xylem
Let's Solve Water

ITP 329

Pump Service & Maintenance

2017

Troubleshooting with Pump Curves and Pressure Gauges

Problem 1

The system is in operation, but you don't know the flow. From the nameplate you determine the pump is a Series 1510 1-1/4"BC with a 8" diameter impeller operating at 1150 RPM (6 pole motor).

Using a pressure gauge you get the following information:

Suction Pressure	=	12.0 psi
Discharge pressure	=	22.5 psi

Determine the flow.

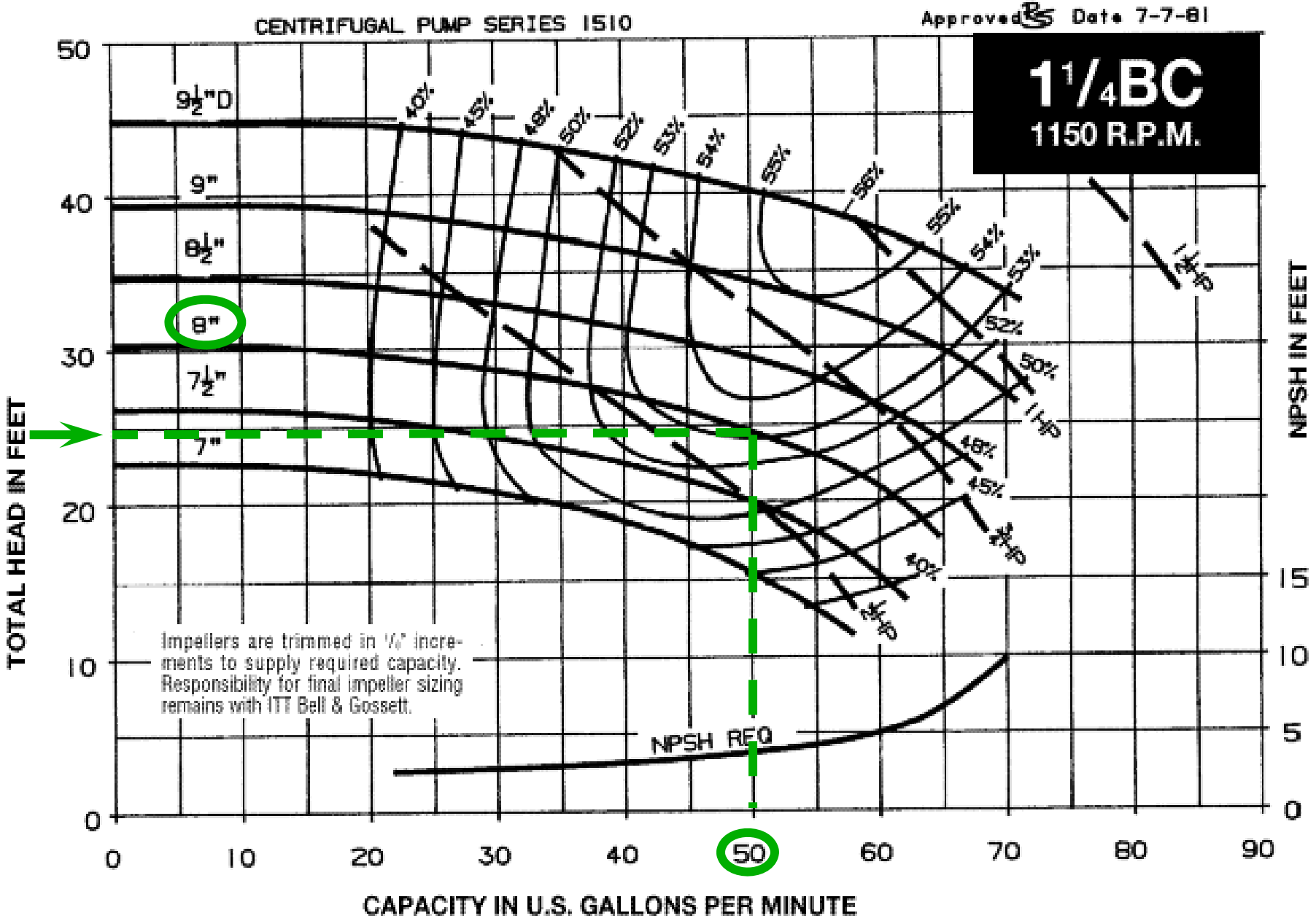
Problem 1

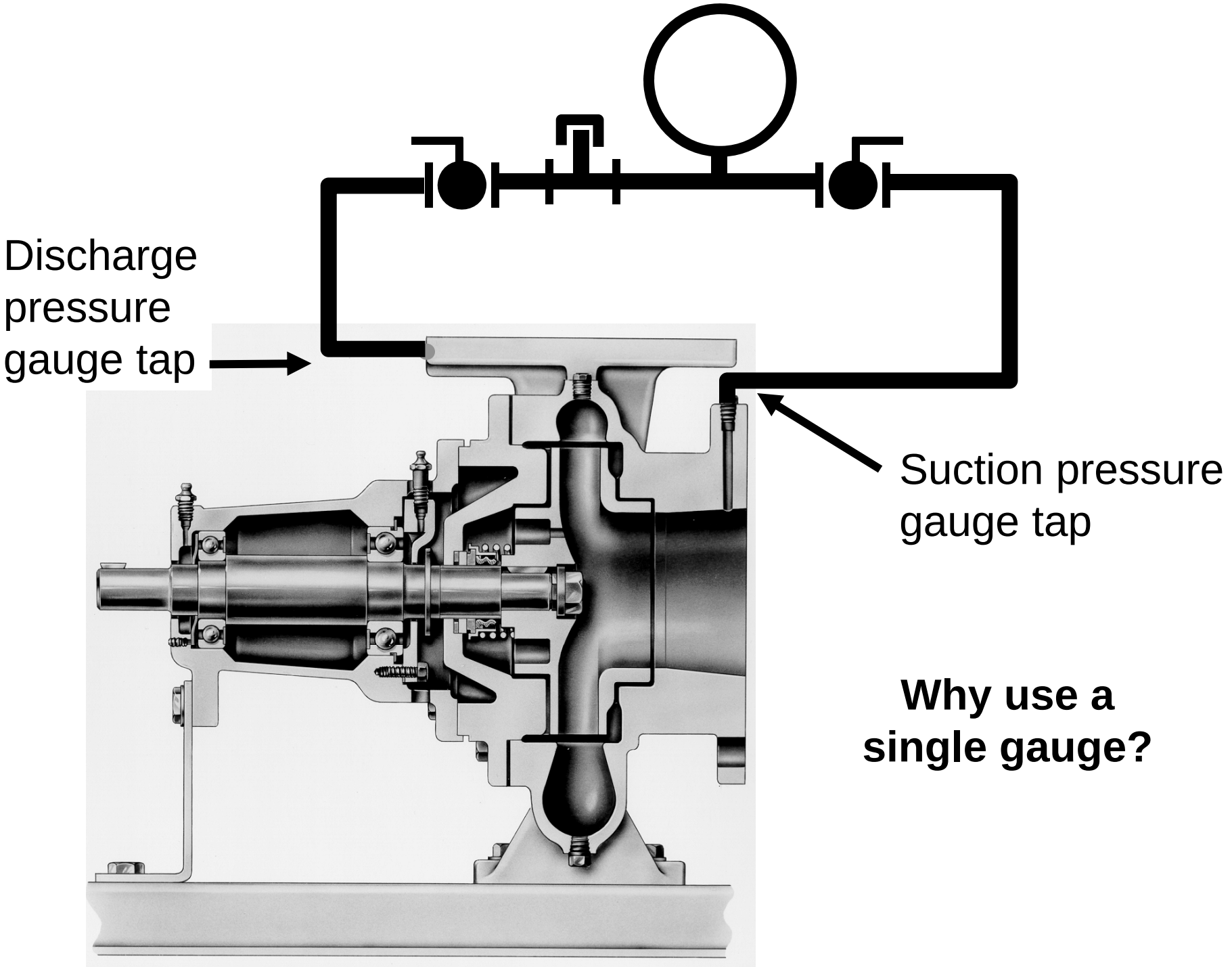
Answer:

