In-Plant Trainings

8 – Session Virtual Platform

U.S. DEPARTMENT OF ENERGY

Session 6

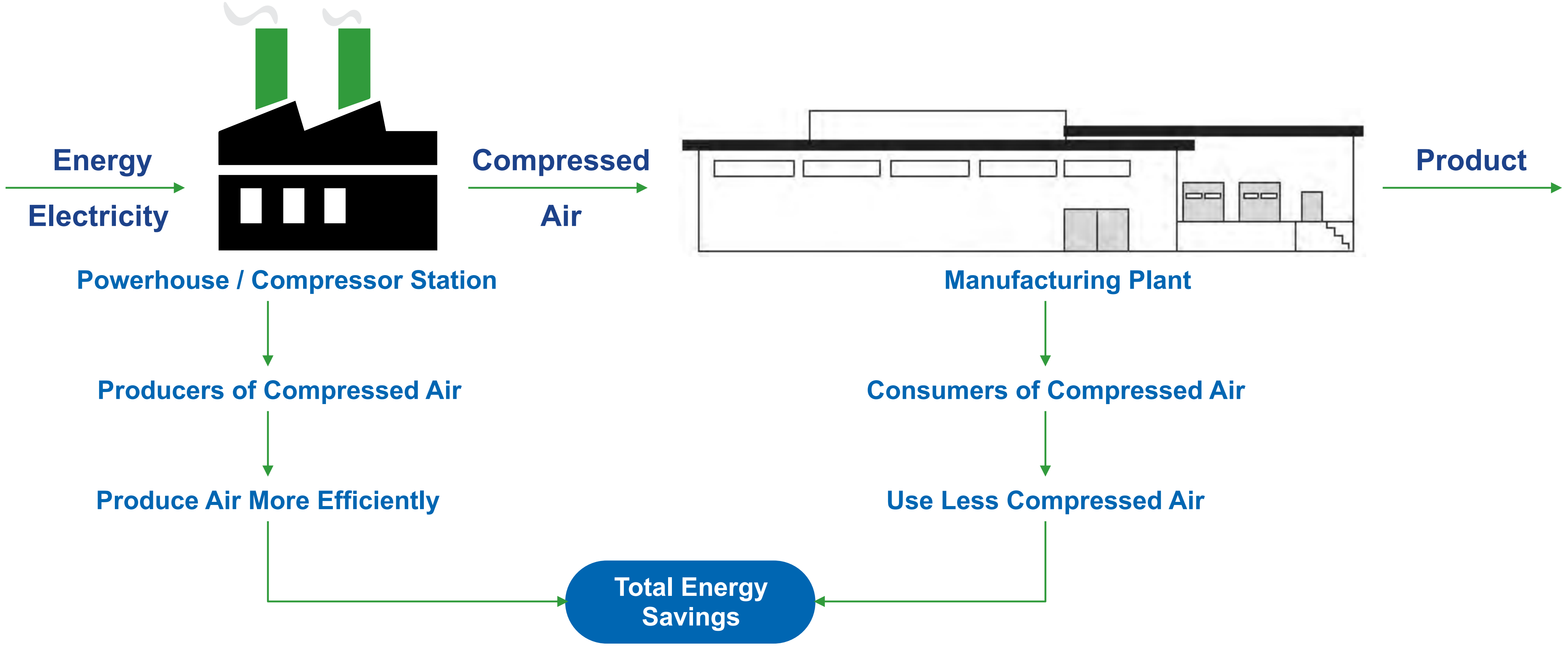
Demand Side

The Demand Side

- The goals of this session:
- To understand how to maintain an efficient compressed air system by managing wastes.
- Learn various methods of energy-saving measures and their applicability for the industrial equipment.
- What is an inappropriate use of air?

Waste

There are two basic ways to reduce the energy consumption of a compressed air system: produce compressed air more efficiently; and consume less compressed air.



Look from the System Level Approach

Market research continues to make it clear that the majority of compressed air systems in use today are inefficient and because of this, often limit their own productivity.

The value trapped in poorly designed and operated air systems in the U.S. markets alone are estimated to range from a low of $1 billion to as much $3.2 billion in energy costs alone.

What Are My Goals?

Produce more efficiently

- Improve Compressor Control
- Discharge Pressure?

Use less compressed air

- Reduce Air Demand (Leaks, Inappropriate Uses, etc…)
- What is the Pressure at End Uses
- How does compressed air support production?

Understanding how compressed air is used is the single most important step to effective management.

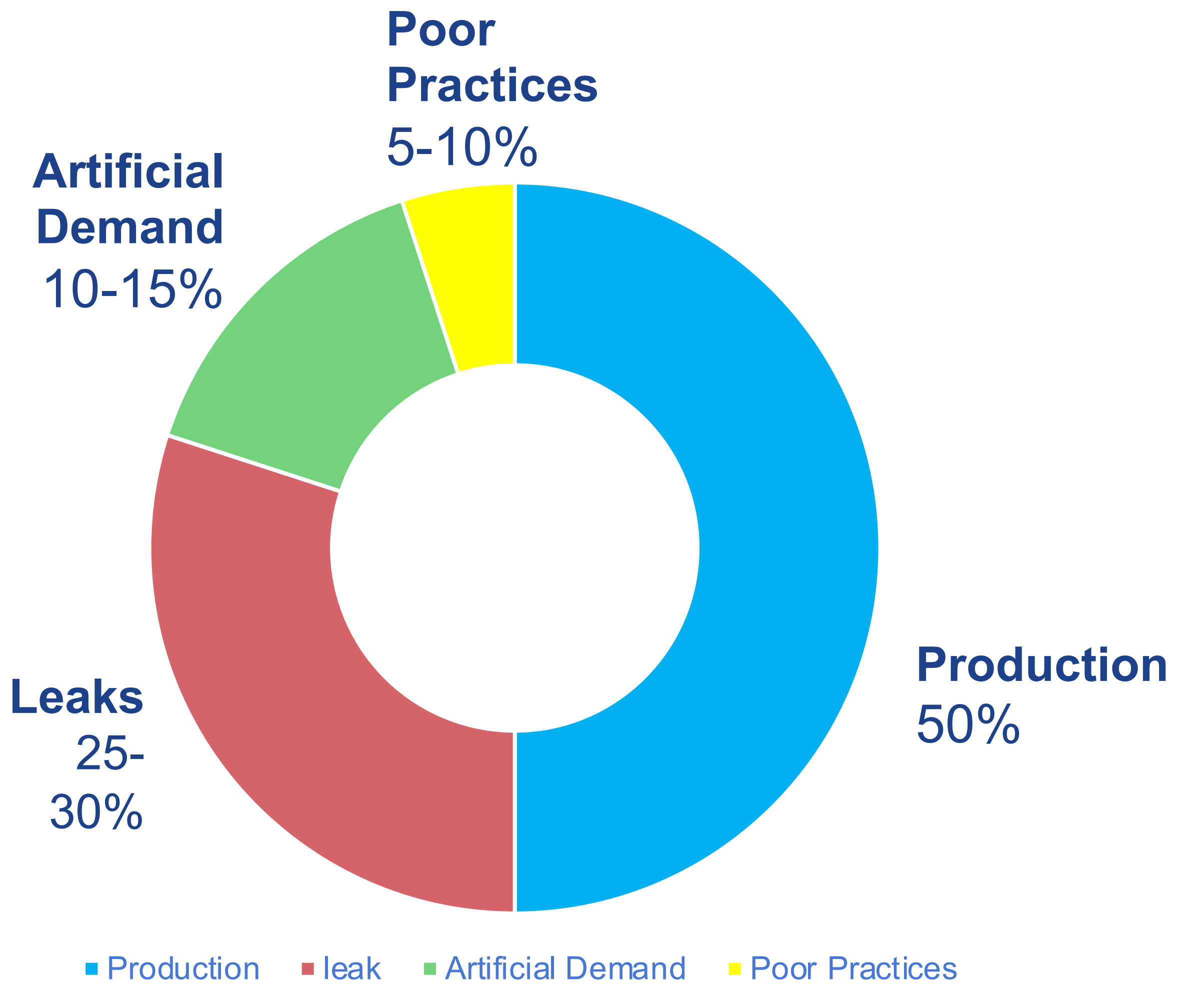
Look from the System Level Approach

- Improve Compressor Control
- Reduce System Pressure
- Reduce Air Demand

What Do I Look For?

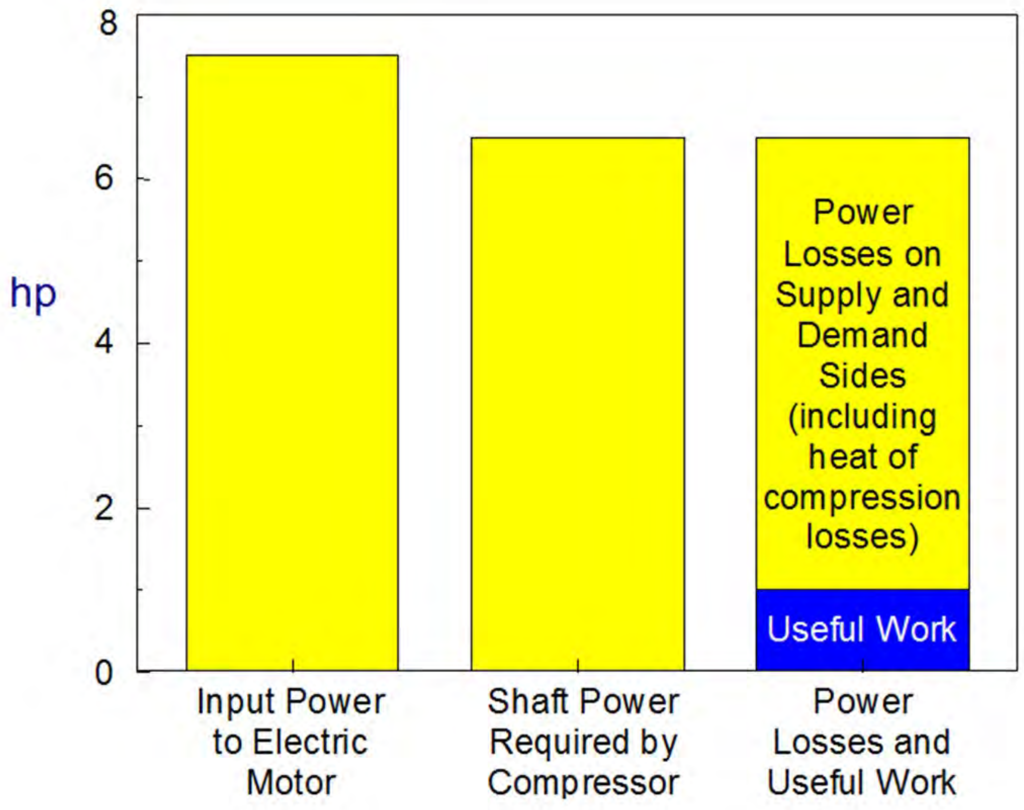
- Produce more efficiently
  - Improve Compressor Control response.
  - Discharge Pressure?
- Use less compressed air
  - Reduce Air Demand (Leaks, Inappropriate Uses, etc…)
  - What is the Pressure at End Uses
  - How does compressed air support production?
    - Understanding how compressed air is used is the single most important step to effective management.

Where does the air go?



Compressed Air Versus Other Energy Sources

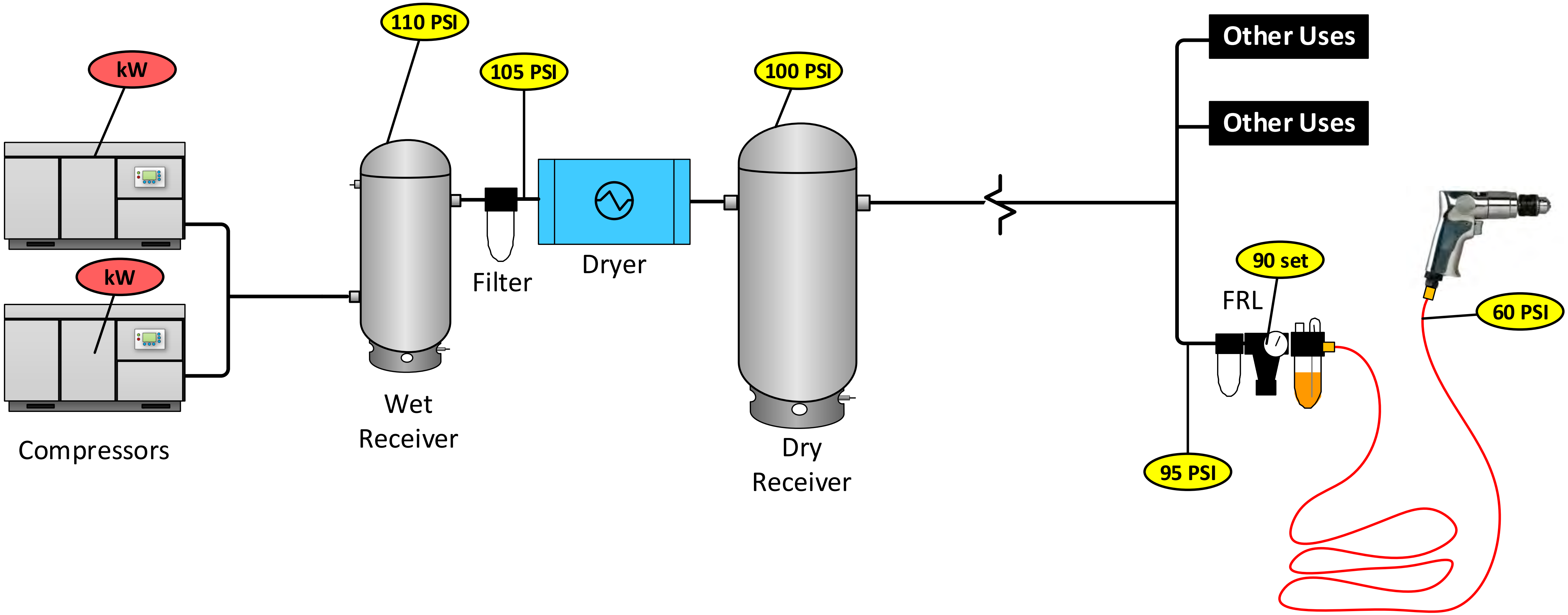
- 1 hp air motor = 7-8 hp of electrical power
  - 30 scfm @ 90 psig is required by the air motor
  - 6 - 7 bhp at compressor shaft required for 30 scfm
  - 7 - 8 hp electrical power required for this
- Annual energy cost for a 1 hp air motor versus a 1 hp electric motor, 5-day per week, 2 shift operation, $0.05/kWh
- **$ 1,164 vs. $ 194**



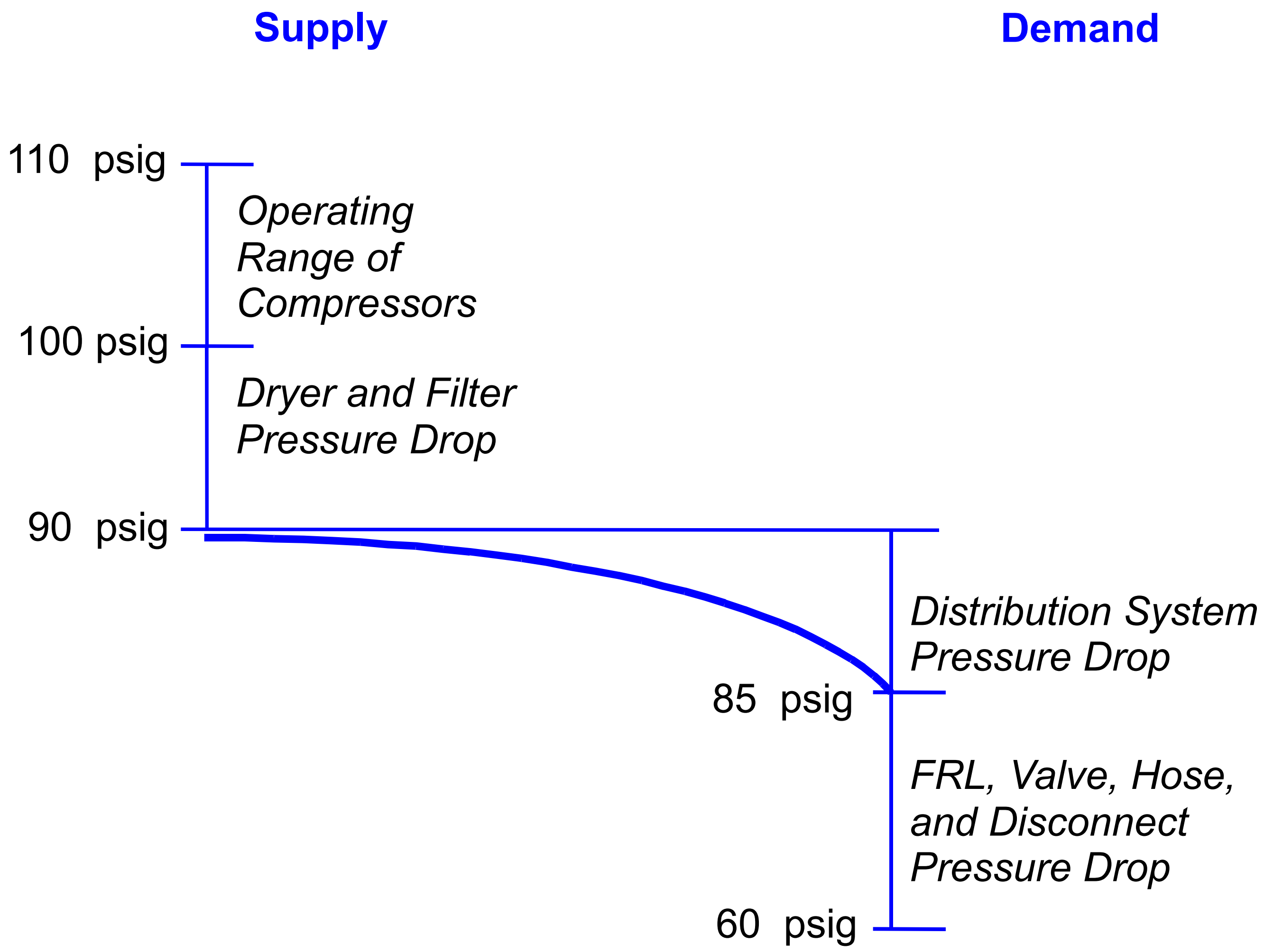
What Measurements Should I Record?

- Produce more efficiently
  - Improve Compressor Control
  - Discharge Pressure?
- Use less compressed air
  - Reduce Air Demand (Leaks, Inappropriate Uses, etc…)
  - What is the Pressure at End Uses
  - How does compressed air support production?
    - Understanding how compressed air is used is the single most important step to effective management.

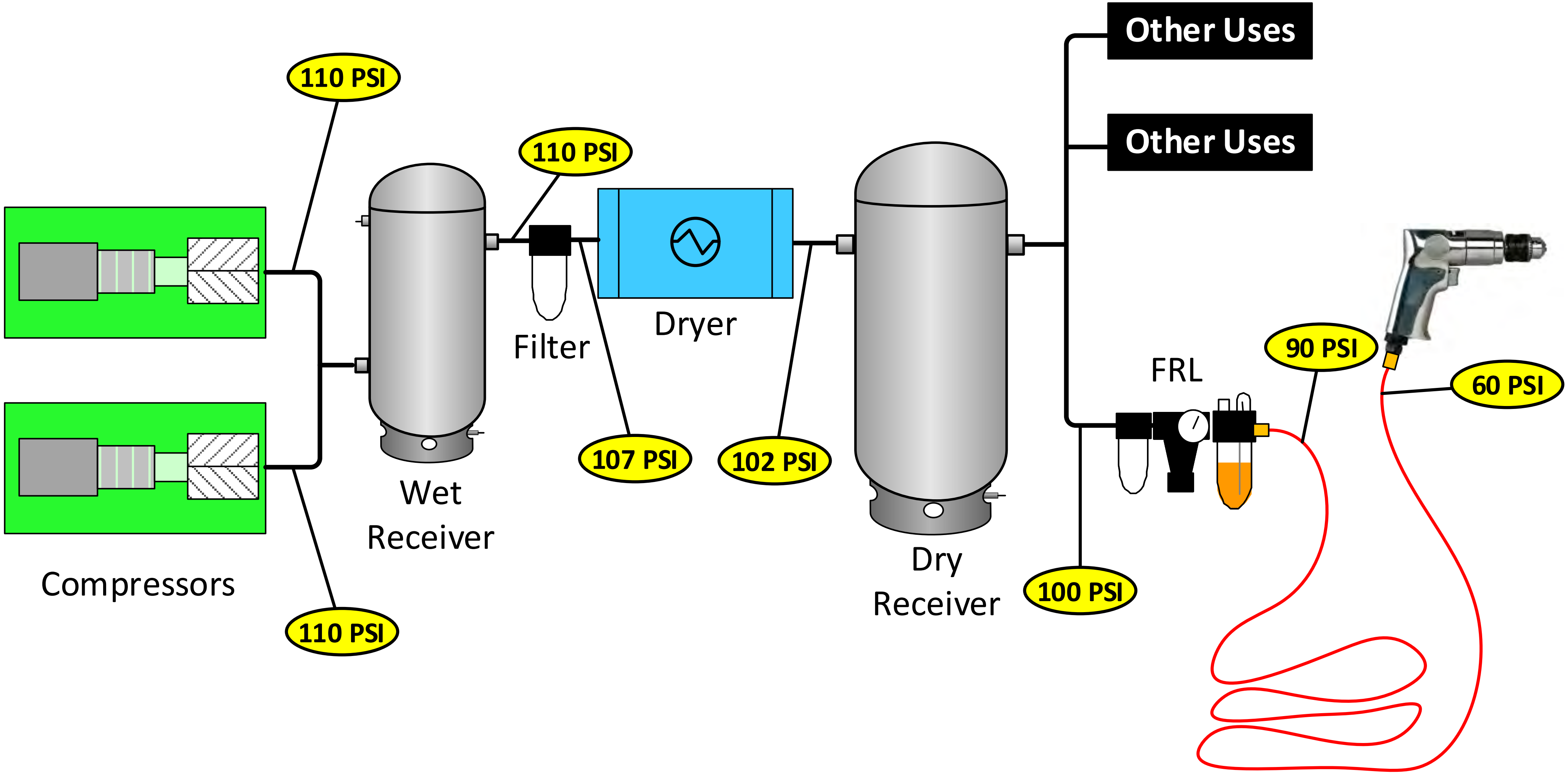
What Measurements Should I Record?



