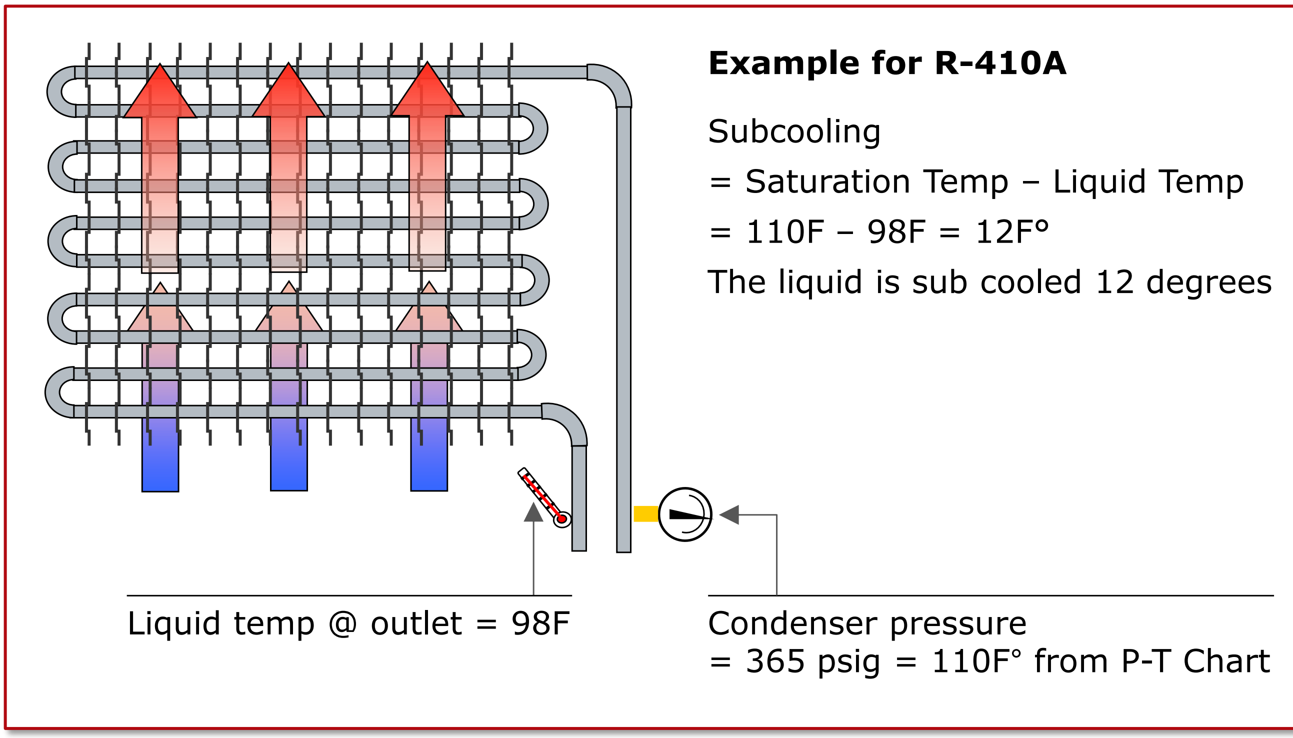
ENGINEERING TOMORROW

Friday Fun Facts |

Subcooling



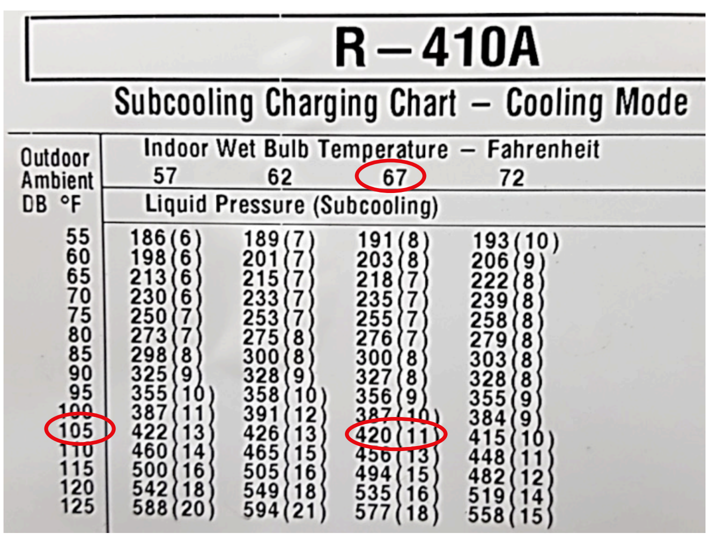
Subcooling is defined as the cooling of a liquid below the temperature it condenses at. To find subcooling, we must subtract the actual liquid temperature as measured using a thermometer from the saturation temperature of the refrigerant. The saturation temperature is found using a pressure temperature chart for the specific refrigerant. If we use ordinary water as an example, we can do a quick calculation for water out of a faucet. Using a thermometer to measure the temperature of water out of a hot water faucet, we measure it to be 140F°. Water boils and condenses at 212F° at normal altitudes so it has a saturation temperature of 212F°. Subtracting 140F° from 212F° we get an answer of 72°F. Thus, the water is subcooled 72F°

In the image above, R410a has a pressure measured to be 365 psig. If we look at a pressure - temperature chart for R410a, this pressure corresponds to a saturation temperature of 110F°. The actual measured temperature of the liquid leaving the condenser is 98F°. When we subtract 98F° from 110F° we get a value of 12 degrees. The liquid R410a leaving the condenser has a subcooling value of 12F°.

The subcooling of the liquid refrigerant occurs in the last sections of the condenser before the refrigerant leaves the condenser and enters the liquid line. Once all the vapor has condensed and only liquid exists, the liquid refrigerant begins to drop in temperature until it exits the condenser and is in the liquid line.

In air-conditioning and refrigeration systems that utilize a TXV, refrigerant charging is done using subcooling as a target value. As refrigerant is added to the system, the condensing pressure increases and the refrigerant starts to condense. This continues until the temperature difference between the refrigerant and the ambient air is great enough to produce the desired subcooling value. The 2 values the technician must know is the indoor wet bulb temperature and the outdoor (Ambient) dry bulb air temperature.

