

## Designing your shop air lines to control water

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You can reduce the moisture at the ends of air hose by designing your plumbing system to help remove water from your compressed air without installing a commercial dehumidifier.

Let's start with some engineering basics;

- Warm air holds more water than cold air
- Compressed air holds less water
- Compressing air will heat it up (adiabatic compression). On my compressor I read temperature that is 60 °F above the shop temperature. On the flip side when you expand air it will cool down.

So, your air compressor heats the air up and increases the pressure. The table below shows the max amount of water that air will hold.

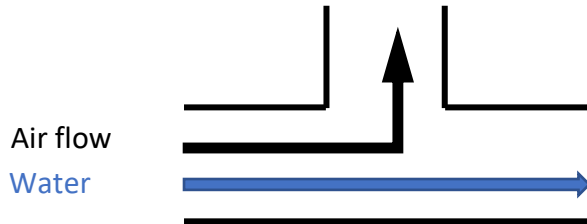
Mass of Water in Air (lbs/100 cfm free saturated air)					
Temperature (°F)	Pressure (psi)				
	0	29	58	87	116
32	0.0281	0.00936	0.00568	0.00406	0.0318
68	0.112	0.0362	0.0219	0.0156	0.0119
104	0.368	0.119	0.0687	0.0493	0.0387
140	1.12	0.331	0.194	0.137	0.106
176	4.06	0.874	0.487	0.337	0.256
212		2.37	1.19	0.812	0.587
248			3.06	1.81	1.31

What does all this mean? If we have a 4 cfm compressor, an air temperature of 68 degrees and a relative humidity of 80%, 2.9 oz of water per hour will come out of the air. This water has to go somewhere. Most would collect in your compressor tank but about 1 oz of it could collect in your air lines. Do not think that because your relative humidity is lower in your area that you do not need to be concerned. With 50% relative humidity you get 1.6 oz of water per hour and with 20% relative humidity you still would get .4 oz per hour.

The whole point is to make sure you keep your compressor tank is drained and to design your air plumbing to make sure that the water in the lines does not make it to your air tools. You want to cool the air down to force the water vapor to condense. Metal piping is better than plastic because it allows the air to cool down more causing more water to condense before getting to the end of your lines. You can remove the water but cannot remove the vapor with just the plumbing design. To design your system, you should have low point drains, take air off of the top of your main distribution line, and to take the air from the side of T's verses straight though (centrifugal force will push most of the water straight).

### SKETCH 1

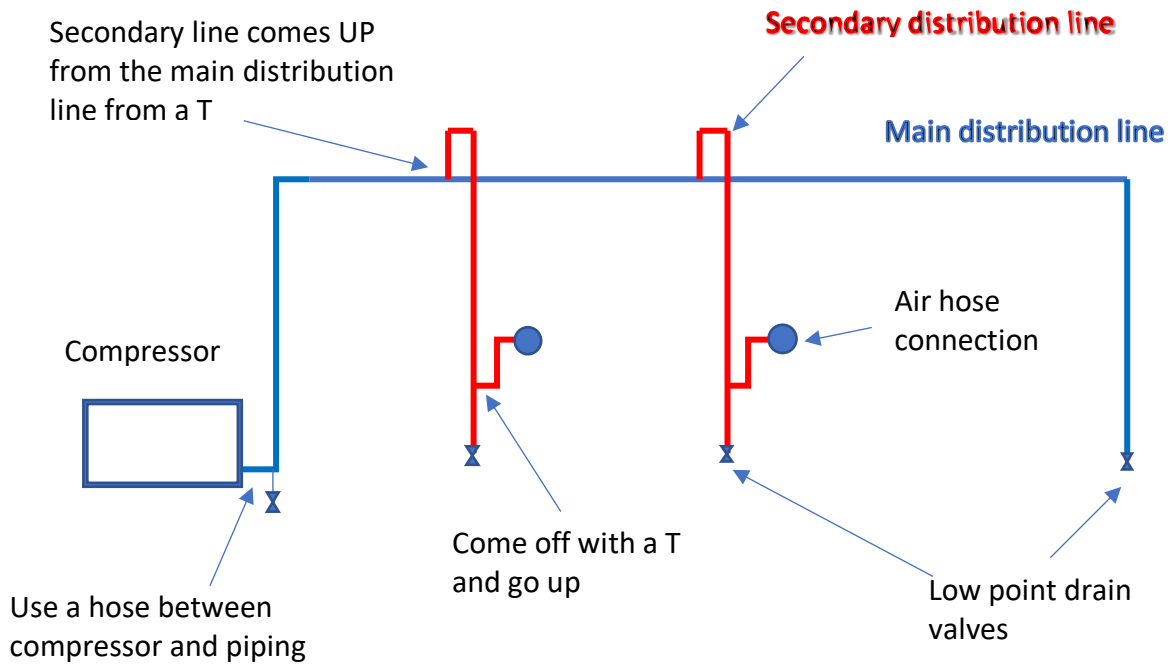
As shown in the following sketch, if you make the air change directions at a T the water in the pipe will continue straight.