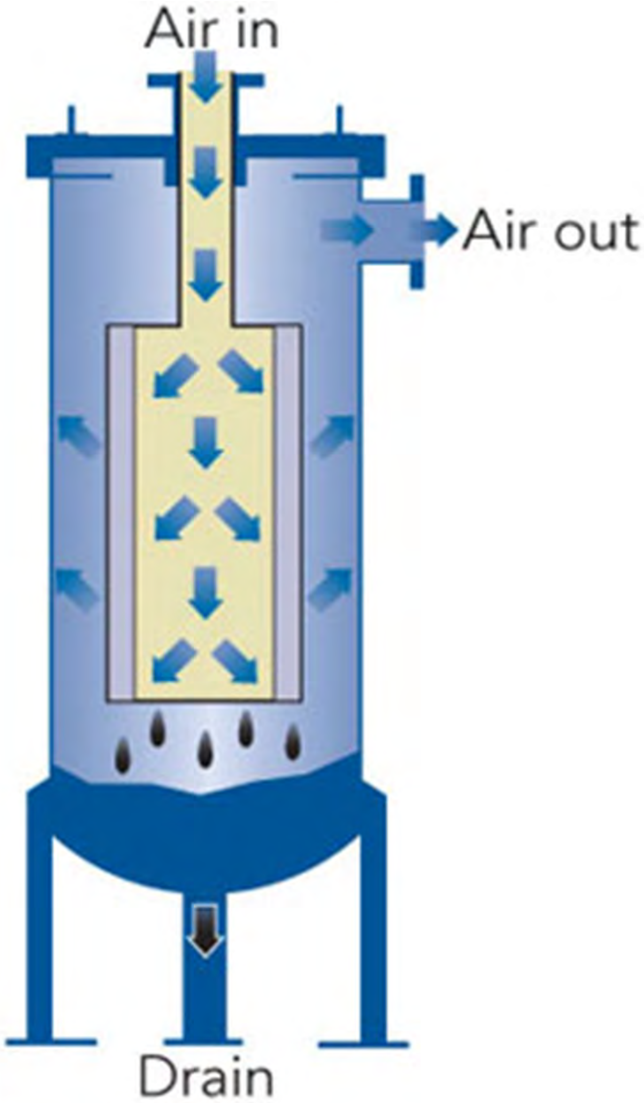
System Pressure Profile



Developing a System Profile

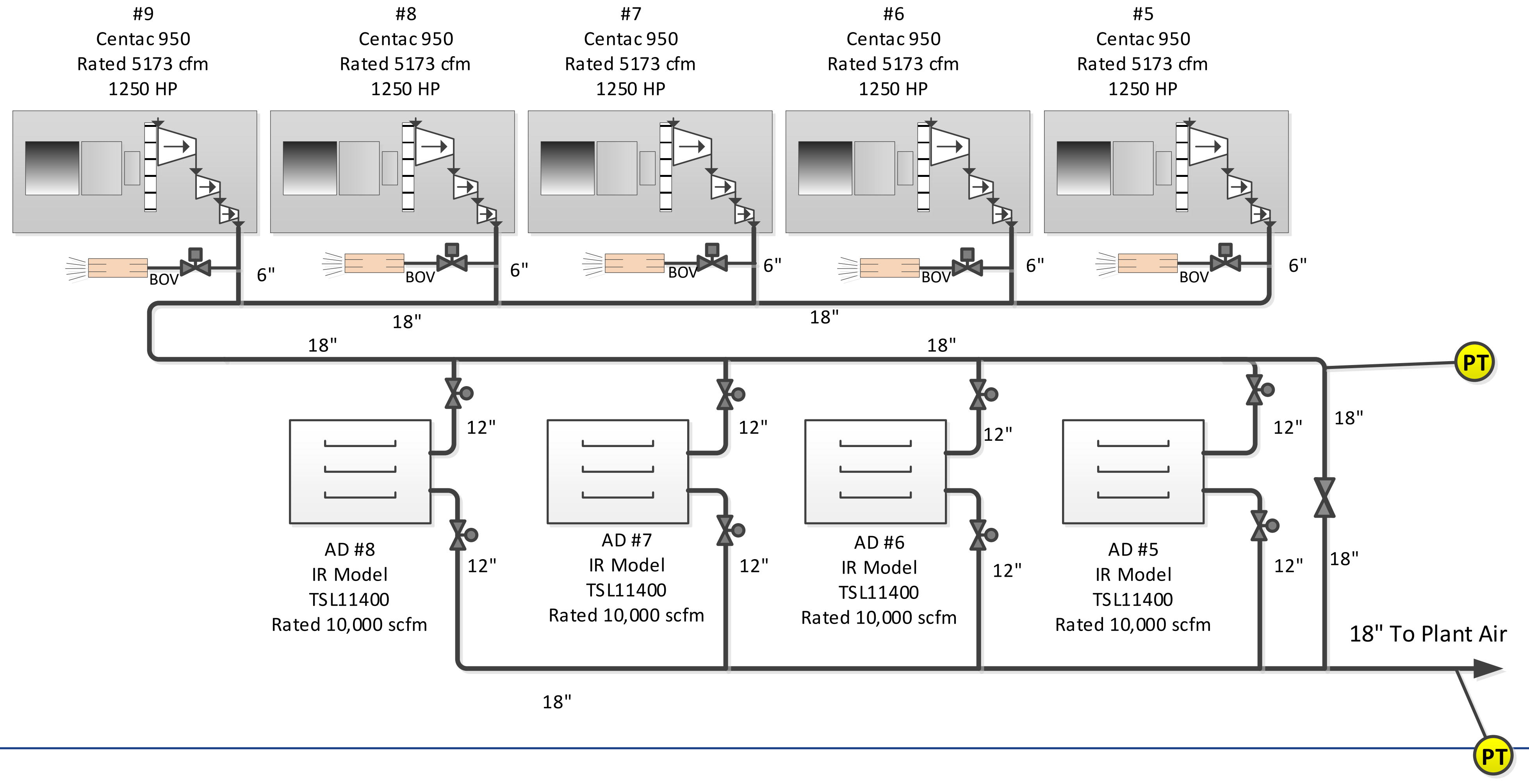


Reduce System Pressure Drop Losses

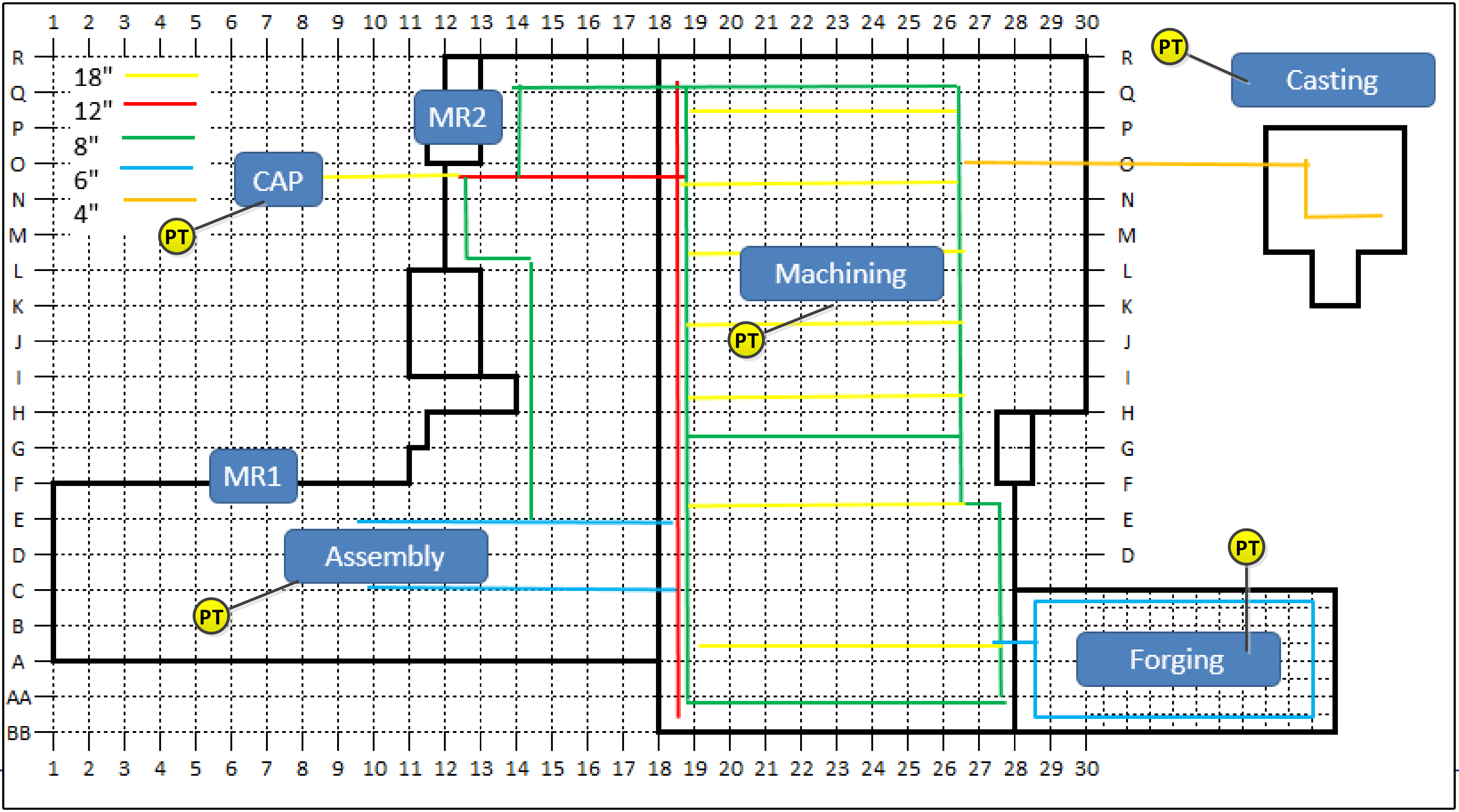


What Measurements Should I Record?

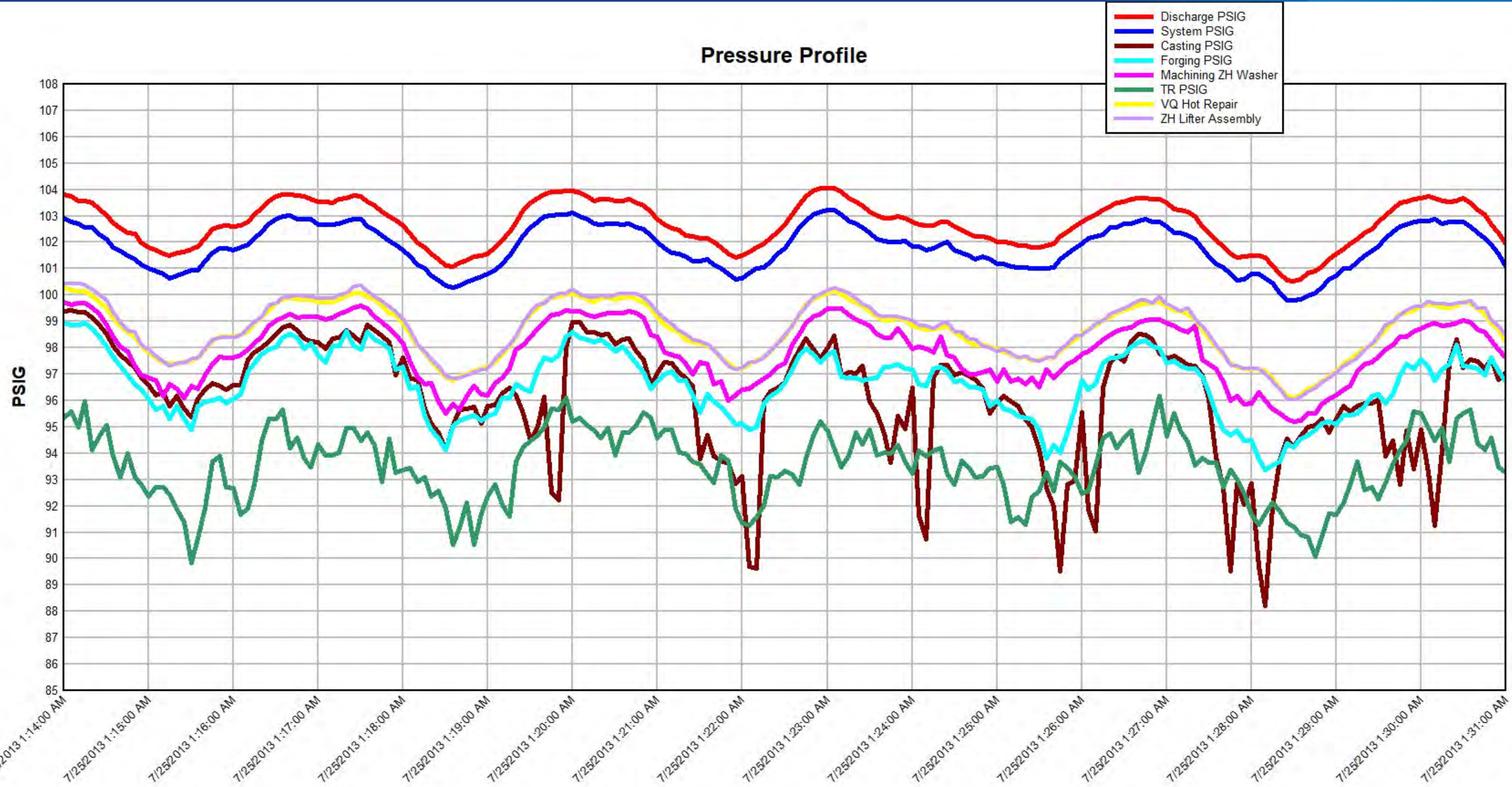
Compressed Air Plant



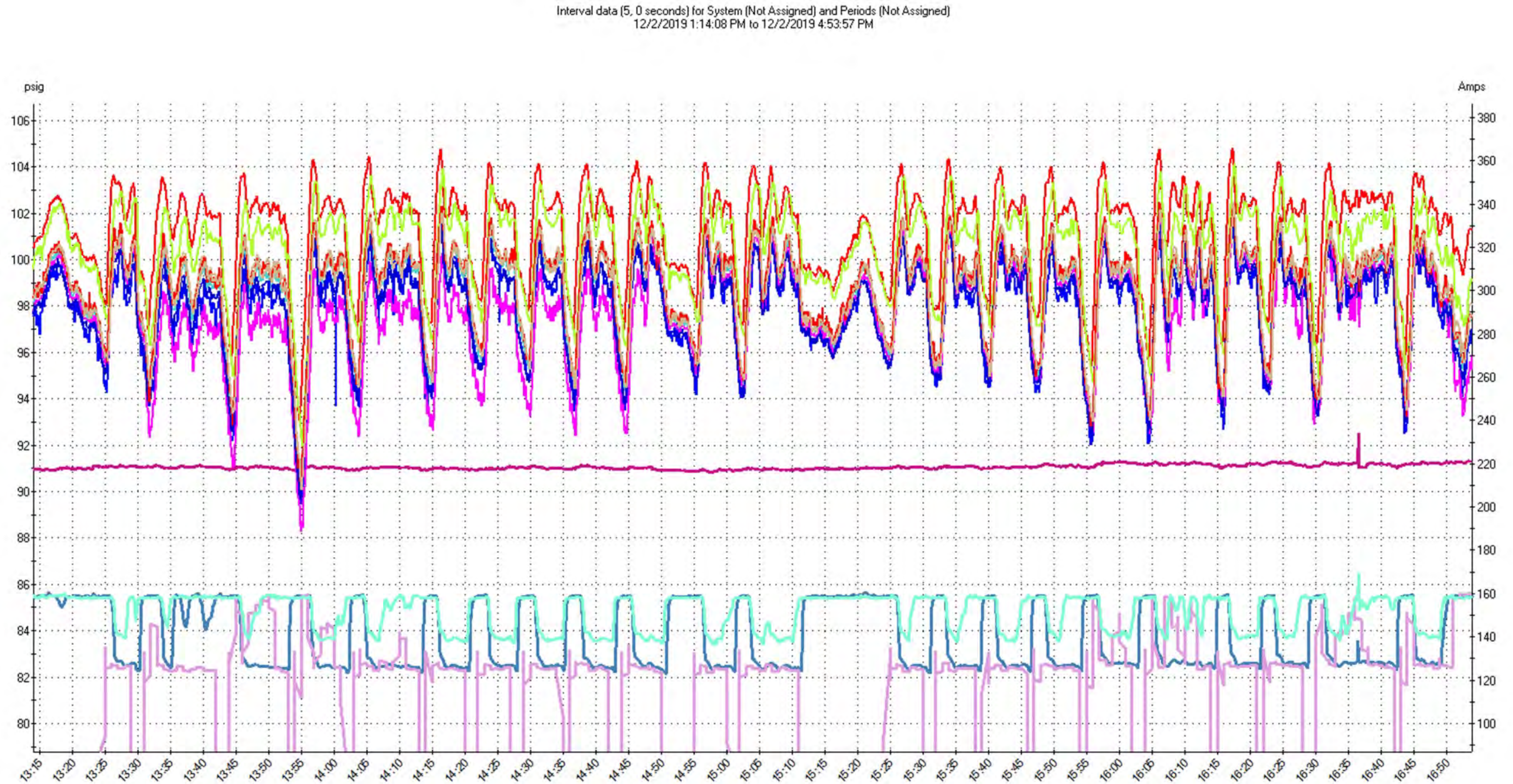
What Measurements Should I Record?



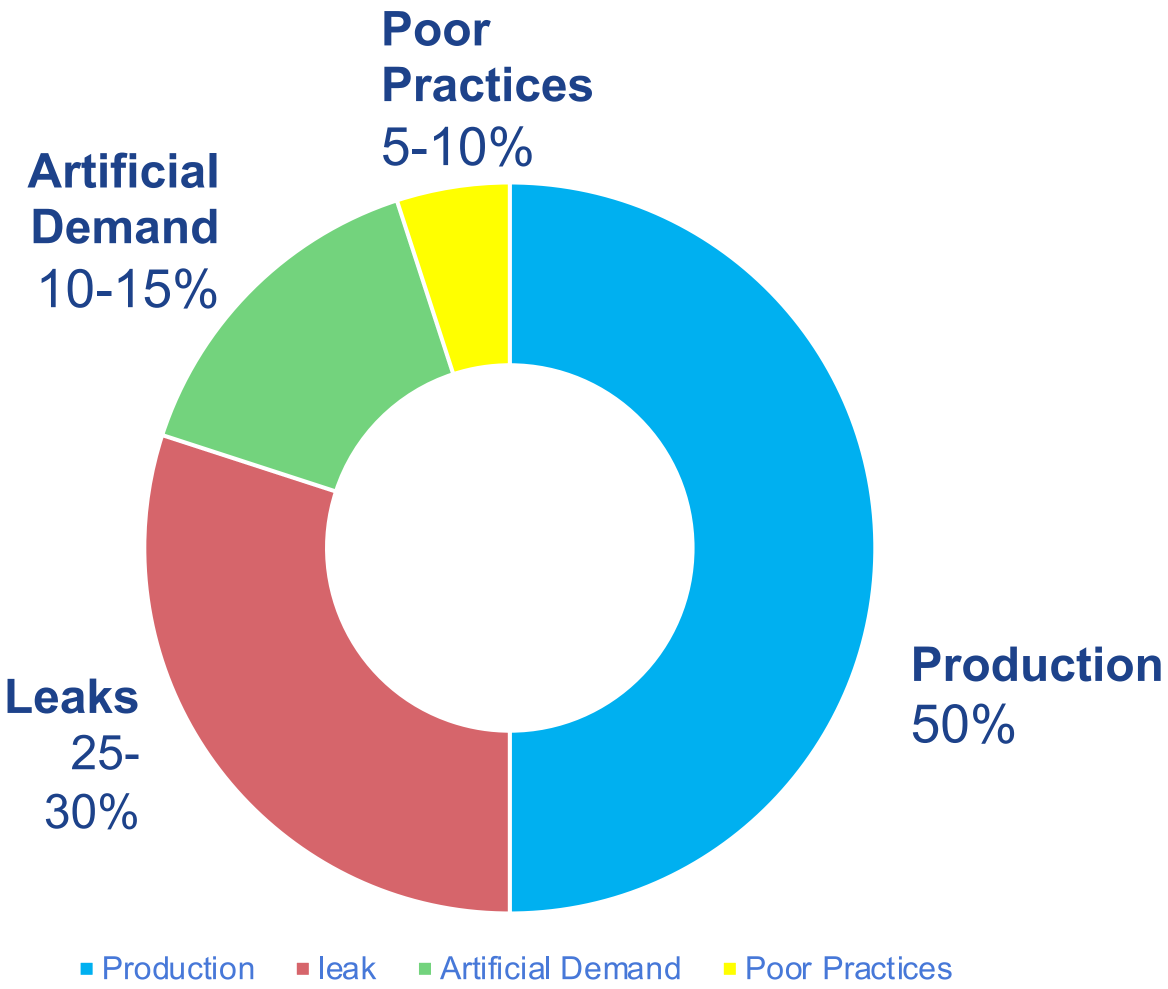
Data Collection Can Be Interpreted



Comparing Pressure and Power

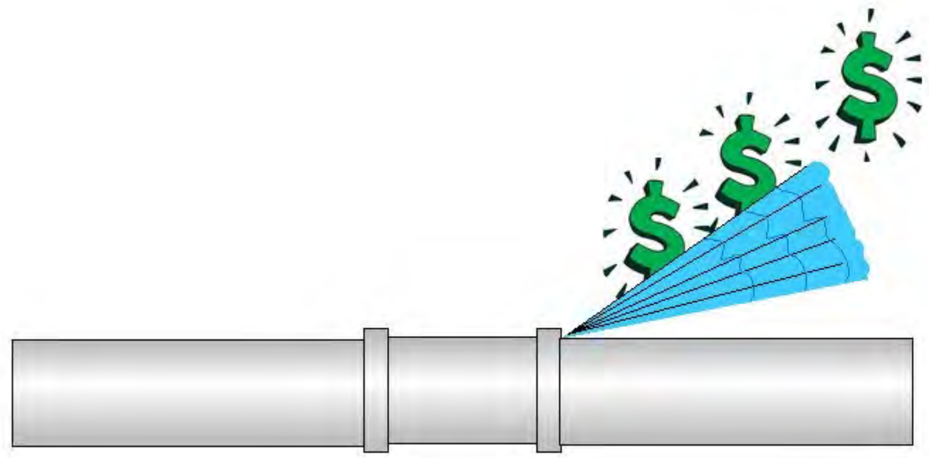


Lets have a look at the waste



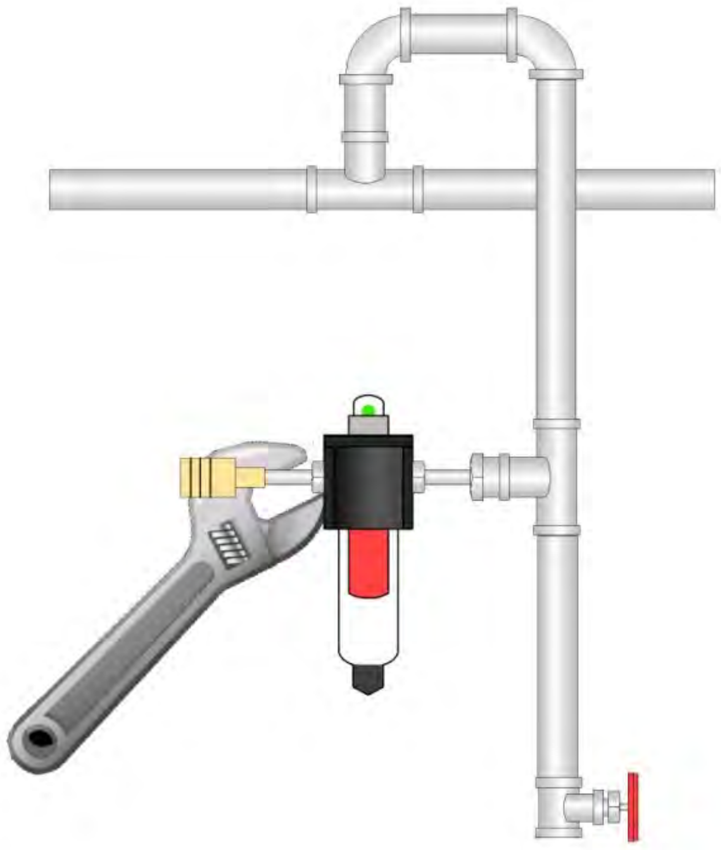
Leaks

- One of the most common types of waste in compressed air system is leaks.
- Leaks can be expensive.



