# AGENDA
# HYDRONIC INFORMATION SESSION

October 10, 1993

1. Basics:
   - What is a BTU?
   - What is a ton of Refrigeration
   - Q = GPM x temp diff x 500
   - What is a foot of water in pressure

2. Pumps
   - How pumps operate
   - What determines a pump size
   - Pump curve and and pump speed

3. System water flow.
   - Friction loss
   - Control valves and effect on system
   - Direct return vs Reverse return
   - System pressure vs Flow

4. Expansion tanks, uses and location.

5. System air removal.

6 Make up water and system pressure.

7. Keeping the system clean. Proper chemical treatment.

8. Hot water converters. Use vacuum breakers. Size for 1 psi steam.

9. Gages, thermometers and valves.

# TYPICAL EQUATIONS AND NUMBERS USED IN WATER SYSTEMS

1. Heat output: Q = GPM x water temp diff x 500

2. Ton of Refrigeration is the eqivalent of melting one ton of ice from 32 deg ice to 32 deg water in a 24 hour time period.

   2,000 lb x 144 BTU/lb = 288,000 BTU/24 hours
   288,000 / 24 hrs = 12,000 BTU/hour.

3. Calculated Pump Horse Power:

   HP = GPM x ft Head x .0002525 / eff.
   eff varies from 60% to 85% above 5 hp pumps.

4. Calculated Fan Horse Power:

   HP = CFM x static press ("H2O") x .000157 / eff.
   eff varies from 55% to 75% above 5 hp fans.

5. Typical flow rates:

| | |
|---|---|
| Chilled water | 2.4 gpm/ton (10 deg rise) |
| Heating water | 1.0 gpm/10,000 btu (20 deg drop) |
| Cooling tower | 3.0 gpm/ton (10 deg drop) |

6. 1 PSI = 2.31 feet water head

   1 BTU = heat to raise 1# water 1 deg F.

7. Hospitals usually require approximately 1 ton of chiller capacity for every 275 square feet of building.

8. 1 therm = 100,000 btu
   1 therm = 100 cu ft natural gas. = 1 ccf
   1 # steam = 1000 btu
   1 boiler HP = 33,600 btu/hr = 33.6 #/hr of steam

9. Air velocities thru coils:

   Chilled water Coils = 500 fpm (600 fpm is maximum)
   Heating coils = 650 fpm (750 fpm is maximum)

10. 1 HP = .75 KW/eff.
    1 KW elect = 3,415 btu/hr.

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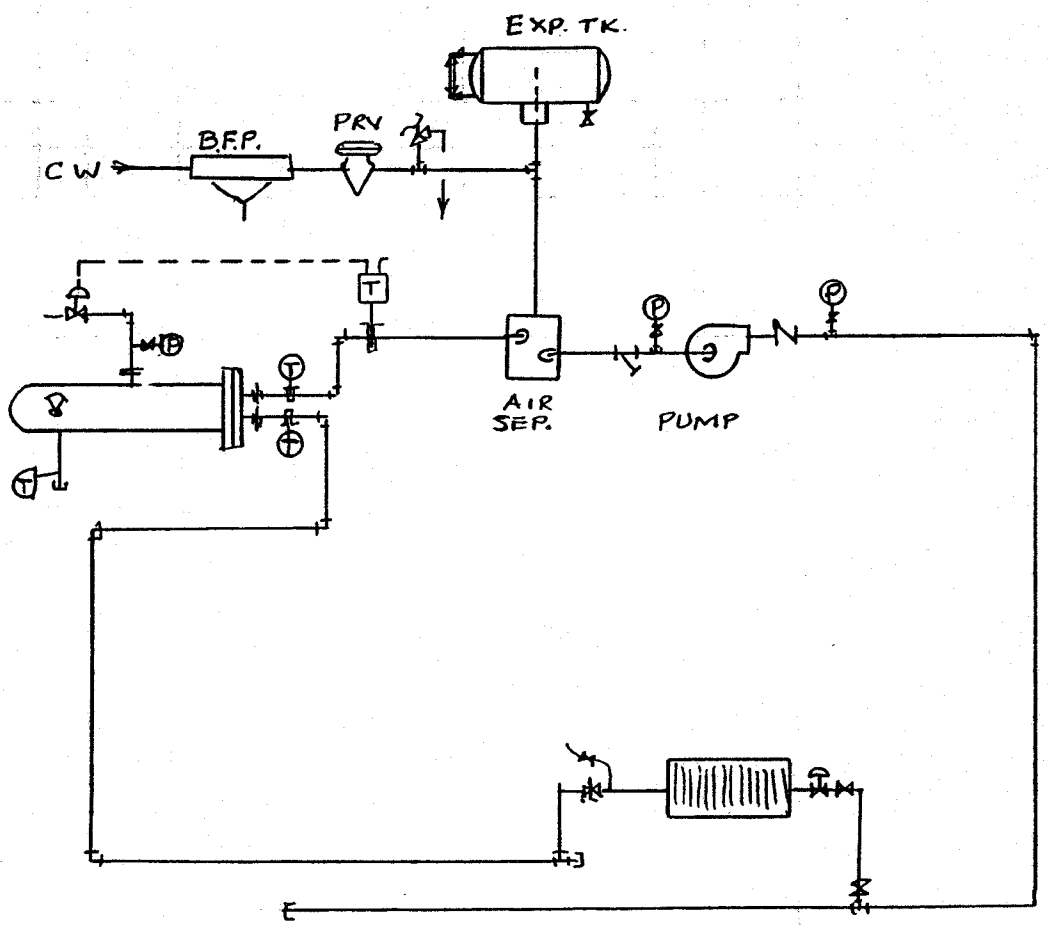
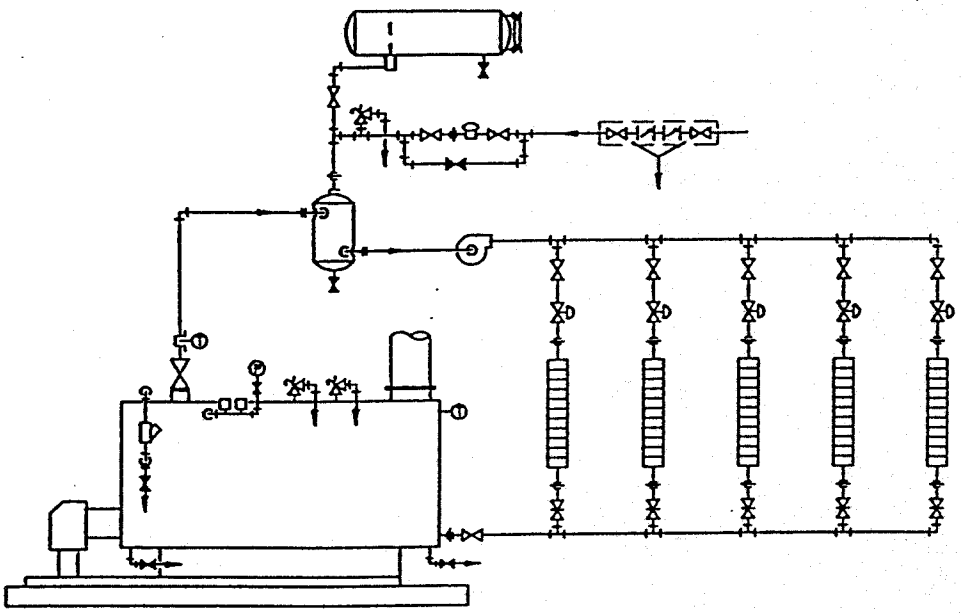
| PROJECT | DATE | BY | PROJECT NO. |
|---|---|---|---|
| BASIC HYDRONIC SYSTEM | 10-14-93 | SCW | |

