MAXIMIZING YOUR MAINTENANCE
(And WHY)

March 2018

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Objectives for the Seminar

- What do you have?
  - A BAS or an Energy Management System?
- What is your system status?
- Who does your “Programming”?
- Engaging your Controls Contractor for mutual benefits.
- Using Trends and creating “Rules”
- Your control system is a “Constant Commissioning” System!

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Building Automation and Maintenance

All of your buildings have a number of energy systems, such as:

- HVAC
- Lighting
- Motors

We should focus on Controls, which allows these systems work together most efficiently.

Controls

Controls are important to ensure systems function properly and perform their intended function.

An example of a “simple control” is a room thermostat.

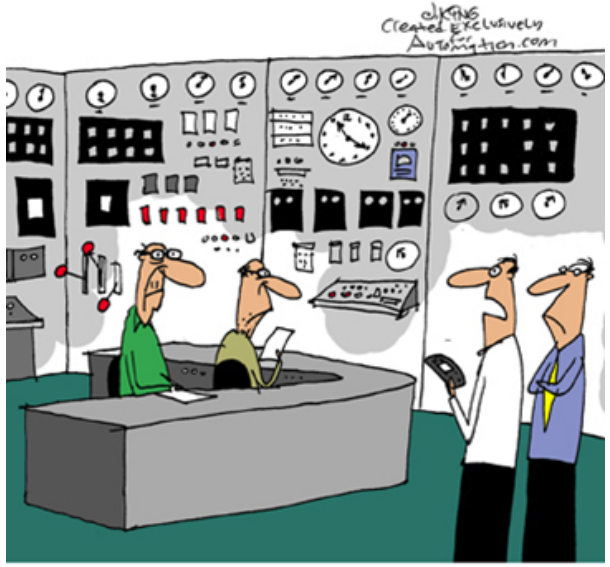
We could turn our heating system on and off manually, but that would not be a very practical way of controlling temperature.

Controls, in cooperation with energy efficient equipment, allow us to control our environment in the most efficient manner

What do you have?

A BAS or an Energy Management System? (what's the difference?)

- A **Building Automation System** controls schedules, temperature setpoints, etc.
- It "Automates" what we previously did manually.



"We put all this high-tech control equipment in 30 years ago. I still don't understand why we can't get the information we need out of the system."