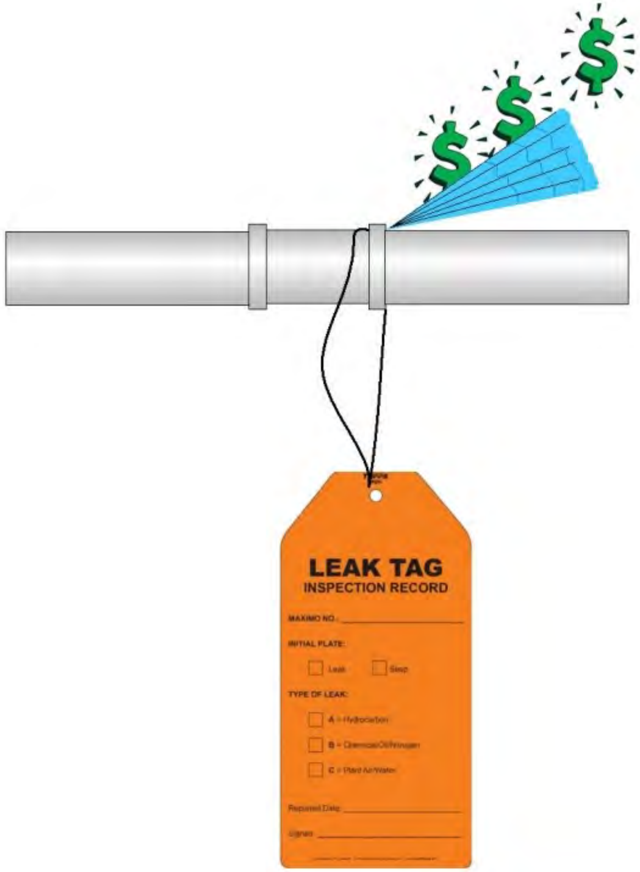
Leaks

- Leaks occur most often at joints and connections.
- Stopping leaks can be as simple as tightening a connection, or as complex as replacing faulty equipment.
- In many cases, leaks are caused by bad or improperly applied thread sealant.
- Select high quality fittings, disconnects, hose, tubing, and install them properly with the appropriate thread sealant.



Leaks

- Leak Tag Program
- Leak is identified with a tag and logged for repair at a later time.
- Tag is often a two-part tag
  - One part stays on leak
  - Other part is turned into maintenance, indentifying the location, size and description of the leak to be repaired.



Leakage Losses

Leaks can account for 20% - 30% of the total amount of air being compressed.

An Ultrasonic or acoustic imager leak detector is the best tool for the job.

An ongoing program involving all departments is essential for success.

Quantifying Leakage Loss using Bag M

Gallon size	Time to fill (seconds)	scfm
50	10	40.1
50	60	6.6
50	120	3.3
30	2	120.3
50	15	26.7

How Do You Find Leaks?

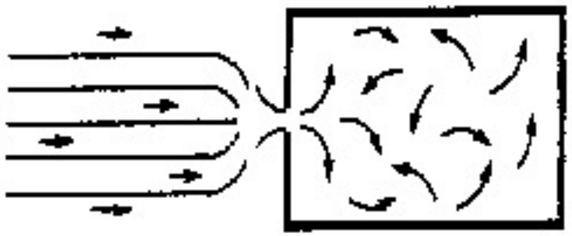
At $0.10/kWh electricity:

- A **$200/year** leak cannot be felt or heard
- A **$800/year** leak can be felt, but not heard
- A $**1,400/year** leak can be felt and heard

How Ultrasonic Leak Detection Works

- During a leak, a fluid (liquid or gas) moves from a high pressure to a low pressure
- As it passes through the leak site, a turbulent flow is generated with strong ultrasonic components, which are heard through headphones and seen as intensity increments on the meter
- It can be generally noted that the larger the leak, the greater the ultrasound level

PRESSURE LEAK

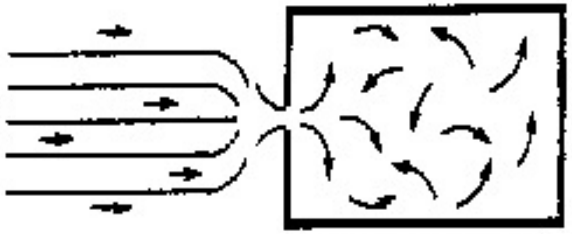


VACUUM LEAK

How Ultrasonic Leak Detection Works

- Ultrasound is a high frequency, short wave signal with an intensity that drops off rapidly as the sound moves away from its source
- The leak sound will be loudest at the leak site, which makes locating the source (i.e. the location) of the leak quite simple

PRESSURE LEAK



VACUUM LEAK

How Acoustic Camera Leak Detection Works

- The acoustic camera uses microphones and sophisticated signal processing and software to identify the loudest source of noise when many sources are present.
- It allows the user to pinpoint sound leaks in walls, doors, and floors and target the leak

How Acoustic Camera Leak Detection Works

- An example of the graphical user interface of the Acoustic Camera is shown here.
- The measured sound value (in dB) is displayed top left of the screen.
- The Acoustic Camera converts this sound value to a leak flow estimation (in scfm or l/min), using the distance to the leak.
- This distance can be selected using the distance slider to the right of the display.
- Some meters calculate their own distance from the leak source.


34 dB
50 kHz
45 kHz
40 kHz
35 kHz
30 kHz
25 kHz
20 kHz
15 kHz
10 kHz
M_22
0:10
0:00:00


51 dB
50 kHz
45 kHz
40 kHz
35 kHz
30 kHz
25 kHz
20 kHz
15 kHz
10 kHz
5 kHz
0:00:01
0:00:09

Estimating Leak Load

- Leak load should be estimated periodically.
- On a well maintained system, leakage should be less than 5-10% of full system flow.
- Tests should be undertaken quarterly.
- The following calculation should be used with load/unload controls.

$$\text{Leakage (\%)} = \left(\frac{T}{T+t}\right) \times 100$$

Where: T = total loaded time (seconds)

t = total unloaded time (seconds)

Estimating Leak Load

Here is an example of 100 hp 460 cfm compressor loading and unloading with no production running.

Time loaded	55 sec	58 sec	55 sec	58 sec
Time unloaded	40 sec	38 sec	40 sec	38 sec

$$\text{Leakage (\%)} = \left(\frac{T}{T+t}\right) \times 100$$

$$\text{Leakage (\%)} = \left(\frac{226}{226+156}\right) \times 100 = 59.2\%$$

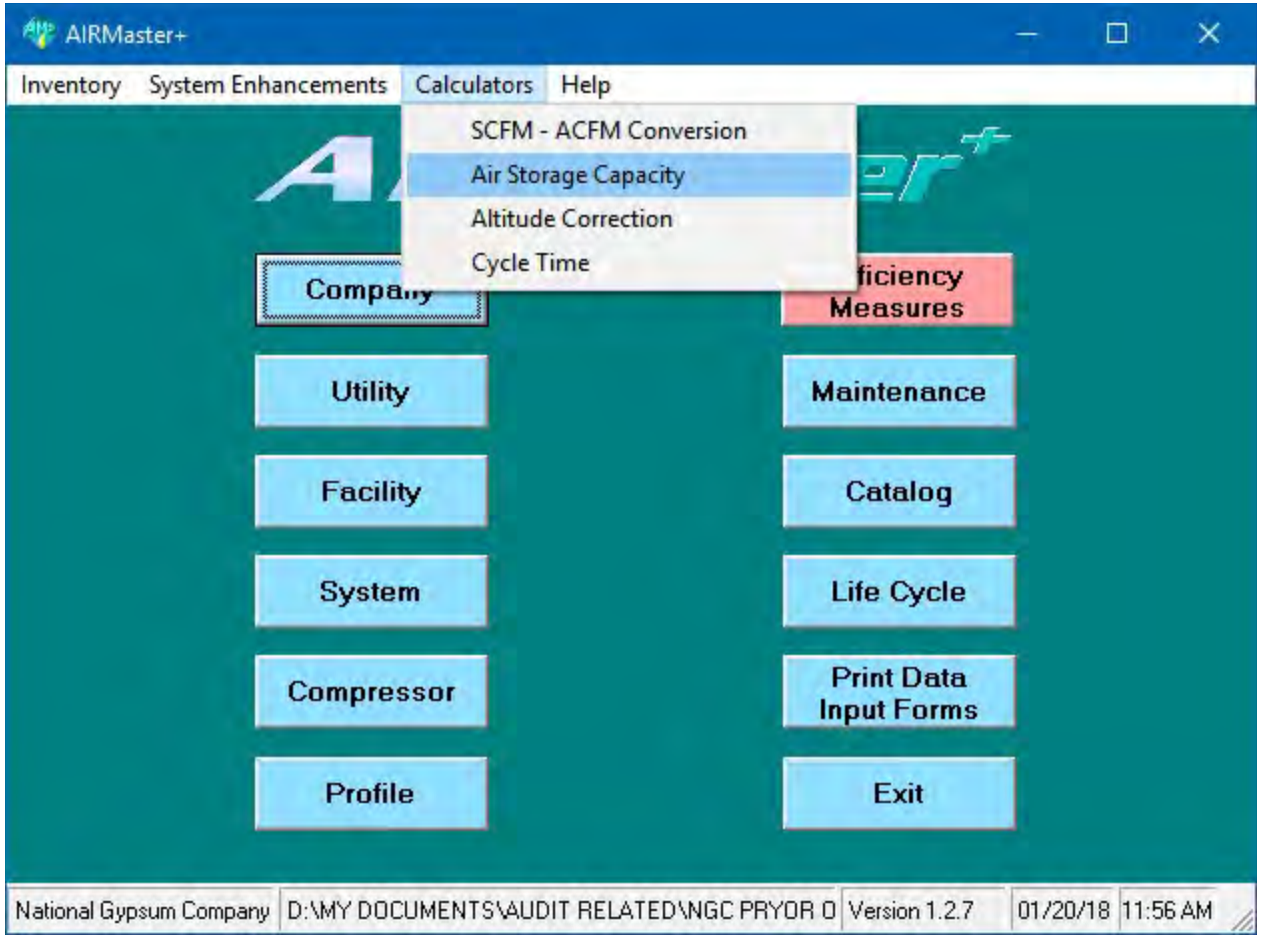
Estimating Leak Load in Systems with Other Controls

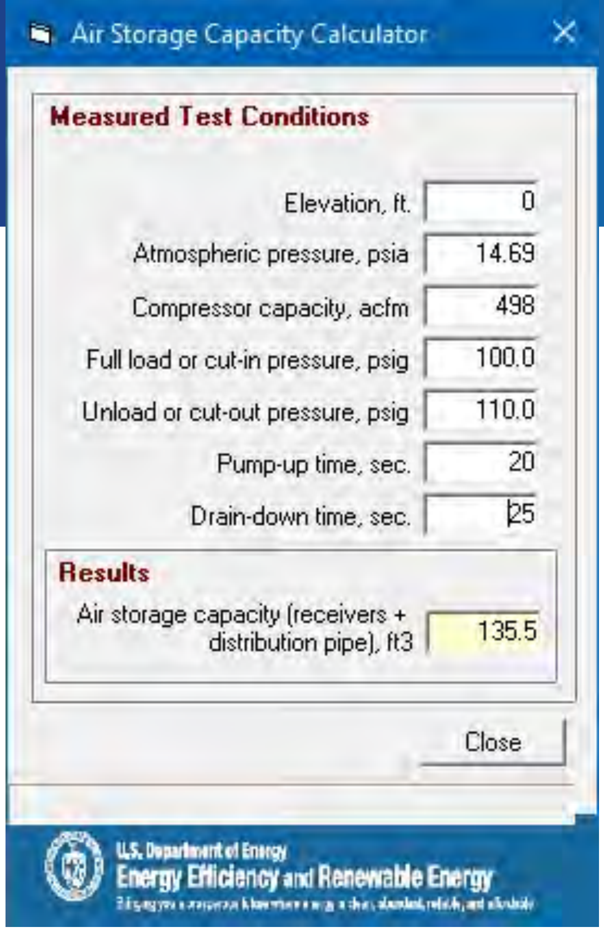
- Requires an estimate of total system piping volume
- Include all receivers
- Bring system to normal operating pressure
- Turn compressors off
- Measure time for system to drop to ½ of starting pressure
- The following calculation can be used with other controls.

$$\text{Leakage (cfm free air)} = \left[\frac{V \times (P_1 - P_2)}{T \times P_a}\right] \times 1.25$$

The 1.25 multiplier corrects leakage to normal system pressure, allowing for reduced leakage with falling system pressure to 50% of the initial reading.

System Volume





- The **mechanical** volume of a system is simply the sum of the individual volumes of each air receiver, pipeline, or other vessel within the compressed air system.
- The **effective** volume of the system is the system's mechanical volume adjusted for the actual pressure increase and decrease that occurs.

System Capacity

SYSTEM CAPACITY

Pipes

Pipe Size (in)	Pipe Length (ft)
3	1150 ft
2	800 ft

Add Pipe

Receiver Tanks

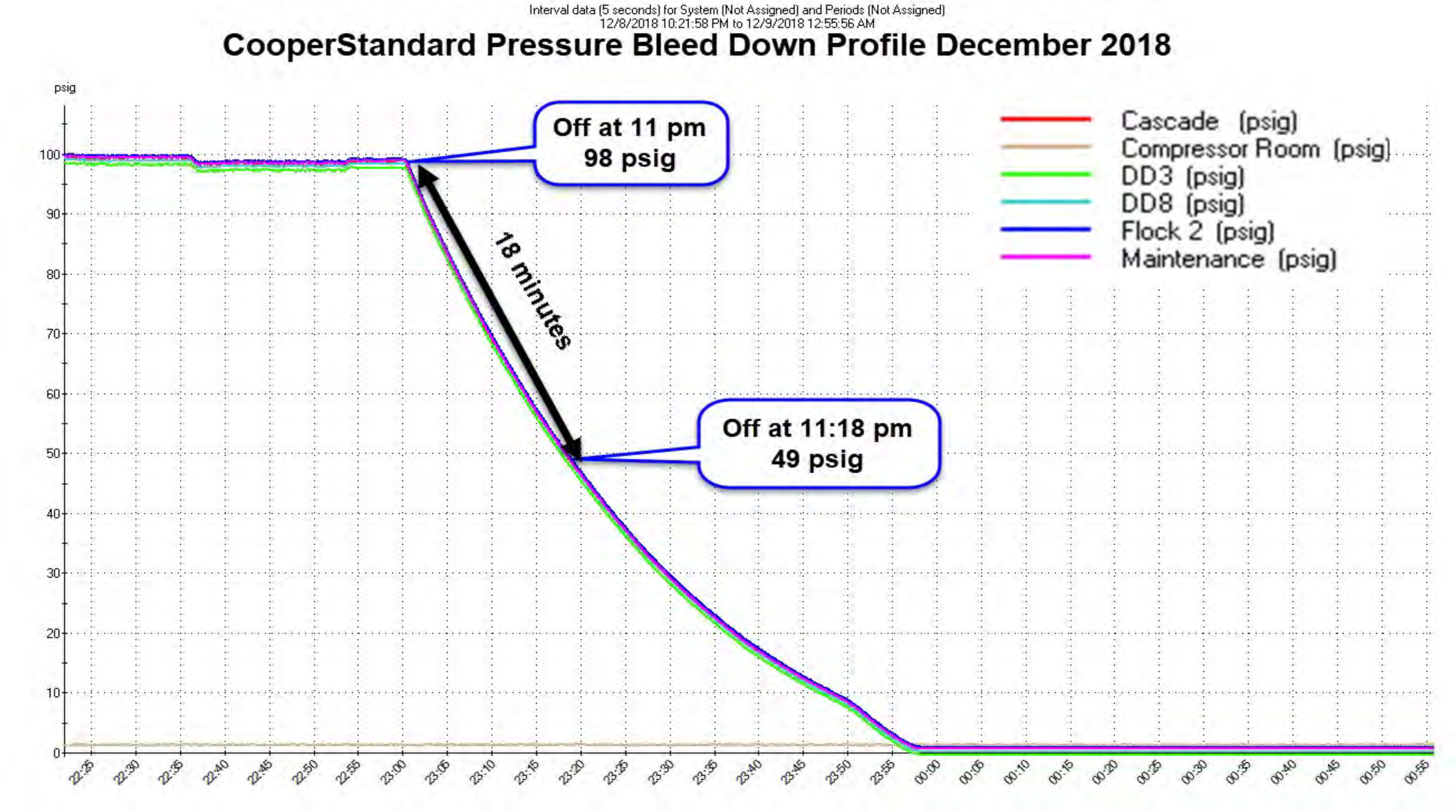
Receiver 1	1000 gal
Receiver 2	1020 gal
Receiver 3	800 gal

Add Receiver Tank

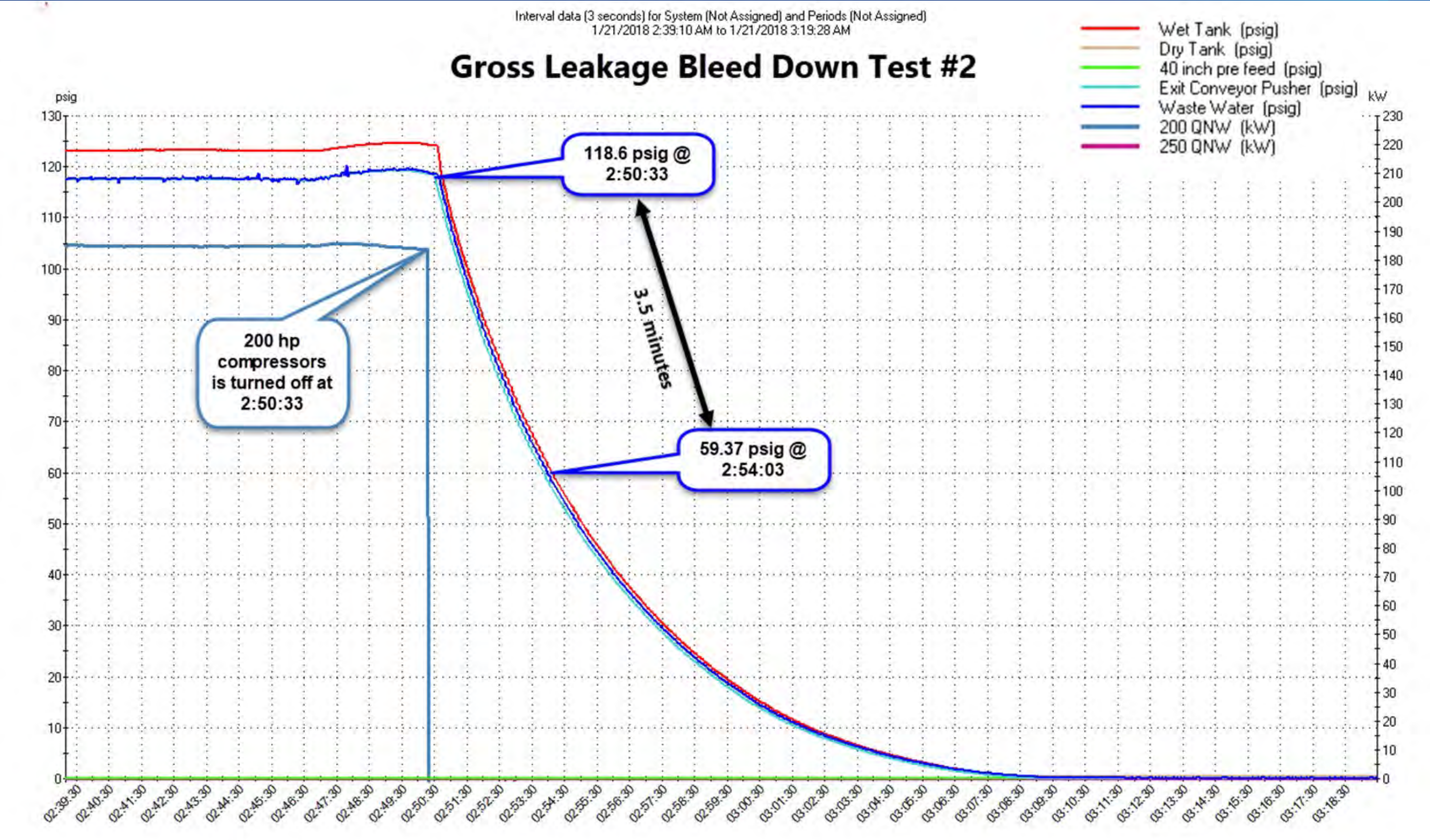
Leak Rate Calculator

Air Pressure - High	0 psi
Air Pressure - Low	0 psi
Discharge Time	0 s
Atmospheric Pressure	0 psia

