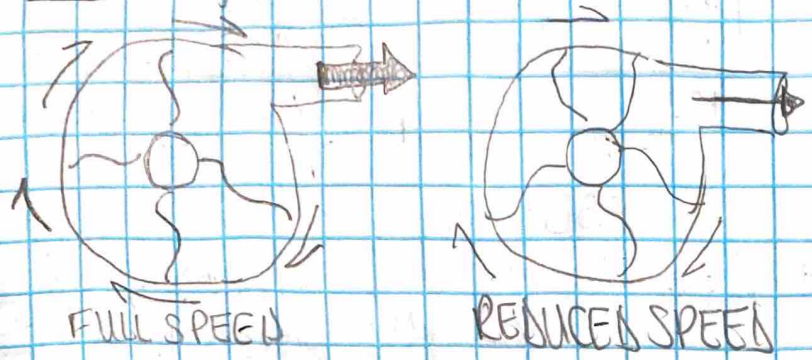
Amber Samm
MET330
Homework #8

13-17 Purpose: Determine change in total head capability.

Drawing(s):




Data
speed of rotation: 1/2 (50%)

$$\frac{H_2}{H_1} = \left(\frac{N_2}{N_1}\right)^2$$

Procedure

$$N_2 = \frac{1}{2}N_1 \rightarrow \frac{N_2}{N_1} = \frac{1}{2}$$

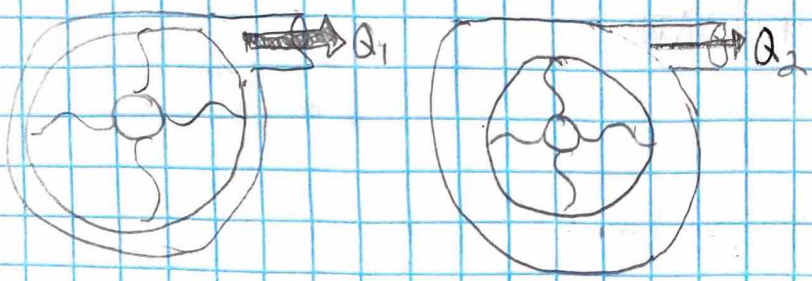
Substitute into affinity law:

$$\frac{H_2}{H_1} = \left(\frac{1}{2}\right)^2 = \boxed{\frac{1}{4}}$$

The total head capacity would be 1/4 of the original capacity.

13-19 Purpose: Determine the change in capacity

Drawing




Data
diameter of impeller: ↓ 25%

$$\frac{Q_2}{Q_1} = \frac{D_2}{D_1}$$

Procedure

$$D_2 = 0.75D_1 \rightarrow \frac{D_2}{D_1} = 0.75$$

Substitute into affinity law:

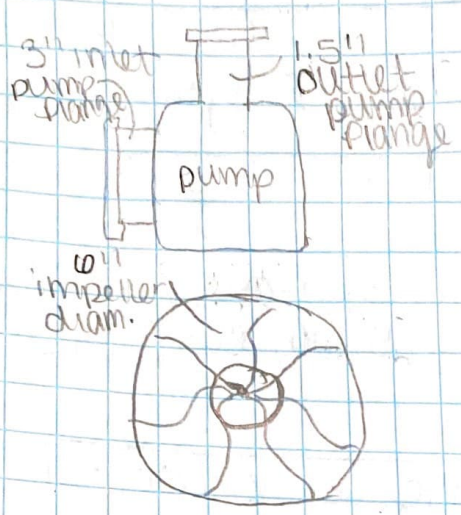
$$\frac{Q_2}{Q_1} = 0.75$$

$$Q_2 = 0.75Q_1$$

Because diameter and flow rate are directly proportional, the 25% decrease in diameter translates to a 25% decrease in flow rate (capacity)

13-22 Purpose: Describe each part of this centrifugal pump designation

Drawing




Data

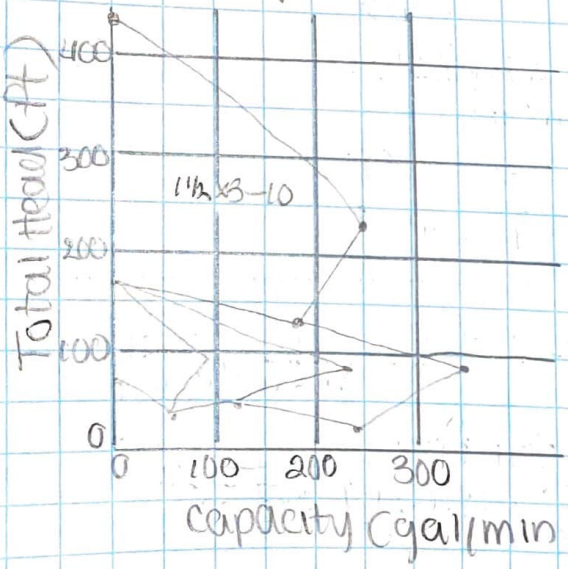
Centrifugal pump:
1 1/2 x 3 - 6

Solution:

1 1/2" corresponds to the nom diameter of the outlet pump flange. The 3" corresponds to the nominal diameter in the inlet pump flange. 6" in the largest impeller diameter the volume could house.

