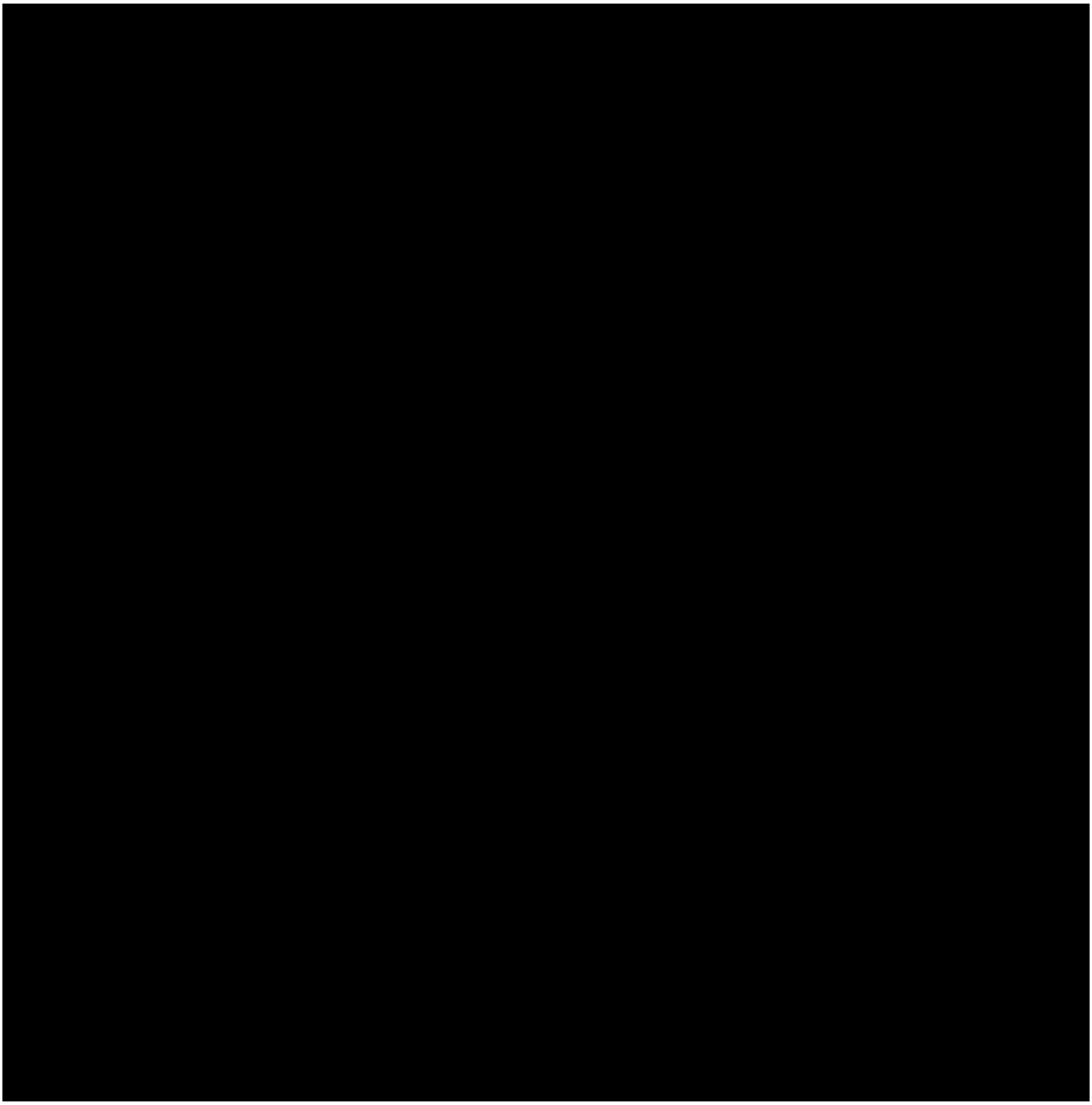
/



Suction pressure, head pressure, subcooling, superheat, Delta T

Taking all five of these calculations into account on every service call is critical. Even if further diagnostic tests must be done to pinpoint the problem, these five factors are designed for 350 CFM per ton the DTD will be closer to 38 40° +/- 5

Make sure you know the actual CFM output of the system before you calculate DTD. It can vary significantly based on the setup of the particular blower. Also keep in mind that oversized evaporator coils that some manufacturers specify for efficiency can also result in slightly lower DTD (higher suction). If you don t know all the details it is my experience that using 35° is the best bet.

