A collection of short pointed topical papers.

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Cold W·A·R·

Whether it's Air Conditioning or Refrigeration

SERVICING KNOW-HOW

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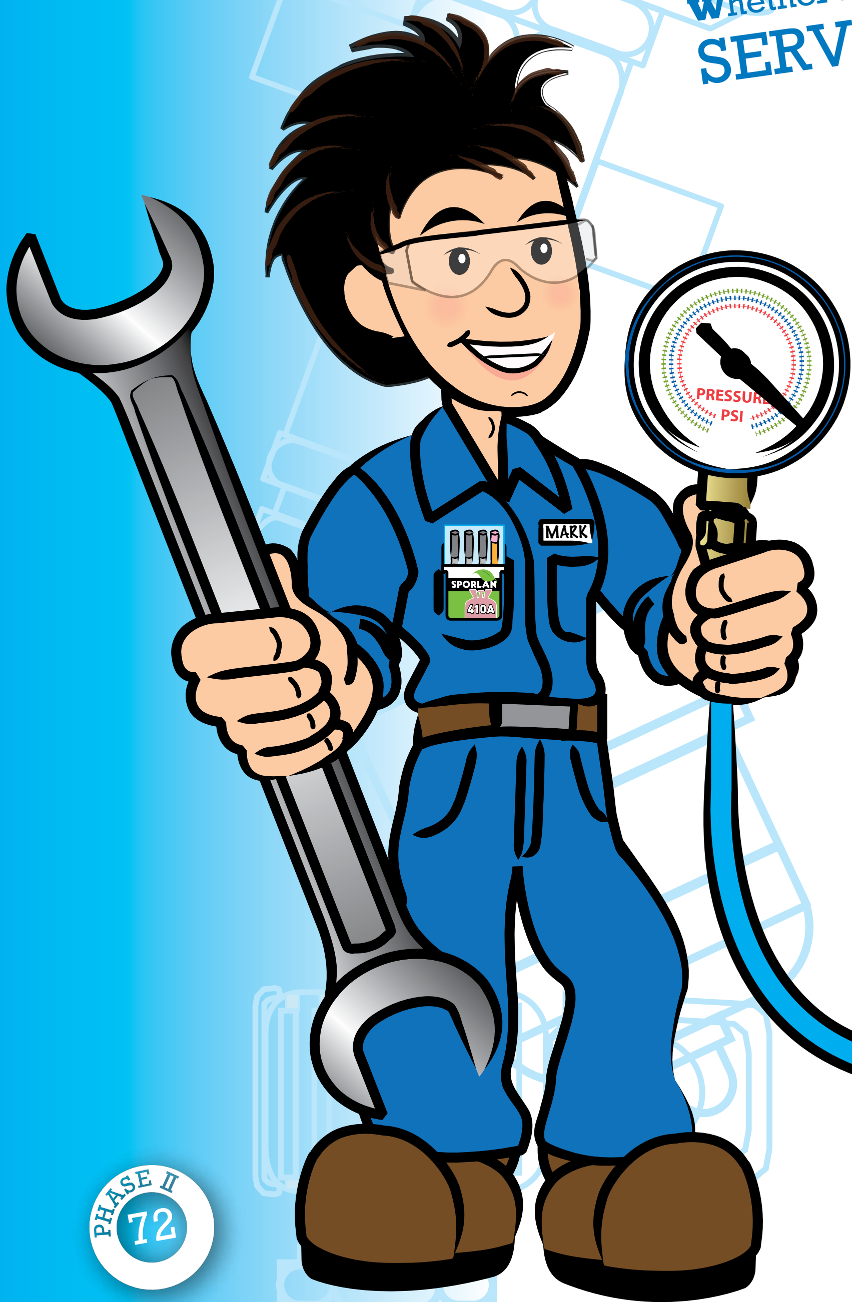

Can you have subcooled refrigerant in the receiver?

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PHASE II 72

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Can you have subcooled refrigerant in the receiver?

We all know that a properly charged refrigeration system utilizing a receiver must have a liquid and vapor interface in the receiver.