Total Pipe Volume	**77.63 ft^3**
Total Receiver Volume	**377.01 ft^3**
Total Capacity of Compressed Air System	**454.64 ft^3**



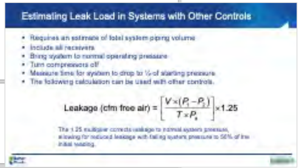
Interval data (5 seconds) for System (Not Assigned) and Periods (Not Assigned)
12/8/2018 10:21:58 PM to 12/9/2018 12:55:56 AM
CooperStandard Pressure Bleed Down Profile December 2018
psig
Off at 11 pm
98 psig
18 minutes
Off at 11:18 pm
49 psig
Cascade (psig)
Compressor Room (psig)
DD3 (psig)
DD8 (psig)
Flock 2 (psig)
Maintenance (psig)
100
90
80
70
60
50
40
30
20
10
0
22:25 22:30 22:35 22:40 22:45 22:50 22:55 23:00 23:05 23:10 23:15 23:20 23:25 23:30 23:35 23:40 23:45 23:50 23:55 00:00 00:05 00:10 00:15 00:20 00:25 00:30 00:35 00:40 00:45 00:50 00:55



Interval data (3 seconds) for System (Not Assigned) and Periods (Not Assigned)
1/21/2018 2:39:10 AM to 1/21/2018 3:19:28 AM
Gross Leakage Bleed Down Test #2
Wet Tank (psig)
Dry Tank (psig)
40 inch pre feed (psig)
Exit Conveyor Pusher (psig)
Waste Water (psig)
200 QNW (kW)
250 QNW (kW)
psig
kW
118.6 psig @ 2:50:33
3.5 minutes
59.37 psig @ 2:54:03
200 hp compressors is turned off at 2:50:33

Bleed Down Test Calculation

Cfm Leakage =	[V x (P1 - P2) x 1.25]/(T x 14.7)						
Where	V=	453.9	Cu ft				
	P1=	118.66	Psig				
	P2 =	59.33	Psig				
	T =	3.50	Minute				
Cfm Leakage =	654.34						
% Leakage =	Measured cfm leakage/total cfm output of plant compressors						
% Leakage =	**32.3%**	Assuming 4cfm/hp and total HP of 450					



System Capacity

SYSTEM CAPACITY

Pipes

Pipe Size (in)	Pipe Length (ft)
3	1150 ft
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Add Pipe

Receiver Tanks

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Add Receiver Tank

Leak Rate Calculator

Air Pressure - High	0 psi
Air Pressure - Low	0 psi
Discharge Time	0 s
Atmospheric Pressure	0 psia

Total Pipe Volume	**77.63 ft^3**
Total Receiver Volume	**377.01 ft^3**
Total Capacity of Compressed Air System	**454.64 ft^3**

Potentially Inappropriate Applications

- Many applications can be served more efficiently by low pressure air from a fan, a blower; or by a vacuum pump, rather than by compressed air. Examples:

- Open blowing
- Sparging (agitating, aerating stirring, mixing)
- Aspirating
- Atomizing
- Padding
- Dilute phase transport
- Dense phase transport
- Vacuum generation
- Personnel cooling
- Open hand-held blow guns or lances
- Cabinet cooling
- Vacuum venturi
- Diaphragm pumps
- Timer drains/open drains
- Air motors

Open Blowing

Air Motors

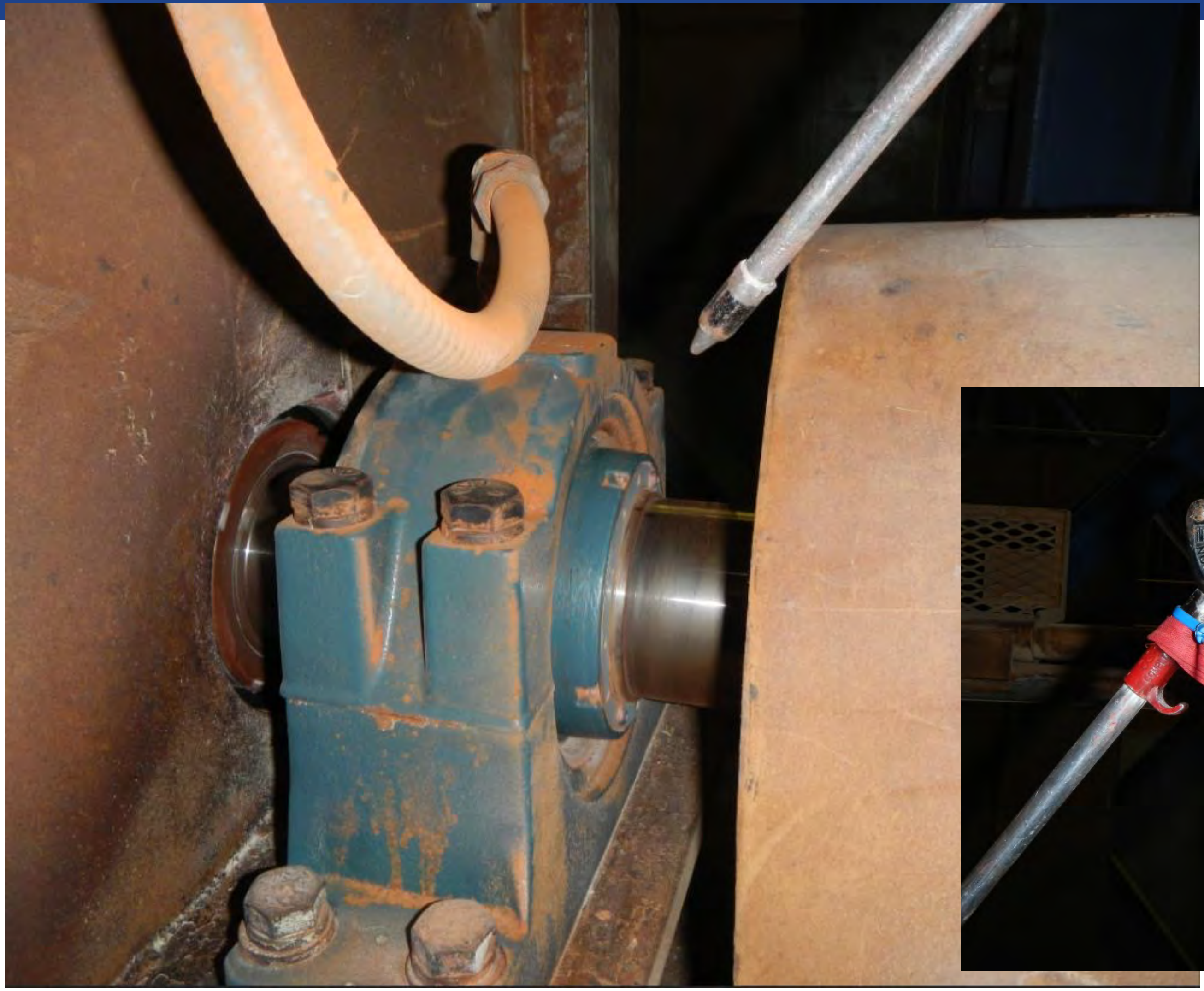
Cooling

Cooling

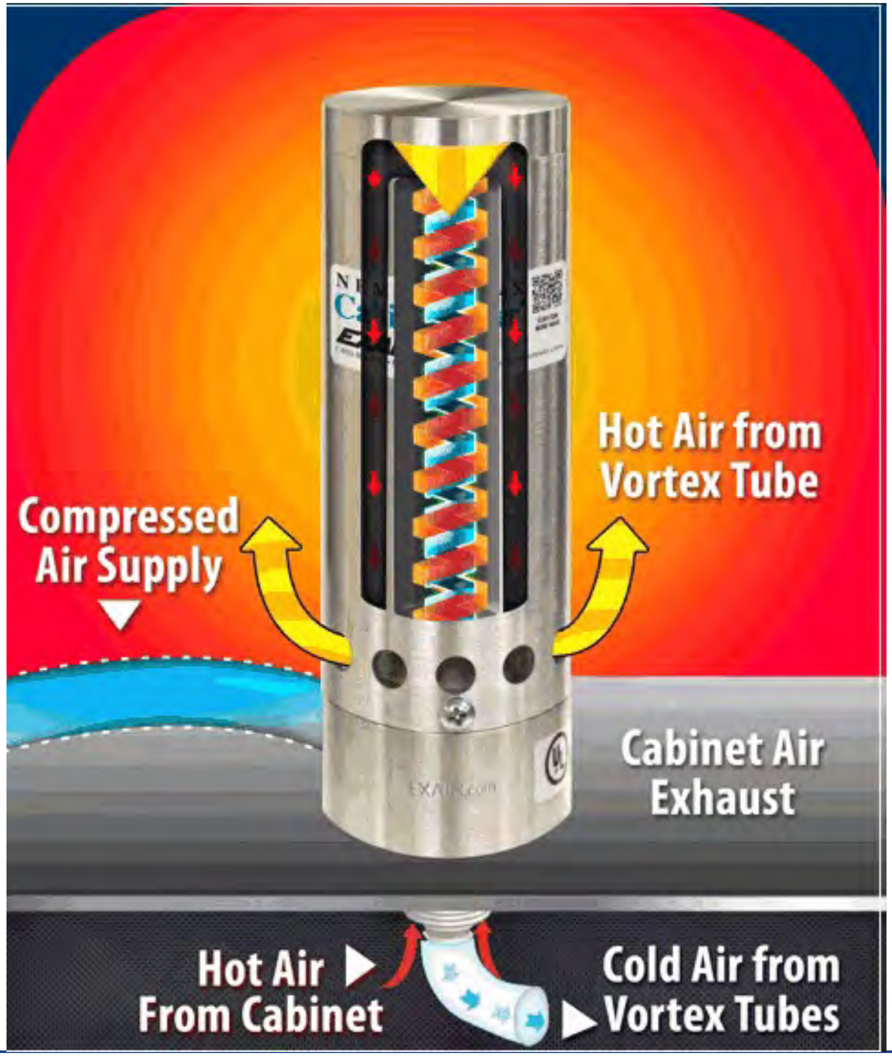
Inlet Pressure- Air Consumption

Model No.	40 psig	60 psig	80 psig
T4-3AMS	36 scfm	50 scfm	62 scfm
T4-3AM	35 scfm	45 scfm	62 scfm
T4-6AM	73 scfm	98 scfm	124 scfm
T4-8AM	114 scfm	152 scfm	193 scfm
T4-10AM	154 scfm	209 scfm	274 scfm

Cooling

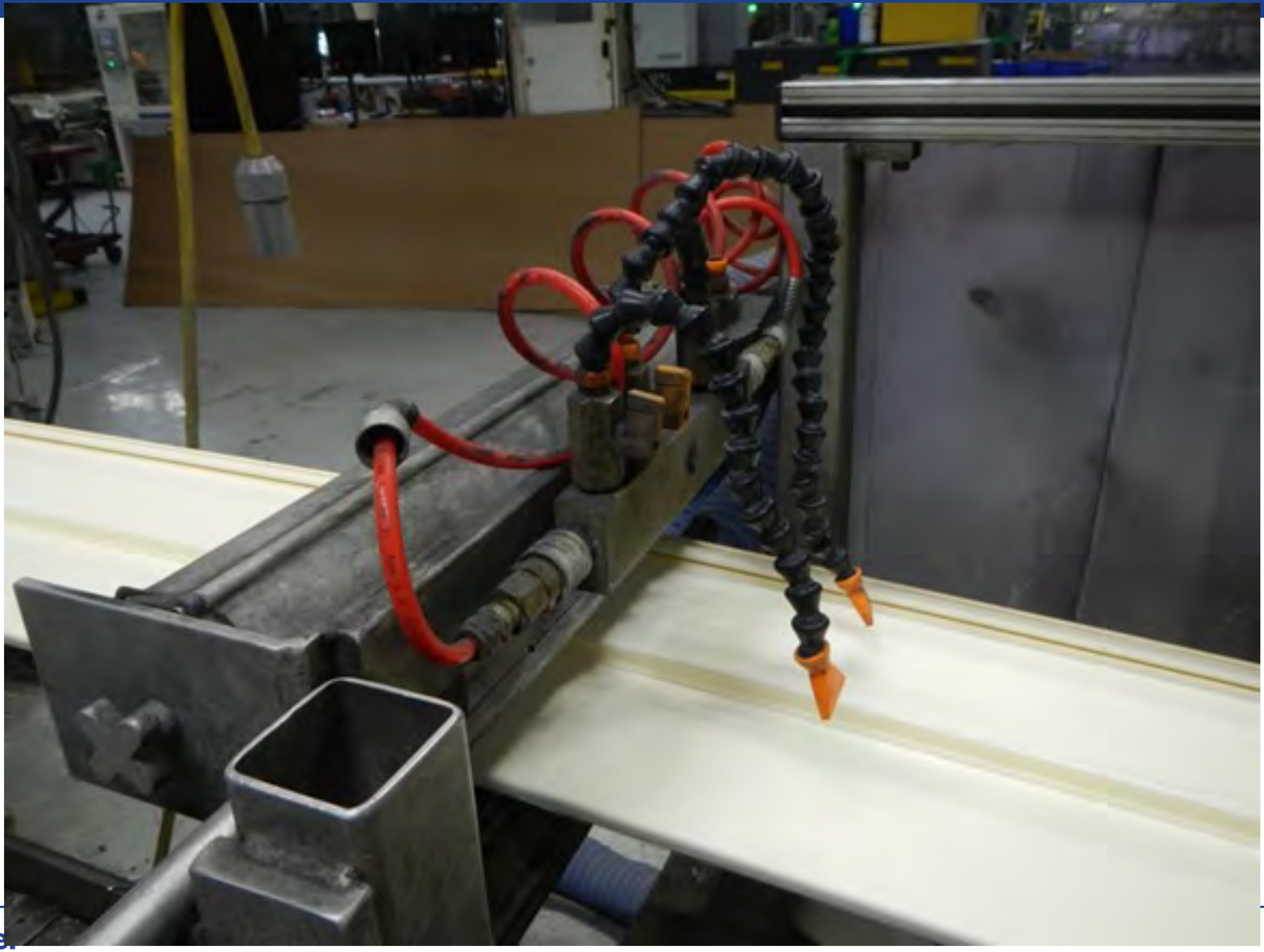


Cooling


Hot Air from
Vortex Tube
Compressed
Air Supply
Cabinet Air
Exhaust
Hot Air
From Cabinet
Cold Air from
Vortex Tubes

VS

Example



Example:

Energy Saving Measures

One nozzle full open valve = 14 scfm, partial open valve = 10 scfm
This one line with 3 nozzles = 42 scfm x $117/cfm/year = $4,914/yr

50 air nozzles at 10 scfm each = 500 scfm x $117/cfm/year = $58,500

3 hp blower 70 cfm, using 2.2 kW running all year = $1,156
Blower plus manifold cost $3,000

Life Cycle Cost Example

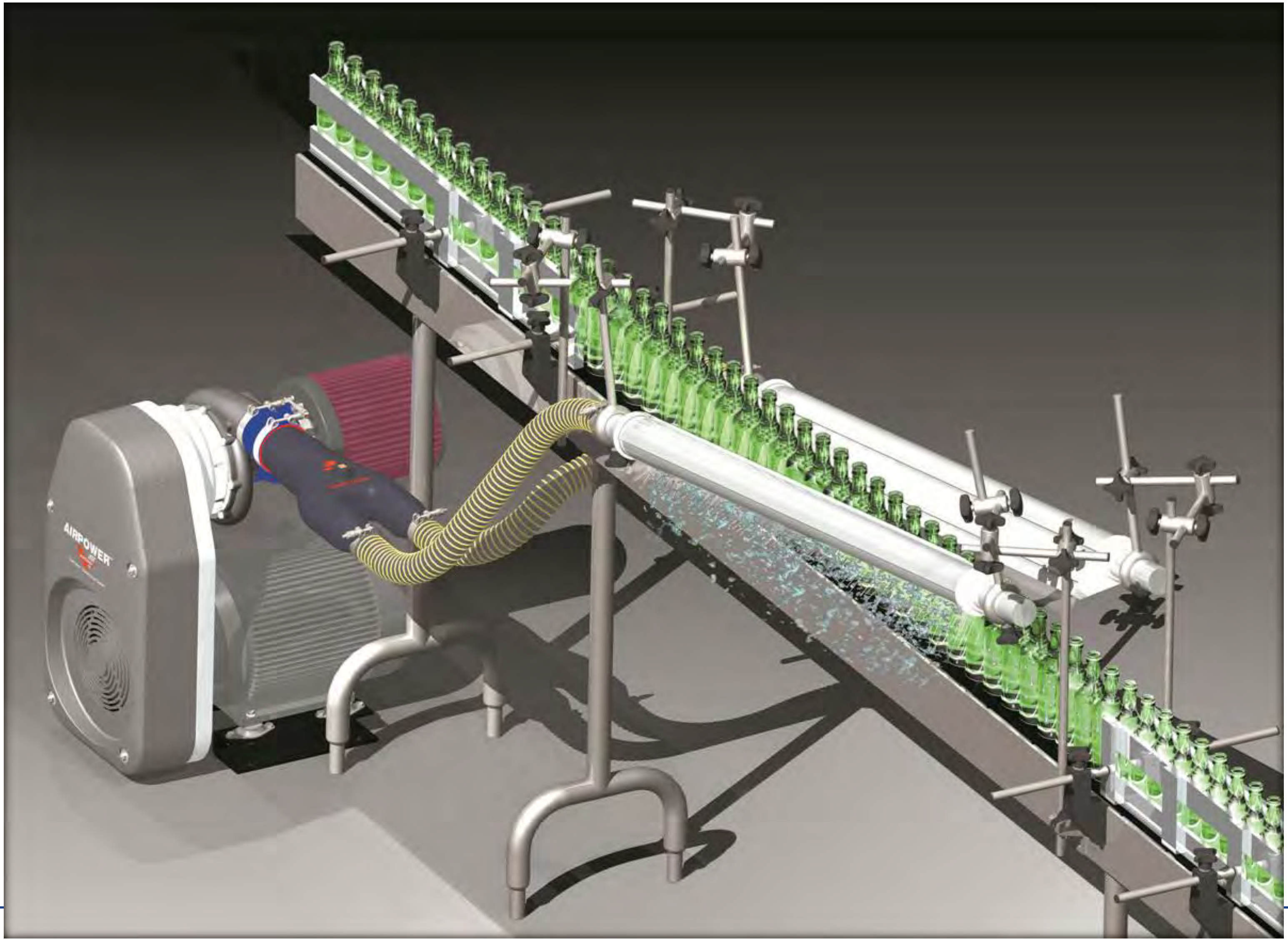
- **Proposed Nozzle replacement with blower:**
- Three Nozzles consumes 42 cfm
- Compressed Air costs $117/cfm/year
- Blower to replace Nozzles
  - $3,000 investment
  - $1,156 per year to operate
- **Annual uniform benefit:**
  - 42 cfm x ($117/cfm/yr) - $1,156/yr = $3,758/yr
  - $4,914/yr - $1,156/yr = $3,758/yr
- **Simple payback:**
  - **$3,000 (investment) ÷ $3,758 (AUB) = 0.79 years or just over 9 months**

Energy Saving Measures

Potentially Inappropriate Applications

Potentially Inappropriate Applications

Appropriate Applications



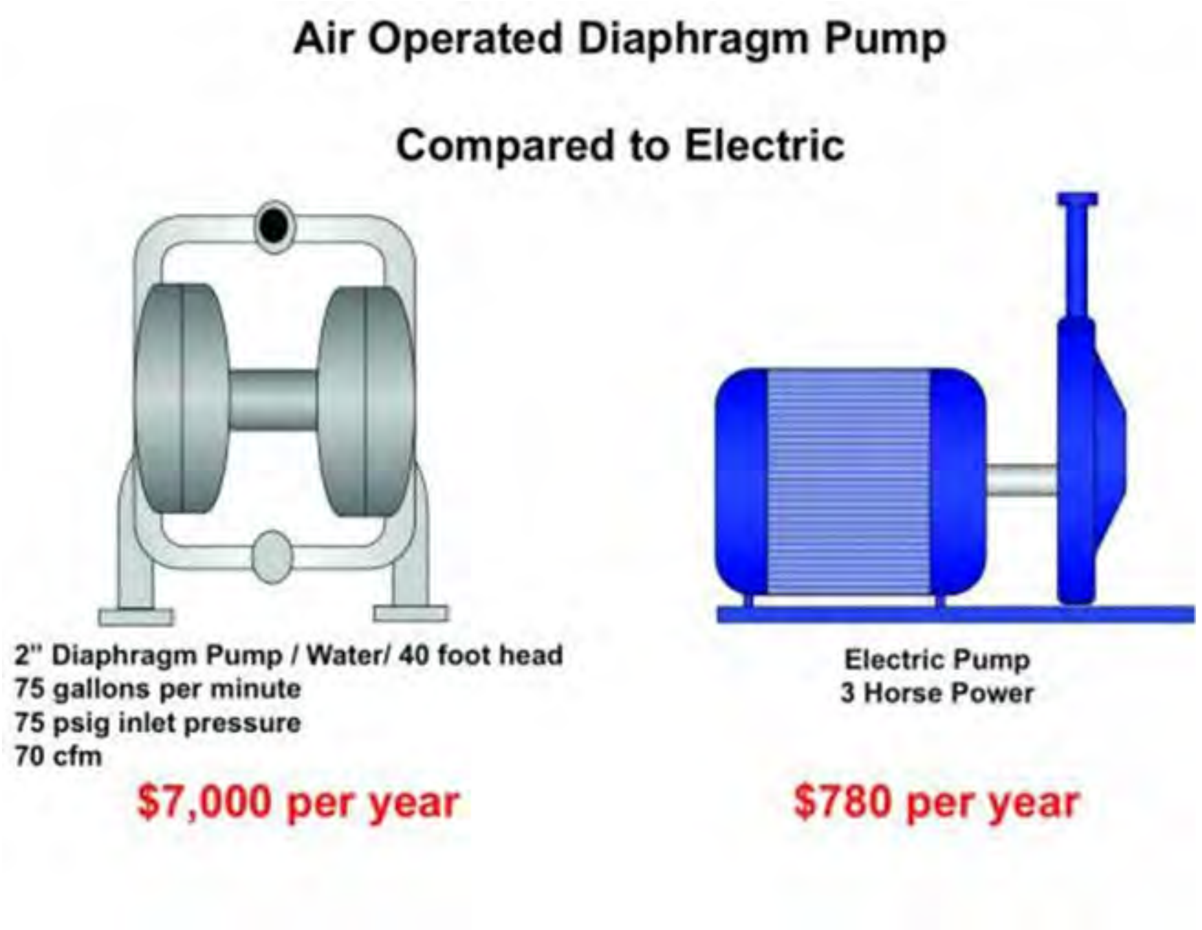
AOD Pumps

- It is not unusual for an operation to have AOD pumps already in place because there's a good chance they arrived at the plant from an equipment supplier as part of the package, or someone selected them in the past.
- Regardless of how they got to the plant, there are number of reasons why they are widely used in a variety of industries.
- For one, they work well if they are "big enough."