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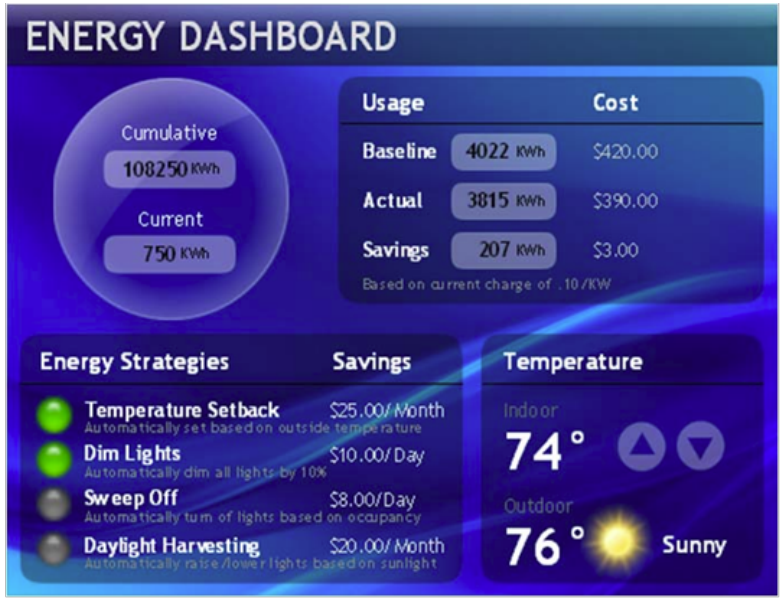
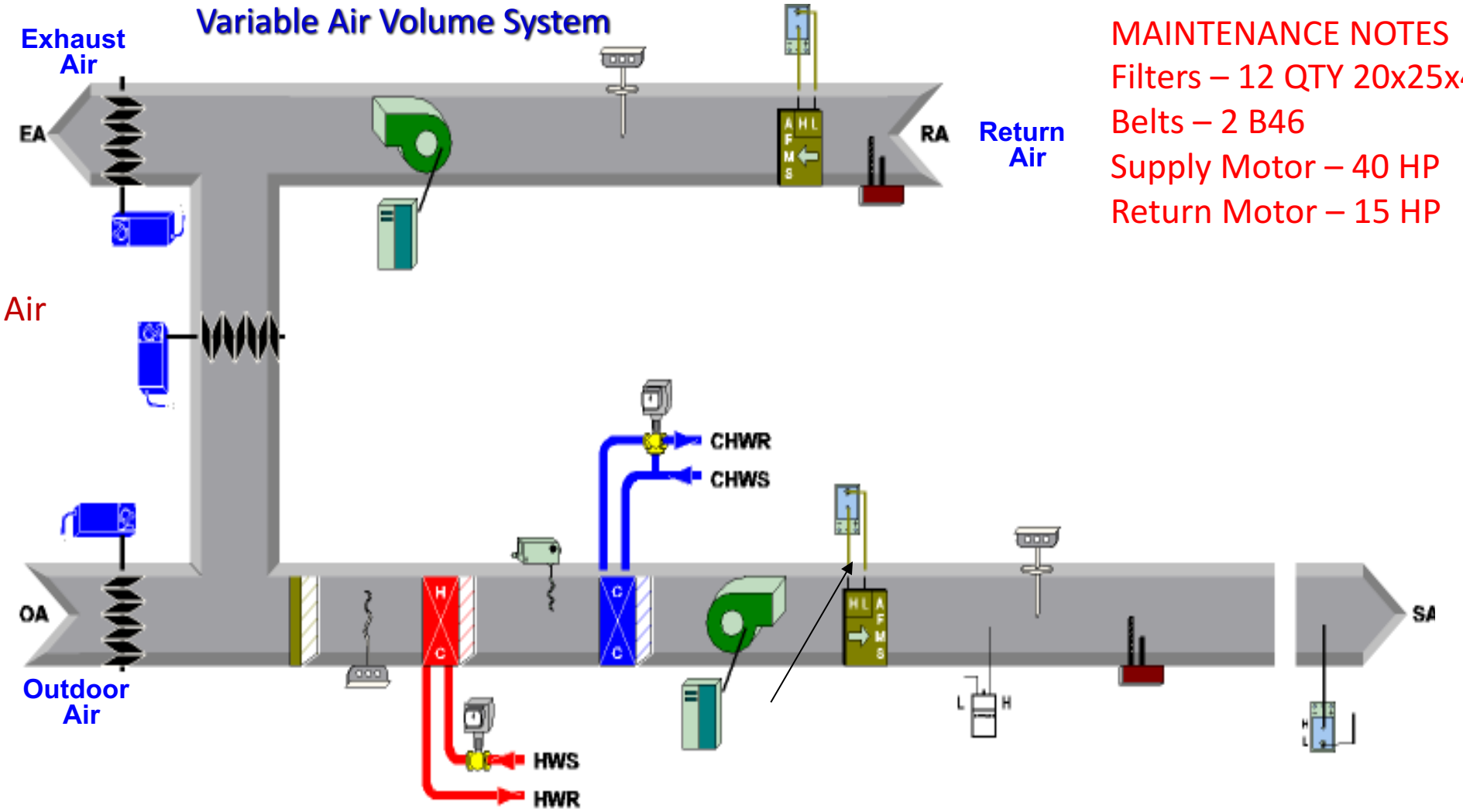
- An **<u>Energy Management System</u>** typically has a “Dashboard” with real time Utility data and weather data.
- It enables the operators to manage and control the facility functions and also control to the extent possible, the energy consumption and comfort of the facility. *(METERS!)*



http://www.beaconenergy.net/electricity-and-your-options

AHU #1 – Serves Lobby



MAINTENANCE NOTES
Filters – 12 QTY 20x25x4
Belts – 2 B46
Supply Motor – 40 HP
Return Motor – 15 HP

How does your control system help?