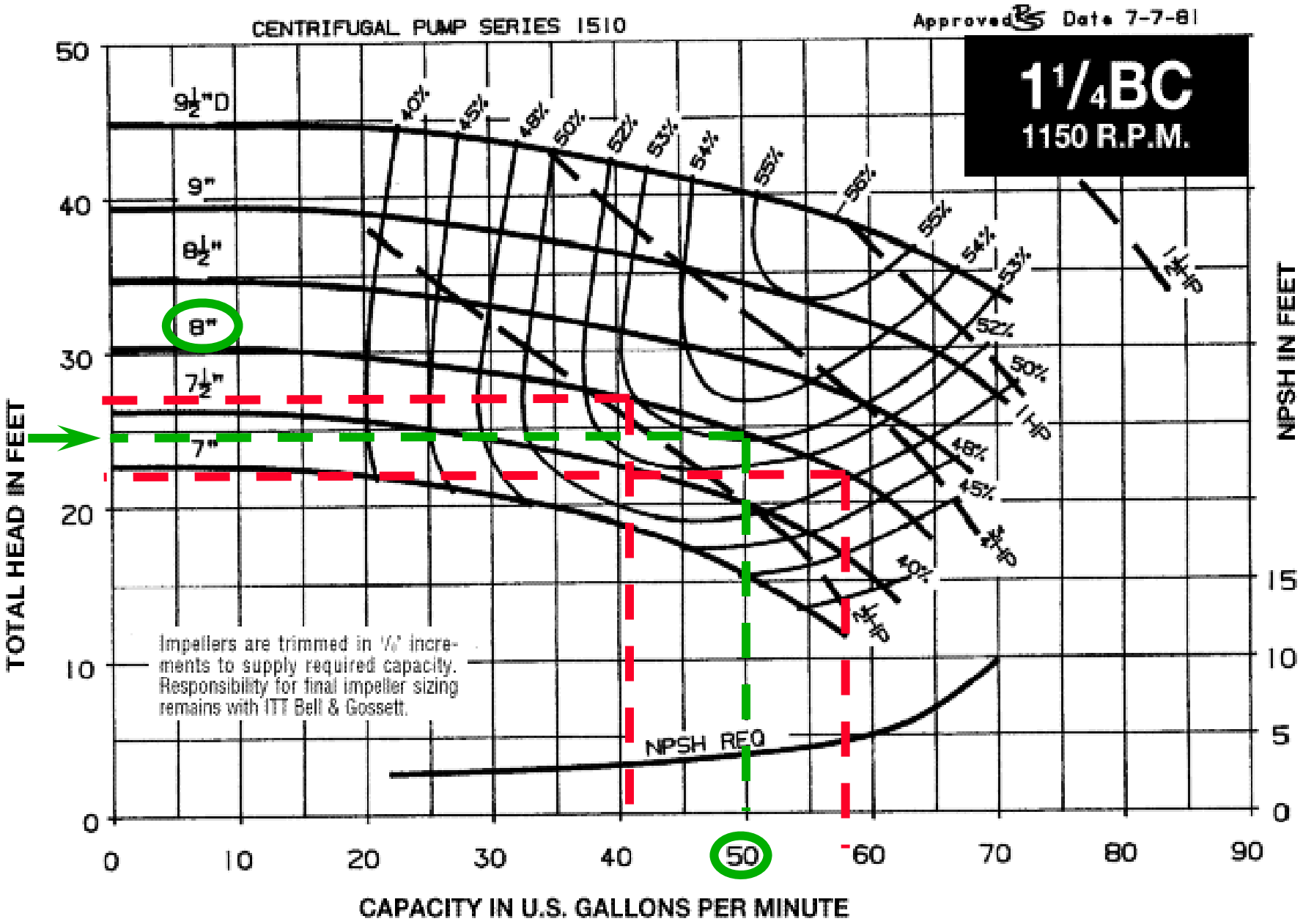
Differential Gauge Reading: 22.5psi - 12psi = 10.5psi

Convert to ft.: 10.5psi x 2.31ft/psi = 24.3ft

Flow?


CENTRIFUGAL PUMP SERIES 1510
Approved Date 7-7-81
1¼BC
1150 R.P.M.
TOTAL HEAD IN FEET
NPSH IN FEET
CAPACITY IN U.S. GALLONS PER MINUTE
9½"D
9"
8½"
8"
7½"
7"
40%
45%
48%
50%
52%
53%
54%
55%
56%
NPSH REQ
Impellers are trimmed in ⅛" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.


Discharge pressure gauge tap
Suction pressure gauge tap
Why use a single gauge?


CENTRIFUGAL PUMP SERIES 1510
Approved BS Date 7-7-81
1¼BC
1150 R.P.M.
9½"D
9"
8½"
8"
7½"
7"
40%
45%
48%
50%
52%
53%
54%
55%
56%
1 HP
¾ HP
½ HP
NPSH REQ
Impellers are trimmed in ½" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.
TOTAL HEAD IN FEET
NPSH IN FEET
CAPACITY IN U.S. GALLONS PER MINUTE
0
10
20
30
40
50
60
70
80
90
5
15

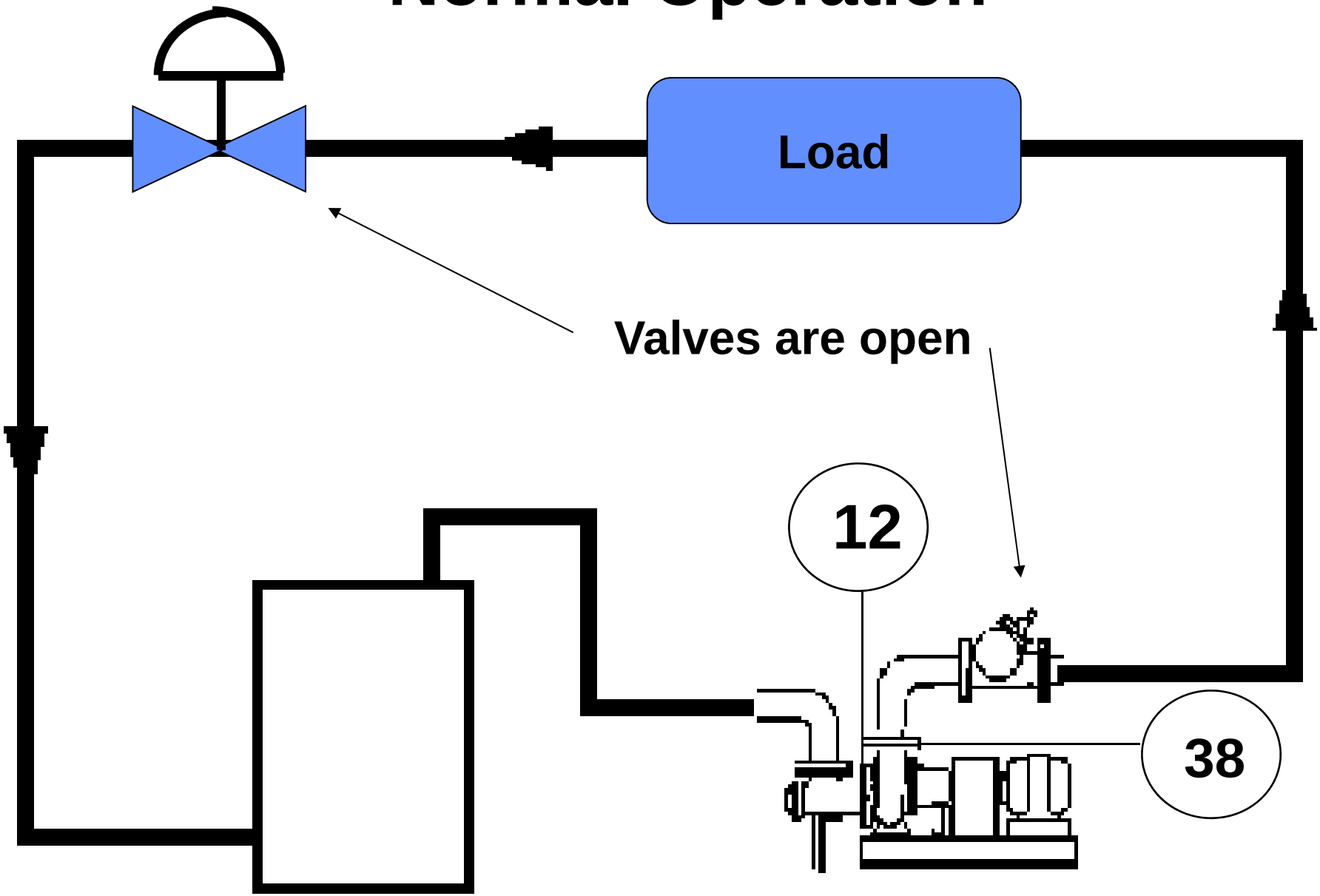
Problem 2

Using a pressure gauge you measure the pressure drop across the pump of your chilled water system. You get the following information:

Suction pressure	=	12psi
Discharge pressure	=	38psi

You look at the nameplate on the pump. All you can read is it's a Series 1510 Model 4BC and the motor operates at 1750 RPM.
What's the flow?

