

Why Suction Lines Must be Sized to Manufacturer's Guidelines

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"Make daily deposits to your box of knowledge, soon it will have many reference cards."--Randal S. Ripley

Precious metals can be defined as high-value, low-volume, scarce metals of the Gold, Silver and Platinum groups and have value as currency or jewelry. These valuable metals that are characterized by their superior resistance to corrosion and oxidation offer an alternative form of investing and are often considered a hedge to inflation.

Being an HVACR Service technician and employed by a supply house, I would like to offer our industries versions of precious metals, **Sheet metal & Copper**. These metals may not have any value as jewelry yet but they sure cost a lot of currency and if their price continues to rise at what seems like a bi-weekly basis we just may see them as jewelry or dangling from a piercing or two on our younger generation.

No, this is not going to be a column on precious metals but it is a column on a practice that is going to become more prevalent with the price of copper continuing upward and the ever increasing distance between the units due to customers wanting them placed where they will be hidden, *"the undersized suction line."*

I am receiving more calls than normal from technicians that query me with questions like, "I know the installation & Operation manual requires a 1 1/8" suction line for this run but it will work with a 7/8", right?"

Only types K (heavy wall) and L (medium wall) copper should be used for refrigeration and air conditioning piping making the 1 1/8" suction line a bear to work with but I think the significant price difference between the 7/8" and 1 1/8" line sets (around \$75) and the necessity of an additional line set needing to be purchased when the run is over 50' is a big factor here as well.

My reply to this is always "What do you mean by work?" If you mean the system will operate at a lower SEER & capacity ratings, be susceptible to premature compressor burn out and have potential oil return problems, yes it will work; but, if you want the system to operate at its peak efficiency and performance, then you must use the manufacturer's recommended line set size.

I am sure all of you have heard the phrase, "the compressor is the heart of the system", so it is not a stretch to say the line set is the "main arteries" and that the refrigerant and oil are the "life blood".

Refrigeration/air conditioning line sets must be sized based on three things: Velocity, Pressure drop and Refrigerant charge. In addition, they must be pitched & trapped properly according to application, compressor above or below the evaporator, to assure maximum refrigerant flow and oil return.

Any under-sizing (which is a restriction) or other type of restriction in these vital conduits that affects the flow of this refrigerant/oil vapor mixture can cause a multitude of problems from diminished capacity, refrigerant system blockages due to oil concentration even outright failure.

A small amount of oil must pass through the compressor cylinders to lubricate them and is always entrained in the refrigerant. Oil and liquid refrigerant are highly miscible (readily mix together), however, oil and refrigerant vapor do not readily mix and oil will only properly flow through the system if the velocity and mass of the refrigerant vapor is great enough to push the oil along.

Nominal minimum velocities of 700 FPM in horizontal suction lines and 1500 FPM in vertical suction lines have been used for years as suction line sizing design

standards according to Copeland. Others say an average suction line velocity of 1200 FPM will suffice.

Horizontal suction lines should be pitched downward in the direction of flow with at least a ½ inch in 10' pitch to aid in oil drainage.

All vertical suction risers (the run of piping where the condenser is higher than the evaporator, that causes the upward flow of refrigerant vapor) of more than three feet in height should have a "P" trap at the base of the riser to move the oil up the riser. For long vertical suction risers, additional traps should be installed every 15'-20' feet to aid in lifting the oil up the riser.

Oil tends to crawl up the inner surface of the pipe on vertical risers and the greater the tubing size, the higher the velocity necessary in the center of the tubing to keep this oil moving. So that the oil doesn't drop out along the way back to the compressor, suction lines must be kept small enough in diameter to keep refrigerant velocities up.

The flip side of this is in our attempt to keep the suction line small enough to keep refrigerant velocity up, we can make the suction line too small, causing resistance to flow (expressed as pressure drop). Pressure drop reduces capacity and efficiency because it decreases the suction pressure and reduces the density of the refrigerant vapor returning to the compressor causing less oil to be pushed back to the compressor, a higher compression ratio and more energy to be used by the compressor.

The denser the refrigerant vapor entering the compressor cylinder, the more volume the compressor can pump. This will lower the compression ratio and increase the efficiency of the compressor.

The refrigerant vapor also cools the windings of the hermetic compressor and a lack of vapor will cause overheating and slowly melt the shellac/varnish like windings insulation, eventually causing a burnout, turn to turn shorts or a short to ground.

How a trap works:

All vapor carrying lines should have oil traps installed to maintain proper oil return. These traps can prevent large slugs of oil from forming by trapping a small amount of oil and returning it to the compressor at a gradual rate. To avoid large quantities of oil from pooling in the trap, it should be constructed with a minimum depth and the horizontal portion as short as possible.

Oil traps are constantly being filled and emptied at a gradual rate, protecting the compressor. When oil collects in the trap, it increases the velocity of the refrigerant gas by causing a small restriction in the line. As the refrigerant vapor travels through this slight restriction of the pipe it picks up small surface droplets of oil from the trap and carries them to either the next trap in line or the compressor.

Although oil traps are necessary in some applications, a line set should never be allowed to become an oil trap. Do not allow the line set to dip or be pitched in the wrong direction, allowing oil to pool in these areas.

General closing notes:

The brands of units I am familiar with have line set sizing charts for up to 74' in the installation & operation manuals, and I can assist you with sizing even longer lengths if necessary. *Always follow the manufacturer's Installation Instructions for the recommended line set sizing.*

For more on compression ratios & volumetric efficiency see the April 07 Tech to Tech Columns on Compressor in the tech column archives on the technical page of the website www.totalairsupply.com. As always, you can reach me at randal@totalairsupply.com or by phone at 603-889-0100.