A Good Maintenance Program yields:

- Annual dollar savings
  - Examples:
  - $10,000/year savings — Fixed compressed air leaks
  - $14,000/year savings — Repaired faulty steam traps
  - $12,000/year savings — Insulated bare steam piping
- *Minimal/No capital investment required*

Just pay attention to what is going on in your facility and get adequate funding to complete repairs.

But- Maintenance is often the first budget "cut"

Maintenance Management *“The Stealth ECO”*

- Problem — We learn to live with maintenance issues and they often go unattended.
  - A hissing air leak that we hear everyday,
  - Or an air leak we don’t know about
  - A broken actuator - damper linkage
  - That water puddle below a steam pipe flange fitting

- We wait until there is a breakdown before we do something

- Solution — Treat maintenance as an integral part of a strong building automation / energy management program

3 Levels of Maintenance

1. **Reactive:** “Fix equipment upon failure”

2. **Preventive:** Regular maintenance, based on operating hours or calendar period

3. **Predictive:** Using technology to “predict” a failure before it happens (best for facilities with “high downtime costs”)

Best Practices:

- *Management commitment / funding*
- *Hire the right people / proper training / record-keeping*

CMMS

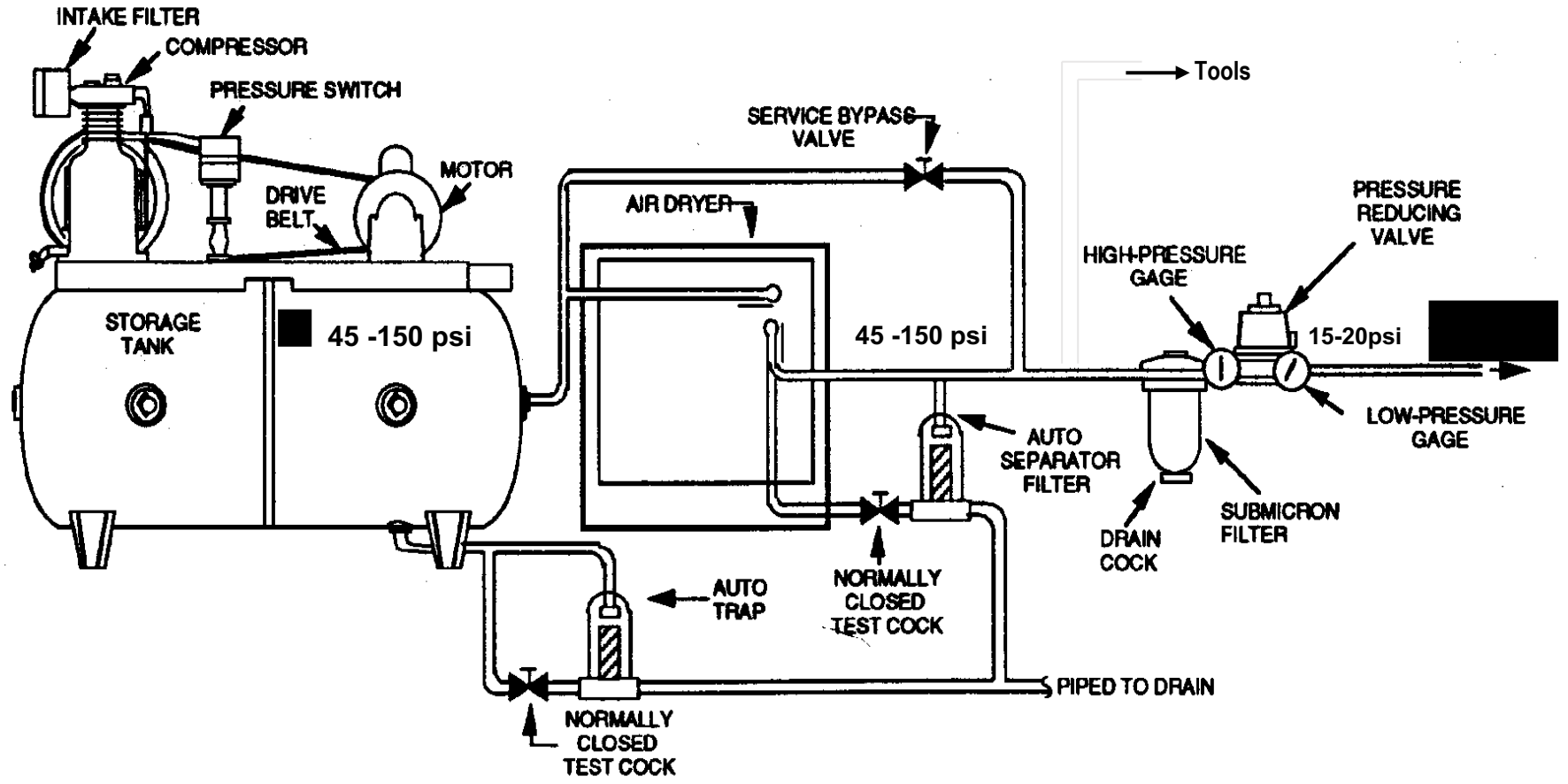
Computerized Maintenance Management Systems