Normal Operation



Problem 2

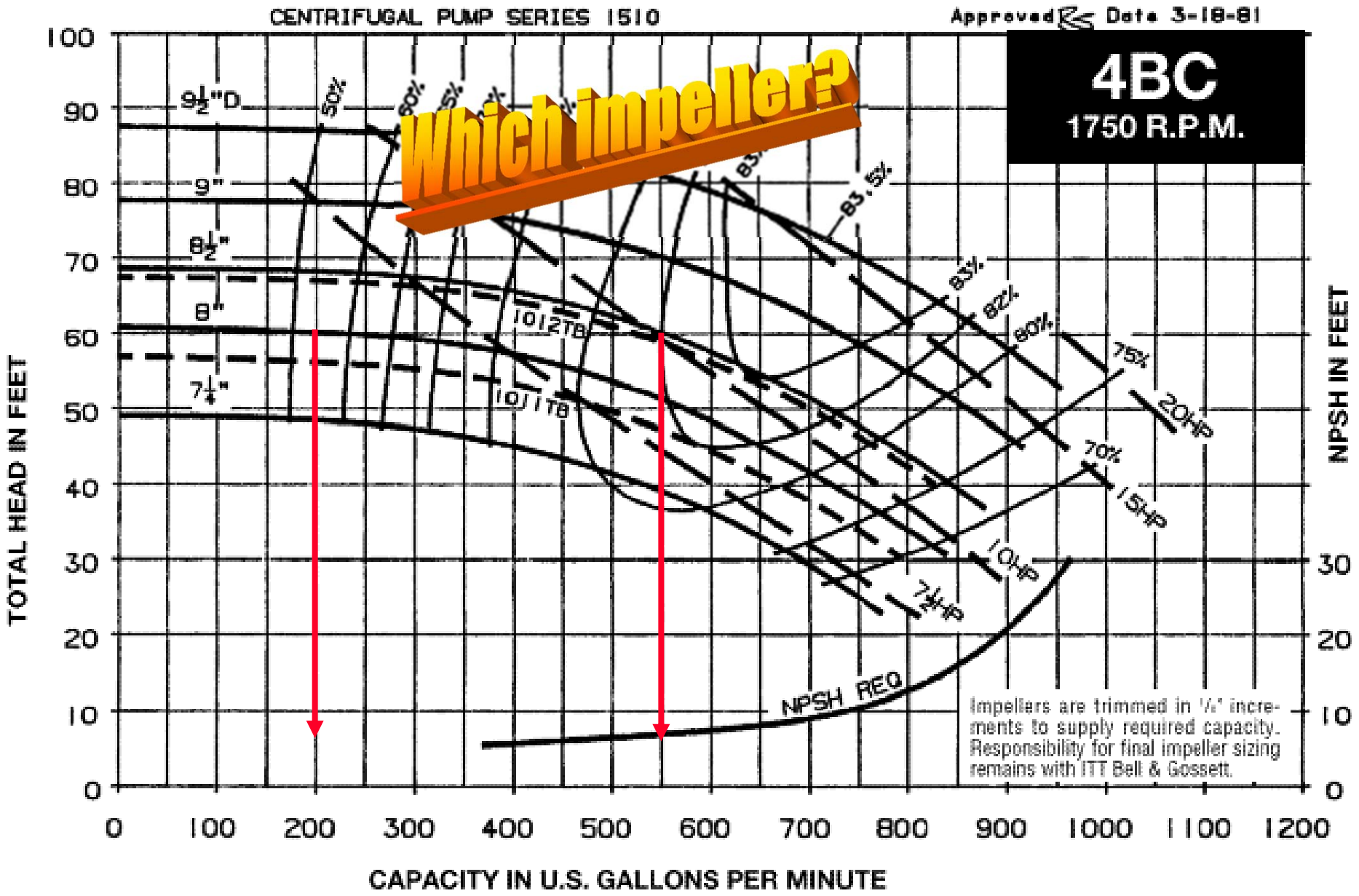
Pressure differential across pump during normal operation:

Answer:

Differential Gauge Reading:

38psi - 12psi = 26psi

Convert to ft.: 26psi x 2.31ft/psi = 60ft

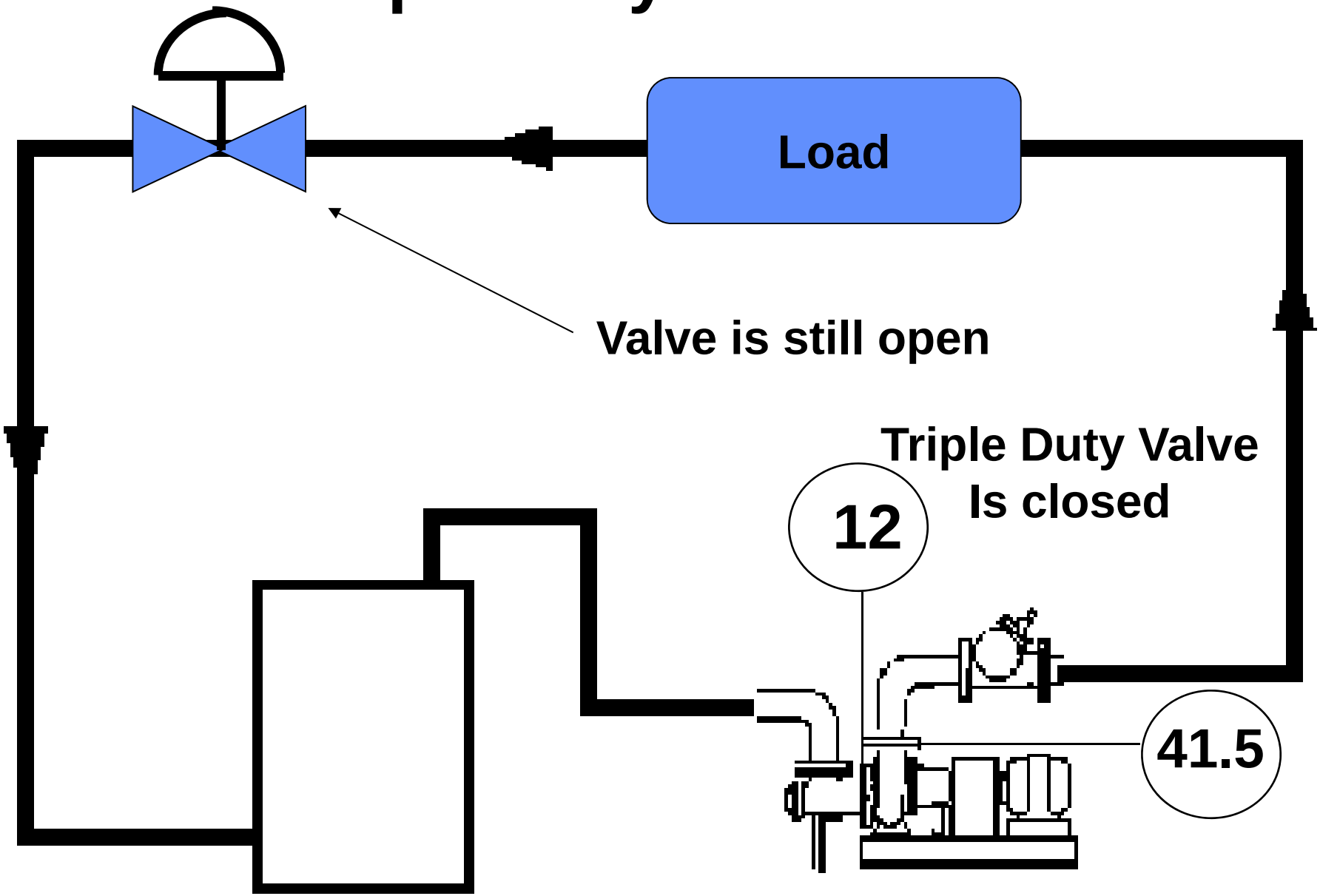

CENTRIFUGAL PUMP SERIES 1510
Approved
Date 3-18-81
4BC
1750 R.P.M.
Which impeller?
9½"D
9"
8½"
8"
7¼"
10J2TB
10J1TB
50%
60%
65%
70%
75%
80%
82%
83%
83.5%
85%
20HP
15HP
10HP
7½HP
NPSH REQ
Impellers are trimmed in ⅛" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.
TOTAL HEAD IN FEET
NPSH IN FEET
CAPACITY IN U.S. GALLONS PER MINUTE
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

