

A Starved Evaporator

While troubleshooting and repairing refrigeration systems, a common problem is a starved evaporator, meaning not enough refrigerant is entering the evaporator for the heat load placed on it. This is usually verified by measuring a higher-than-normal refrigerant superheat value leaving the evaporator.

There are several possible system issues which can cause this condition. It is important to determine the correct root cause. Misdiagnosing the problem can lead to an improper repair and create additional issues, compounding the system failure and perhaps masking the original issue.

The most common cause of a starved evaporator is a lack of refrigerant in the system, meaning there is a leak which needs to be located and repaired, and the lost refrigerant added back into the system. However, that is definitely not the only system problem that will cause a starved evaporator. Another possibility is the refrigerant is simply not getting to the evaporator due to either a metering device failure or a liquid line restriction. One other less likely cause is that the heat load placed on the evaporator is too great for the size of the evaporator and system's BTU capacity. To determine if these or other issues are causing the starved evaporator condition, we need to further examine the system and look at some of its other operating characteristics.

Generally, I start by determining if the charge is adequate and a loss of refrigerant is causing the current problem. On systems with a thermostatic/electronic expansion valve, measuring the condenser's subcooling value will generally indicate if the system has an adequate amount of refrigerant. If the system has a liquid line sight glass, a clear sight glass is also a good indication of an adequate refrigerant charge, but measuring the condenser's subcooling is best practice. On systems using a blended refrigerant it may be possible for the sight glass to show slight bubbling and the system charge is okay. Attempting to clear the sight glass may cause the system to be overcharged. Additionally, if the sight glass is piped downstream of the filter/drier, bubbles in the sight glass may be from a restricted filter/drier and not a lack of refrigerant. So again, measuring the condenser's subcooling is generally the way to go. Measuring the condenser's subcooling on systems with an outdoor air-cooled condenser operating in a cold ambient and using fan cycling to control the head pressure could be a little tricky. As the fan(s) cycles on and off and the high-pressure changes, it may be difficult to get an accurate reading. On those systems blocking the air inlet to the condenser to get the head pressure up to a condenser pressure simulating a steady 110°F condensing temperature may help to get an accurate subcooling value.

If the condenser's subcooling is okay there is generally enough liquid refrigerant available, why is it not getting to the evaporator? Is there a restriction somewhere in the liquid line or is the metering device not feeding properly? You will need to either find the restriction or determine if the metering device is defective. Misdiagnosing the problem and adding refrigerant thinking the issue is a lack of refrigerant will not solve the problem and will likely create new problems.

If the system is using a capillary tube as its metering device, determining the difference between a loss of charge and a restricted capillary tube is a little more challenging. One possible test is to add a small amount of refrigerant to the system. If the low and high pressures begin to approach normal levels, it is likely a loss of charge problem. If the high side pressure increases and starts to go too high with no real change in the suction pressure, it is a restriction.