Can provide both energy and labor cost savings.

CMMS elements:

- PC-Based system; best when integrated with BAS or FMS
- Specialized software; or part of a Building Automation System
- Time-based and performance based (e.g., ΔP across filters)
- Enter existing plant information into the CMMS
- Work order generation from the CMMS with tools needed, parts needed, special instructions — for both PM and CM
- Parts tracking for reorder — JIT-type inventory management
- Conduct PM rather than CM when possible

Compressed Air System Maintenance



Compressed Air Leaks

- Quantifying air leaks
  - Apply the following formula to find standard cubic feet per minute (SCFM) lost

$$R = \frac{V\,(P_1 - P_2)}{(\Delta T)\ 14.7\ \text{lb/in}^2}$$

A standard cubic foot of air is one cubic foot of air at 14.7 lb/in^2.

R = average leakage rate (Scfm)

V = system volume (ft^3)

P_1 = initial pressure (psig)

P_2 = final pressure (psig)

ΔT = time interval over which leaks are measured (minutes)

If V=200 ft^3, $P_1 - P_2$ = 10 psig and ΔT = 12 min, compute R.

Compressed Air Leaks

Table in psig, and for 8760 h/yr operation

Costs of Compressed Air Leaks

Hole Diameter (in)	Energy Loss at Pressure (kWh/year)		
	110 psi	100 psi	90 psi
3/8	226,100	208,100	190,000
1/4	100,500	92,500	86,300
1/8	25,100	23,100	21,100
1/16	6,300	5,800	5,300
1/32	1,600	1,400	1,300

Compressed Air Leak Example

- A 110 psig air system used for operating tools around an industrial plant has three $^{1}/_{16}''$ leaks and two ¼″ air leaks. The air circuit (line) is pressurized 8760 hours per year. The energy cost part of the electric energy rate (energy plus demand) is $0.08/kwh.
- What are the annual energy costs of the leaks?
- What would have to happen in a leak correction program for a facility to be able to count demand savings?