Because of the mass of the water centrifugal force pushes most of it straight through

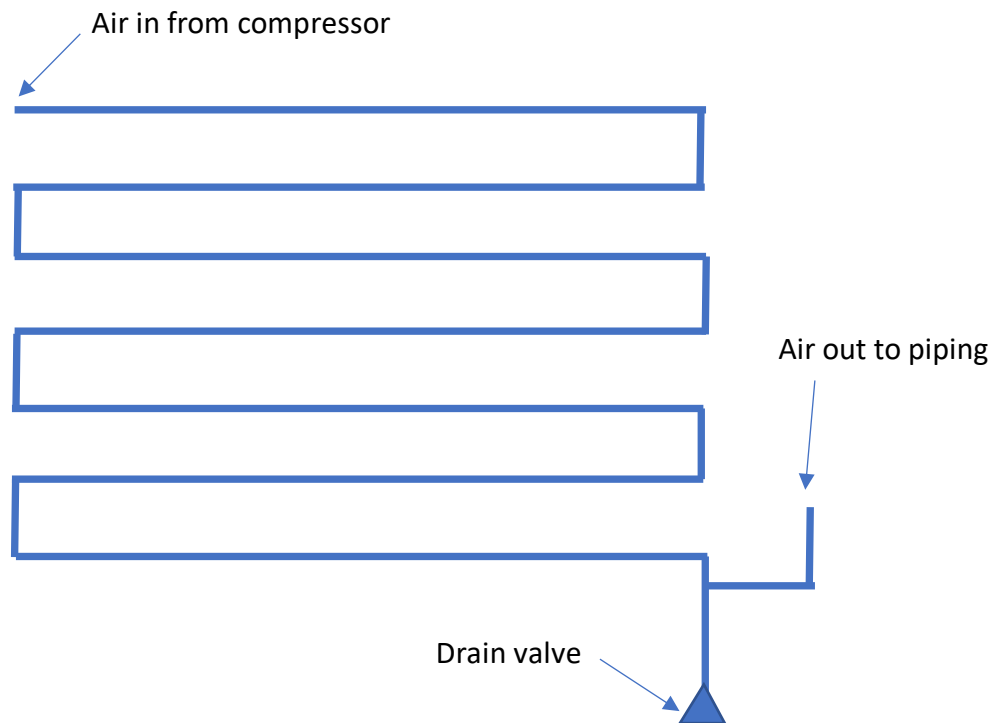
### SKETCH 2

This sketch shows the recommendation how to connect your plumbing. You may not be able to follow it in all cases but try the closer the better.



### SKETCH 3

This sketch shows the plumbing to cool the air coming off the compressor. You may need this if you live in high humidity area. It brings the air from the top and snakes copper tubing back and fore.



### Type of piping

Each type of plumbing has pros and cons.

- DO NOT USE PVC - PVC pipe may splitter when it fails – it is a safety hazard
- Pipe that conducts heat will allow the air in it to cool down so that the water vapor can condense into water allowing you to remove it.
  - Iron pipe is a good option in shops that it may become damaged. You see commercial shops generally with iron pipe. Pipe may rust over time.
  - Copper pipe conducts heat very well and is a cost effective option for home shops (this is what I have in my shop but to be honest PEX tubing was not around when I ran air lines in my shop)
- PEX piping – is relatively new but should work fine for air lines in home shops however it does not conduct heat as well as copper piping. Should not be used for high pressure systems (150 psi) and should not be used next to the compressor due to the high temperatures. Pressure rating is effected by temperature. PEX is not rated for air lines and you use it at your own discretion.
- Air hoses – Not a very good option for the complete layout but may work well to tie sections of piping together.
- There are other tubing options

Between copper and PEX you will need to do a cost analysis to compare the two. Copper tubing is more expensive than PEX tubing per foot but copper tubing fittings are much cheaper than the brass PEX tubing fittings. I do not know about the plastic fittings for PEX tubing.

## Some thoughts

1. Should use a hose between the compressor and your piping.
2. May wish to move the compressor outside of main shop area due to noise.
3. On YouTube I see several people install copper tubing back and forward on the wall to cool down the air coming off the compressor. This will help to remove water coming off the compressor. See sketch 3.
4. The size of the air compressor tank, pressure, how much air you use at a time and your climate all effect the moisture issues that you may or may not have. I have a large 2 stage compressor with a large tank and normally I am not using large volumes of air at a time. Most of my water condenses in the tank and does not get into the piping system. When I had a smaller compressor and tank, I did get a lot more moisture in the piping system.
5. Make sure you drain the water from the low point drains.
6. Make sure that the drain from the bottom of your compressor is easy to use. I have plumbed the drain from my compressor tank out to a valve that is easy to get to. I also have added a piece of clear hose to the end to dump the water outside (clear so that you can see if you have drained all the water from the system). Drain frequently, water in tank can cause it to rust from the inside.
7. Plan where you need air. Having connections near outside doors is helpful.
8. Plan for having pressure regulators in areas required. I have a pressure regulator near my paint area. Make sure you do not exceed the recommended pressure for your air tools.
9. Install shutoff valves near hoses and hose reels. Hose fittings and hose reels tend to leak air.
10. Unless you cool the air down below the room temperature, install a commercial dehumidifier or drop the air pressure after it is cooled down, the air coming out the hose will be at 100% humidity. The important thing is that you do not have water coming out the hose.

## Recommendation

1. Use copper tubing (1/2 inch should be good for most home shops)
2. Use hose between compressor and tubing – put a shut off valve between compressor and piping
3. Run tubing as shown on sketches with T's and low point drains
4. Install low point drains
5. In a high humidity area, you may wish to install copper tubing as shown in sketch 3 between the compressor and distribution piping. If you elect not to do this, recommend that you leave an area in your shop to install at a later date if you have a problem

6. Install regulators and shut off valves.
7. Install a short run of pipe from your compressor drain to a valve that you can easily get to. If it is easy to drain water from your compressor tank you are more likely to drain it.