Problem 2

You don’t know the impeller size. But you know that if you close the Triple Duty Valve you can get the shutoff head, which will then lead you to the impeller size. The pressure rise across the pump with the 3D valve closed reads:

Suction Pressure	=	12.0 psi
Discharge pressure	=	41.5 psi

Triple Duty Valve Closed



Problem 2

Pressure differential across pump with the 3D valve closed:

Answer:

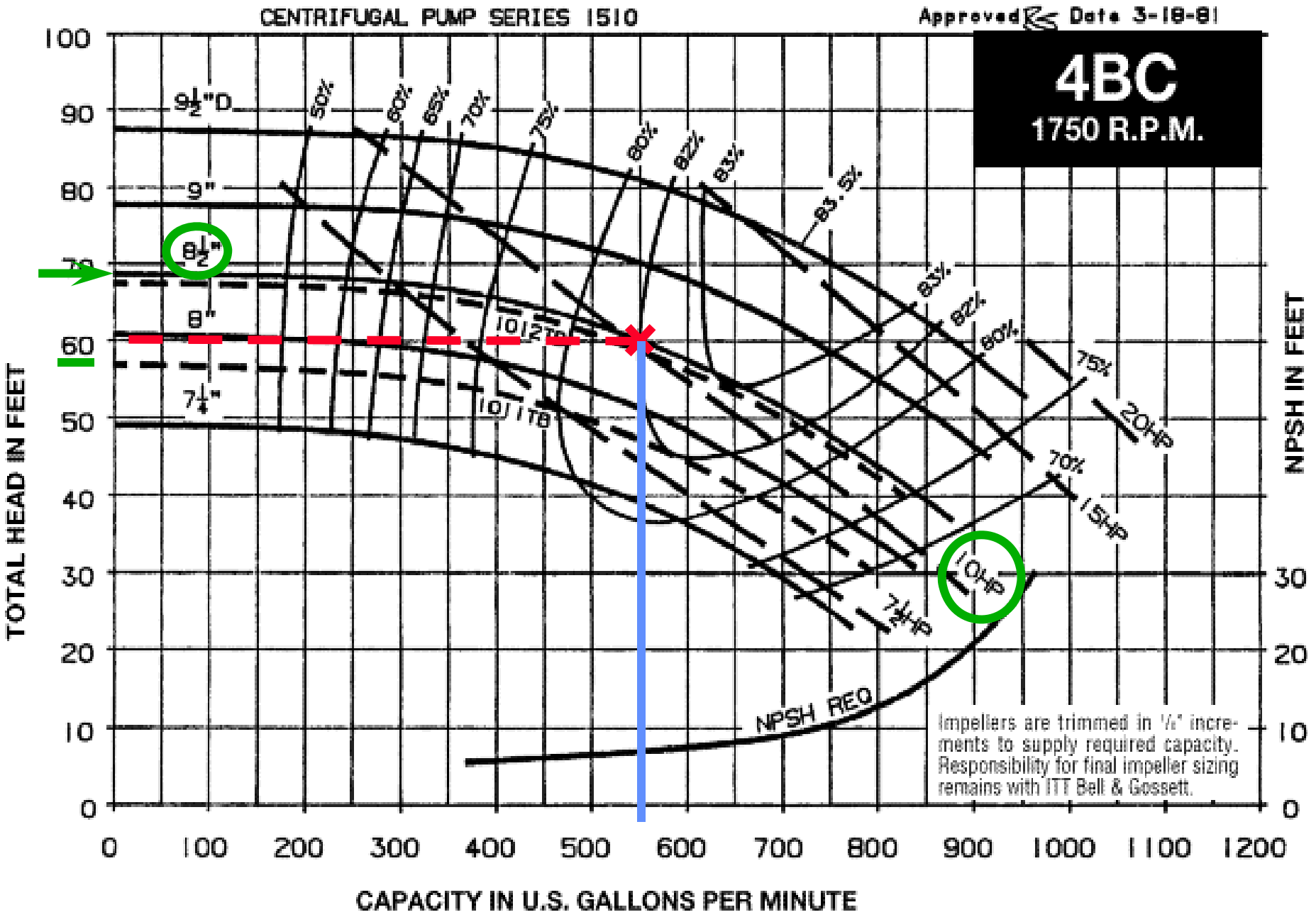
Differential Gauge Reading:

41.5psi - 12psi = 29.5psi

Convert to ft.: 29.5psi x 2.31ft/psi = 68ft

Determine the:

- Impeller Size
- Flow Rate
- Horsepower


CENTRIFUGAL PUMP SERIES 1510
Approved
Date 3-18-81
4BC
1750 R.P.M.
TOTAL HEAD IN FEET
NPSH IN FEET
CAPACITY IN U.S. GALLONS PER MINUTE
9½"D
9"
8½"
8"
7¼"
10J
10H
NPSH REQ
50%
60%
65%
70%
75%
80%
82%
83%
83.5%
85%
20HP
15HP
10HP
7½HP
Impellers are trimmed in ⅛" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.

Problem 2

Determine the following:

Impeller Size	8-1/2”
Flow Rate	550 GPM
Horsepower	10
NOL	15

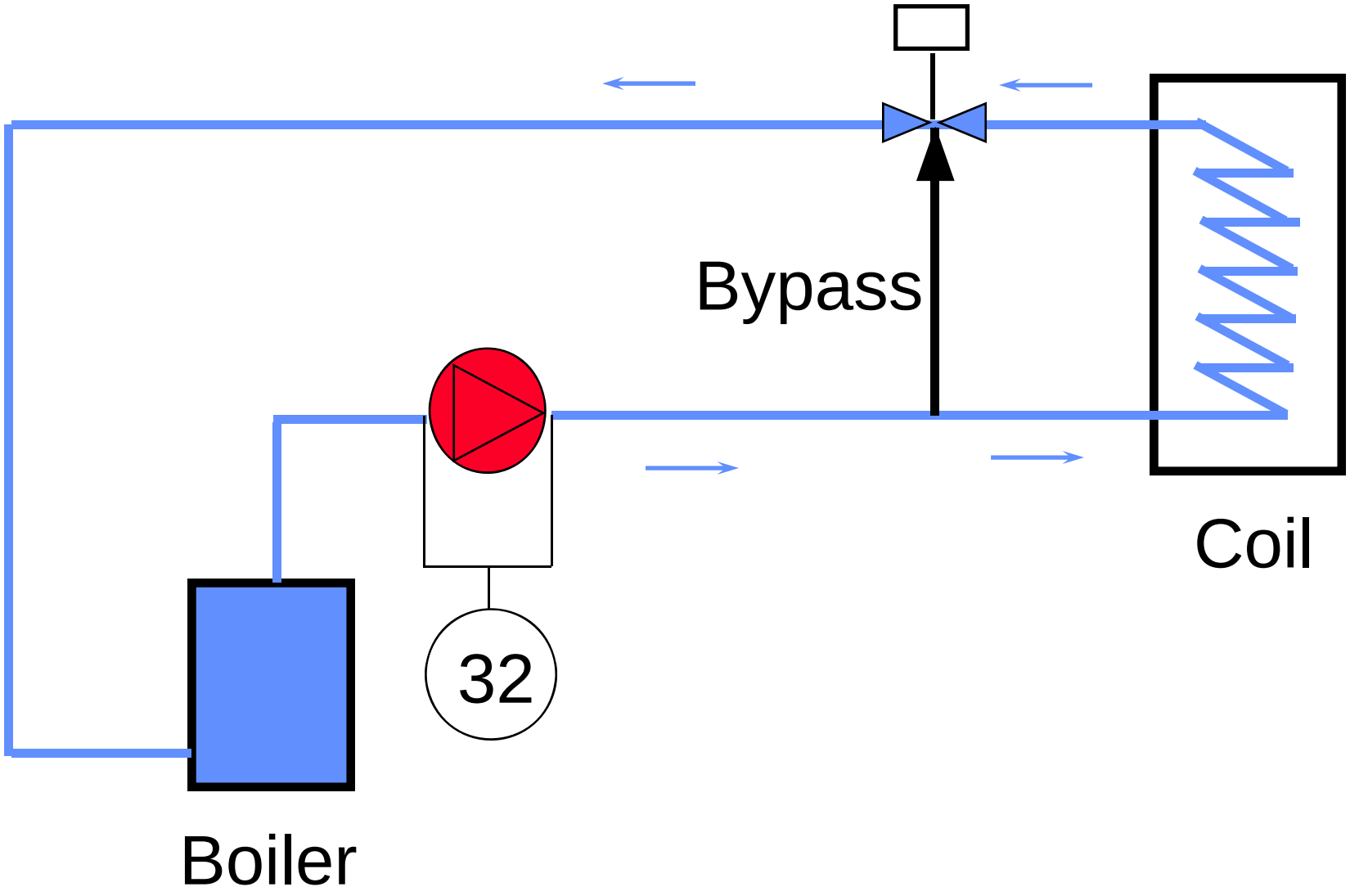
Problem 3

Your 2 HP, Series 1510 1-1/4BC regularly trips its circuit breaker. From the name plate you know you have an 8-1/2” impeller.

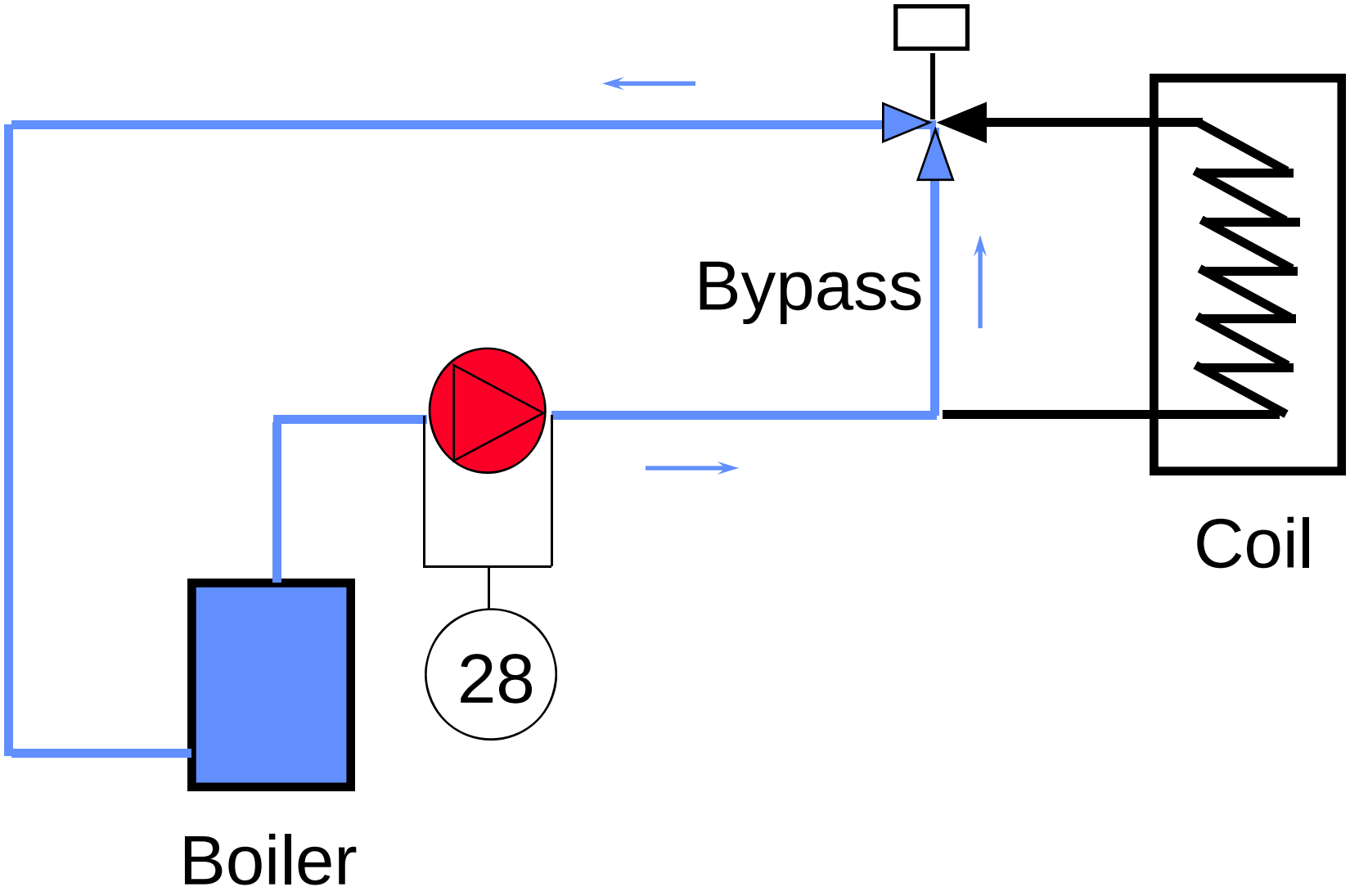
When the 3-way valve is fully open to the coil, the PD across the suction and discharge of the pump is 32 psi.
When the 3-way valve is open to bypass, the PD is 28 psi.

What’s the flow through the coil? Bypass? What is the cause of the problem?

Problem 3 - Coil



Problem 3 - Bypass



Problem 3

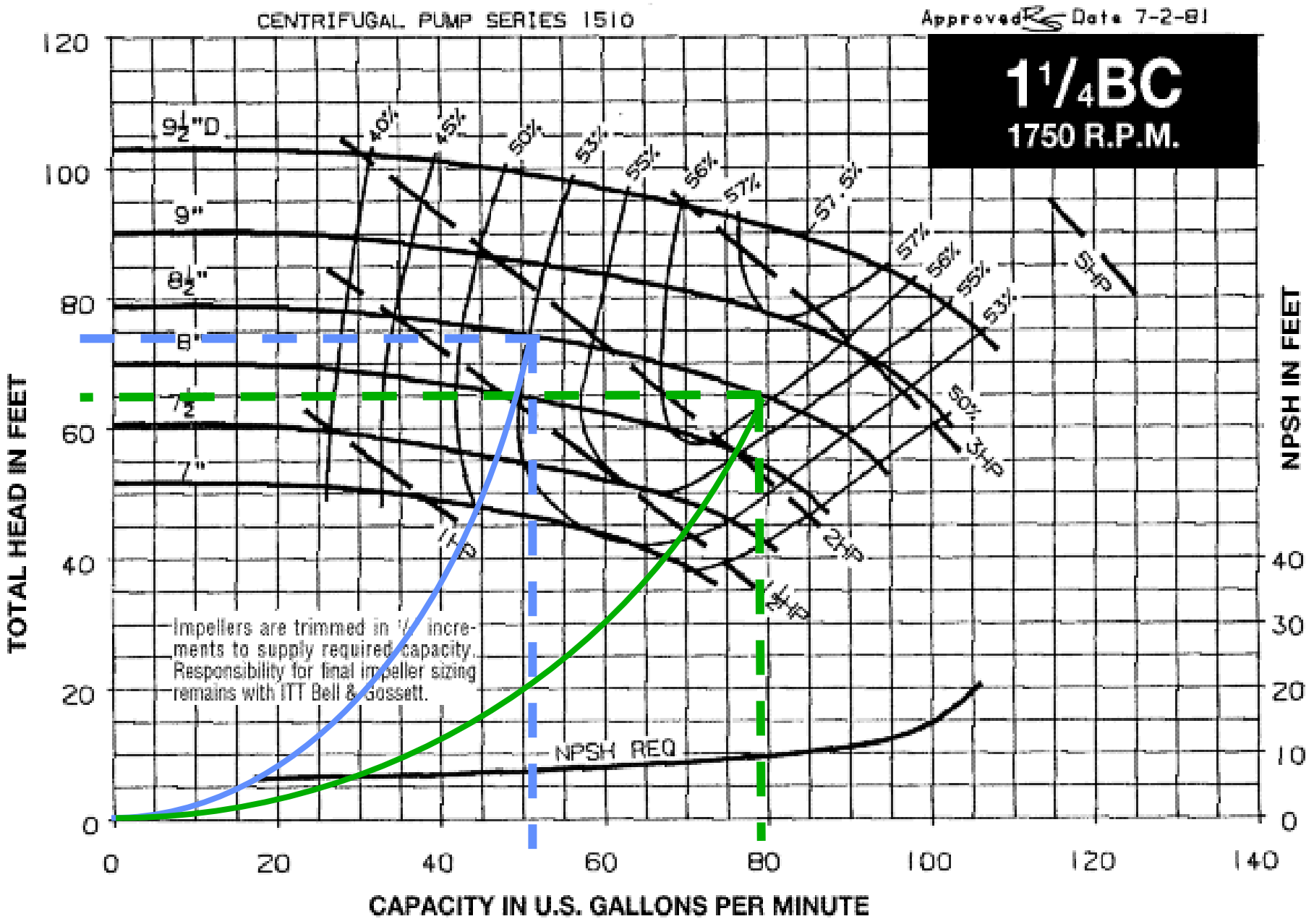
Answer:

Coil

Convert to ft.: 32psi x 2.31ft/psi = 74ft

Bypass

Convert to ft.: 28psi x 2.31ft/psi = 65ft


CENTRIFUGAL PUMP SERIES 1510
Approved
Date 7-2-81
1¼BC
1750 R.P.M.
9½"D
9"
8½"
8"
7½
7"
40%
45%
50%
53%
55%
56%
57%
57%
56%
55%
53%
50%
5HP
3HP
2HP
1HP
¾HP
½HP
Impellers are trimmed in ¼" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.
NPSH REQ
TOTAL HEAD IN FEET
NPSH IN FEET
CAPACITY IN U.S. GALLONS PER MINUTE
0
20
40
60
80
100
120
140
Coil
Bypass

Problem 3

Answer:

Coil flow 74 Ft Hd (32 PSI) >> 51 GPM

Bypass flow 65 Ft Hd (28 PSI) >>79 GPM

What is the cause of the problem?
Solution?

Problem 3

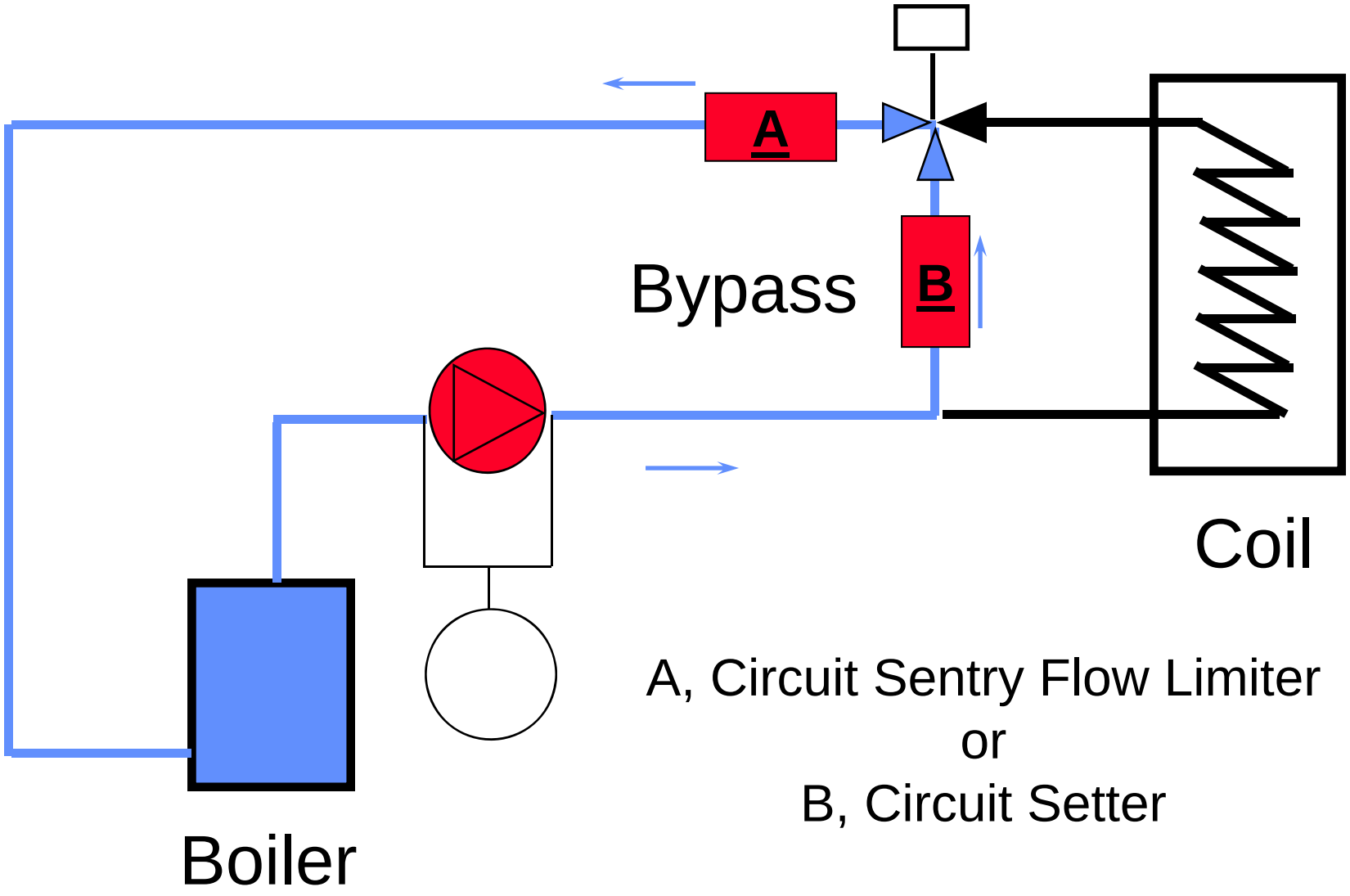
Cause of the problem:

- Not enough PD across the bypass.
- Pump rides out on its curve
- Flow increases
- Greater HP draw
- Overload

Solution?

- Introduce PD across bypass equal to that of the coil.
- Balance valve
- Trim impeller - No

Problem 3 - Solved



Problem 4

The “new guy” calls you back from vacation early with a problem. There is sometimes a high pitched noise throughout the building and the motor sometimes cuts out.

You find:

- the pump running smoothly.
- voltage at the pump is normal, but the ammeter shows that the motor is drawing more than nameplate current.
- wiring isn’t loose.
- pump rotates freely, no binding.

You consult with the design engineer. The pump was selected for 1300 gpm @ 179’. A 13-1/2” impeller was required. The motor selected was 75 Hp.