Appropriate Applications

AOD Pumps

- A 2-inch AODD pump will use an average of 90-120 cfm of compressed air at 95psig or 23 hp to 30 hp of compressed air supply.
- An electric-driven pump under the same conditions would draw between 3 hp and 5 hp.
- If the net horsepower savings here is an average of 21 hp, it translates to a savings of $7,000 per year (x.746/.10 = 16.5kw x $.06kwh x 8000 hr/y) when an electric-driven pump is used for power rather than compressed air under these conditions.



Appropriate Applications

Appropriate Applications

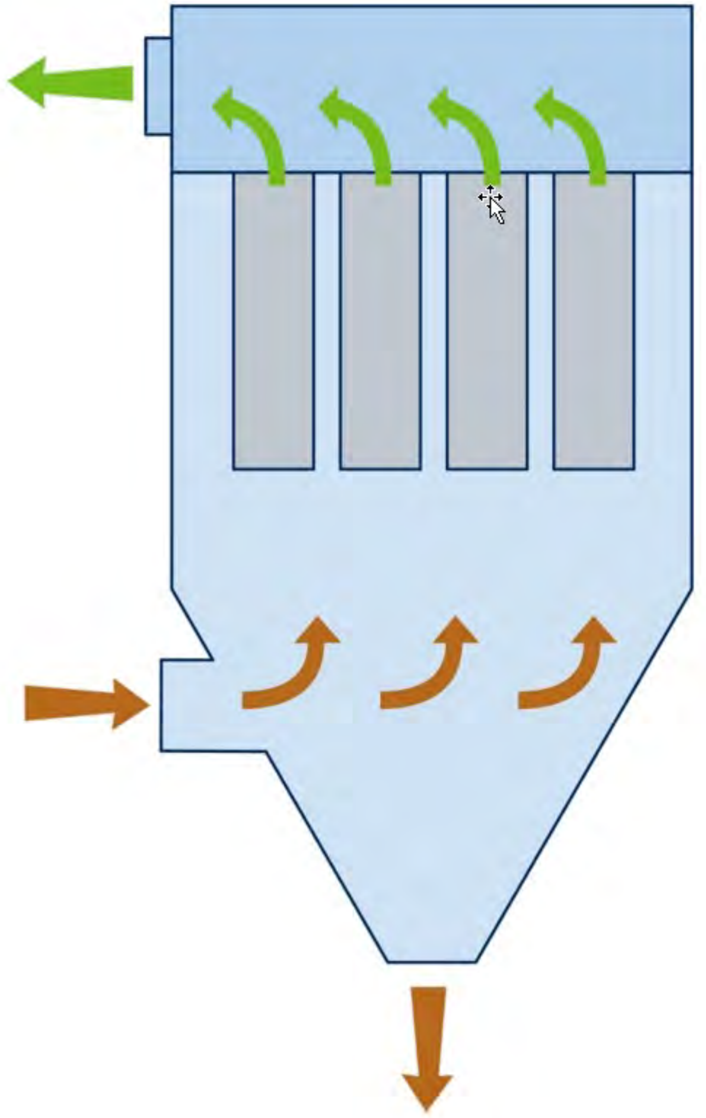
Appropriate Applications

Dust Collectors

- Most industrial dust collectors use compressed air to clean and extend the life of their filters.
- This is typically accomplished using short pulses of compressed air inside of the individual bag filters or cartridge filters in order to blow or knock the dust off of the outside of the filter.
- Those responsible for the operation of industrial dust collectors need to manage the compressed air supplied to the dust collector to ensure proper performance while controlling operational costs.
- Doing so helps reduce costly compressed air consumption, maximizes dust collector airflow performance, and reduces collector maintenance and down-time costs.

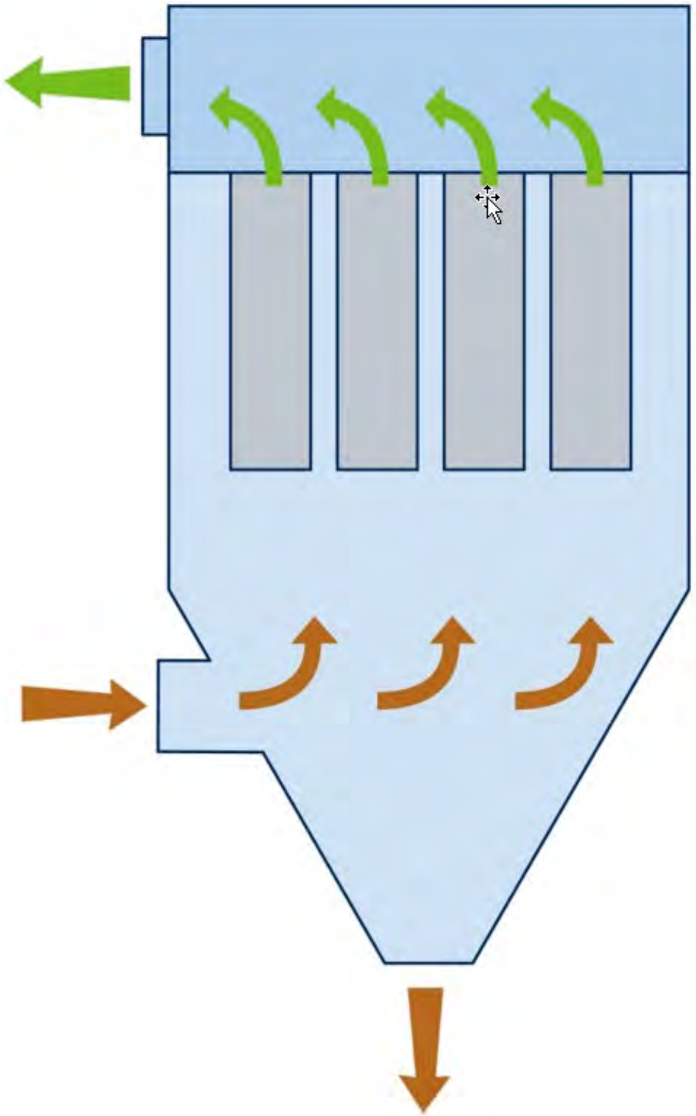
Dust Collectors

- Clean-On-Demand vs. Continuous Cleaning
  - The first tip for controlling compressed air consumption for industrial dust collectors is to invest the extra money for quality on-demand-cleaning controls when buying your industrial dust collector.
  - Many collectors come standard with a control panel that continuously and automatically pulses filters with compressed air every 10 or 15 seconds — whether the filters need to be cleaned or not. This adds unnecessary costs for multiple reasons.

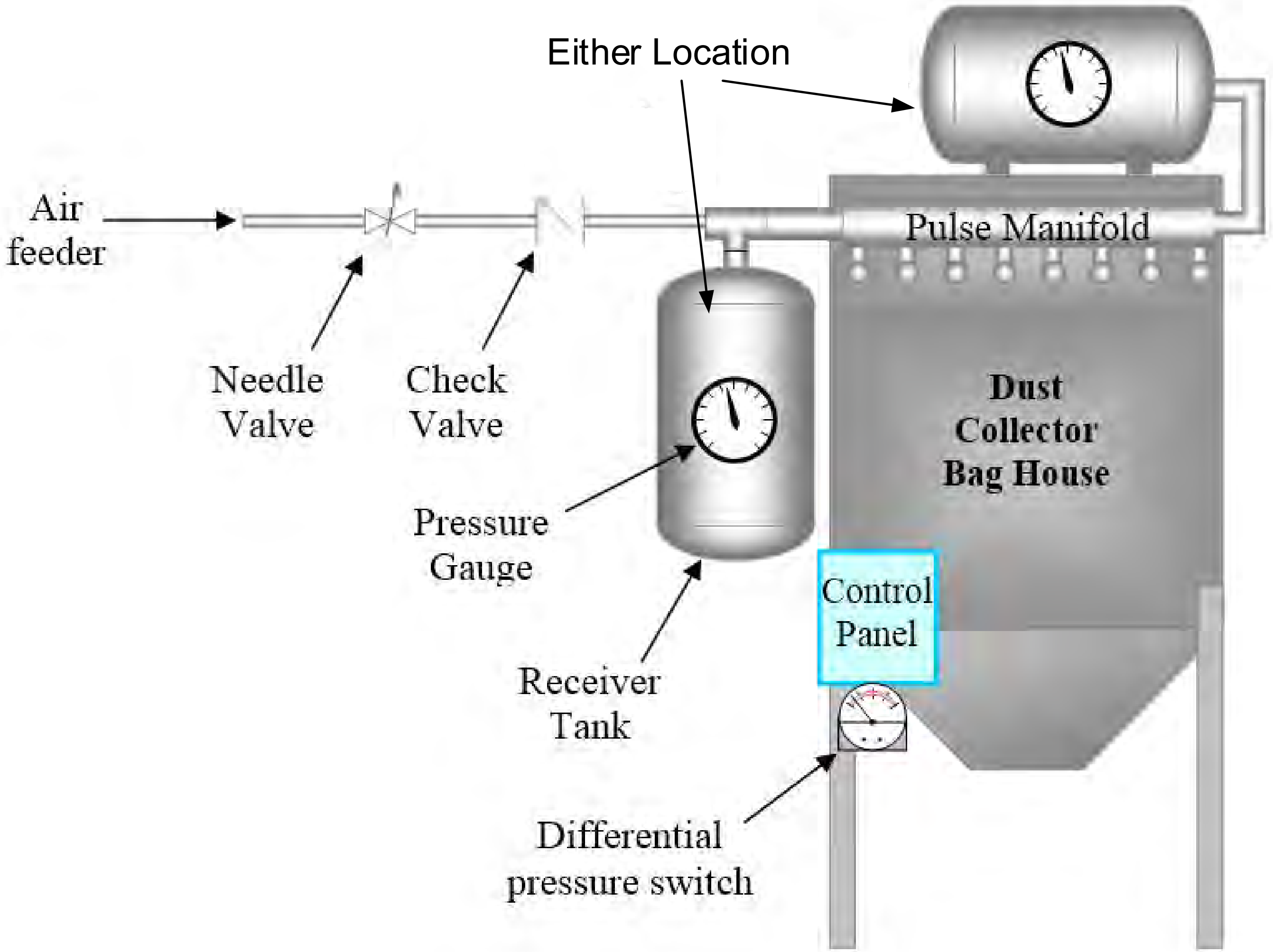


Dust Collectors

- First, in most situations with continuous cleaning, more compressed air is being consumed than is needed to maintain stable collector operation.
- Depending on how a collector was initially sized and the volume of dust the collector is handling, it is likely that the frequency of cleaning (and the compressed air consumption) can be cut in half.
- In the case of a 50,000-cfm dust collector, a 50% reduction in pulsing could result in an annualized savings of over $1,300.
- This calculation assumes the collector is running two 8-hour shifts per day, 5 days per week.
- This kind of savings could easily offset the investment of an on-demand controller in a month or two.

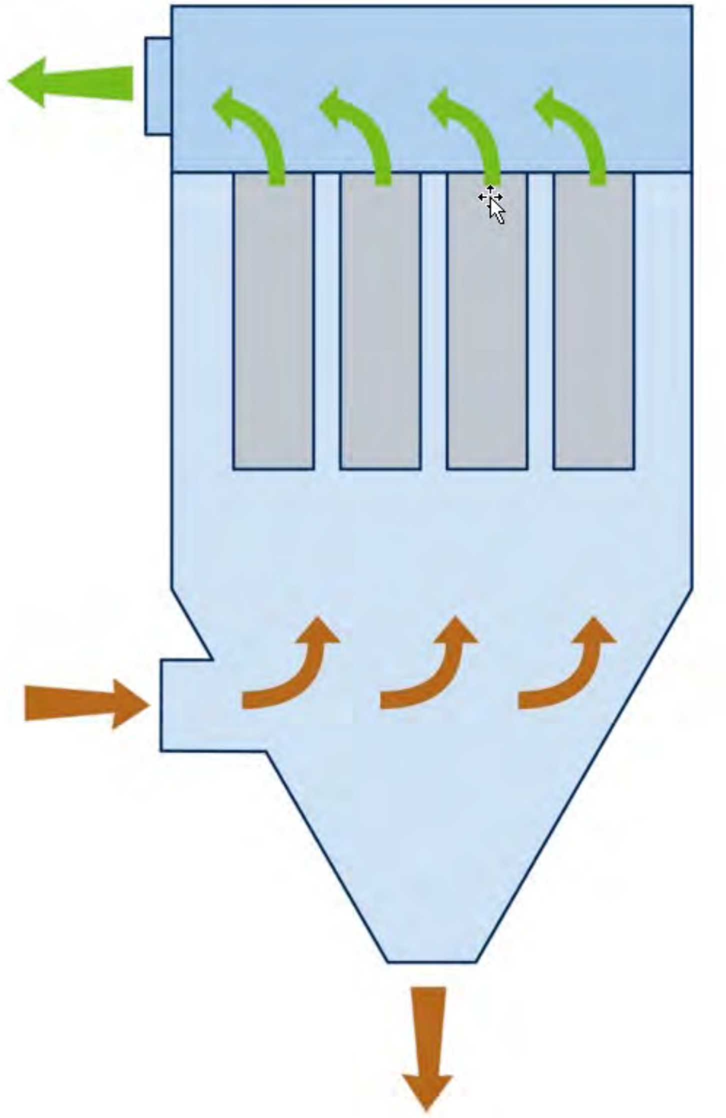


Point of Use Storage

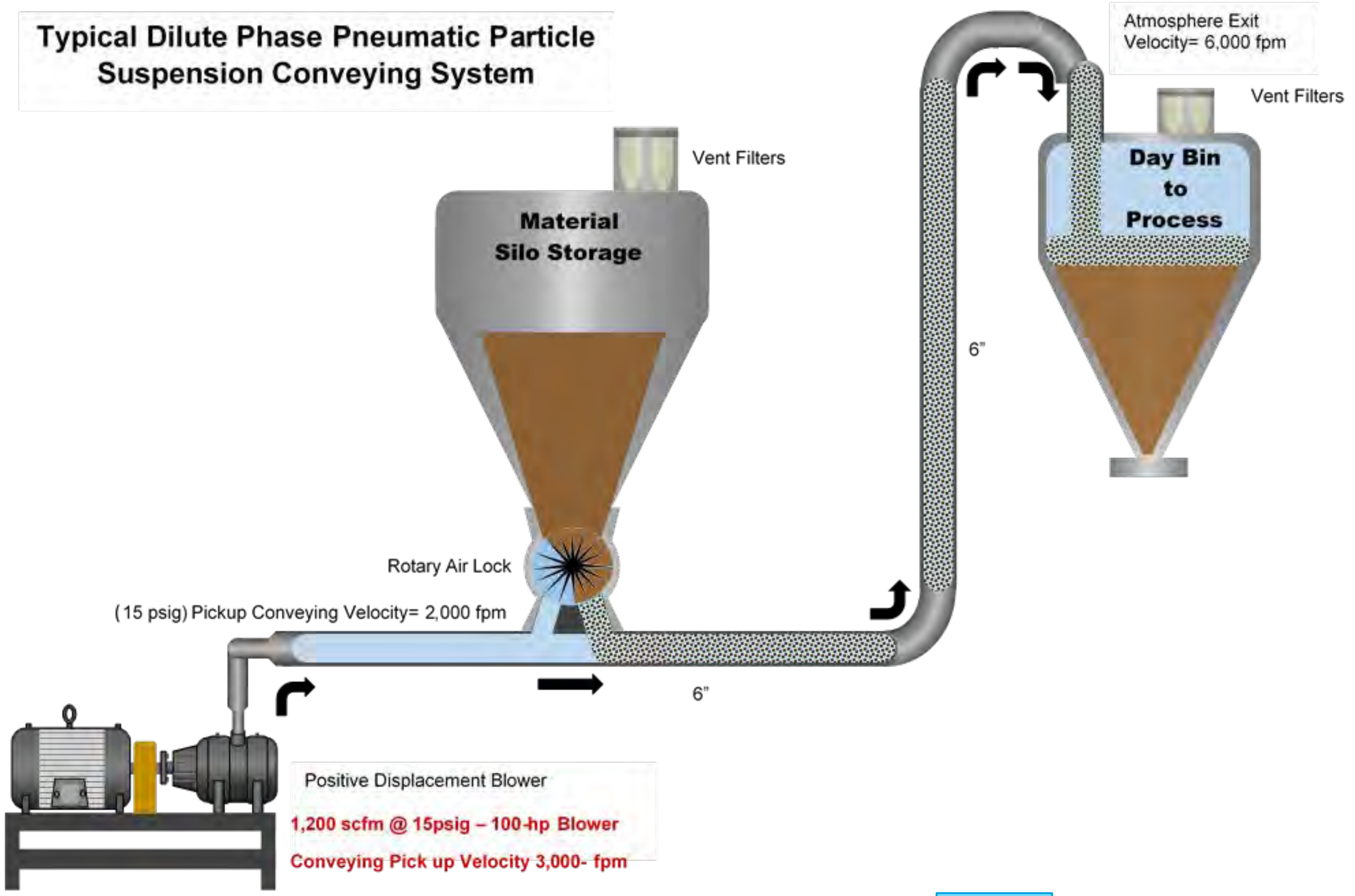


Dust Collector Best Practices

- Use proper line size to handle rate of flow without high pressure loss.
- Monitor inlet pressure and drop at pulse.
- Monitor flow.
- Use appropriate regulator with dedicated storage and metered refill to supply air without pulling down local pressure in surrounding piping.
- Too much pressure loss at pulse will deliver incomplete cleaning.
- When you are dealing with pulse demands of less than several seconds, regulation of the actual air to the pulse jet is **almost never** appropriate.