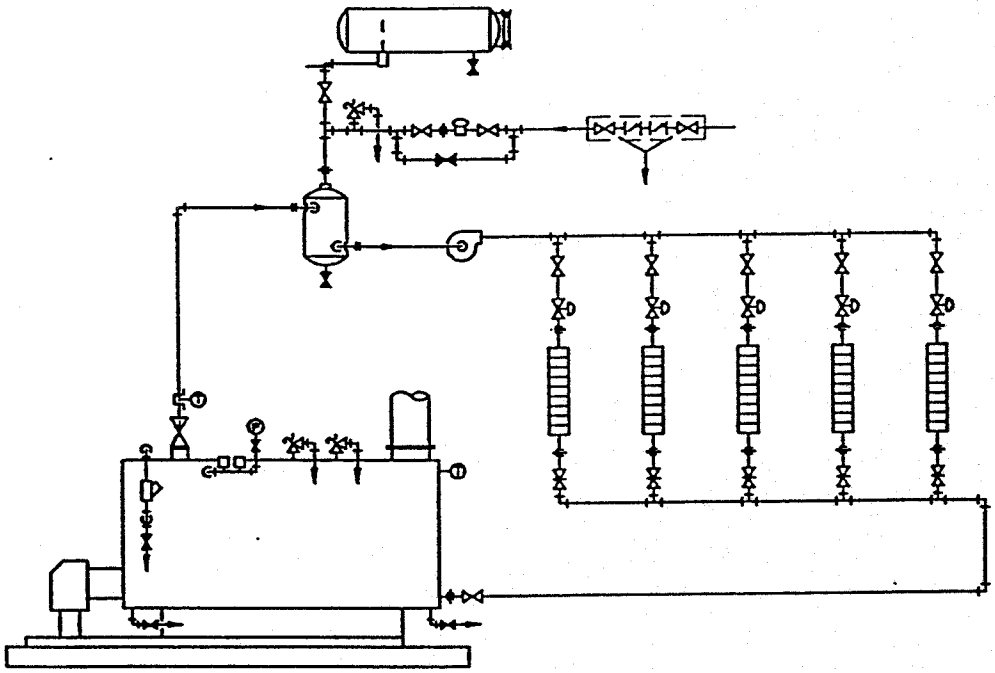



BASIC HYDRONIC SYSTEM



DIRECT RETURN

DIAGRAM 'A'



REVERSE RETURN

DIAGRAM 'B'