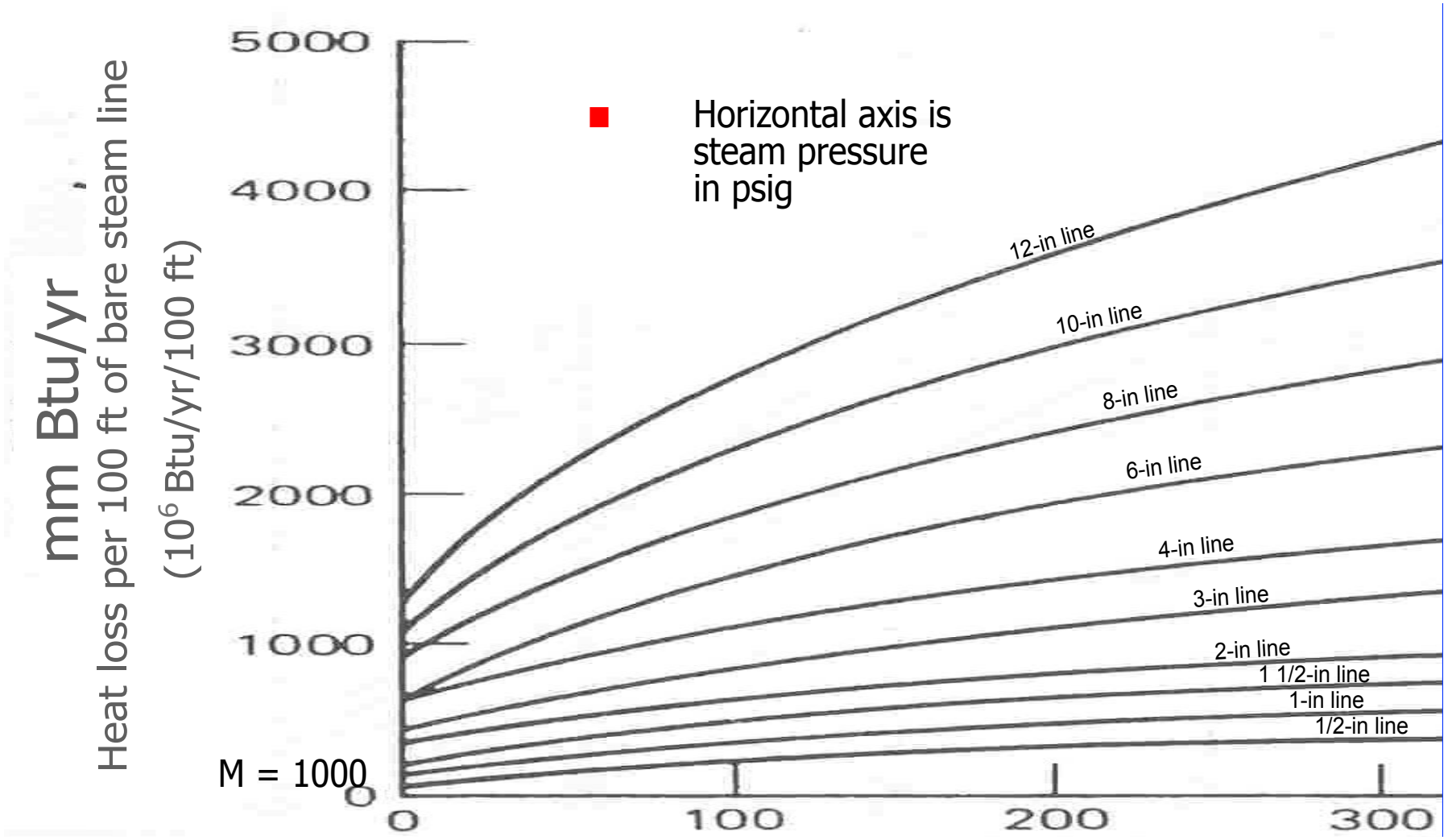
Energy Loss From Uninsulated Pipes

Insulation

The more insulation used, the lower the heat loss and the greater the energy savings. Use LCC to evaluate economic viability.