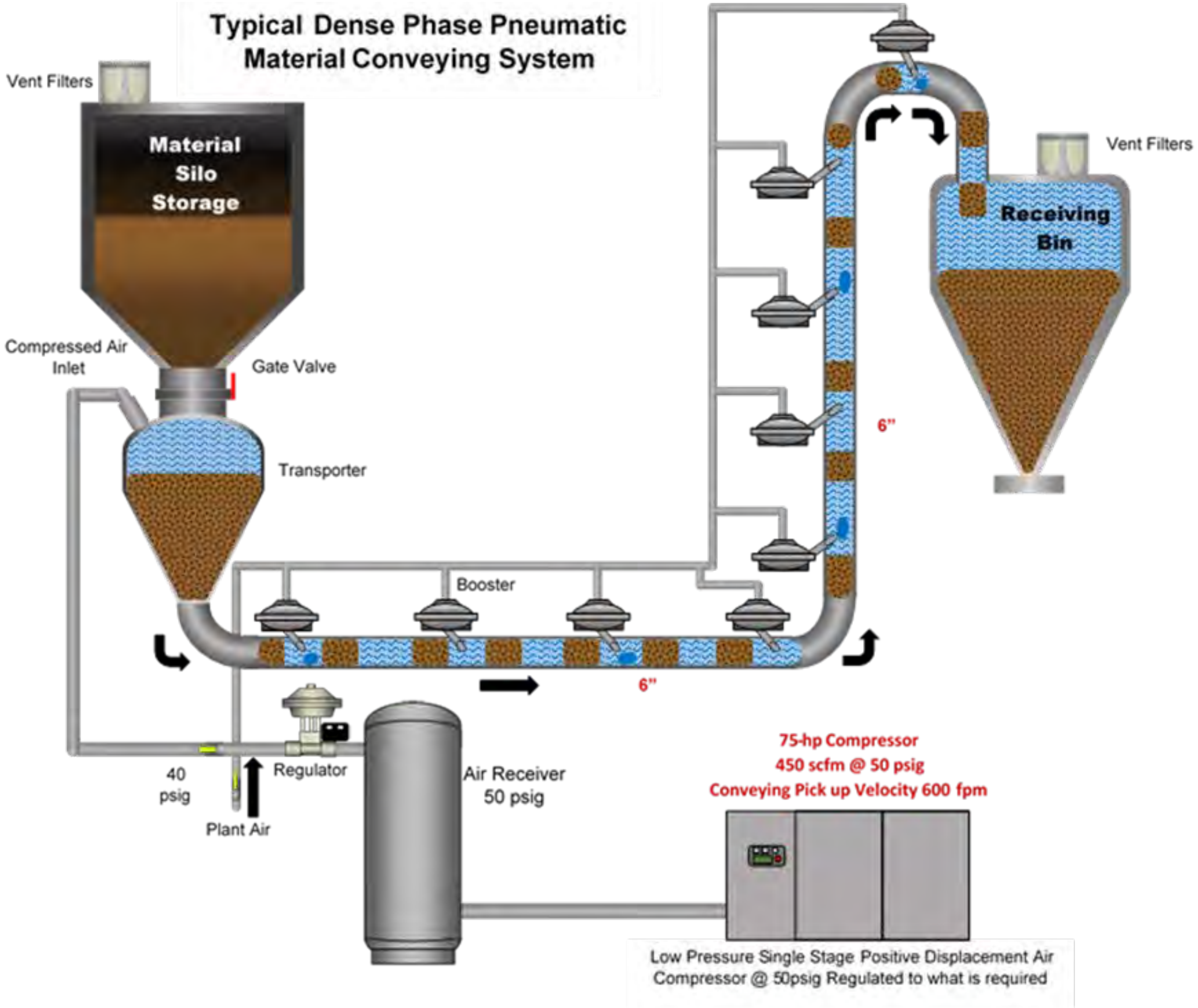


Dilute Phase Conveying



- Blower pressure 6-15 psig
- Particle velocity about 2,000 fpm
- Usually carries the highest product flows
- Material must be able to handle higher velocities

Dense Phase Conveying

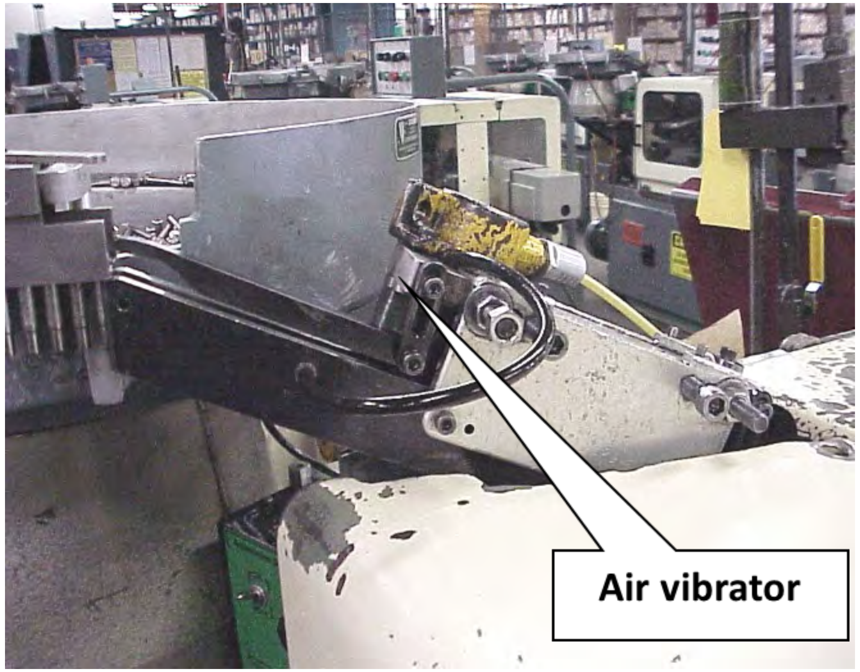


- Compressed air 15 psig up to 50 psig.
- Particle velocities 100 to 1,000 fpm.
- Generally lower product flow than dilute.
- Used for products not able to handle higher velocities due to product deterioration or extreme wear.

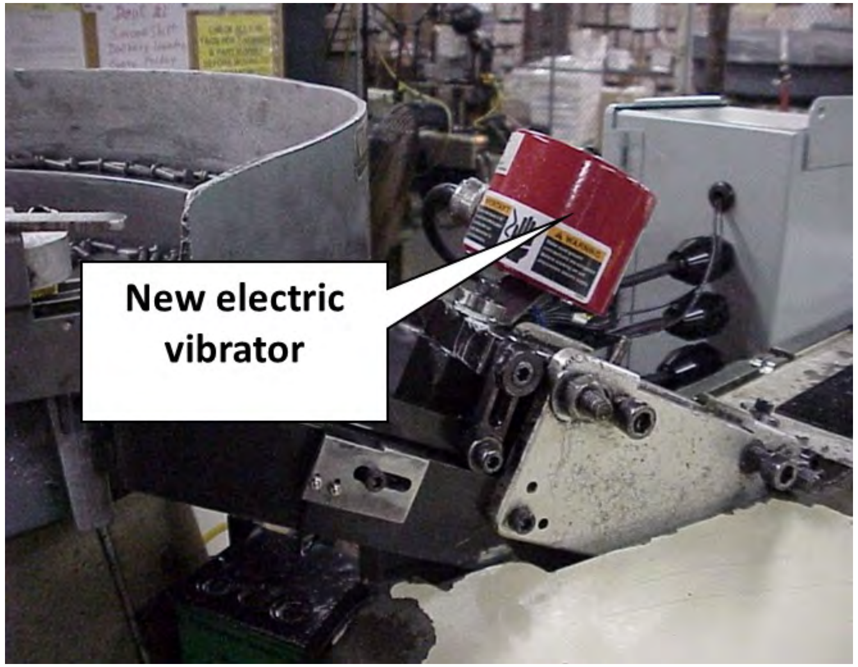
Other Missed Demand Reduction Opportunities

- Additional and often missed demand reductions include the following:
  - Air Vibrators
  - Industrial Vacuums
  - Air Movers and Air Horns
  - Agitation
  - Air Motors
  - Air Hoists
  - Air Motor – Driven Mixers

Air Vibrators vs. Electric Vibrators



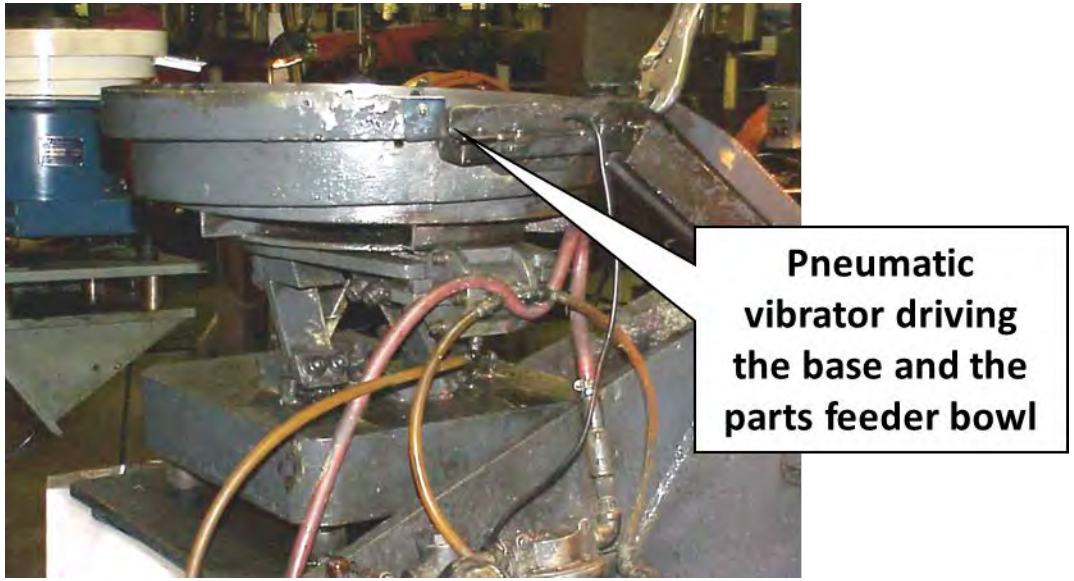
Air Vibrators - $700/year

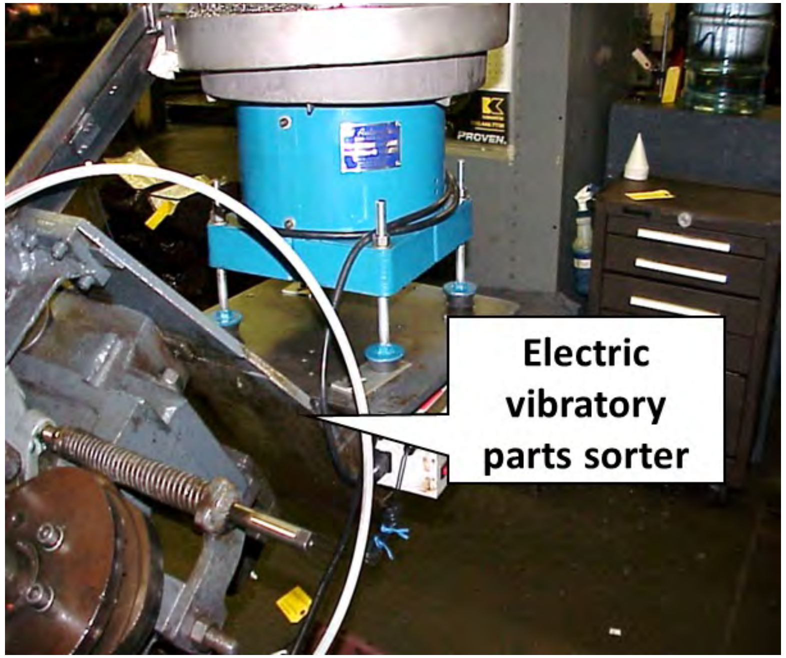


Electric Vibrators $109/year

Vibrator Parts Sorters

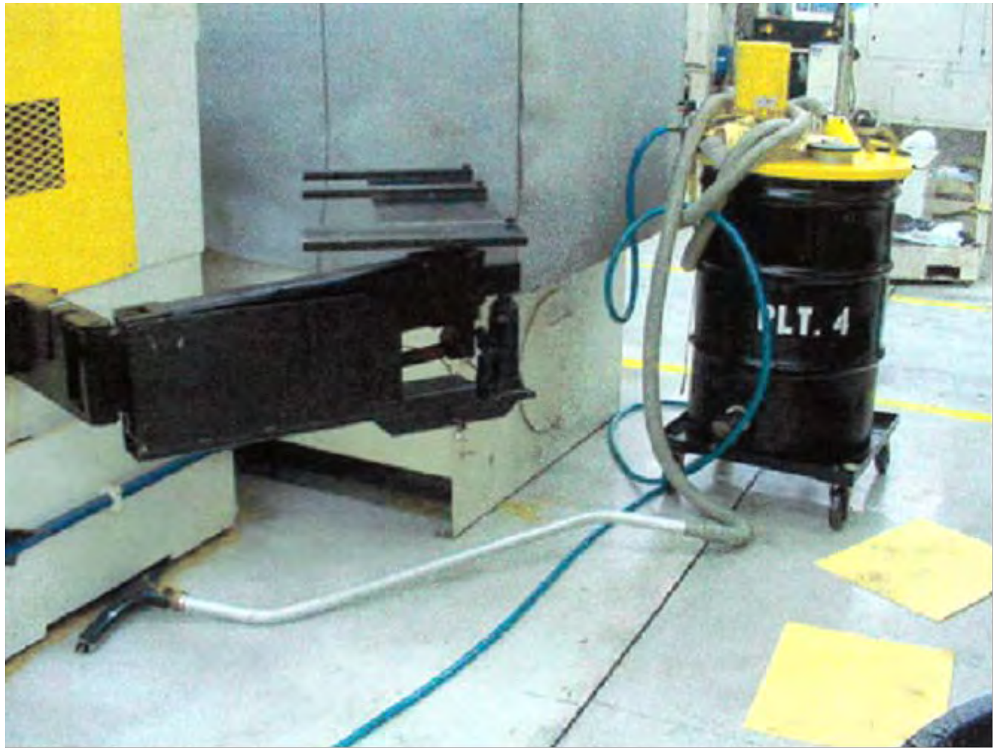
Compressed Air $800/yr.





Electric $100/yr.

Industrial Vacuum Cleaners Liquid & Cuttings



Air-driven vacuum system for cutting fluids, running continuously with machine off – 24/7 operation
$6,000 year

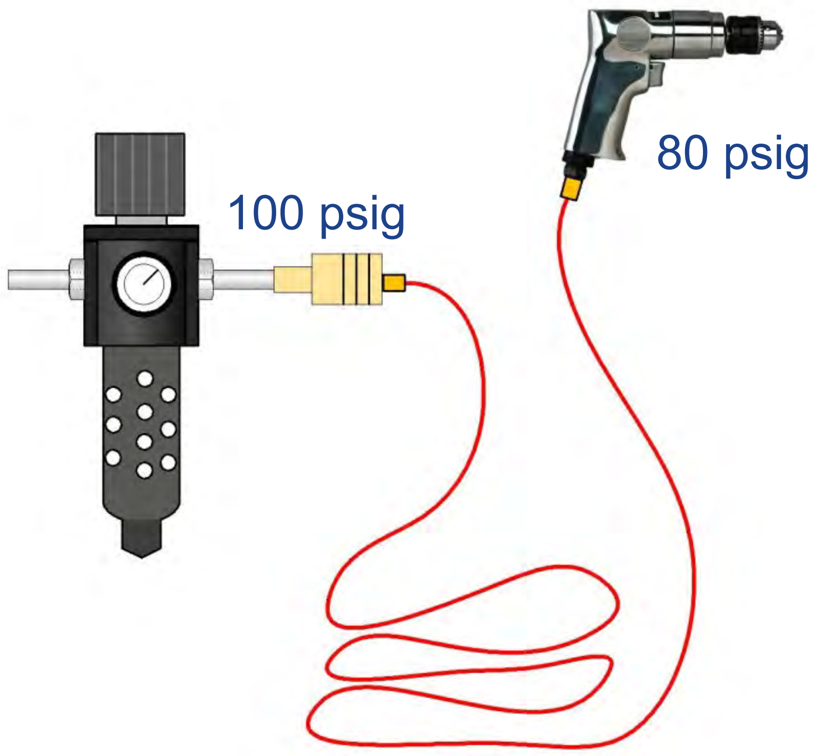
Electric motor-driven vacuum system for cutting fluids. Off, not running
$878 year

System Pressure Drop Losses (Most Important)

- Many systems have outgrown their original size requirements.
- Distribution pipe diameters are too small . Velocities should not exceed 20 ft/sec.
- Filters should be sized for maximum flow conditions. (Peak Flows)
- Hoses and connectors are problematical.

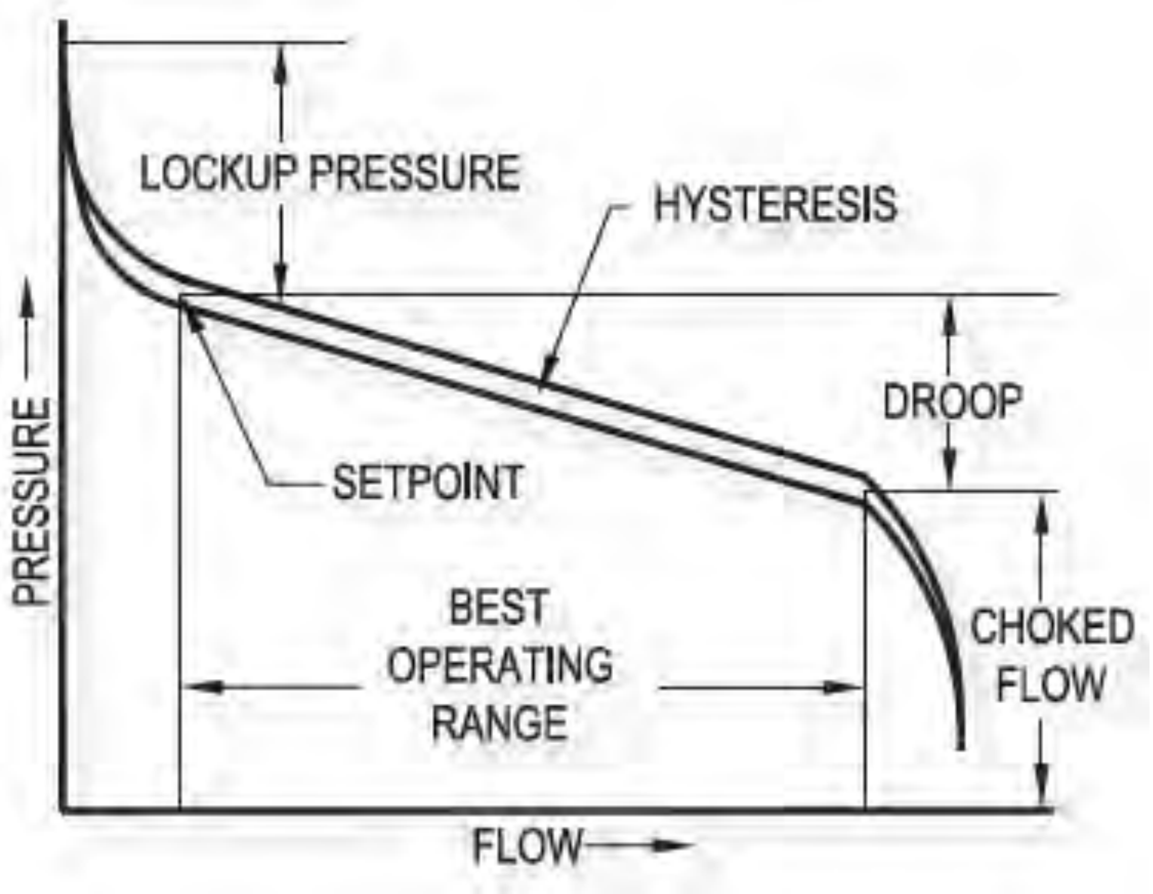
End Use Control

- A pressure regulator is used to limit maximum end-of-use pressure and is placed in the full distribution system just prior to the tool.
- If a tool operates without a regulator, it uses full system pressure.
- This results in increased system air demand and energy use, since the tool is using air at this higher pressure.
- High pressure levels can also increase equipment wear, resulting in higher maintenance costs and shorter tool life.



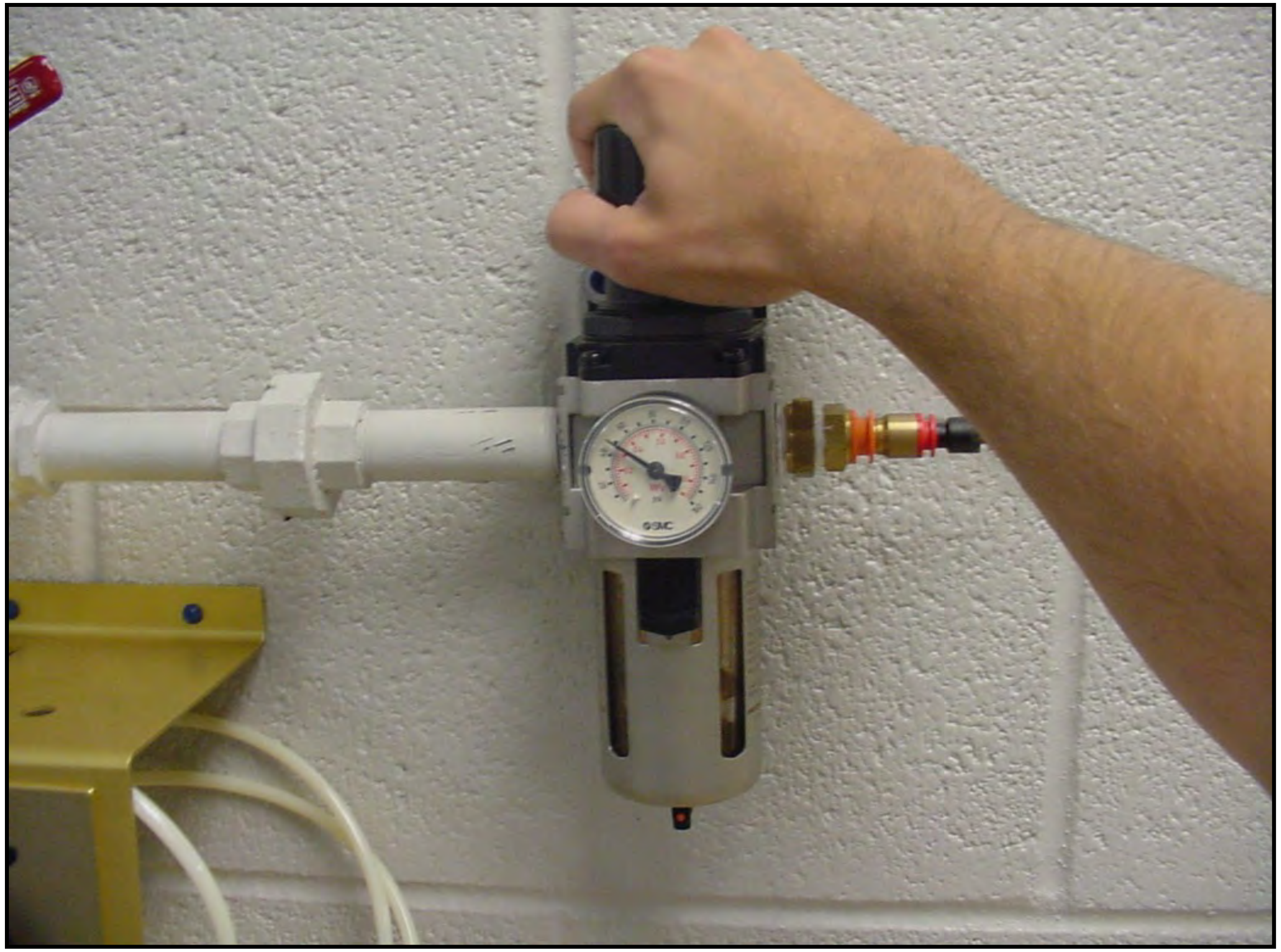
Regulators

- The accuracy of a pressure regulator is determined by charting outlet pressure versus flow rate.
- The resulting graph shows the drop in outlet pressure as the flow rate increases.
- This phenomenon is known as droop.
- Pressure regulator accuracy is defined as how much droop the device exhibits over a range of flows; less droop equals greater accuracy.
- When selecting a regulator, you should examine pressure versus flow curves to ensure the regulator can meet the performance requirements necessary for the proposed application.
- Size these components based upon the actual flow rate (peak flow), not the average flow rate.