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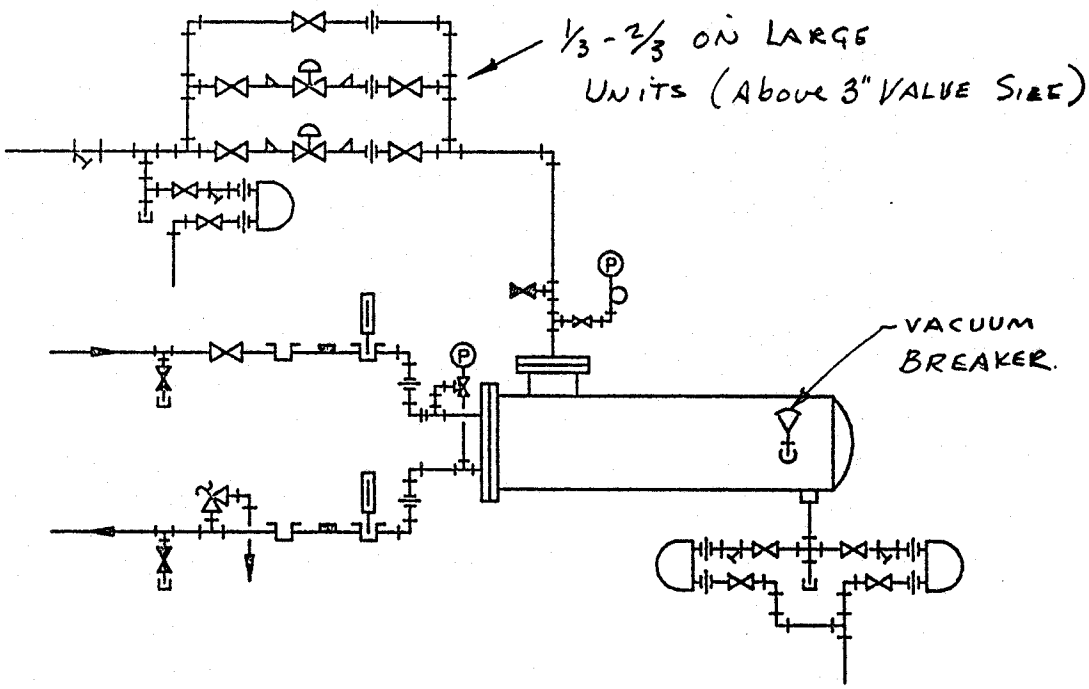
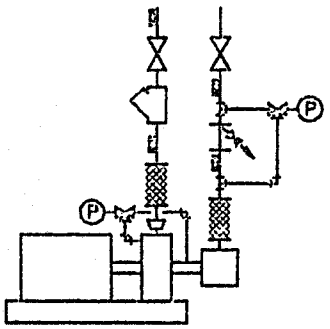
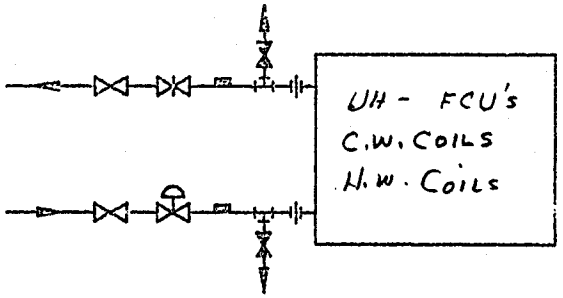
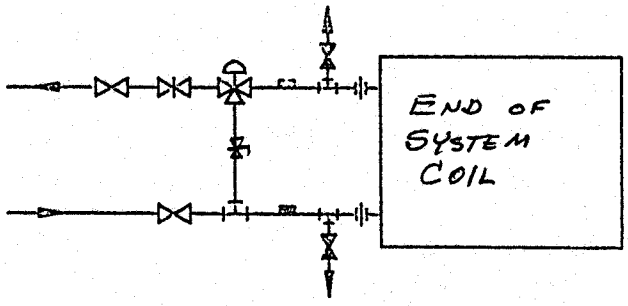
# DIAGRAM 'A' AND 'B'