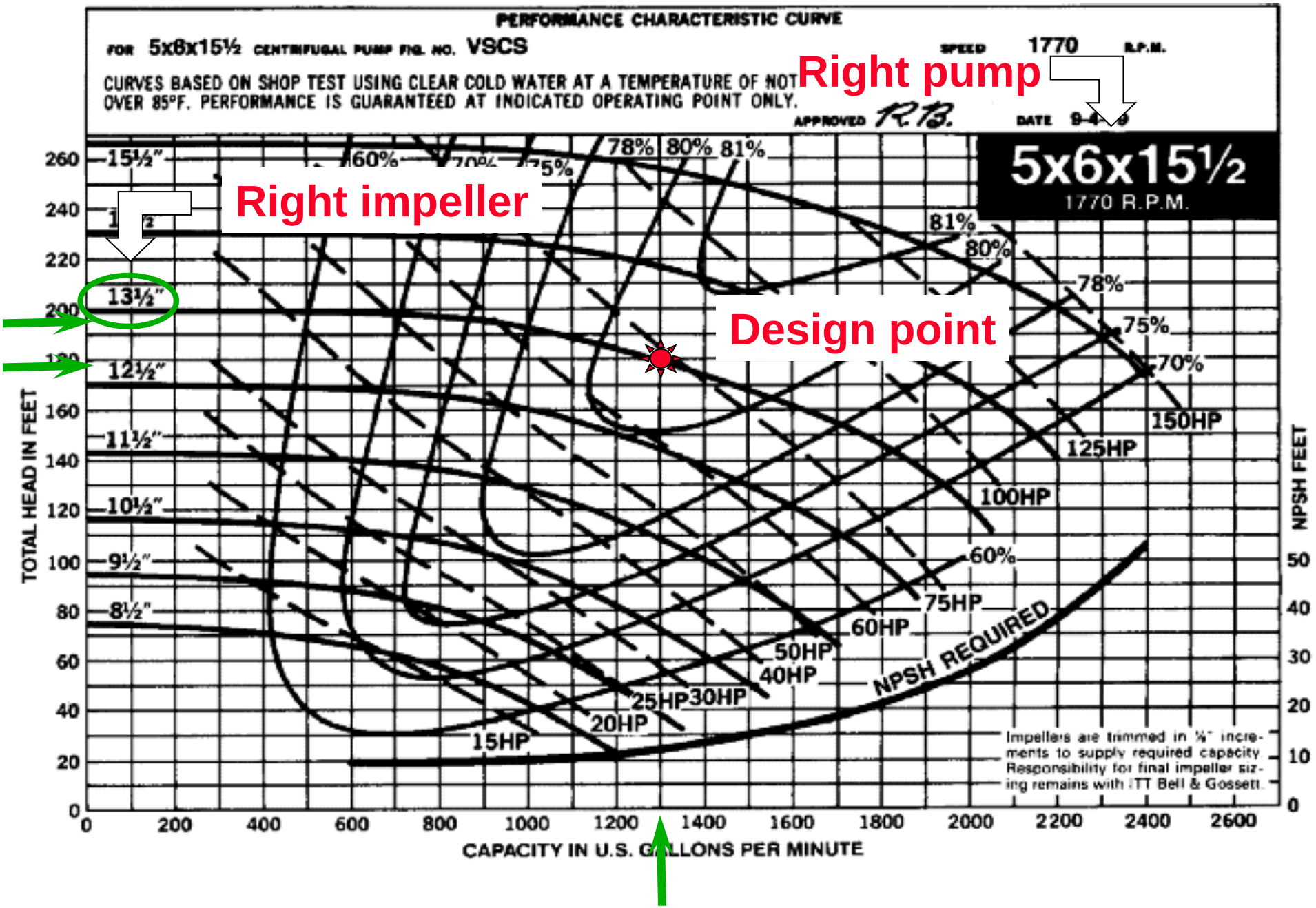
Problem 4

Good thing you placed a gauge across the pump suction and discharge before you took vacation.

Checking to make sure that no one changed the impeller while you were on vacation last week, you close the 3D Valve for a few seconds.

Your PD = 86psi. (116 - 30)

Converting to ft: 86psi x 2.31ft/psi = 199’


PERFORMANCE CHARACTERISTIC CURVE
FOR 5x6x15½ CENTRIFUGAL PUMP FIG. NO. VSCS
SPEED 1770 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.B. DATE 9-4-
Right pump
Right impeller
Design point
5x6x15½
1770 R.P.M.
15½"
13½"
12½"
11½"
10½"
9½"
8½"
60%
70%
75%
78%
80%
81%
150HP
125HP
100HP
75HP
60HP
50HP
40HP
30HP
25HP
20HP
15HP
NPSH REQUIRED
Impellers are trimmed in ⅛" 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
0
20
40
60
80
100
120
140
160
180
200
220
240
260
0
10
20
30
40
50
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600

Problem 4

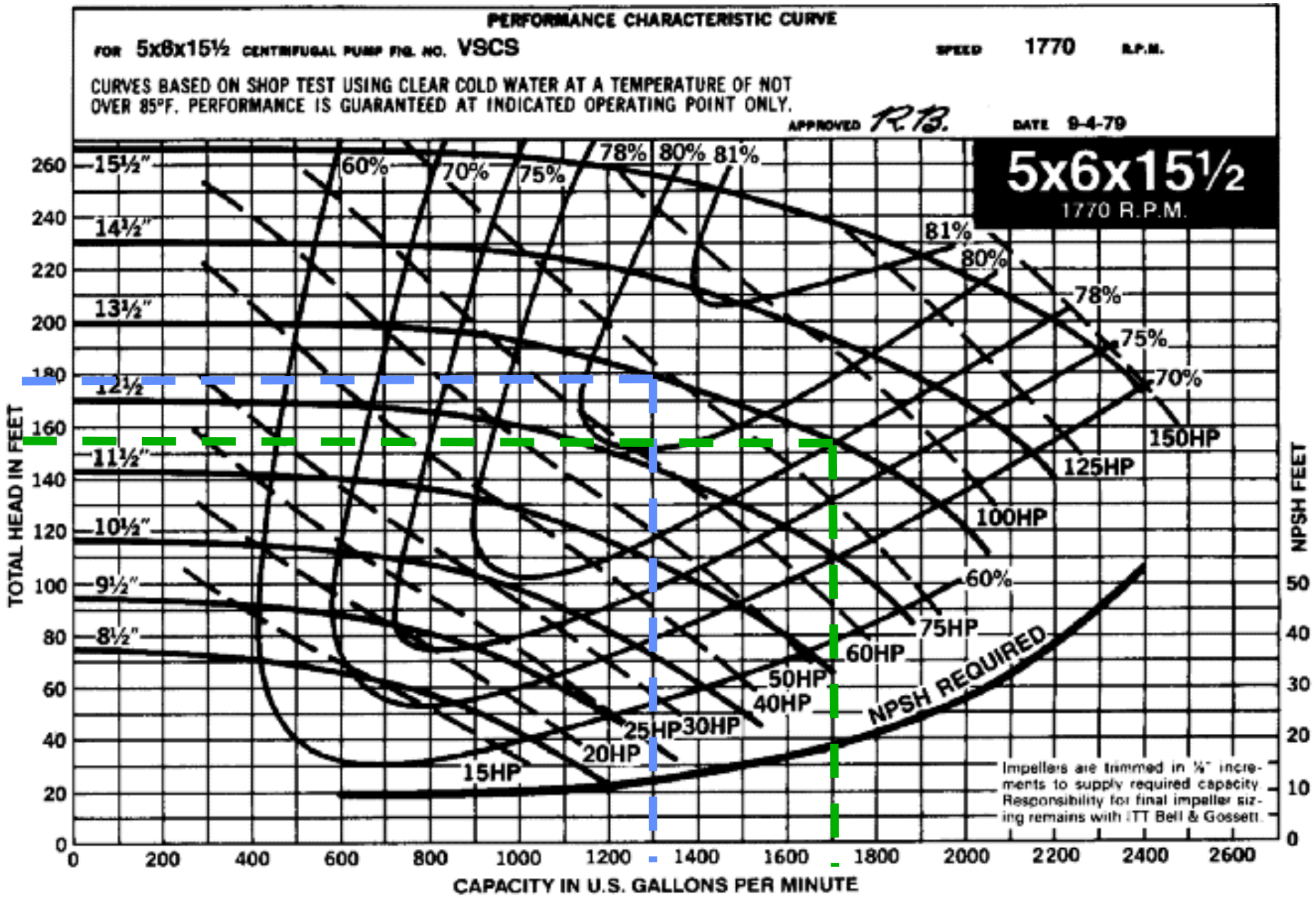
The impeller checks out.

Knowing you shouldn't dead head a pump for too long, you return the 3D Valve back to its original position.

Now you take another reading. In normal operation, the PD = 67 psi. (97 psi – 30 psi)

Converting to ft: 67 psi x 2.31 ft/psi = 155'

Strange, the engineer specified 1300 gpm @ 179'.



Design Actual

Problem 4

Why does the motor cut out at times?

What is the cause of the noise?

What do you recommend for a solution?

What should you do to the new guy?