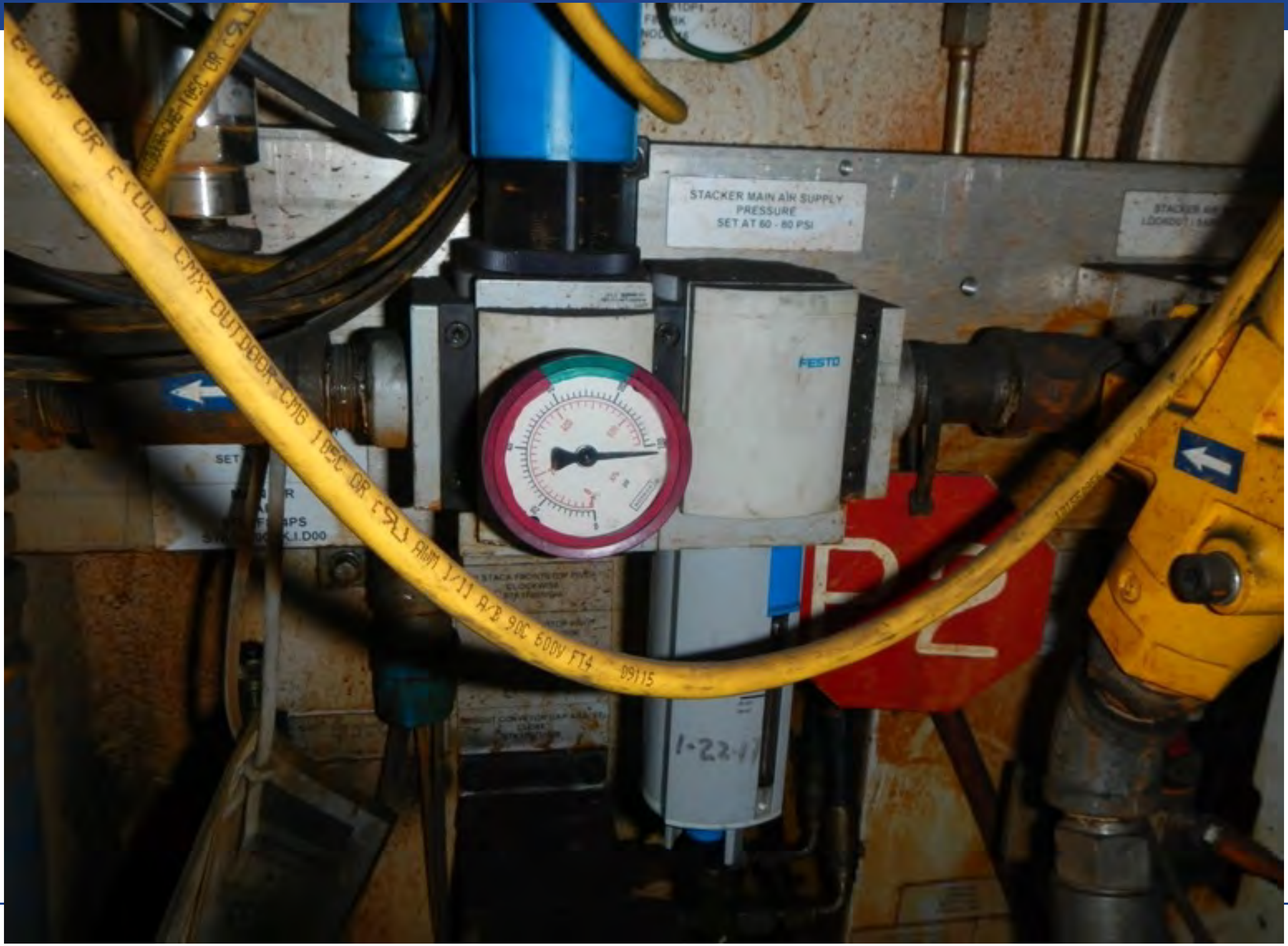


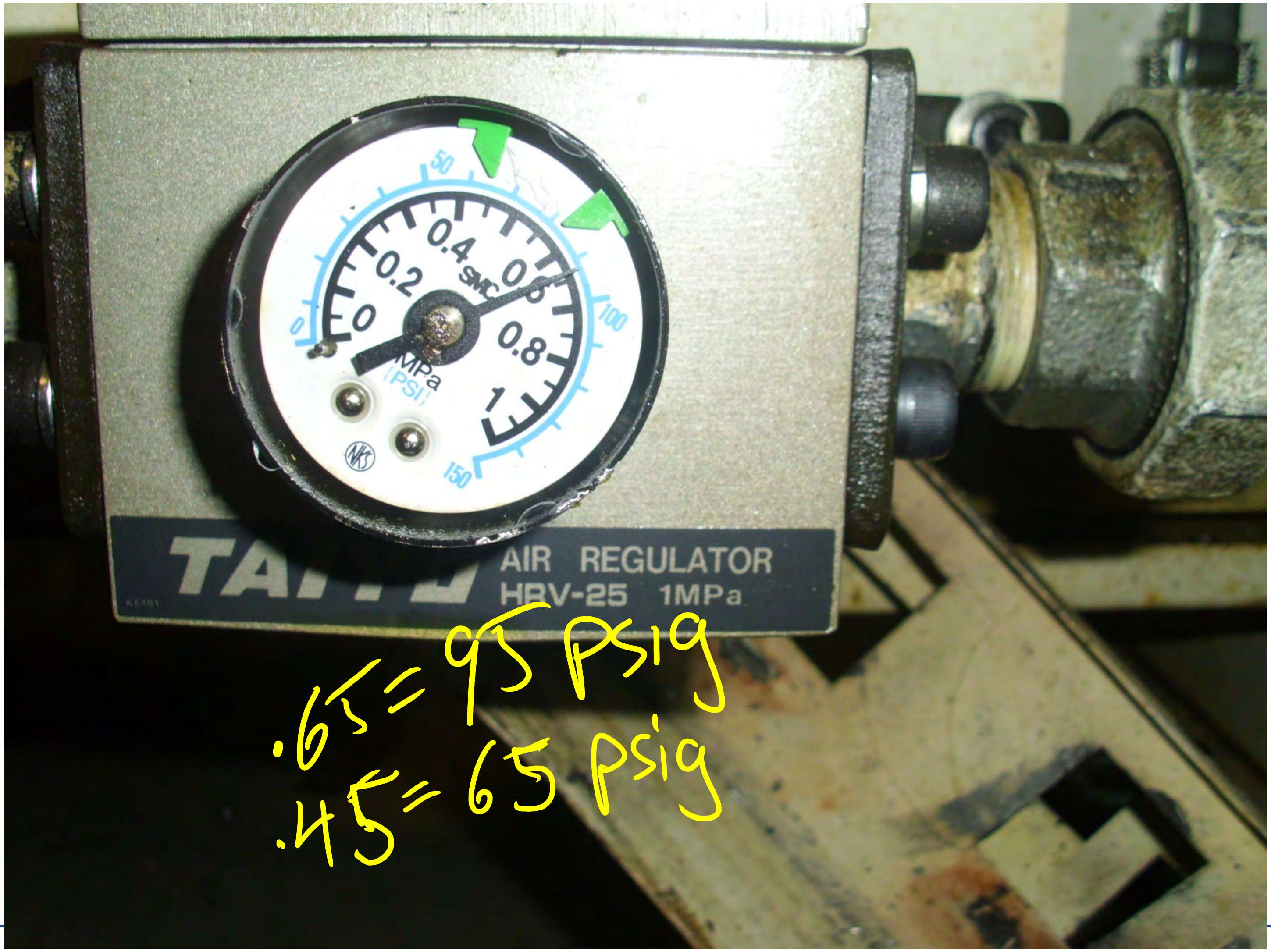
Over-Pressurization Examples

- Equipment operators rarely understand the relationship between flow and pressure. What leads to excessive pressurization of pneumatic systems?
- Misdiagnosis of equipment malfunction
- Flow rate increases force a “droop” in downstream pressure
- Mismanaged point-of-use filtration
- In each case, equipment operators respond by increasing the pressure at the regulator.

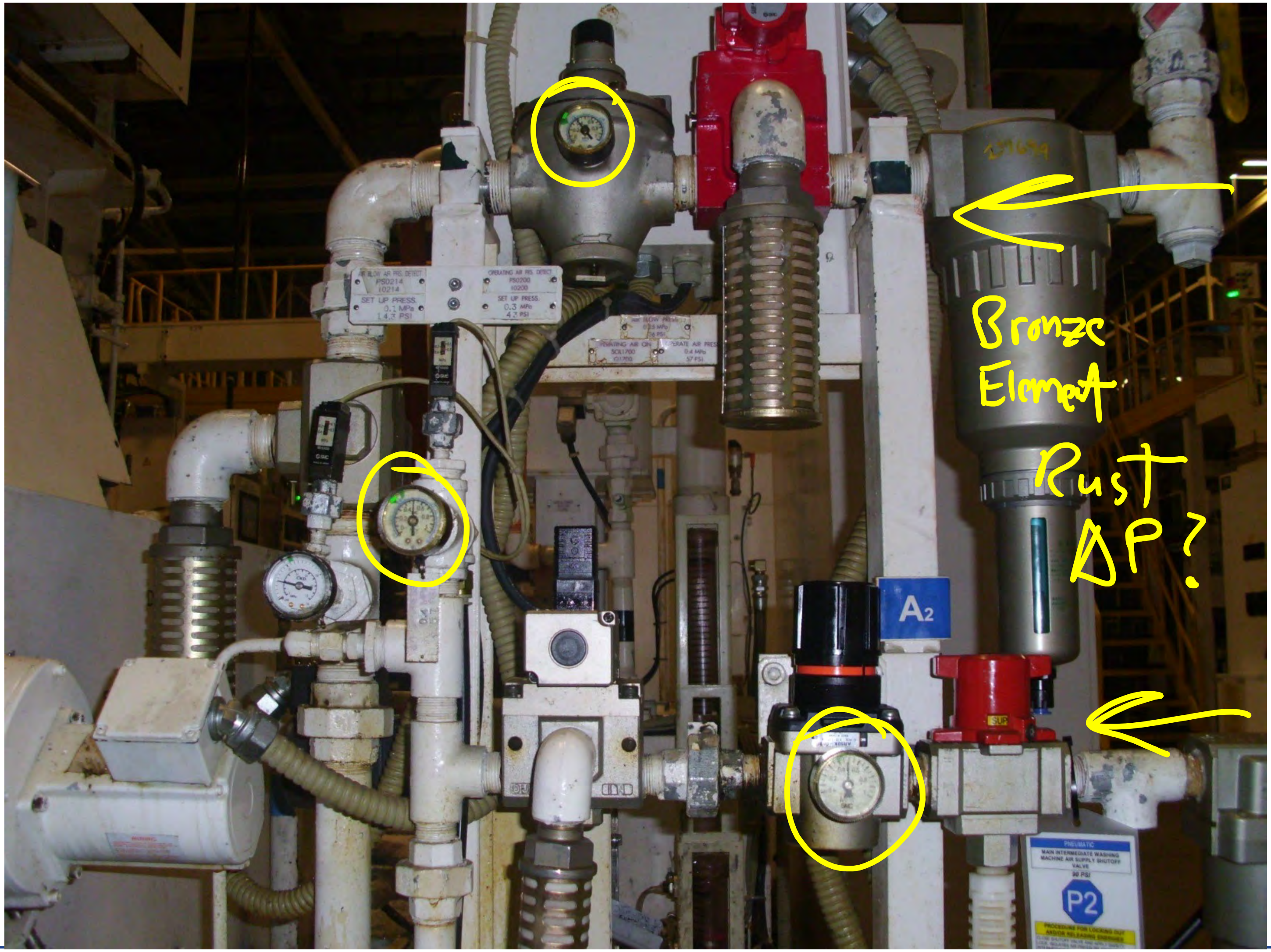


Pressure at points of use.

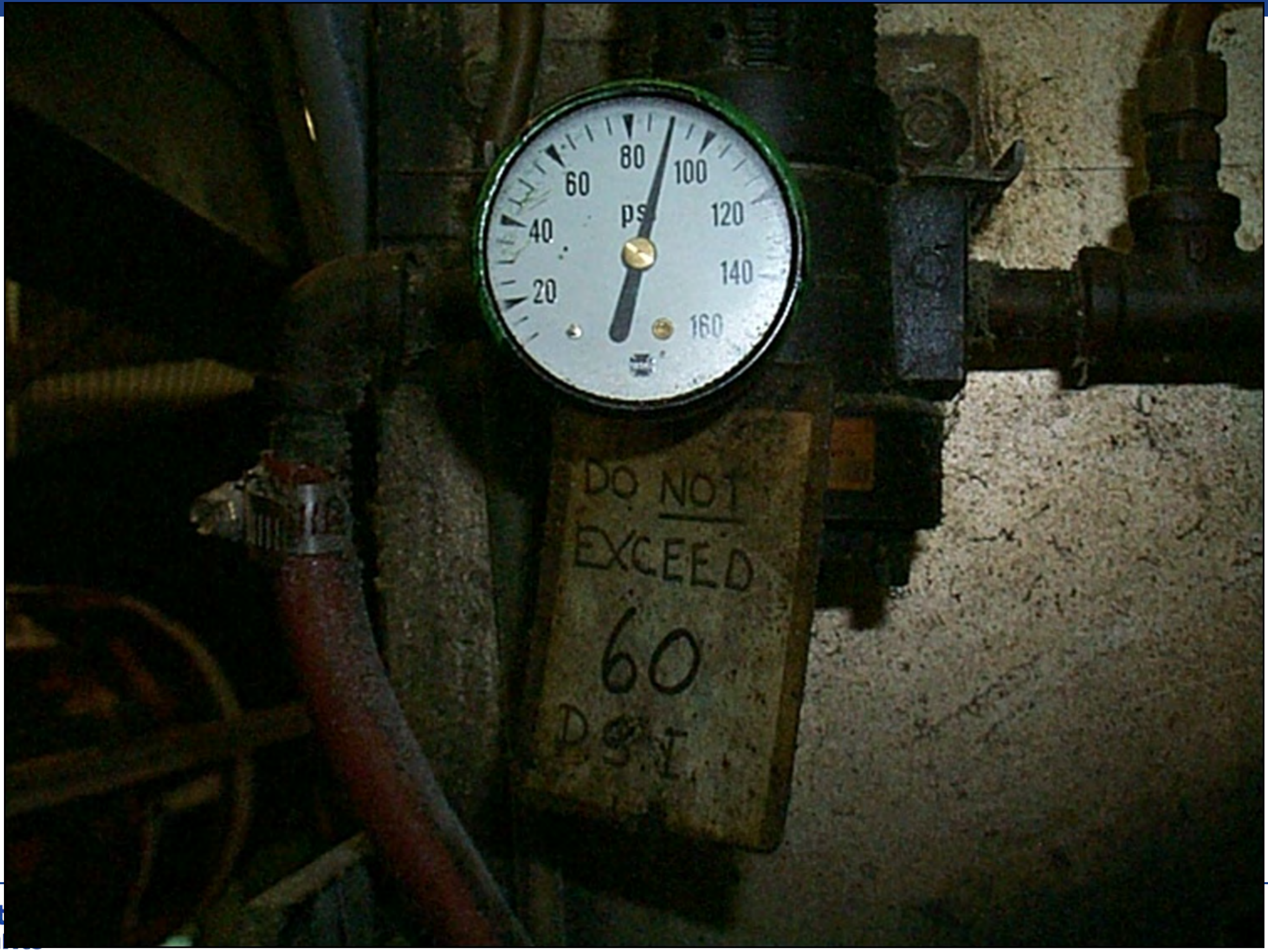




0.2
0.4
0.6
0.8
0
1
50
100
150
SMC
MPa
(PSI)
AIR REGULATOR
HRV-25 1MPa
.65 = 95 psig
.45 = 65 psig


Bronze
Element
Rust
ΔP?
A2
P2

Pressure at points of use.



Pressure Drop

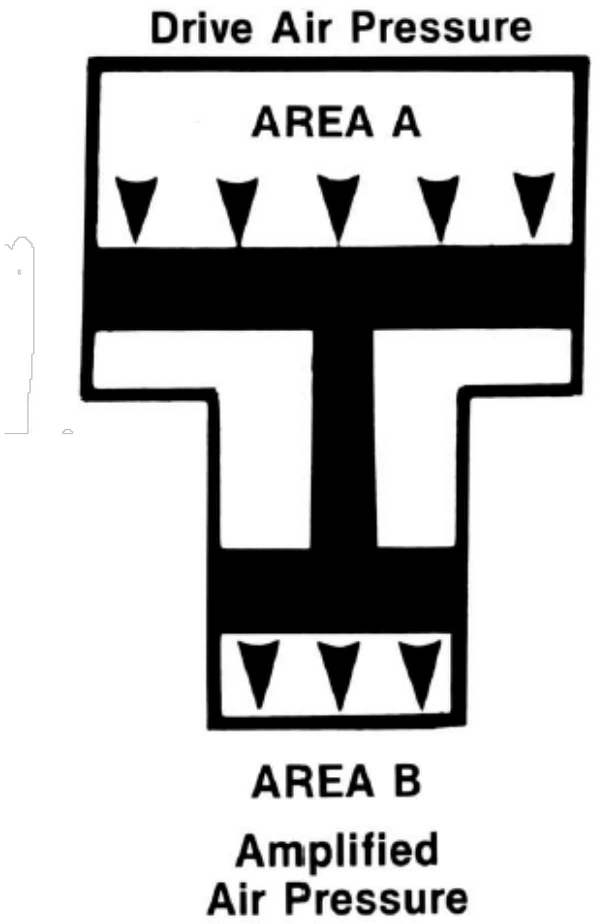
Rubber Hose Losses Without the Fittings

Air Flow CFM	Air Pressure Loss (PSI) in Standard power tool hoses Based on 100 psi Line Pressure — Hose Number and Size														
	1/4" x 10'	5/16" x 8'	3/8" x 10'	1/2" x 12 1/2	1/2" x 25'	1/2" x 50'	3/4" x 12.5'	3/4" x 25'	3/4" x 50'	1/2" x 50' + 1/4" x 10'	1/2" x 50' + 3/8" x 10'	1/2" x 50' + 5/16" x 10'	1/2/" x 50' + 1/2" x 12.5'	3/4" x 50' + 1/2" x 25'	3/4" x 50' + 3/4" x 12.5'
10 - 11	5.0	0.9								5.3	0.7	1.4			
11 - 12	5.9	1.0								6.2	0.8	1.6			
12 - 13	6.8	1.2	0.4							7.2	0.9	1.9			
13 - 14	8.0	1.4	0.5							8.4	1.1	2.2			
14 - 15	9.3	1.3	0.6							9.8	1.3	2.5			
15 - 16	11.0	1.9	0.7							11.6	1.5	2.9			
16 - 18	14.0	2.4	0.8							15.0	1.9	3.5	1.7		
18 - 20	19.6	3.0	1.0							21.4	2.4	4.5	2.0		
20 - 25		4.3	1.4	0.7	1.0	1.3					3.5	6.4	2.6	1.3	
25 - 30		6.6	2.1	1.0	1.5	2.3					5.2	9.8	3.8	1.9	
30 - 35		9.5	3.1	1.3	2.1	3.6					7.3	13.7	5.3	2.6	
35 - 40		12.8	4.2	1.7	2.8	5.2					9.6	18.4	7.1	3.5	
40 - 50		19.3	6.3	2.4	4.1	8.0					14.0		10.4	5.2	1.8
50 - 60			9.6	3.7	6.3	12.2					21.8		16.0	7.8	2.3
60 - 70			13.5	5.3	9.0	17.4	0.9	1.4	1.9				22.8	11.1	3.0
70 - 80			18.7	7.1	12.4		1.1	1.7	2.5					15.0	3.7
80 - 90			25.0	9.0	16.1		1.4	2.2	3.2					19.8	4.6
90 - 100				11.0			1.7	2.7	4.0						5.8
100 - 120							2.3	3.5	5.6						7.9
120 - 140							3.2	4.8	8.0						11.2
140 - 160							4.6	6.6	11.0						15.5
160 - 180							5.6	8.7	15.2						20.4
180 - 200							7.2	11.0							
200 - 220							9.0								

