Direct Talking

By Andy Pearson, Ph.D., C.Eng., Member ASHRAE

This article is the fifteenth in a series exploring refrigeration and heat pump concepts without using jargon.

The skill of fridge guys in confusing others (and often themselves) has been mentioned in these columns before. This month, we tackle a word that is frequently used, but seldom understood, although most people seem to be oblivious to this. The word is "direct."

When we talk about direct and indirect systems, the meaning is usually clear. A direct system uses refrigerant to cool the target stuff: air, product or whatever; whereas an indirect system has one or more intermediate steps of heat transfer, usually using water, brine or glycol to move heat from the stuff to be cooled to the suction side of the compressor. So far so good, but now it gets complicated.

Safety standards such as ASHRAE Standard 15-2010, *Safety Standard for Refrigeration Systems*, refer to the risk of refrigerant leaking from the system into the place where people are located. Such systems are also sometimes loosely referred to as direct systems, but there is a subtle difference. If the evaporator is in the same place as the people being cooled, then the system is described as direct: a leak from the refrigeration circuit would expose occupants to refrigerant gas. The term "direct" applies in this sense even if the evaporator is cooling a secondary fluid (for example, a water chiller in a production area). It should be understood in the sense of "directly releasable," a phrase that was tried in the standards a few years ago but never really caught on.

The amount of refrigerant allowed in the system is determined by the hazardous effect that it would have if it leaked into the occupied space. To mitigate this risk a secondary coolant, such as water, is used to provide the cooling effect to the people, and the evaporator is placed outside the area where the people are located.

If refrigerant leaks into the water, it does not affect the people being cooled. However, if the water circuit was sealed, with no means to relieve excessive pressure, then the refrigerant leak could, in theory, pressurize the water circuit and damage it.

To avoid this nomenclature clash, a secondary circuit without any vent is called an "indirect closed system," and is treated in the same way as a direct system. Likewise, a water circuit that had automatic air purgers installed in the pipes within the area that was occupied also would have to be treated as a direct system.

If the refrigerant leaked into the water circuit, it would be released into the same place as the occupants. To avoid this problem, some method of venting the water circuit is required. This could be an automatic air purger outside the occupied area, or a header tank or relief valve, provided any refrigerant venting from the system could not reach the occupants of the place being cooled.

Stanley thought it was a direct expansion indirect system, but he wasn't sure.

Such systems are called "indirect open," "indirect vented" or "indirect closed vented," depending on how the refrigerant would be released if it leaked into the water.

We also talk about "direct expansion" systems (but funnily enough nobody ever refers to an "indirect expansion" system). Often shortened to "DX," this actually means a system where the refrigerant goes directly from the expansion valve to the evaporator. If you think all systems are like that, then you need to get out a bit more!

The alternative is that the refrigerant goes from the expansion valve to a receiver and the liquid from there is circulated to the evaporators by pumps or gravity. This means that the gas created during the expansion process does not go through the evaporator but passes straight to the compressor suction. Such systems are usually called "flooded" because the outlet from the evaporator is a mix of gas and liquid in contrast to the typical DX system where the outlet is superheated. However, the terms "DX" and "flooded" are not opposites; it is not uncommon to have a direct expansion system that uses flooded evaporators. For this reason, the opposite of a flooded system is sometimes called a "dry expansion" system, also abbreviated to "DX." So next time you hear a system described as "direct," pause for thought.

Andy Pearson, Ph.D., C.Eng., is group engineering director at Star Refrigeration in Glasgow, U.K. ■