Problem 4

Motor cut out:

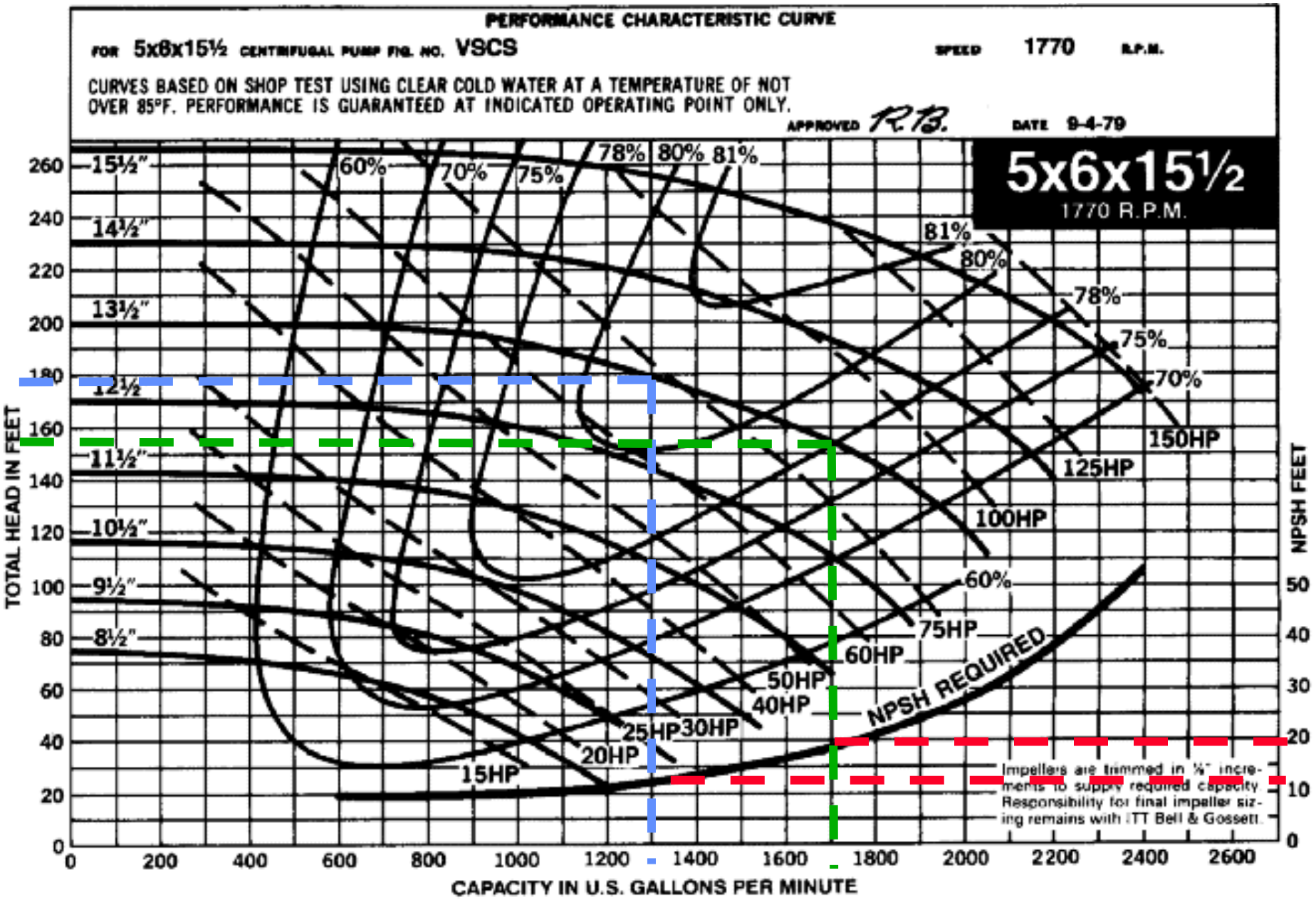
- Actual PD lower than designed
- Greater GPM
- Greater HP draw
- Overloaded motor.

Noise:

- Fluid Velocity in Pipe

Pump Noise:

- Greater GPM
- Greater NPSHR
- It could be that NPSHR > NPSHA
- Cavitation



Design Actual

Problem 4

Recommendation:

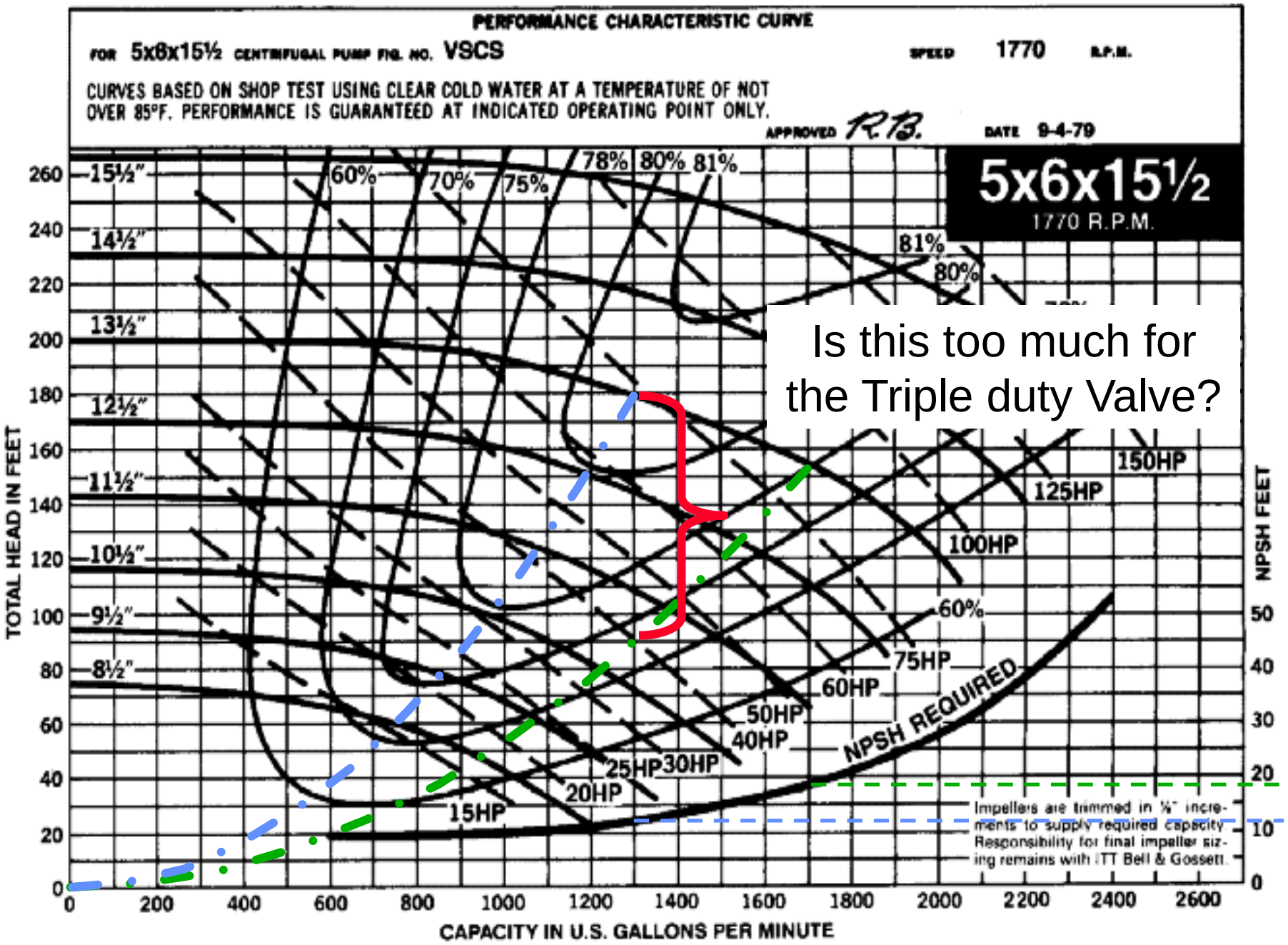
- Close down on the 3D Valve
  - May substitute one problem for another
  - May damage the valve
- Trim impeller, then throttle 3D Valve
- Any other ideas?

New Guy:

Training

Send him to The Little Red Schoolhouse ®

If that doesn’t work, then ...


PERFORMANCE CHARACTERISTIC CURVE
FOR 5x6x15½ CENTRIFUGAL PUMP FIG. NO. VSCS
SPEED 1770 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.B.
DATE 9-4-79
5x6x15½
1770 R.P.M.
Is this too much for the Triple duty Valve?
TOTAL HEAD IN FEET
NPSH FEET
CAPACITY IN U.S. GALLONS PER MINUTE
15½"
14½"
13½"
12½"
11½"
10½"
9½"
8½"
60%
70%
75%
78%
80%
81%
150HP
125HP
100HP
75HP
60HP
50HP
40HP
30HP
25HP
20HP
15HP
NPSH REQUIRED
Impellers are trimmed in ⅛" increments to supply required capacity. Responsibility for final impeller sizing remains with ITT Bell & Gossett.

Avoid Pump Cavitation

- NPSH Required

by the pump

  - Head loss in the impeller.
  - Impeller design, materials.
  - Flow rate.

- NPSH Available

from a closed system

  - Static head
  - System pressurization

Questions?

Additional Resources

- http://bellgossett.com/training-education
  - On-Line Training
  - Seminar Information
- AWS Newsletter
- Our Representative in your area.

Bell & Gossett

a xylem brand