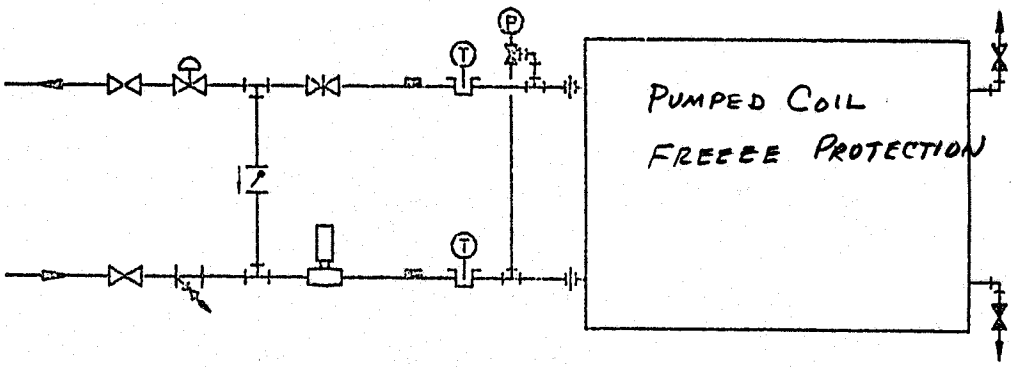
M-1


1/3 - 2/3 ON LARGE
UNITS (ABOVE 3" VALVE SIZE)
VACUUM
BREAKER


P
P


UH - FCU's
C.W. COILS
H.W. COILS


END OF
SYSTEM
COIL


P
T
T
PUMPED COIL
FREEEE PROTECTION

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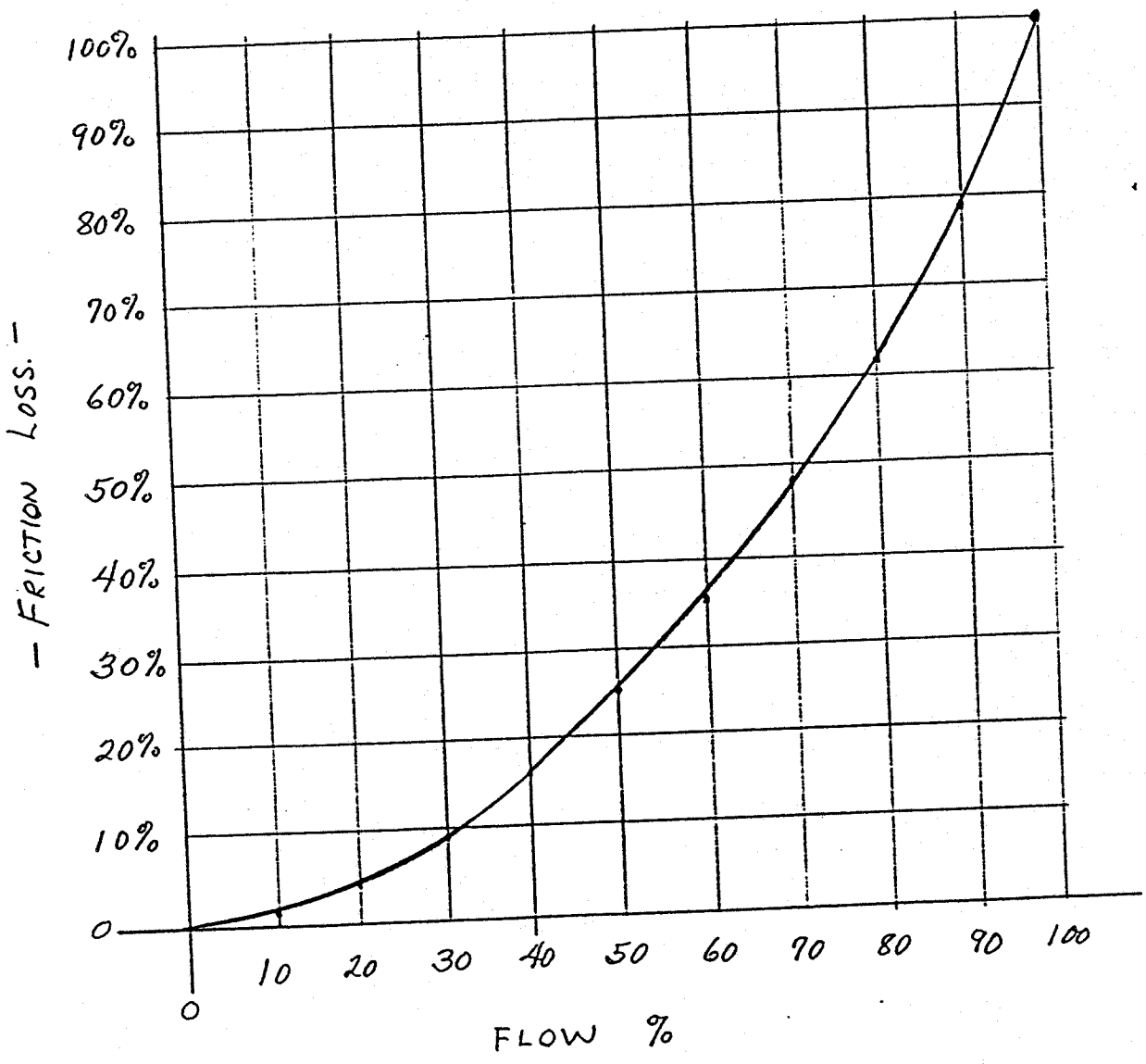
| PROJECT | DATE | BY | PROJECT NO. |
|---|---|---|---|
| TYPICAL SYSTEM FLOW | 7-16-91 | SCW | |