When used in conjunction with liquid line temperature, we can know what state the refrigerant in the liquid line and that the compressor is pumping / operating in the required compression ratio. We can also know something about the state of the metering device as to whether or not refrigerant is backing up against the metering device. A good rule of thumb for head pressure is a 15 20 saturation above outdoor ambient +/- 3 for most modern systems. These saturation / ambient calculations are only indicators; they are not set in stone. Keep in mind, when I say ambient; I am talking about the air entering the evaporator for suction pressure and the condenser for head pressure.

Jim Bergmann points out that different equipment efficiencies will have different target Condensing Temperature Over Ambient (CTOA) readings. Keep in mind that these date ranges don t guarantee the SEER but rather give the date ranges that these efficiencies will be most likely. The larger the condenser coil in relationship to the volume of refrigerant being moved the lower the CTOA will be.

\+ ( )

Superheat is important for two reasons. It tells us whether or not we could be damaging the compressor and whether we are fully feeding the evaporator with boiling, flashing refrigerant. If the system has a 0 superheat, a mixture of liquid and vapor is entering the compressor. This is called liquid slugging and it can damage a compressor. A superheat that is higher than the manufacturer s specification can both starve the evaporator, causing capacity loss, as well as cause the compressor to overheat. So how do we know what superheat we should have? First, we must find out what type of metering device the system is using. If it is using a piston or other fixed metering device, you must refer to the manufacturers superheat requirements or a superheat chart like the one below.

If it is a TXV type metering device, the TXV will generally attempt to maintain between a 5 to 15 superheat on the suction line exiting the evaporator coil (10 +/- 5)

TXV target superheat setting may vary slightly based on equipment type.

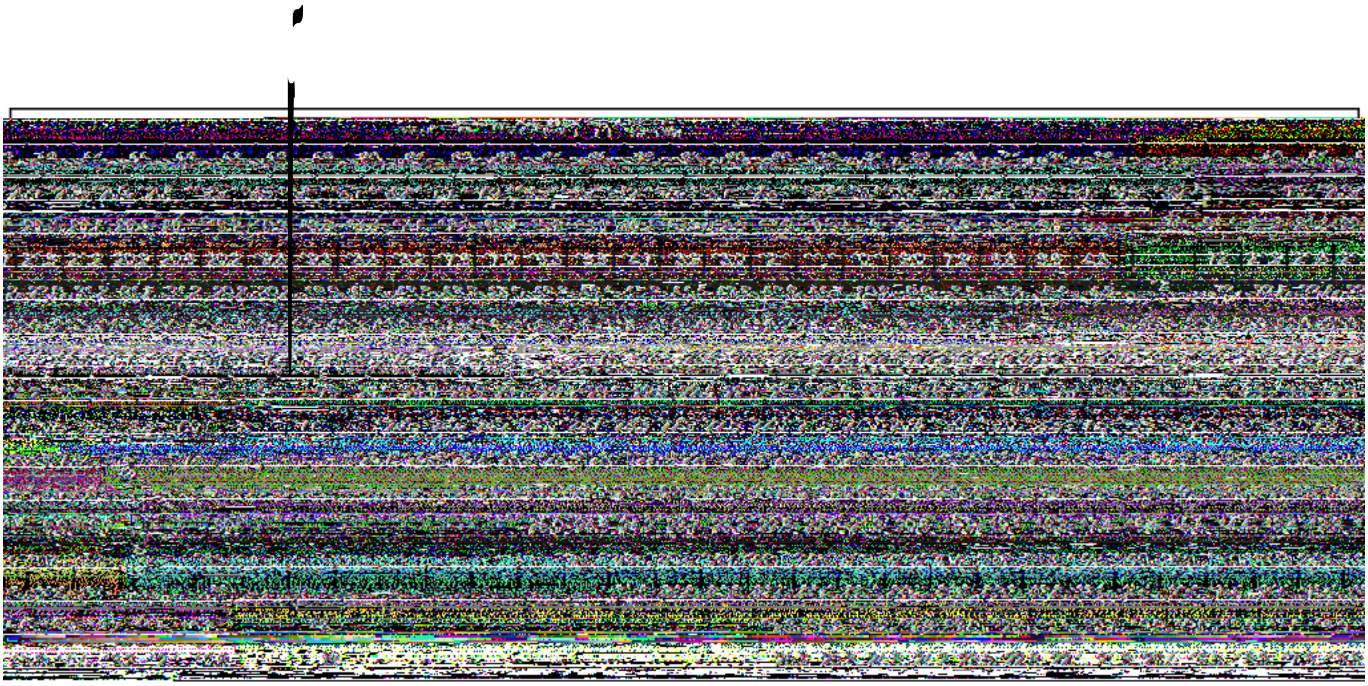
Subcooling tells us whether or not the liquid line is full of liquid. A 0 subcool reading tells us that the refrigerant in the liquid line is part liquid and part vapor. An abnormally high subcool reading tells us that the refrigerant is moving through the condenser too slowly, causing it to give up a large amount of sensible heat past saturation temperature. A high subcool is often accompanied by high head pressure and, conversely, a low subcool by low head pressure. Subcool is always a very important calculation to take because it lets you know whether or not the metering device is receiving a full line of liquid. Typical ranges for subcooling are between 8 and 14 degrees on a TXV system, but always check the manufacturer s information to confirm. in general on a TXV system using 10° +/- 3° at the condenser outlet is the best rule of thumb in the absence of manufacturer s data.

