

$h_L = K\left(\frac{v_2^2}{2g}\right) = 0.5\left(\frac{(2.62)^2}{2 \cdot 9.81}\right) = 0.175$

H_L pipe $= 0.018\left(\frac{7.9m}{0.0779m}\right) = 1.83$

$H_{L\,All} = 0.288 + 1.62 + 1.8 + 0.175 + 1.83 = 5.713m$

$\Delta z = 4.65m$

$H_A = 5.713 + 4.65 + 0.35 = 10.71m$

$= 35.14ft$

$\frac{v_2^2}{2g} = 0.35$

Q = 198 gpm

13.2 $H_a = H_L + \Delta z + \left(\frac{V_2^2}{2g}\right)$

$= 5.713 + 4.65 + 0.35 = 10.71\ m$ $Q = 198\,gpm$

$=35.14\,ft$

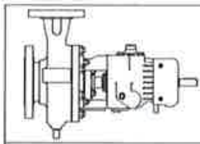
$\frac{ha^1}{ha^2} = \left(\frac{N_1}{N_2}\right)^2 = ha^2 = ha^1\left(\frac{N_1}{N_2}\right)^2 = 10.71\left(\frac{2910}{1475}\right)^2 = 42.84\ m$

Pump preselection = 3x4x8B pump
using sulzer curve - Type OHH and
$H_A \approx 42.84\,m$ + $Q = 198\,gpm$
approx

$Q = 175\,gpm = 39.7\,m^3/h$
$Q = 200\,gpm = 45.4\,m^3/h$
$Q = 225\,gpm = 51.1\,m^3/h$

impeller diameter = 180mm = 7.09"

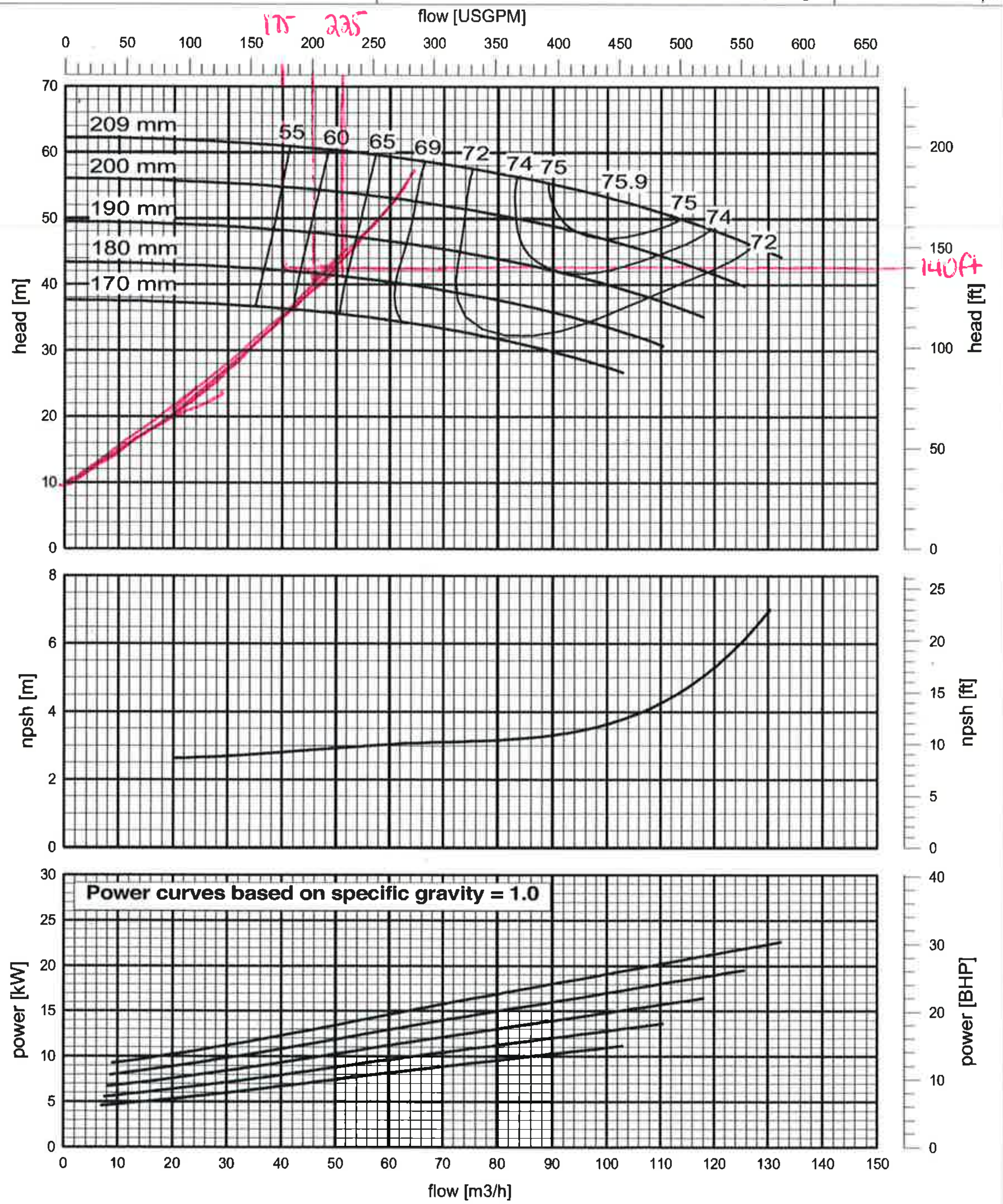
Final system would be 3 90° elbows,
2 gate valves, 1 check swing valve, 3" nominal
steel piping in total length of 7.9m, and
a pump in class 3x4x8B
(verify with customer if flow rate ≥198 gpm
is acceptable). H_A after pump selection ≈ 41 m
Q after pump selection = 200 gpm



3 x 4 x 8B -1 OHH

SULZER
Series 2.00 / 50Hz E014

Curve No	OHH 68-1-2-01	NSS	183 (9448)	Speed
Efficiency Basis	API Std. clearances	nq	25 (1287)	2910
Max Solid	11 mm (.43 in)	Rotation	CCW viewed from coupling	rpm



Rated Conditions		
Project	Item	
H =	Q =	P =
Calculated Efficiency =		$NPSH_{3\%}$ =

Issued: MSC / 12.21.2001

SULZER

CURVES - TYPE OHH

Range of Performances - 50 Hertz / 1475 rpm

Series **2.00**	Page
CURVES	50hz
12 February 2002	**E0G**