Last **Word**

Refrigeration Basics: Troubleshooting Fundamentals

BY DON GILLIS

Welcome to the second installment of this refrigeration basics series. This month, I am covering troubleshooting common compressor issues.

How condensing removes heat from an environment—When we think of the role of a condenser, it is where heat is rejected in a cooling system—from the motor it is the act of compression, etc. The refrigeration system must also reject superheat as well as the load heat from the evaporator. As part of the refrigeration cycle, the system also condenses the refrigerant. This process involves taking a vapor, removing the heat outside, and condensing it into a liquid by removing the heat and returning it to its condensing temperature. On most condensers that the vapor enters at the top and leaves at the bottom, where the liquid is much heavier than the weight of the vapor.

Superheat/where to check it—Superheat is any heat added to a vapor above its boiling point. For example, water boils at 212°F at atmospheric pressure. The second that last droplet of water evaporates, the temperature rises to 213°F. That increase in temperature is 1 degree of superheat. Superheat also is the temperature of the vapor leaving that evaporator on the suction side. A compressor needs superheat in order to function. When checking superheat, first, determine what temperature is needed. A system designer more than likely will want to know the superheat leaving the evaporator. Remember that superheat is a vapor, so you can check it on the low side—the evaporator side—of the system. Take a reading of the temperature from the suction line and subtract it from the saturated suction temperature inside the evaporator.

Subcooling—Subcooling refers to the heat that is removed from a liquid below its boiling point. For example, if we again use water with a boiling point of 212°F at atmospheric pressure, its subcooled liquid temperature would be 211°F. Subcooling is determined by subtracting the condenser saturating temperature from the liquid line temperature—either leaving the condenser or entering the metering device.

Discharge line temperature—Discharge line temperature (DLT) is the temperature of superheated vapor leaving the compressor. If the DLT is higher than 225°F, something is causing the compressor to run extremely hot. The temperature reading is taken after leaving the compressor on the discharge line, about 6 in. If the DLT is higher than 225°F, check the superheat level before entering the compressor. If the superheat temperature is also high, continue moving down the line to check the temperature leaving the evaporator. The high readings could be caused by a malfunctioning metering device, but often, it is due to a high compression ratio.

Compressor overheating—When compressor temperatures are higher than normal, it's typically due to a high compression ratio. A high compression ratio indicates either a high head pressure and a very low suction pressure, or a combination of both. Often, a high compression ration is due to thinning of the oil inside the system, leading to more friction on moving parts inside the compressor. Friction adds heat, which can increase wear and tear on the parts and lead to premature compressor failure. Compressors are designed with a thermal operating disc to provide internal protection. However, it's crucial to monitor the compressor's internal temperature; always check the discharge line temperature for an indication.

How low should you pump a compressor?—This depends on the model number of the compressor, the application and the refrigerant you're using. Check with the compressor manufacturer. Never pump a compressor down to zero or into a vacuum.

Floodback vs. flooded start—Floodback occurs when refrigerant leaves the evaporator and enters the running compressor as a liquid instead of a vapor, which can ultimately lead to system failure. Conditions contributing to floodback include air flow, ice buildup, overcharging refrigerant or misadjusted expansion valves. Symptoms include overheating from a loss of lubrication and decreased system efficiency. Prevent floodback by modifying defrost cycles, checking refrigerant charging levels, adjusting or replacing expansion valves, and making sure that evaporator coils are cleaned and not damaged. A flooded start is different because it can occur when the compressor is not running and has not been operated for some time. The DT from the crankcase oil, and the vapor refrigerant in the evaporator causes it to migrate towards the compressor oil. There, it condenses into a liquid and is absorbed by the oil. Then, when the compressor is started, the refrigerant boils into a vapor, diluting the oil in the crankcase and reducing the lubrication of bearings, rods and other critical surfaces. Symptoms include erratic wear or seizure damage to the rods or bearings and the crankshaft. Prevent a flooded start by installing a continuous pump down cycle on the compressor to remove from the low-pressure side. Pump downs would typically not be used in residential applications. A crankcase heater can be installed or the compressor can be located where ambient temperatures are controlled.

Don Gillis has 27 years of HVAC industry experience including roles as an Installer, Service Technician, Service Manager, Tech. Support, Territorial Sales Manager, and a full time Instructor with Emerson. He is a licensed Journeyman, EPA 608 certified, and he is a judge at SkillsUSA Nationals. This column was adapted with permission based on the Emerson Refrigeration Basics Blog 1 R1-v3. For more information about the topics listed here and more, visit www.education.emerson.com.