Appendix

LRA - Locked Rotor Amps: The current you can expect under starting conditions when you apply full voltage. The current builds up in milli-seconds when the compressor contactor closes at start up and decays to the running current over 100-200 milli-seconds (the time it takes for the motor to start spinning at a significant fraction of running speed). Note: The running current is affected by starting in Stage 1 or Stage 2, but the initial LRA current surge into a non-spinning motor is not affected by what stage is enabled.

RLA - Rated Load Amps: The maximum current a compressor should draw under any operating conditions. Often mistakenly called running load amps which leads people to believe, incorrectly, that the compressor should always pull these amps.

MCC – Maximum Continuous Current: RLA x 1.4 (for Emerson Copeland Scroll Compressors). This current rating is used as the minimum for sizing wiring and circuit breakers.

Example: 2.5 Ton Copeland ZPS31K5E-PFV

- LRA is 83A
- RLA is 17.9A
- MCC is 25.1A
- Actual Stage 1 run current is 7.3A (heating)
- Actual Stage 2 run current is 11.3A (heating)

TXV - Thermostatic eXpansion Valve: The TXV is a complex control element using temperature and pressure feedback to meter refrigerant flow. Warm, condensed liquid, high pressure refrigerant is metered through a controlled orifice to a saturated liquid/vapor mix at lower pressure and lower temperature. The TXV monitors the temperature and pressure at the suction input to the compressor and controls the flow of liquid refrigerant through the TXV to achieve 10-15 °F of super-heating above the saturation temperature at the compressor input (suction) pressure. TXV component failure, poor thermal coupling of the TXV to the suction line, internal or external clogs, the wrong refrigerant charge, and operating temperature extremes can prevent the TXV from achieving the desired super-heat.

Sub-Cooling – Liquid refrigerant at the condenser output has been cooled below the saturation temperature at the compressor output pressure - refrigerant is all liquid. The amount of cooling below the critical liquid/gas saturation temperature is called Sub-Cooling. Sub-Cooling of 5-10 F° is desirable because it prevents the liquid from flashing to gas until it passes through the TXV orifice and all possible heat of condensation has been released by the refrigerant. Too much sub-cooling is unnecessary and reduces the efficiency of the system.

Super-Heat – Gas refrigerant at the evaporator output (and suction input to the compressor) has been heated above the critical liquid/gas saturation temperature – refrigerant is all gas. The amount of heating above the critical liquid/gas saturation temperature is called Super-Heat. Super-Heating of 10-15 °F is desirable because it ensures that no liquid enters the compressor and all possible heat of vaporization has been absorbed by the refrigerant. Too much super-heat reduces the efficiency of the system.

PG, or Propylene Glycol, ($C_3H_8O_2$) PG Is a viscous colorless liquid which is nearly odorless but possesses a faintly sweet taste (Wikipedia). It has very low volatility (will not easily evaporate) and low toxicity (which is why the local regulations often require its use in geothermal ground loop piping). PPG, or Polypropylene Glycol, is more toxic. **A Food Grade Glycol Should be Used.**

PG Properties at 20% Concentration in water by Volume

Property	Value	Units	Conditions	Water
Thermal Conductivity (1)	0.277	BTU/Hr-Ft-°F	50°F	0.338
Specific Heat	0.970	BTU/Lb-°F		1.002
Density	64.23	Lb/Ft^3		62.38
Viscosity	2.79	cP		1.310
Thermal Conductivity	0.272	BTU/Hr-Ft-°F	40°F	0.332
Specific Heat	0.968	BTU/Lb-°F		1.005
Density	64.03	Lb/Ft^3		62.42
Viscosity	3.41	cP		1.546
Thermal Conductivity	0.267	BTU/Hr-Ft-°F	32°F	0.327
Specific Heat	0.966	BTU/Lb-°F		1.009
Density	63.92	Lb/Ft^3		62.42
Viscosity	4.23	cP		1.794
(1) W/m-K x 0.5782 yields BTU/Hr-Ft-°F				

Accumulator or Receiver

The tank on the suction line between the evaporator and the compressor is a suction accumulator. The tank on the liquid line between the condenser and TXV is a liquid receiver. They do look similar but they serve two completely different purposes.

The primary function of the suction accumulator is to catch and hold any liquid refrigerant that didn't boil off in the evaporator. Liquid refrigerant getting to the compressor can damage the pistons or scrolls. This liquid will also dilute or even flush the oil out of the compressor crank case. This loss of oil will prevent proper lubrication to the compressor, causing compressor damage or failure. Liquid slugging can occur even on a properly installed system with the loss of air flow. Improper evaporator air flow due to dirty filters, coil or loose belt will have the same effect. Low suction temperatures such as on a heat pump in the heating mode can also cause liquid slugging of the compressor. Many heat pump manufactures utilize suction accumulators as standard equipment.

The accumulator function is quite simple. The suction gas leaving the evaporator enters the accumulator at the top and passes through a baffle or screen. Any liquid present collects on the screen and falls to the bottom of the accumulator. Inside the accumulator is a U-shaped tube that will allow only the refrigerant vapor to exit and enter the compressor. A small orifice in the bottom of the U tube will allow any oil that collected in the accumulator to exit and return to the compressor through the suction line. Accumulator failures are rare on properly maintained systems. A plugged orifice in the U tube would be the most likely problem. This plugged orifice would prevent oil from returning to the compressor.

An accumulator is inexpensive and can be added to almost any system that has experienced compressor slugging. The cause of the slugging should still be determined and corrected if possible. Systems that run under low load conditions may be a good place to add an accumulator. Parker recommends that the accumulator be replaced when a compressor is being replaced. Contaminated oil from the old compressor may be in the old accumulator. Also, a considerable amount of oil may still be in the old accumulator. This oil combined with the oil from the new compressor may create an oil overcharge.

Proper accumulator sizing is important when replacing or adding. The pressure drop across the accumulator should be kept as low as possible. The accumulator's internal volume must be sufficient. On a heat pump system with a fixed metering device the accumulator should be capable of holding 70% of the system charge. In a TXV system the accumulator should be able to handle 50% of the system charge. Refer to sizing charts for proper sizing. The accumulator should never be sized by connection sizes.

https://www.behler-young.com/tech-tips/accumulator-or-receiver-that-is-the-question/