Energy Loss from Uninsulated Pipes

steam pressure in psig, for 8760 hr/yr operation, per 100 feet of pipe

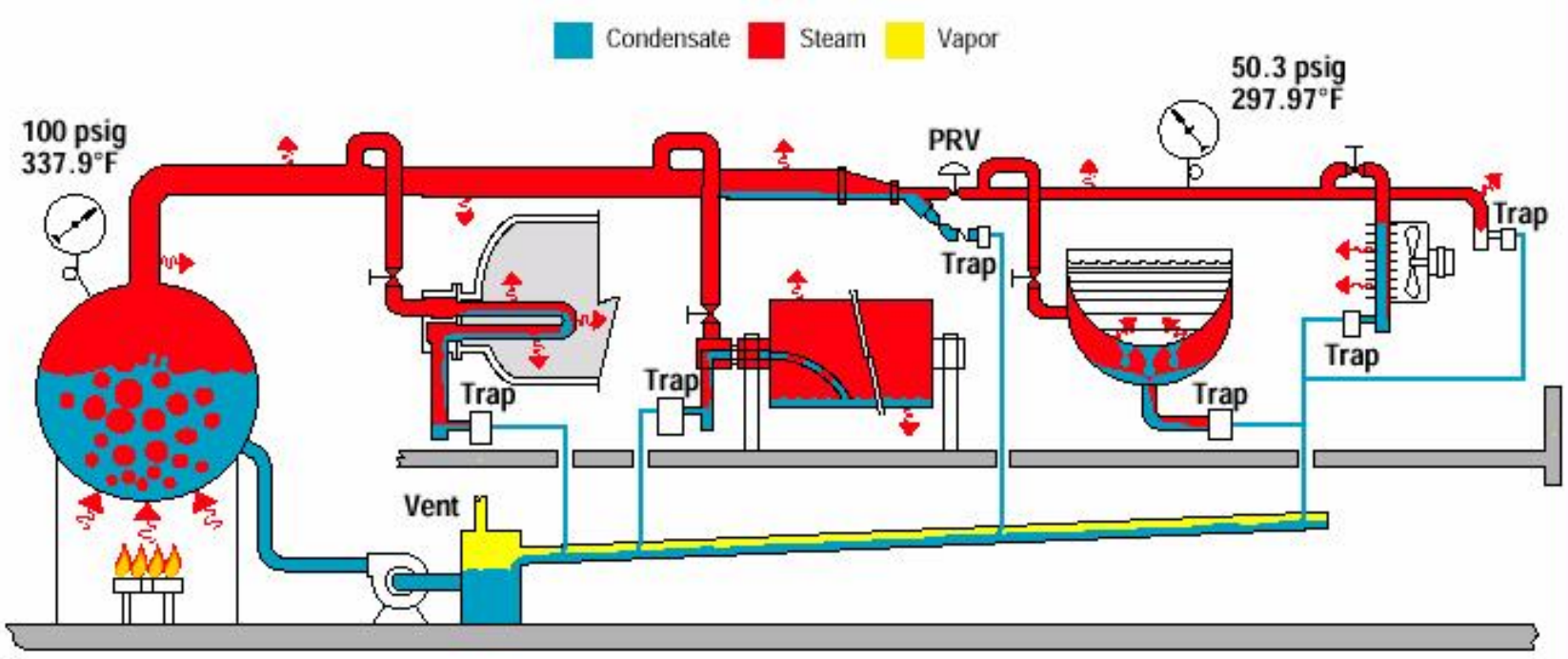


Uninsulated Steam Line Loss Example

- A 100 psig steam system in a manufacturing plant has 150 feet of four inch steam pipe that is not insulated. The steam system is operated 4000 hours per year. The boiler is 76% efficient, and the fuel cost is $6 per million Btu.
- What is the annual energy cost of the heat lost from the pipe?