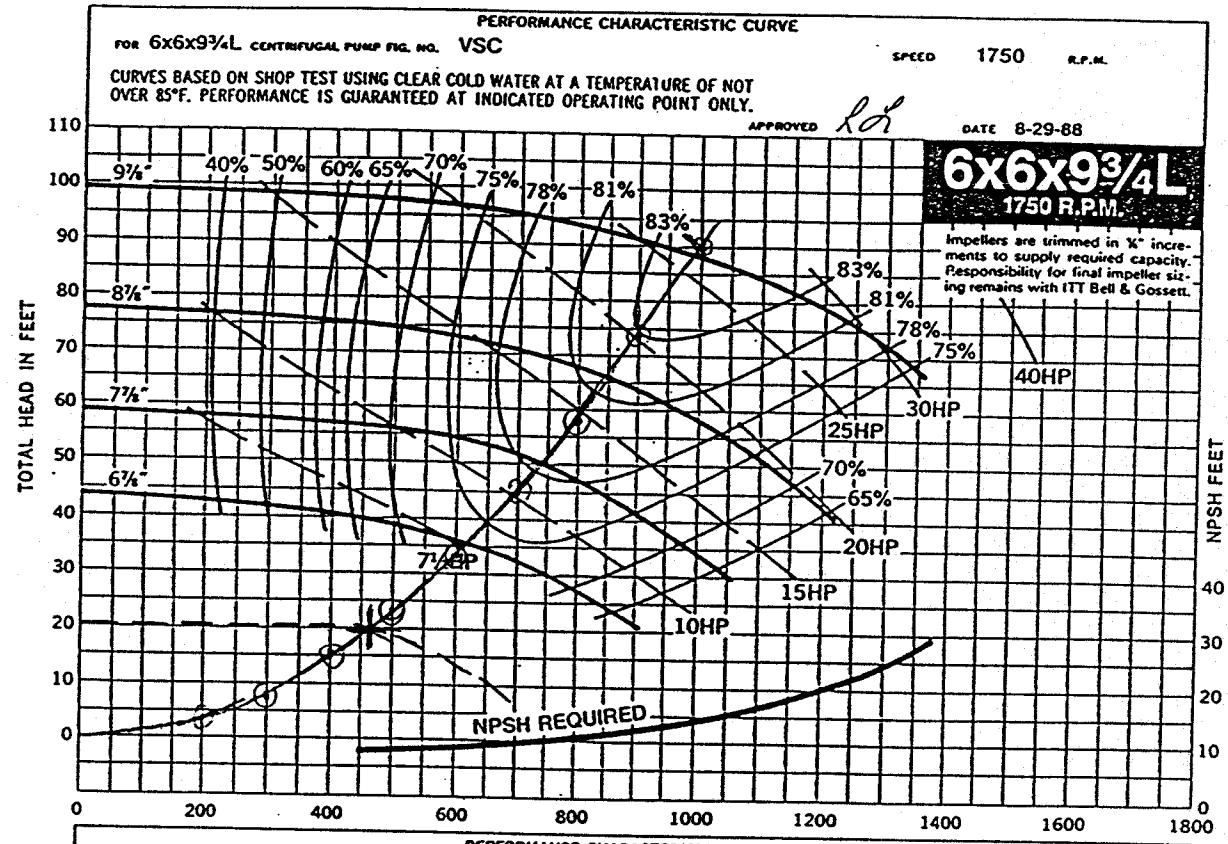
## FRICTION LOSS IN SYSTEMS

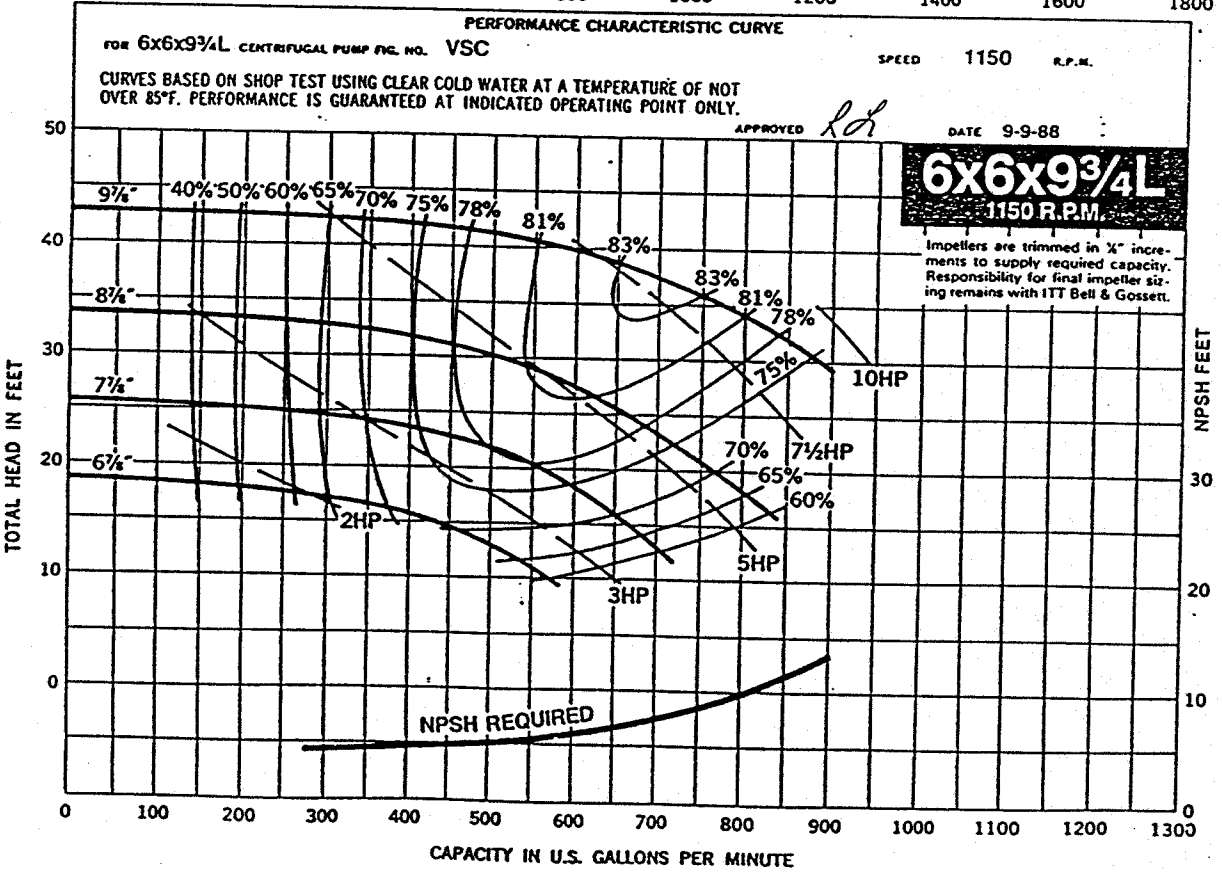



PRESSURE LOSS VS FLOW.