13-23 Purpose: Specify a suitable size for delivering 100 gal/min of water at a total head of 300 ft.

Drawing: Fig 13.22



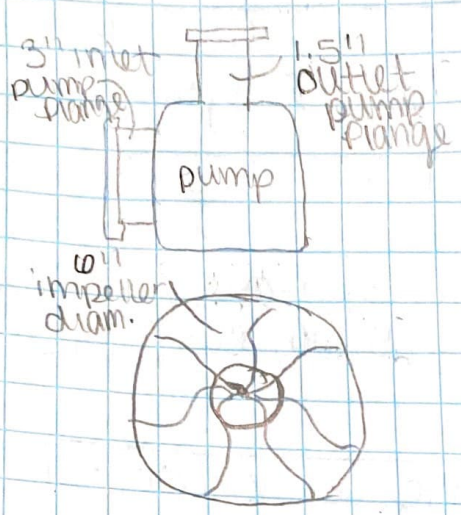

Data:
Q = 100 gal/min
H = 300 ft
Reference Fig 13.22

Solution:

According to Fig 13.22
1 1/2 x 3 - 10 would be a suitable size for the conditions given.

13-22 Purpose: Describe each part of this centrifugal pump designation

Drawing

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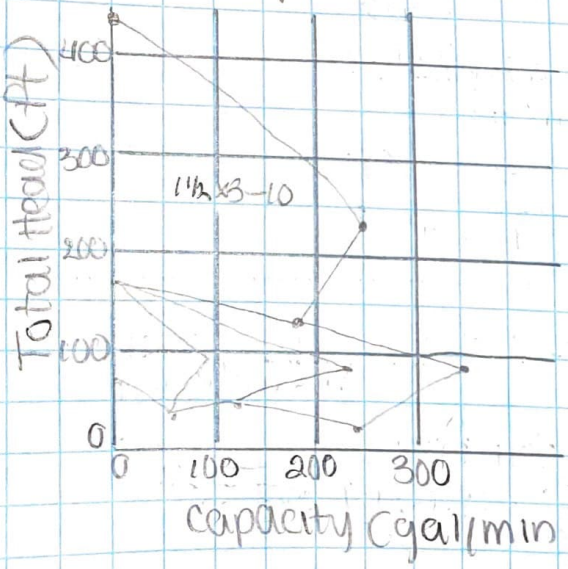
13-23 Purpose: Specify a suitable size for delivering 100 gal/min of water at a total head of 300 ft.

Drawing: Fig 13.22




Data:
Q = 100 gal/min
H = 300 ft
Reference Fig 13.22

Solution:

According to Fig 13.22
1 1/2 x 3 - 10 would be a suitable size for the conditions given.

13-2 (cont.)

Procedure/Calculation (cont.):

③ Compute head using Bernoulli's: $L_{pipe\ total} = 8.05m$

$$H_a = H_L + \Delta z + \frac{V_2^2}{2g}$$

$$h_{HF} = f_T\left(\sum \frac{L_{eq}}{D}\right)\times\frac{V^2}{2g}$$

$\frac{V_2^2}{2g} = \frac{(2.62m/s)^2}{2\times 9.81 m/s^2} = 0.35m$

$\Delta z = 3.45m$

$= 0.018 \times 156 \times 0.35$ = 156 ← 2 gate valves

$= \underline{0.98m}$ 50 ← 1 check valve

90 ← 3 elbows

Total 156 1 entrance flow

$\frac{D}{\varepsilon} = \frac{0.0731m}{5.16\times10^{-5}m} = 1093.5$

$f = 0.018$ (Moody)

Total $H_{minor} = 0.98 + 0.18 = 1.16m$ $h_{ent} = 0.5 \times 0.35m = 0.18m$

$h_{major} = 0.018 \times \left(\frac{8.05m}{0.0779m}\right) \times 0.35m = \underline{0.67m}$

$H_L = 0.67 + 1.16 = 1.83m$

$H_a = H_L + \Delta z + \frac{V_2^2}{2g}$

$= 1.83m + 3.45m + 0.35m$

$= \underline{5.63m}$

$\frac{425 kPa}{9.58 kN/m^3} =$

$H_T = 50.23m$

④ Select pump(s) from pump map: 2×3-7.5A 44.60m

2×3-6.75 RPM 3520 (pg 369)

operating point: $45 m^3/h$, $h = 50.23m$

⑤ Apply Affinity Equations

$\frac{h_1}{h_2} = \left(\frac{D_1}{D_2}\right)^2 = \left(\frac{D_1}{171.2mm}\right)^2 = \frac{50.23m}{48.77m}$

$= \sqrt{1.03} = 1.02$

$171.5 \times 1.02 = 174.93m \div 25.4$

$= 6.88$ inches ideal

*Impeller choice 6.75in to leave space if client needs a larger impeller for higher flow in the future.

Summary: My system consists of 8.05m of 3in schedule 40 steel piping. It contains 3 elbows, 2 gate valves, 1 check valve, and an entrance valve. It has a 2×3-6.75 sulzer pump which will operate slightly below the desired flow rate of 198gal/min but still within reason. The impeller would need to be roughly 6.88 in diameter in order to hit the exact flow rate.