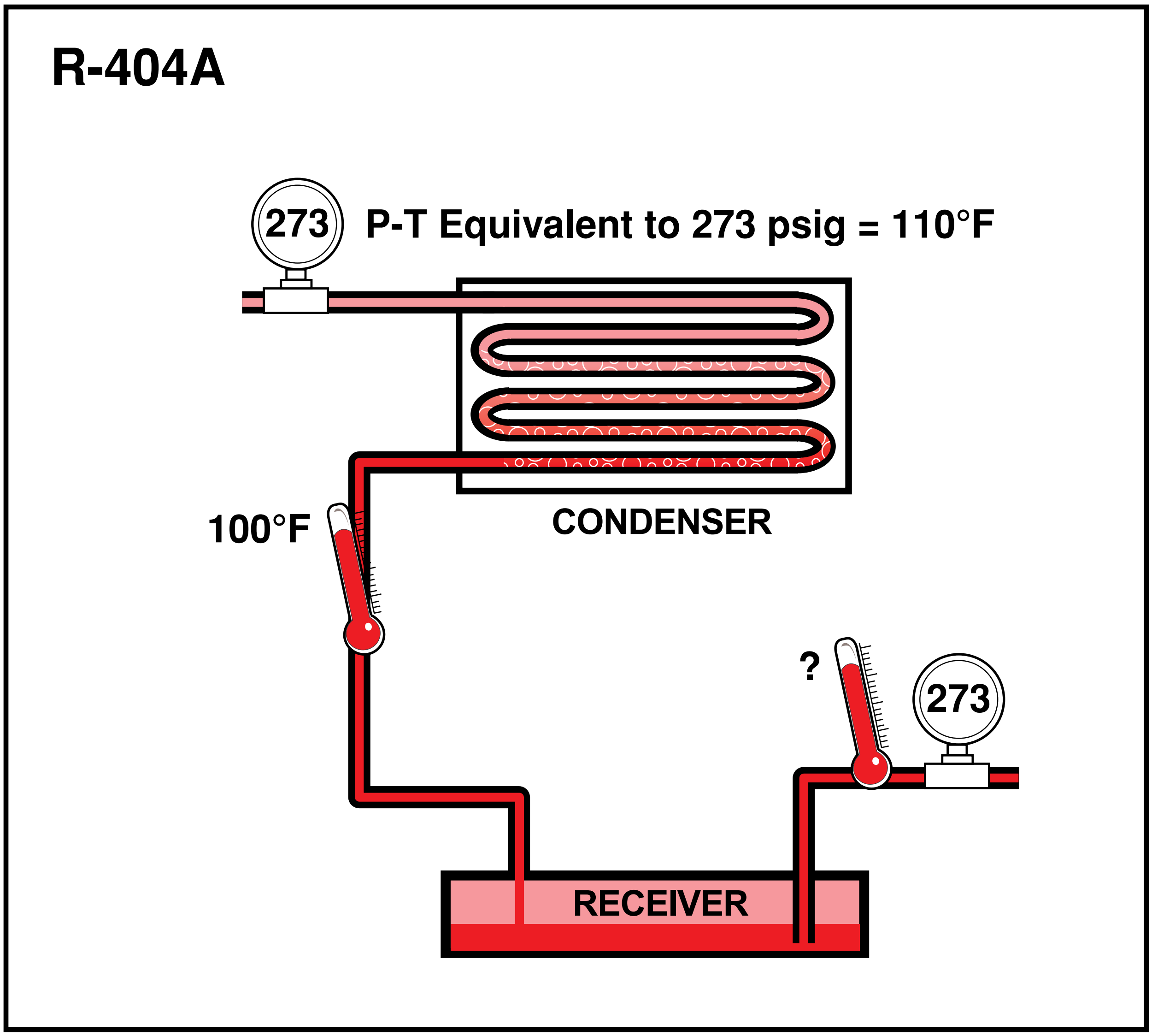
And we also know that saturated pressure and temperature conditions must exist at the liquid and vapor interface.

So, can we have a condition in which we have subcooled liquid from the receiver flowing into the liquid line?

This question is generally answered as follows:

1. **No,** except for the minor amount of subcooling generated by static pressure due to the liquid level in the receiver. For example, R-404A liquid will generate about 0.42 psi static pressure per foot of liquid level in the receiver, or about 0.13°F of subcooling per foot of liquid level at 100°F.

2. **Yes,** because I'm sure I've measured subcooled liquid flowing from the receiver.



Can you have subcooled refrigerant in the receiver?

Which is correct?

When analyzing a problem such as this, it is often useful to consider it in its simplest form, i.e., we do not have any pressure drop from the outlet of the condenser to the outlet of the receiver, and we do not have any heat exchange between the refrigerant and the environment.

This allows us to make the following observations:

a. The receiver pressure is the same as the pressure of the liquid leaving the condenser

b. The refrigerant cannot gain or lose energy flowing from the condenser outlet to the receiver.

Now let's say we have an R-404A system having a 110°F condensing temperature (273 psig) with 10°F subcooled refrigerant leaving the condenser. Given the above scenario, we must have a receiver pressure of 273 psig with 100°F liquid, i.e., 10°F subcooled liquid. This is a simple application of the law of conservation of mass and energy. But how is this possible if we have a liquid vapor interface in the receiver?

It is simple: we will have 110°F at the liquid and vapor interface, but the refrigerant liquid immediately below the interface will be at 100°F. The 110°F saturation temperature will only be found at the interface, and with the vapor above the interface.

But don't we need energy to create the 110°F interface? We've stated the refrigerant cannot gain or lose energy flowing from the condenser outlet to the receiver. Where is this energy coming from?

Yes, we do need energy to create the 110°F interface, but it is already being supplied by the 273 psig pressure. Enthalpy, or the amount of energy in the refrigerant, is the sum of both internal energy and the work created by pressure multiplied by the refrigerant volume.

The real world scenario would include pressure drop and some amount of heat exchange between the refrigerant and environment. But when you account for these factors, you find our simple scenario to be sufficiently accurate to show answer "2" to be the correct response to the subject question. Answer "1", however, is correct when the refrigeration system is not in operation.