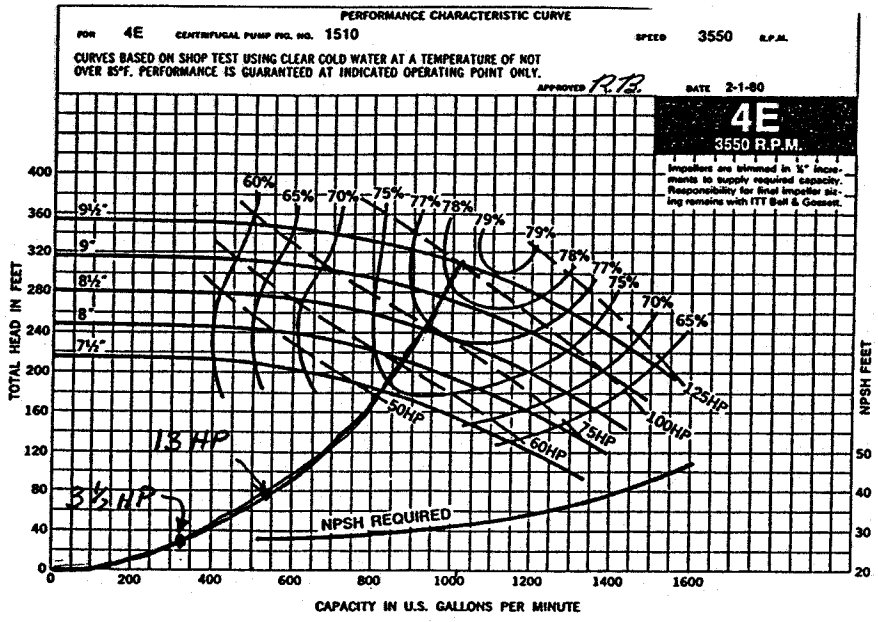
DIAGRAM C

# VSC CENTRIFUGAL PUMP PERFORMANCE CURVES

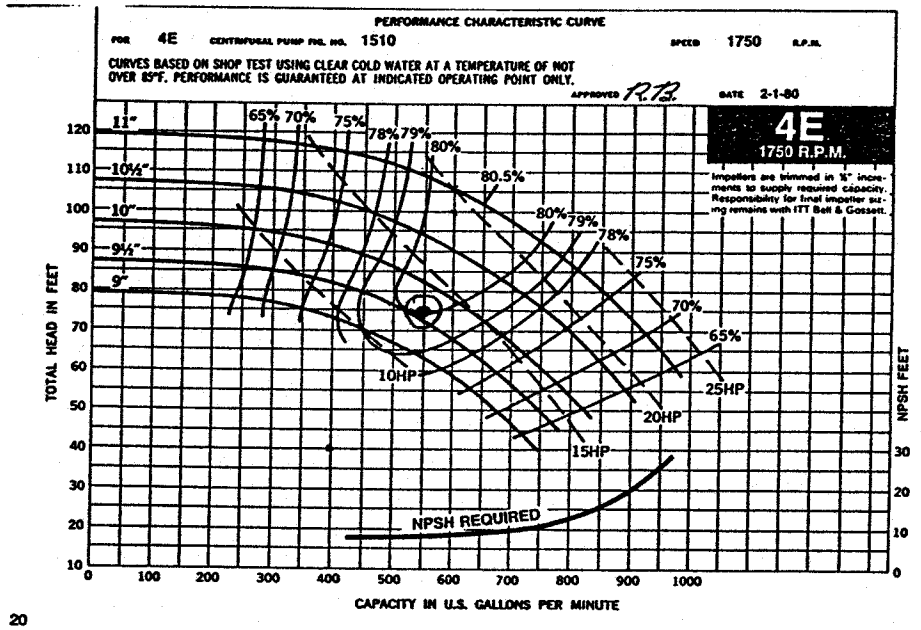


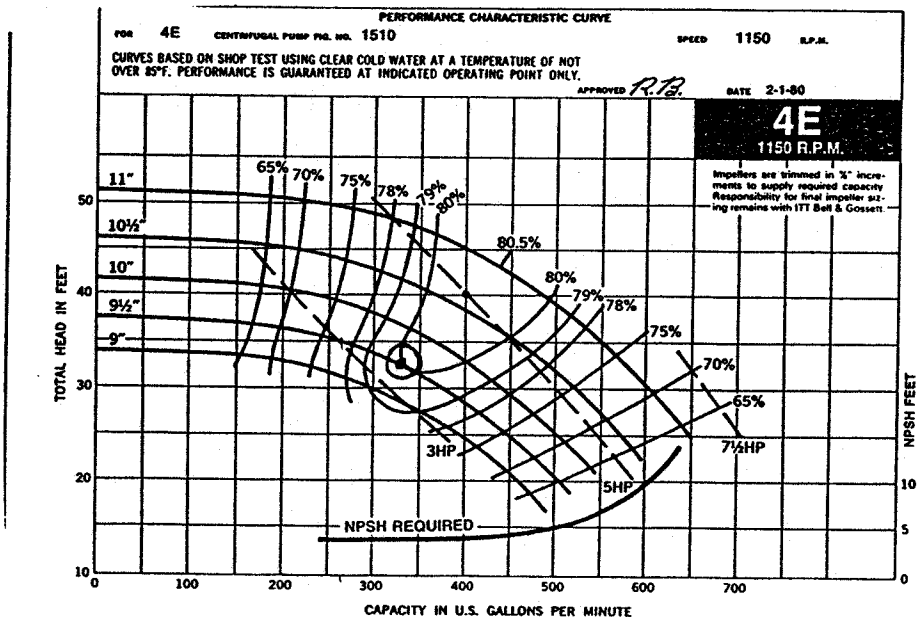

For further information, contact ITT Bell & Gossett, 8200 N. Austin Avenue, Morton Grove, IL 60053, Phone: (312) 966-3700 — Telex 4949943 — Facsimile (312) 966-9052.