Steam Leaks

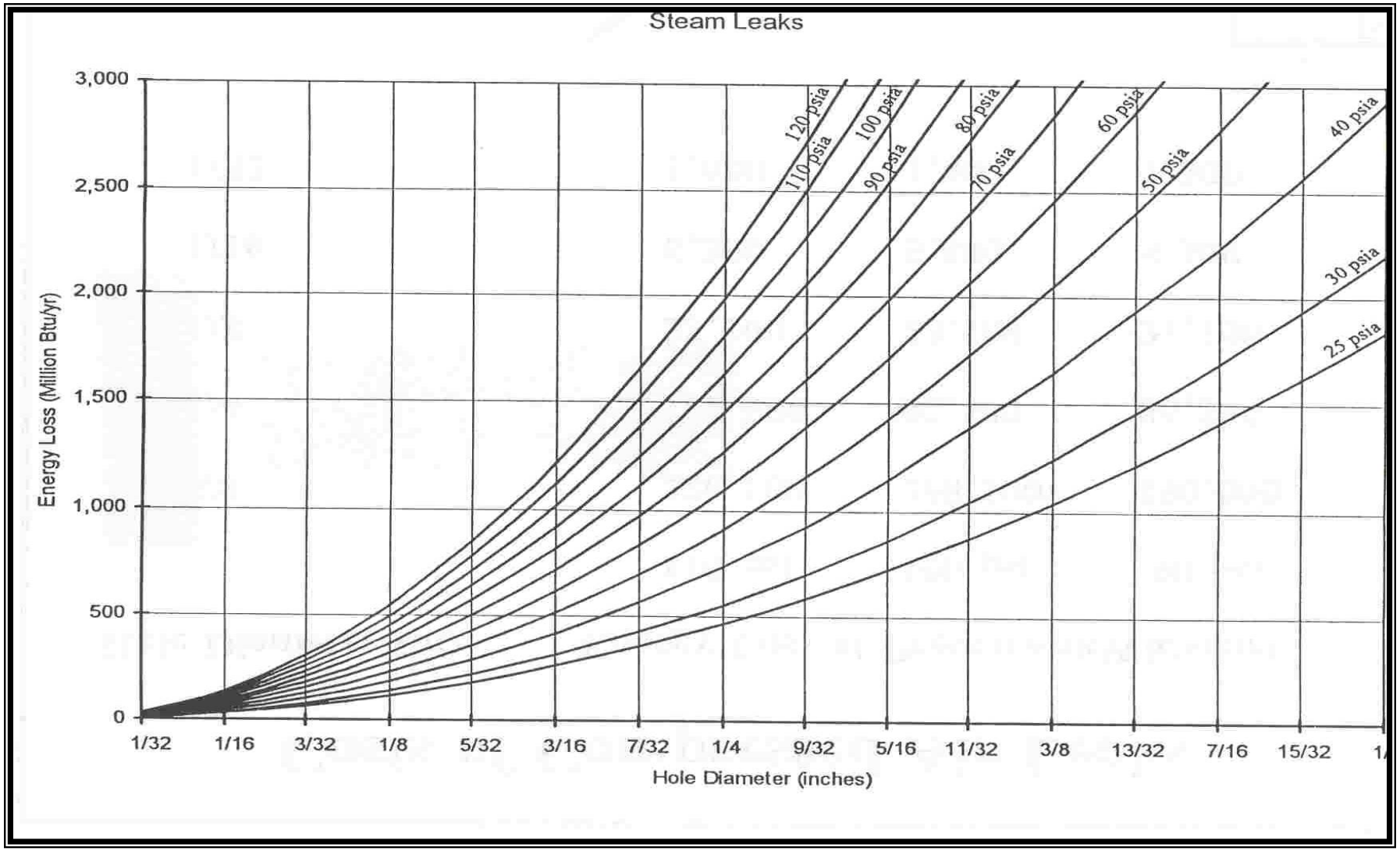
- Steam leaks can be caused by pipe corrosion, weld failure, leaking valves, faulty steam traps, flange misalignments, etc. Whatever the cause, steam leaks can be costly!