On a fixed orifice / piston system the subcooling will vary even more based on load conditions and you will see a range of 5° to 23° making subcooling less valuable on a fixed orifice system. In my experience during normal operating conditions the subcooling on a fixed orifice system will still usually be in the 10° +/- 3° range.

( )

The evaporator air temperature split (Delta T) is a nice calculation because it gives you a good look at system performance and airflow. A typical air temperature split will be between 16 and 22 degrees difference from return to supply. Keep in mind, when you are doing a new system start up, high humidity will cause your air temperature split to be on the low side. Refer to the air temperature split and comfort considerations sheets for further information.

For systems that are set to 400 CFM per ton, you can use a target Delta T sheet like the one shown below



If the leaving temperature/delta T split is high it is an indication of low airflow. If it is low it is an indication of poor system performance / capacity.

Again, this only applies to 400 CFM ton. 350 CFM per ton or less are more common today than ever and in those cases the above chart won t apply.

The way this list must be utilized is by taking all five calculations and matching up the potential problems until you find the most likely ones. A very critical thing to remember is that a TXV system will maintain a constant superheat, and a fairly constant suction pressure. The exceptions to this rule are when the TXV fails, is not receiving a full line of liquid or does not have the required liquid pressure/pressure drop to operate. This situation would show 0 subcooling and in this case, will no longer be able to maintain the correct superheat. Before using this list, you must also know what type of metering device is being utilized, then adjust thinking accordingly. Also remember, in heat mode, the condenser is inside and the evaporator is outside.

Low on charge

Low air flow /load dirty filter, dirty evaporator, kinked return, return too small, not enough supply ducts, blower wheel dirty, blower not running correct speed, insulation pulling up against the blower, etc.

Metering device restricting flow too much piston too small, piston or TXV restricted, TXV failing closed

Liquid line restriction clogged filter/drier, clogged screen, kinked copper

Low ambient (Low evaporator load)

Extremely Kinked suction line (after the kink)

Internal evaporator restriction

Overcharge

High return temperature (Evaporator Load)

Metering device allowing too much refrigerant flow piston too large, TXV failing open, piston seating improperly

Too much airflow over the evaporator (Blower tapped or set too high)

Compressor not pumping properly bad suction valve, bad discharge valve, bad or broken crank

Reversing valve bypassing

Discharge line restriction

Low on charge

Low ambient temperature / low load

Metering device allowing too much refrigerant flow piston too large, TXV failing open, piston seating improperly

Wet condenser coil

Compressor not pumping properly bad suction valve, bad discharge valve, bad or broken crank

Reversing valve bypassing (heat pump units)

Kinked suction line

Restricted discharge line

Severe Liquid Line Restriction

Overcharge

Low condenser airflow condensing fan not operating, dirty condenser, fins bent on condenser, bushes too close to condenser, wrong blade, wrong motor, blade set wrong

High outdoor ambient temperature

Mixed / incorrect refrigerant / retrofit without proper markings

Non-condensables in the system

Liquid line restriction + overcharge (someone added charge when they saw low suction) piston too small, piston or TXV restricted, TXV failing closed, restricted line drier

Compressor not pumping properly

Reversing valve bypassing

Discharge Line Restriction

Compressor not pumping

Overcharge

Metering device restricting too much flow

Liquid line restriction

Wet condenser coil

Dirty Condenser Coil on New High Efficiency Condensers
(

)

Having an H.R.U. in the discharge line ( )

Internal evaporator restriction

Low air flow

" (

Abnormally low humidity (WB Temp)

Blower not running the correct speed or running backward

Undercharge

Severe Overcharge with fixed orifice metering device

Metering device not functioning properly restricting too much flow or allowing too much flow

Too much airflow through the evaporator blower not running correct speed

Heat strips running with air

Abnormally high humidity

Liquid line restriction

Compressor not pumping properly bad suction valve, bad discharge valve, bad or broken crank

Reversing valve bypassing
Discharge line restriction

This is an incomplete list designed to help you. Always keep your eyes and ears open for other possibilities. Diagnosis is an art as well as a science.

Bryan