PERFORMANCE CHARACTERISTIC CURVE
FOR 4E CENTRIFUGAL PUMP FIG. NO. 1510
SPEED 3550 R.P.M.
CURVES BASED ON SHOP TEST USING CLEAR COLD WATER AT A TEMPERATURE OF NOT OVER 85°F. PERFORMANCE IS GUARANTEED AT INDICATED OPERATING POINT ONLY.
APPROVED R.T.B. DATE 2-1-80
4E
3550 R.P.M.
Impellers are trimmed in ¼" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.
TOTAL HEAD IN FEET
NPSH FEET
CAPACITY IN U.S. GALLONS PER MINUTE
9½"
9"
8½"
8"
7½"
60%
65%
70%
75%
77%
78%
79%
79%
78%
77%
75%
70%
65%
125HP
100HP
75HP
60HP
50HP
13 HP
3½ HP
NPSH REQUIRED

11


PERFORMANCE CHARACTERISTIC CURVE
FOR 4E CENTRIFUGAL PUMP FIG. NO. 1510
SPEED 1750 R.P.M.
CURVES BASED ON SHOP TEST USING CLEAR COLD WATER AT A TEMPERATURE OF NOT OVER 85°F. PERFORMANCE IS GUARANTEED AT INDICATED OPERATING POINT ONLY.
APPROVED R.T.B. DATE 2-1-80
4E
1750 R.P.M.
Impellers are trimmed in ¼" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.
TOTAL HEAD IN FEET
NPSH FEET
CAPACITY IN U.S. GALLONS PER MINUTE
11"
10½"
10"
9½"
9"
65%
70%
75%
78%
79%
80%
80.5%
80%
79%
78%
75%
70%
65%
25HP
20HP
15HP
10HP
NPSH REQUIRED

20

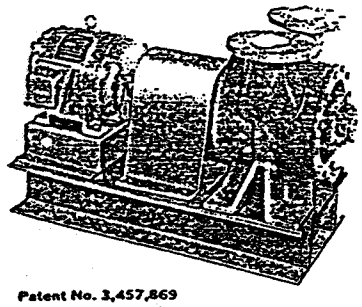

PERFORMANCE CHARACTERISTIC CURVE
FOR 4E CENTRIFUGAL PUMP FIG. NO. 1510
SPEED 1150 R.P.M.
CURVES BASED ON SHOP TEST USING CLEAR COLD WATER AT A TEMPERATURE OF NOT OVER 85°F. PERFORMANCE IS GUARANTEED AT INDICATED OPERATING POINT ONLY.
APPROVED R.T.B. DATE 2-1-80
4E
1150 R.P.M.
Impellers are trimmed in ¼" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.
TOTAL HEAD IN FEET
NPSH FEET
CAPACITY IN U.S. GALLONS PER MINUTE
11"
10½"
10"
9½"
9"
65%
70%
75%
78%
79%
80%
80.5%
80%
79%
78%
75%
70%
65%
7½HP
5HP
3HP
NPSH REQUIRED

33

# BELL & GOSSETT

**SUBMITTAL**

B-445.8



Patent No. 3,457,869

# 6 x 6 x 9¾L
# VSC® Centrifugal Pumps
## Base Mounted—Double Suction
## 6″ Discharge—6″ Suction

JOB

B & G REPRESENTATIVE _____

UNIT TAG NO. _____ ORDER NO. _____ DATE _____

ENGINEER _____ SUBMITTED BY _____ DATE _____

CONTRACTOR _____ APPROVED BY _____ DATE _____

### SPECIFICATIONS

_____ GPM _____ FT.

MATERIALS OF CONSTRUCTION:

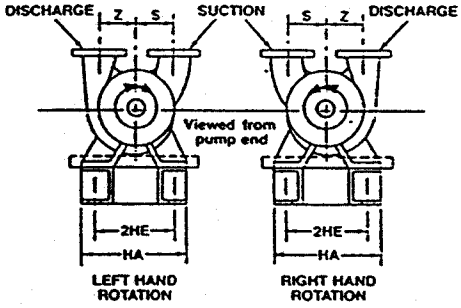
☐ BRONZE FITTED

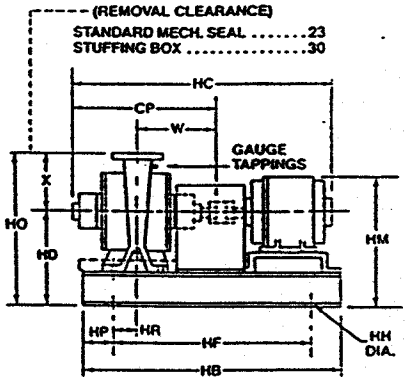
ELECTRICAL DATA: _____ HP

MOTOR ENCL. _____

SPEC. CONSTR. _____

_____ VOLTS _____ CY. _____ PH. APPROXIMATE WEIGHT _____ LBS.




TYPE OF SEAL

☐ VSC, Standard Seal (Crane Type 2, Carbon/Ceramic)

☐ VSC-F, Standard Seal with flush line

☐ VSC-S, Stuffing Box Construction with Flushed Single Mechanical Seal (Durametalic RO, Carbon/Tungsten Carbide)

☐ VSC-D, Stuffing Box Construction with Flushed Double Mechanical Seal (Durametalic CRO, Carbon/Ceramic) Requires external fresh water source

☐ VSC-PF, Stuffing Box Construction with Packing

WORKING PRESSURE

☐ Standard Seal 175 psi W.P. with 125# ANSI flange drilling

☐ Standard Seal, 300 psi W.P. with 250# ANSI flange drilling (Note: Suction Pressure must not exceed 160 psi)

☐ Flushed Single Seal 300# W.P. with 250# ANSI flange drilling

6" flange 12⅛" O.D. - 1⅞₁₆" thick.

RIGHT HAND ROTATION IS FURNISHED UNLESS OTHERWISE SPECIFIED.