Source: www.energysolutionscenter.org/BoilerBurner/Eff_Improve/Primer/Steam_Basics.asp

Cost of Steam Leaks

in psia, and for 8760 hr/yr operation



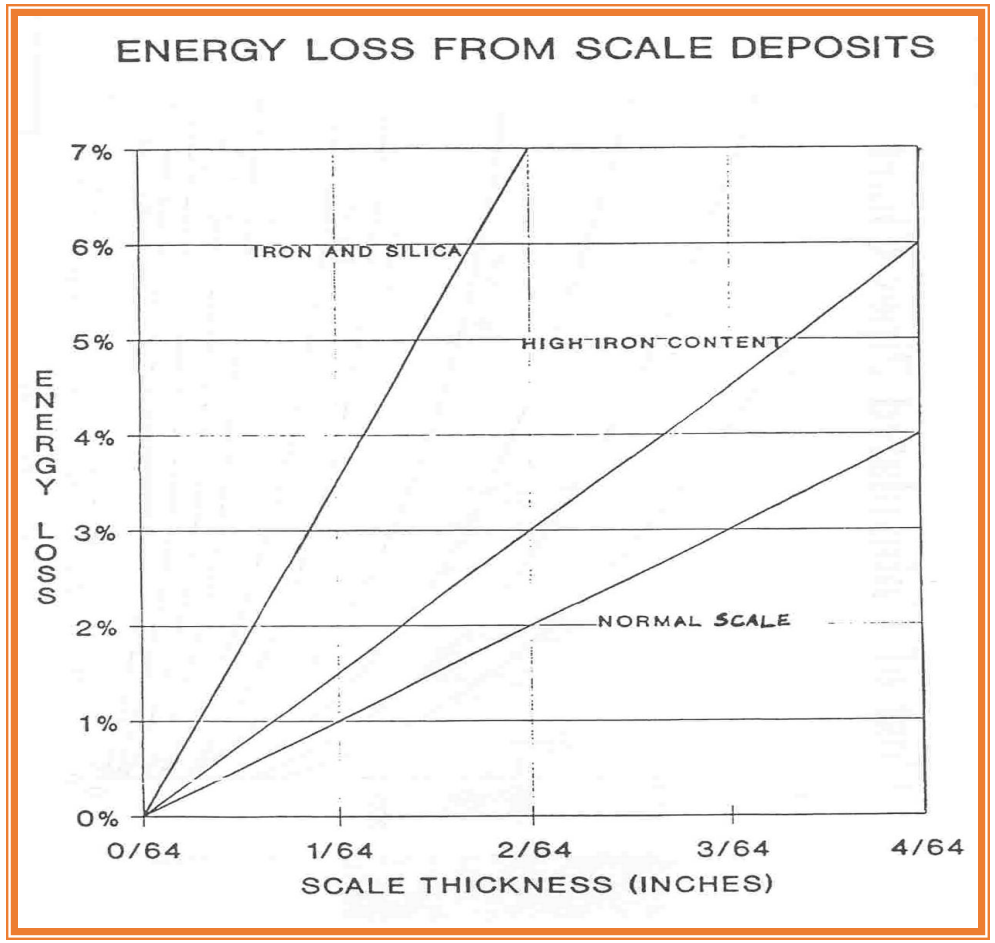
Failed Steam Trap Example

1. Five bucket steam traps are stuck open in your facility. They all exhaust to the drain. If gas costs $7.00/MCF (M=1000) and your steam system is 78% efficient, what is the cost of these malfunctioning steam traps per year? Each trap has a 1/8 inch orifice. The steam line pressure is 110 psia. The steam line is energized 8760 hr/y.

2. In problem 1 above, we seek to return condensate (and passed steam) to the boiler when possible to reduce water procurement costs, energy costs to heat city water and water treatment costs.

Cost of Boiler Scale Chart

percent loss from factory clean



End of This Module

Any Questions?