Criminal Waste of Compressed Air

Compressed Air Systems Waste 50 Percent

There is no justification for the wasted compressed air with techniques that have become **institutionalized**. In an article in Motion Systems Design (MSD) magazine about air actuators on of the panel of "Industry Experts" said: "Compressed air is not a free utility. The energy to compress free air and move it through a plant with attendant frictional loss is high." At least some industry experts are willing to accept the fact that we pay twice as much for compressed air by our own doing and consider that normal. That is what I mean when I say **institutionalized**. An old ITT Pneumotive Air Data Book states: **"Up to 300 feet of ½" pipe (internally clean, no elbows) will handle 10 CFM at 100 PSI with no appreciable pressure loss."** It is not necessary to lose 50% of the air pressure and pay twice as much for compressed air.

A small to medium sized manufacturing plant might have a 100 HP compressor that can provide 400 Standard Cubic Feet per minute of compressed air. Actual usage is an average 200 SCFM at 100 psig at 50% duty cycle. Various charts give the energy cost of compressing 1000 SCF to 100 PSIG as $.50.
For this example 200SCFM = $.10 per minute, $6.00 per hour, $48 per 8 hour shift. At $48 shift by 5 days a week x 52 weeks = $12,480 per year.

If the usage of air is more or less than the example, in many cases half of that cost is being wasted.
A cost savings goes straight to the bottom line. If your enterprise is making 10% net, saving $6,240 is like an increase in business of $62,000.

"What is the bull about wasting half of our compressed air? Our air systems have less leakage that average and everything is pretty much by the book." **By the book** and **what everybody does IS the problem.**

If your compressor is set for 125 psig and your air pressure in the plant is 80 psig (sound familiar?) you have lost 36% of the pressure just transporting the compressed air from the source to the point of use. "But 36% is a lot less than 50%." A filter, regulator and lubricator (FRL) at the point of use has been sized from catalog data that suggests a maximum flow rate based on from 5 to 7 psid pressure drop or a nominal 18 psi for three pieces. At half of that or 9 psi from 80 psig we are down to 71 psig or a loss of 43%. If you ever watched a gauge on a regulator dive 20 psi or more from the static pressure setting each time a valve operates you are witnessing this pressure drop phenomena.
Next is the valve and cylinder with the valve sized for a 10 psi or greater pressure drop to make the cylinder travel at the required velocity. At the end of the pressure supply chain, the air cylinder is driven by 61 psig, 49% (loss of 51%) of the original 125 psig compressor output.
When the compressor has performed a work stroke with 10 psid or more lost across the valve **the additional flow after the cylinder stops moving is a total waste.** Block the air when the cylinder stops or replace the Valve and plumbing with larger components for a 2 psid or less pressure loss. Consider a lower pressure or air spring to return the cylinder after the work is done. Lower return pressure also allows the forward or work stroke to develop speed rapidly.

Added to the pressure drop in most systems, the loss from leaks which commonly waste 10% or more of the compressed air may bring the efficiency of a compressed air system down to 35% or a loss of 65%.

A drastic paradigm shift is necessary in the way we think about, design, install and maintain pneumatic systems and components. Womack earns an "Atta Boy" for information in their FLUID POWER data book that shows they get it. They give data about the amount of horse power required to compress air and the loss of compressing to a higher pressure before regulating the pressure back down. Also their data for air flow through piping does not use a pressure drop of 5% or 10% per 100 feet. Many Mechanical Contractors, Facilities Engineers etc. work from reference data that suggests a 5 or 10% pressure loss in 100 feet of pipe, 5 psid across a filter and other archaic practice..

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Turbulent compressed air has increased resistance caused by the turbulence. The pressure drop in slower air with smooth laminar flow is primarily dependent upon the viscosity of air. The pressure loss is significantly lower than the pressure loss of viscosity and turbulent flow.
Remember, **"Up to 300 ft. of ½" pipe (internally clean, no elbows) will handle 10 CFM at 100 PSI with no appreciable pressure loss."** No Appreciable Pressure Loss is possible and should be the normal .

Double the pipe diameter as a minimum for correct size from the old charts that suggest 5 and 10% pressure drop per 100 feet. Go even larger for less pressure drop and to allow for future growth. No pipe is too large. A 6" pipe manifold that is 100 feet long would equal a 150 gallon or 20 cubic foot reservoir with negligible pressure drop under, at least, 2000 SCFM at 100 psig or a 500 Horse Power compressor. See Figure 1. The pipe sizes shown in red should be considered minimum for efficient pneumatic systems

In addition to oversized plumbing cut the pressure and centralize the air source. Compression, drying, filtration, lubrication should be centralized to reduce the number of point of use components and sized to cut the pressure drop they cause.

For a pneumatic system that is efficient and effective consider the following:

1. Double (or more) the size of your air system plumbing.
2. Reduce the compressor output pressure.
3. Centralize the source of clean, dry, lubricated compressed air.
4. Constantly monitor the air wasters and repair leaks on a PM schedule.
   a) Centralize filtration and eliminate point of use or replace filter elements with PM.
   b) Eliminate regulators or use non-relieving regulators.
   c) Centralize lubrication to eliminate point of use pressure drop.
   d) Use pressure switches, transducers and controls wisely
   e) Don't add air to cylinders after they stop!
   f) Replace quick connectors with a larger size.

The initial cost for rework and installation of larger plumbing and improvements can be amortized in energy saving and man hours. After that the savings continue year after year.

SCFM FOR PIPE ID AT TURBULENT vs LAMINAR FLOW

	PIPE I.D.	(½) 0.5"	Loss	(3/4) 0.75"	Loss	1"	Loss	(1½) 1.5"	Loss	2"	Loss	3"	Loss	6"	Loss
	PSIG	FLOW	-PSI	FLOW	-PSI	FLOW	-PSI	FLOW	-PSI	FLOW	-PSI	FLOW	-PSI	FLOW	-PSI
STD	40	23	4	34	2	62	2	200	2	385	2	1100	2	4405	2
LAMINAR		**6**	**0.25**	**14**	**.31**	**24**	**.26**	**55**	**.14**	**97**	**.12**	**219**	**.08**	**877**	**.31**
STD	60	34	6	50	3	93	3	290	3	560	3	1600	3	6405	3
LAMINAR		**8**	**0.33**	**19**	**.42**	**33**	**.36**	**75**	**.19**	**133**	**.16**	**299**	**.11**	**1197**	**.42**
STD	80	44	8	65	4	120	4	380	4	720	4	2100	4	8411	4
LAMINAR		**11**	**.49**	**24**	**.53**	**42**	**.45**	**95**	**.24**	**169**	**.21**	**379**	**.13**	**1518**	**.54**
STD	100	54	10	80	5	150	5	470	5	900	5	2600	5	10400	5
LAMINAR		**13**	**.57**	**29**	**.64**	**51**	**.55**	**115**	**.29**	**204**	**.25**	**460**	**.16**	**1830**	**.64**

FIGURE 1