**STANDARD SEAL VSC & VSC-F**

| PUMP SIZE | MOTOR FRAME | DIMENSIONS (INCHES) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CP | HA | HB | HC MAX. | HD | 2HE | HF | HH | HM MAX. | HO | HP | HR | S | W | X | Z |
| 6x6x9¾L | 213T | 22¾ | 26 | 53¼ | 46⅝ | 15½ | 23½ | 41⅞ | 1 | 21⅜ | 27 | 6 | 3 | 8 | 13½ | 11½ | 8 |
| | 215T | | | | 48⅛ | | | | | | | | | | | | |
| | 254T | | | | 51¼ | | | | | 22⅜ | | | | | | | |
| | 256T | | | | 53⅜ | | | | | | | | | | | | |
| | 284T | | | | 54⅜ | | | | | 23½ | | | | | | | |
| | 286T | | | | 55⅞ | | | | | | | | | | | | |
| | 324T | | | | 58 | | | | | 24⅝ | | | | | | | |

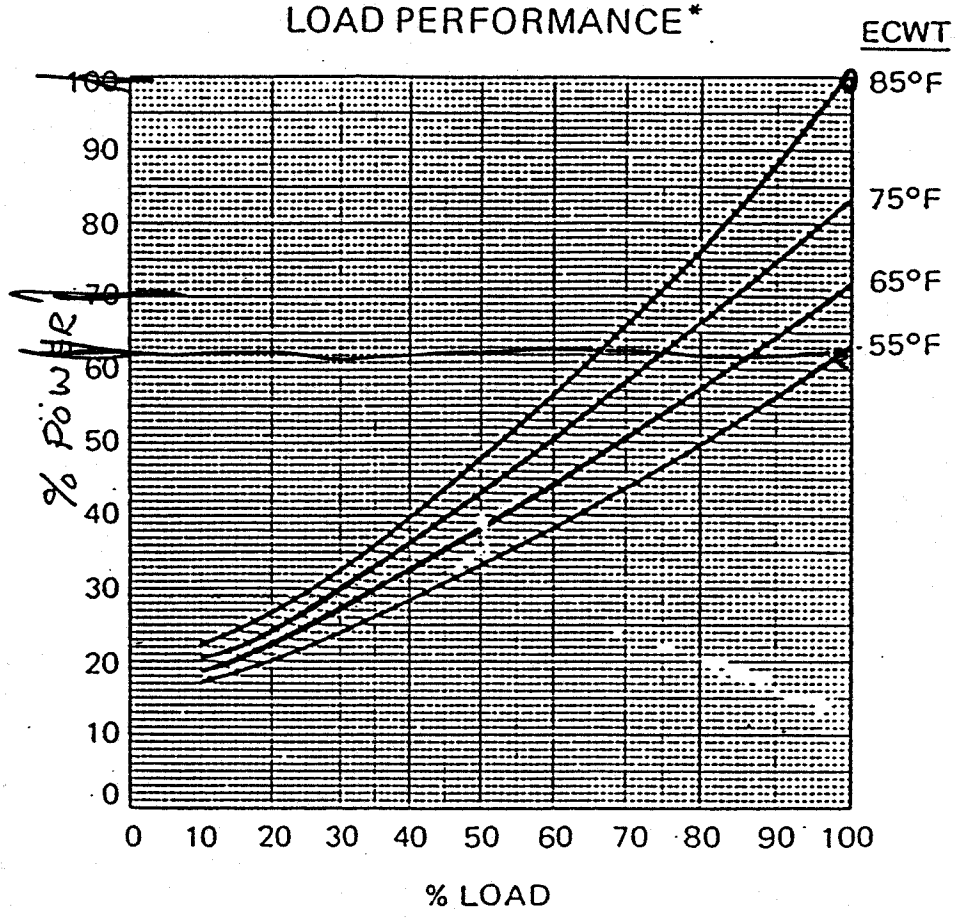
**STUFFING BOX VSC-PF, VSC-S & VSC-D**

| PUMP SIZE | MOTOR FRAME | DIMENSIONS (INCHES) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CP | HA | HB | HC MAX. | HD | 2HE | HF | HH | HM MAX. | HO | HP | HR | S | W | X | Z |
| 6x6x9¾L | 213T | 30⅛ | 26 | 53¼ | 54¼ | 15½ | 23½ | 41⅞ | 1 | 21⅜ | 27 | 6 | 3 | 8 | 17⁹⁄₁₆ | 11½ | 8 |
| | 215T | | | | 55¾ | | | | | | | | | | | | |
| | 254T | | | | 59½ | | | | | 22⅜ | | | | | | | |
| | 256T | | | | 61¼ | | | | | | | | | | | | |
| | 284T | | | 59¼ | 62 | | | 47¼ | | 23½ | | | | | | | |
| | 286T | | | | 63½ | | | | | | | | | | | | |
| | 324T | | | | 65⅝ | | | | | 24⅝ | | | | | | | |

Not to be used for construction purposes unless certified.



ITT Bell & Gossett
ITT Fluid Technology Corporation




*Based on 2.4 GPM/Ton of 44°F leaving chilled water temperature; 3 GPM/Ton of condenser water; 0.0005 FF on both circuits.;

1. A typical 600 ton centrifugal chiller uses approx 0.70 KW per ton of refrigeration at design conditions. (85 deg condenser water).

2. 600 tons x 0.7 = 420 KW. or @ $.06/KWH = $25.20/hour. 1000 hours costs $25,200.

3. Using 75 deg tower water lowers KW/ton to 83% for a savings of 17% or $4,248/1000 hours.

4. Using 65 deg tower water will save 28% or $7,056/1000 hrs.

5. Demand savings will be approx $14.40 per KW.

6. Look at partial loading, and remember the tower and pumps involved which are not a part of the above KW/ton figures.

DIAGRAM E