DESIGNING A PROPER AIR LINE SYSTEM FOR YOUR SHOP

There are some important rules you must observe when piping your shop for compressed air. These rules generally add very little to the overall cost of the job, but pay-off big time in supplying clean water free air with even air pressure distribution. Condensing water vapor is the biggest problem that hinders most compressed air piping systems in any application. It does not matter if the system is a small, simple home hobby shop, a professional body, paint, or repair shop, or a large industrial plant. Water is the enemy.

Understanding the cause of water in all air systems will help you solve the problem by following a few simple rules. When air is compressed, two things happen as a result. 1) Heat is generated in the compression cycle raising the compressed air temperature, and 2) the density of the relative humidity (at atmosphere) increases dramatically in compressed form. As the humidity is raised in a compressed air system above 70%, water vapor is carried downstream. Since the air temperature is also raised to somewhere above 135 degrees Fahrenheit, this water vapor is then suspended until the air is cooled downstream in the piping system.

The solution is to cool the compressed air before it can be carried downstream. This eliminates most free water from collected throughout the piping system and likely discharged at the end use airdrop. There are some simple ways to cool air insuring the relative humidity of compressed air drops below the dew point allowing the free water to drain away and not be carried downstream in our air system. Installing a water trap or filter unit will not prevent water from condensing downstream contaminating the air system. Moisture-laden hot air carries water through most any water trap or filter as a vapor.

There are a few simple steps in piping layout for your shop that can make traps & filters effective. Let's discuss the way the piping should be designed. Four major features must be applied to the air piping system to minimize water condensation.

1) The system should be plumbed as though it were a steam piping system. That is the pipes should slope to a few vertical drops with ball valves at the terminus, and all other air supply drops are teed from the top of the main pipe runs to prevent free water from entering the airdrops through gravity.
2) The plumbing circuit should be a closed loop (not dead-end lines) pipe layout to equalize air pressure and reduce friction throughout the system.
3) Use of black iron gas pipe in construction of the system is less restrictive to air movement through it is smoother and larger I.D than that of galvanize water pipe. NEVER USE PLASTIC PIPE FOR AIR SUPPLY! (a great shrapnel source in event of rupture and a wonderful way to force-feed a fire)
4) Use 2" or greater diameter pipe as the first leg of your system where the air compressor connects to the air piping system, and no less than ¾" for the runs and drops.

Now let us start at the compressor to treat our air. Free water will collect in the air receiver each day of operation. Air compressor manufacturers instruct owners to drain the tank daily. Well that seldom happens, so to insure excessive water is not retained in the air receiver (tank) install an automatic moisture drain valve in the bottom of the tank and plumb it to the outside of the shop. Add a tee and a bypass ball valve to mechanically drain water from the tank when you are not certain the automatic drain valve is operating properly. OK, now we have one area of moisture controlled.

Next we want to do a couple of things to reduce compressed air temperature. Remember the 2" or greater pipe in the fourth main design feature of our air system?.

A few ways air can be is cooled includes:

a.) venturi effect as larger pipe of the fist leg reduces to smaller pipe runs.
b.) increased surface area of pipe acts as a heat sink.

It is also important to note that the first drop in any compressed air system should be at least 25′ away from the compressor. This gives time for water vapor to cool, form free water through condensation and drain back to the air receiver and out the auto drain valve. The addition of a refrigerated air drier is an excellent source to remove water from a compressed air system. However, these units are very pricey, but in very high humidity regions of the country, this is a sure-fire moisture stopper.

The addition of desiccant air driers is another good choice, but these units are also fairly expensive and require desiccant changes on a frequent basis to keep the air dry. Mechanical water separators and water traps are cheap but hot humid air will pass right through them unless the incoming air is cooled. A simple modification in piping design will help solve air temperature reduction problems eliminating the majority of water that could collect downstream. Pre-cooled air makes refrigerated air driers, mechanical separators, traps, and filters much more effective in eliminating moisture at the end use drops.

This suggested air piping design plan lowers discharge air temperature from compressor, but in order to manage the initial size of the expansion leg of the system., a zig-zag pipe layout is needed. This design is a 25' cooling/gravity drain tower built from a 2" pipe. A zigzag pipe run is attached to the wall next to the air compressor. This design conserves space as well as allowing free water to drain back to the compressor tank. The zig-zag tower is constructed using 2" pipe with 90 degree elbows up the wall.

This initial pipe design creates a venturi effect as the compressed air enters into the 2" pipe tower, and cools as it expands into the larger pipe. The greater surface area of the larger pipe helps to condense water from the hot incoming air as well. This zigzag design reduces the need for a long sloping 25' pipe run to our first airdrop. The zigzag 2" pipe tower arrangement can be constructed of five 5' X 2" pipes and elbows, or any combination of length to fit you needs. It can also be a straight long sloping run if you have the room to run it in your shop.

After the zig-zag pipe layout is constructed, driving 2"X2" blocks of appropriate length will slope each 5' run up the wall prior to mounting the pipe permanently. Unless you have an extremely high humidity situation in your area, this piping design will all but eliminate water in your air system. As an additional precaution, adding a good air filter at the airline drops throughout the shop will insure good clean air.

Again, if you live in an area of constant high humidity, the addition of a refrigerated air drier will be required along with these piping recommendations to eliminate free water contamination in your air system. I recommend that you consider adding a refrigerated drier as a permanent solution to eliminating any moisture at all from entering your system. It is also worthy to note that if you undersize your compressor, or use high volumes of air for long periods, a refrigerated air drier is the only true solution to controlling water vapor in your compressed air system.

The final design feature in our air system is a good air filter. Most major air compressor or spray gun manufacturers carry a line of water filter/trap components. Some of these are Sharp, DeVilbiss, and Binks.

So let's recap: Only use black gas pipe for your plumbing. Plumb as for steam. Build the piping in a closed loop design. Slope pipe runs in the loop to drip leg drops. Add an automatic water drain to you air compressor tank. Build a vertical cooling tower of 2" or greater diameter pipe at the compressor connection. Install water filters at all airdrops.

This system is effective, and will eliminate all your water and contamination problems. A clean air system is peace of mind. If you would like a detailed drawing of a typical air system layout, go to www.sharpe1.com/dr-pipe.htm This is a web page of the Sharpe Mfg Co. and the web site has a lot of good additional and alternative information concerning air control, piping, filters, air driers and spray guns.

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