Subcooling is important in assuring that only a solid column of liquid is present at the metering device inlet. If there is any vapor present, it will cause the metering device to become unstable and the evaporator pressure and temperature will fluctuate considerably, resulting serious performance issues. After the system is charged using subcooling, it is important to verify that superheat is within the range of values specified by the manufacturer to ensure proper heat transfer is taking place and the TXV is operating as designed.



R–410A

Subcooling Charging Chart – Cooling Mode

Outdoor Ambient DB °F	Indoor Wet Bulb Temperature – Fahrenheit 57	62	67	72
	Liquid Pressure (Subcooling)			
55	186 (6)	189 (7)	191 (8)	193 (10)
60	198 (6)	201 (7)	203 (8)	206 (9)
65	213 (6)	215 (7)	218 (7)	222 (8)
70	230 (6)	233 (7)	235 (7)	239 (8)
75	250 (7)	253 (7)	255 (7)	258 (8)
80	273 (7)	275 (8)	276 (7)	279 (8)
85	298 (8)	300 (8)	300 (8)	303 (8)
90	325 (9)	328 (9)	327 (8)	328 (8)
95	355 (10)	358 (10)	356 (9)	355 (9)
100	387 (11)	391 (12)	387 (10)	384 (9)
105	422 (13)	426 (13)	420 (11)	415 (10)
110	460 (14)	465 (15)	456 (13)	448 (11)
115	500 (16)	505 (16)	494 (15)	482 (12)
120	542 (18)	549 (18)	535 (16)	519 (14)
125	588 (20)	594 (21)	577 (18)	558 (15)

Image details:

This is the charging chart for a SEER 13 TXV equipped AC residential unit. We will use this for the example below. Clockwise from top, the 3 values circled are:

- Indoor WB
- Condensing Pressure-(Subcooling)
- Outdoor Ambient DB.

In this example, the technician measures an outdoor dry bulb temperature of 105F° and an indoor wet bulb temperature of 67F° Using these 2 values on the charging chart, the target condensing pressure is 420 psig and target subcooling value is 11F°.