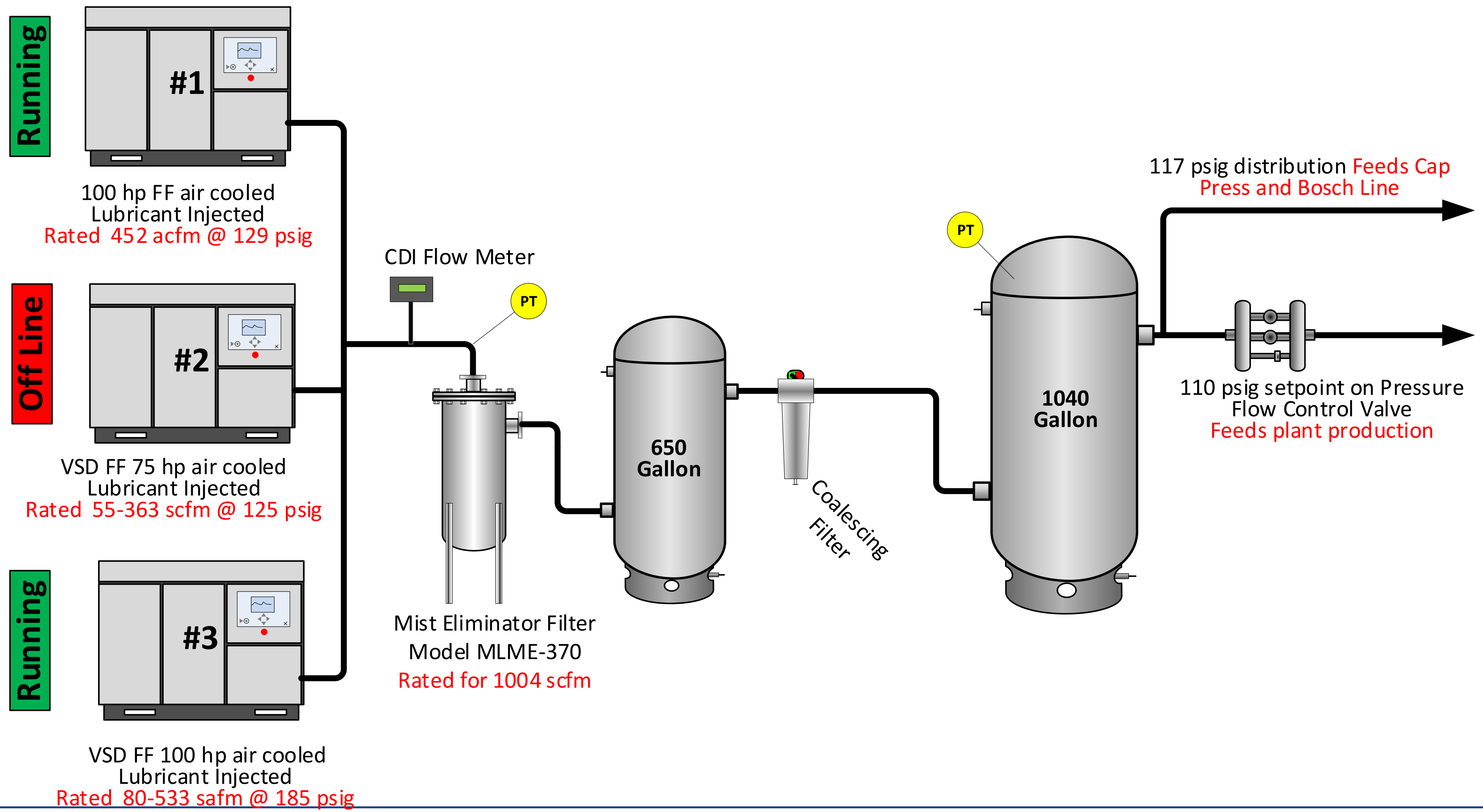
Pressure at points of use.

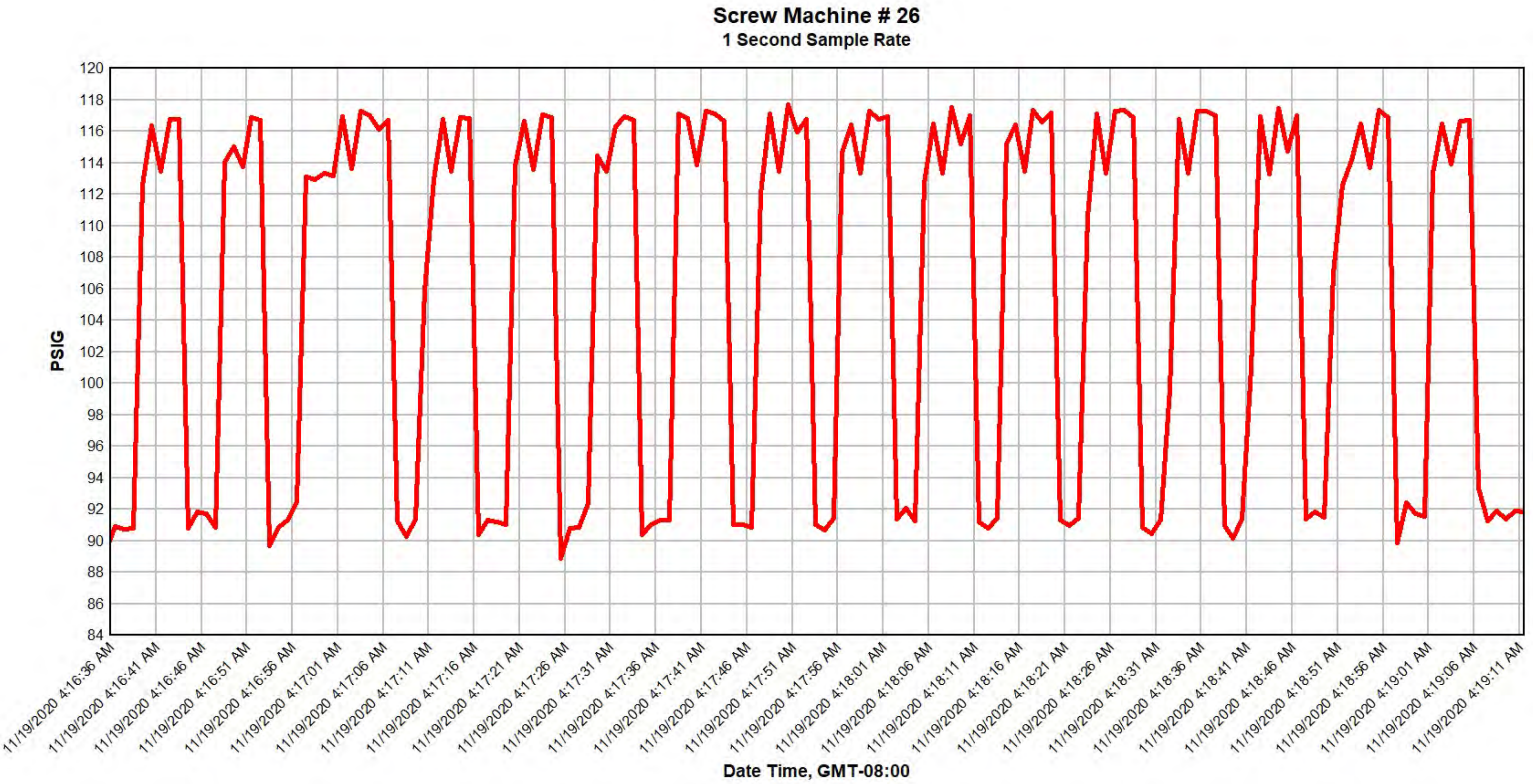
- The total system may be running at a higher pressure to satisfy the needs of only one point of use.
  - If the high-pressure application can be modified to operate at lower pressure, make the fix.
  - **If the high-pressure application is valid, find a better way to serve it.**
  - The single high-pressure point of use can be met with a separate compressor or by a booster.
  - The remainder of the system can operate at a lower pressure, reducing leakage and usage rates and at reduced energy consumption.

Pressure at points of use.



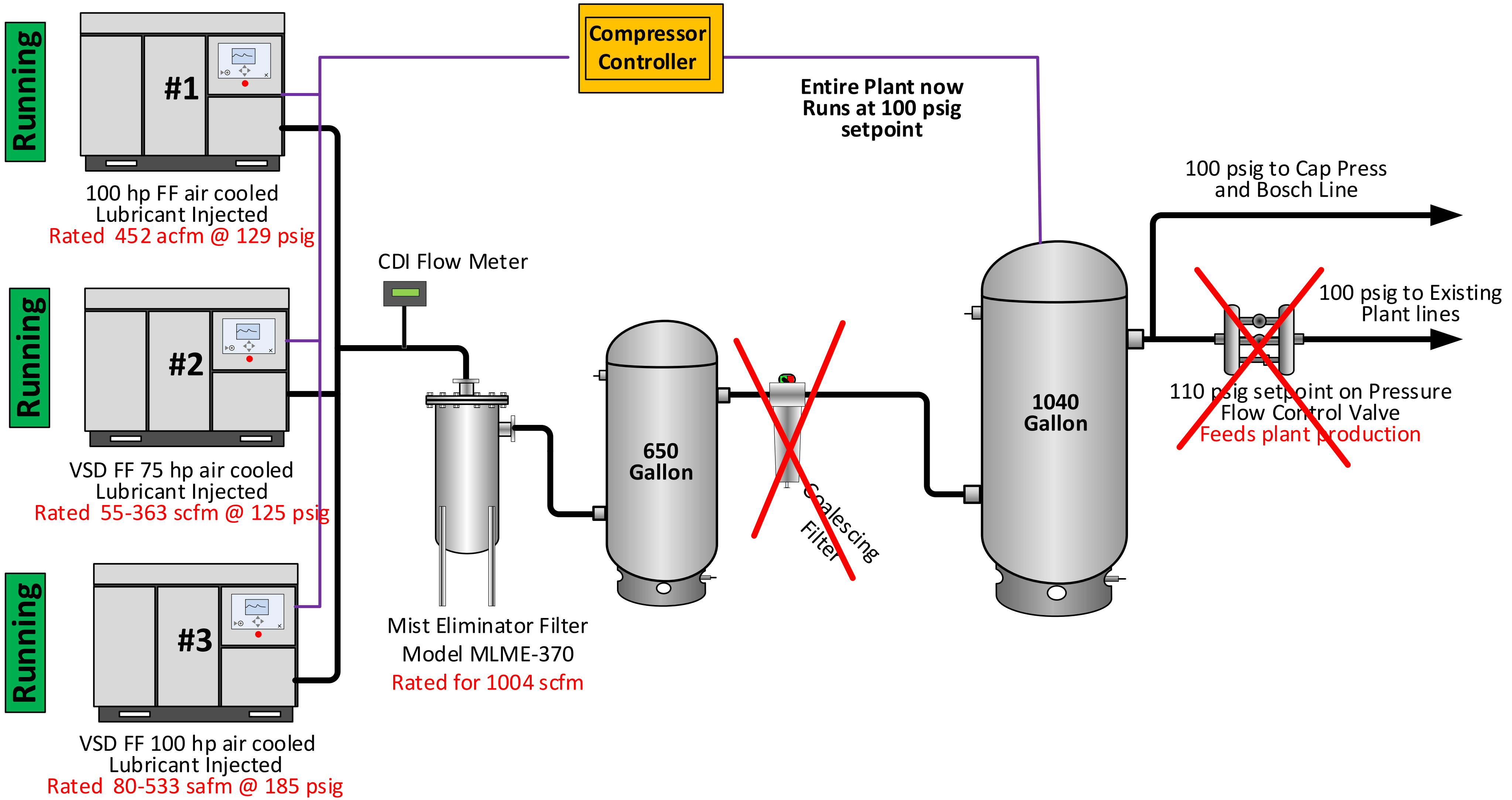
Pressure at points of use.



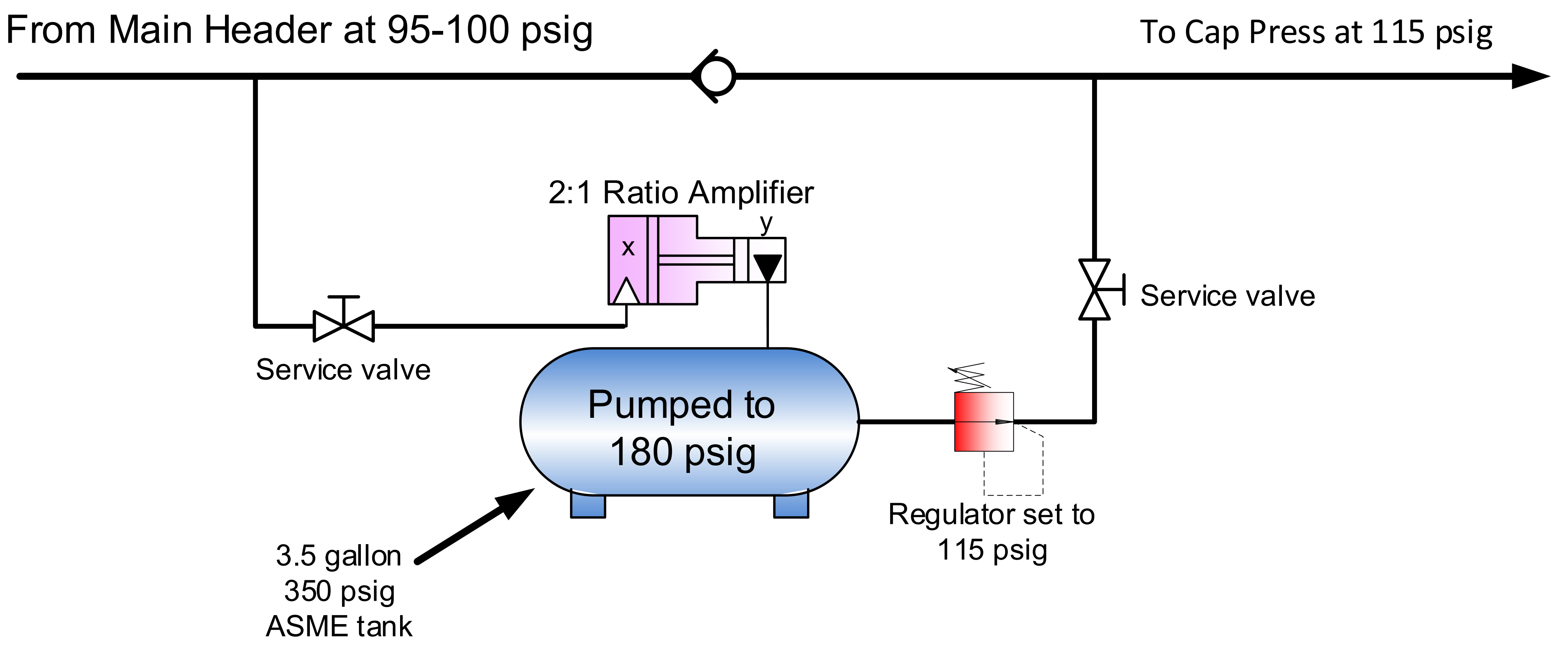


Screw Machine # 26
1 Second Sample Rate
PSIG
120
118
116
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
11/19/2020 4:16:36 AM
11/19/2020 4:16:41 AM
11/19/2020 4:16:46 AM
11/19/2020 4:16:51 AM
11/19/2020 4:16:56 AM
11/19/2020 4:17:01 AM
11/19/2020 4:17:06 AM
11/19/2020 4:17:11 AM
11/19/2020 4:17:16 AM
11/19/2020 4:17:21 AM
11/19/2020 4:17:26 AM
11/19/2020 4:17:31 AM
11/19/2020 4:17:36 AM
11/19/2020 4:17:41 AM
11/19/2020 4:17:46 AM
11/19/2020 4:17:51 AM
11/19/2020 4:17:56 AM
11/19/2020 4:18:01 AM
11/19/2020 4:18:06 AM
11/19/2020 4:18:11 AM
11/19/2020 4:18:16 AM
11/19/2020 4:18:21 AM
11/19/2020 4:18:26 AM
11/19/2020 4:18:31 AM
11/19/2020 4:18:36 AM
11/19/2020 4:18:41 AM
11/19/2020 4:18:46 AM
11/19/2020 4:18:51 AM
11/19/2020 4:18:56 AM
11/19/2020 4:19:01 AM
11/19/2020 4:19:06 AM
11/19/2020 4:19:11 AM
Date Time, GMT-08:00

Pressure at points of use.

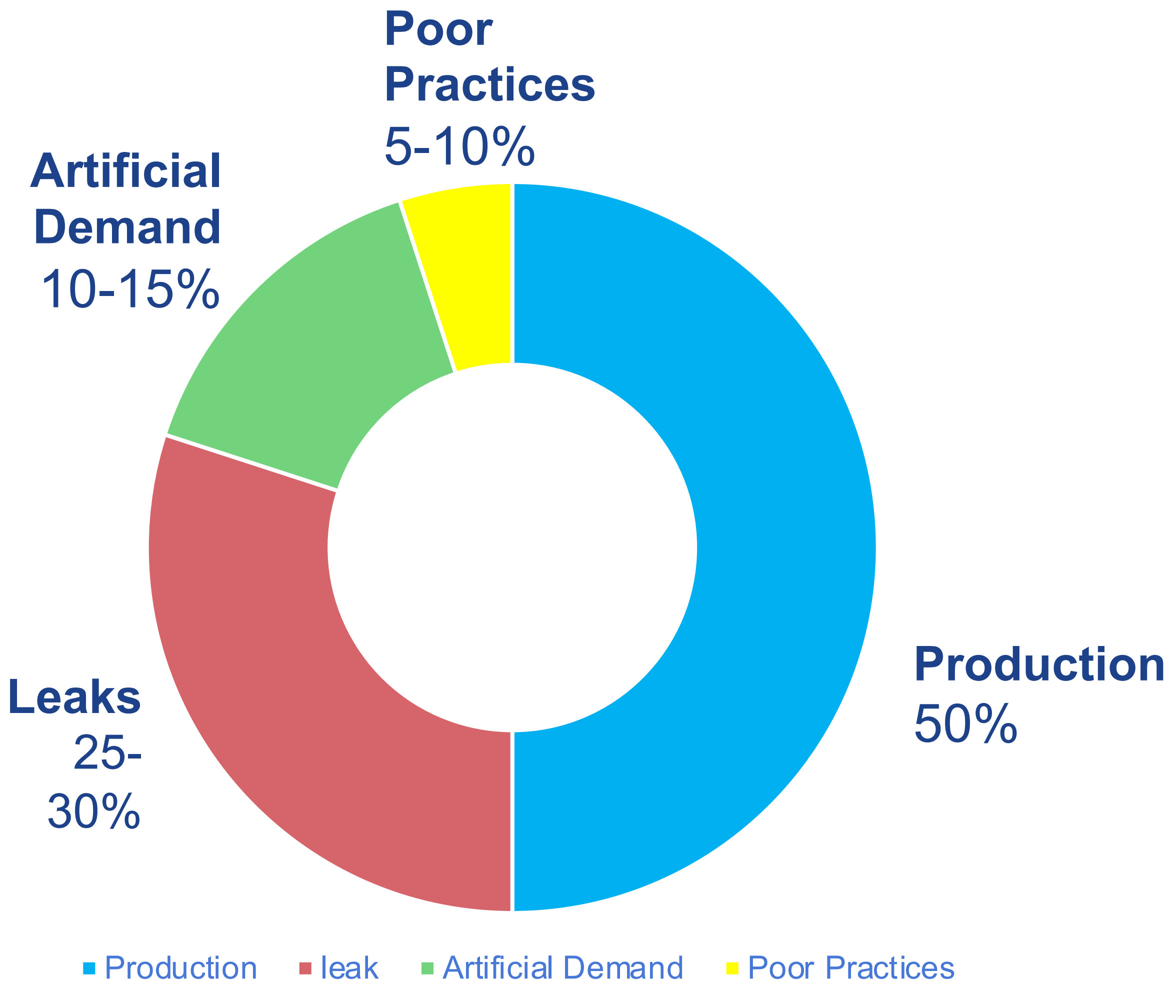


Pressure at points of use.



Summary

- Look for these three unproductive demands:
  - Inappropriate Uses
  - Leaks
  - Increased demand due to excessive system pressure (Artificial Demand)



Summary -Top 10 Ways to Increase Compressed Air Energy Efficiency

To help get you started on the path to energy savings, we've summarized the top 10 ways to increase the energy efficiency of your compressed air system today.

1. Turn It Off.
   - Set your machines to switch off when they are not being used. Depending on your shift pattern, turning your compressors off during evenings and weekends could reduce your energy bills up to 20 percent.
2. Fix Existing Leaks.
   - Start with the oldest and biggest pipes; remember that approximately 80 percent of air leaks are not audible so you may need a third-party auditor to help detect leaks.
3. Prevent New Leaks.
   - It's simple: dry and filtered compressed air keeps piping dust- and sludge- free, which helps prevent new leaks from forming.
4. Reduce Pressure.
   - Run at required pressures, not beyond, and remember each 2 psig reduction cuts energy consumption by one percent.
5. Check Drains.
   - Are your timer condensate drains stuck open? If so, you could be wasting compressed air. Go one step further and replace timer drains with zero-loss drains to save.

Summary -Top 10 Ways to Increase Compressed Air Energy Efficiency

6. Review Piping Infrastructure.
    - Increasing the size of your pipe from two to three inches can reduce pressure drops by up to 50 percent. Shortening the distance air must travel can further reduce pressure drops by about 20 to 40 percent.
7. Change Filters Systematically.
    - Just as you change the oil in your car at scheduled intervals to ensure optimum performance, be sure to change the filters in your air compressor and air system regularly to ensure air quality and to prevent pressure drops.
8. Recover Heat.
    - Compressing air generates heat; you can recover as much as 90 percent of the heat from compressed air for use in your operation.
9. Emphasize Proper Maintenance.
    - Proper compressor maintenance cuts energy costs by approximately one percent and helps prevent breakdowns that result in downtime and lost production.
10. Stop inappropriate use of compressed air.
    - Inappropriate uses of compressed air include any application that can be done more effectively or more efficiently by a method other than compressed air.

Next Week Session 7

System Volume vs Storage

We will focus on applications that consume a relatively high volume of air for short durations of time (sometime called “events”) and how to minimize them. A common solution to high volume, intermittent needs is compressed air storage. Learn the math behind calculating air storage.