**Building Science Education Solution Center – Smart Refrigeration Tools**

Proficiency Level 3: Apply

**Learning Objective 3.1:**

* Provide examples of how smart diagnostic tools can be applied to the task of charging refrigerant.

**Lecture Notes 3.1:**

*This is used for illustrative purposes only and is not meant to be a guide on charging refrigerant.*

For example, consider the refrigerant charging process for a non-thermostatic expansion valve (non-TXV) system where the Total Superheat method is used. The technician can properly set refrigerant charge once they have ensured the airflow is correct, that coils and filters are clean and the system piping and ductwork has been installed properly. With the conventional method, the technician will identify the refrigerant and locate the correct manifold for the type of refrigerant that is being used and connect the manifold to the proper refrigerant service ports to measure refrigerant pressures and corresponding saturation temperatures.

The technician will attach a thermocouple to the suction line and use an additional thermocouple to measure outdoor drybulb temperature. The technician will walk inside to the indoor unit and place a psychrometer inside the return air duct to measure indoor air wetbulb temperature.

The technician can now calculate target superheat using the target superheat chart – note, this is a moving target! The technician will now walk back outside to the condenser to read off suction line temperature and read off the suction pressure and corresponding saturated suction temperature. Actual superheat can now be calculated (Superheat = Tsuction – Tsaturated). The technician adds or removes charge and recalculates superheat until it is within 5 degrees of the target superheat. Using conventional tools, this may require multiple manual measurements and calculations as the technician adds or removes charge.

Now, consider the same task using smart diagnostic tools. Again, the technician can properly set refrigerant charge once they have ensured the airflow is correct, coils and filters are clean, and the system piping and ductwork has been installed properly. The technician connects the digital manifold or probes and selects the refrigerant type on the manifold or smartphone app.

The technician connects a temperature probe or a digital manifold thermistor to the suction line, while also using a temperature probe or digital manifold thermistor to measure outdoor drybulb temperature. The technician walks inside to place a digital psychrometer into the return air ductwork.

The smartphone app or digital manifold will automatically calculate target superheat and the actual superheat of the system. With this information, the technician can add or remove charge as needed. Because the app or digital manifold are streaming measurements in real time, target superheat is constantly being recalculated and the technician is able to charge the system more easily and accurately.

**Problem Set 3.1:**

Which set of diagnostic tools requires repeated manual temperature readings?

1. Conventional diagnostic tools
2. Smart diagnostic tools

**Learning Objective 3.2:**

* Demonstrate how smart diagnostic tools can be applied to commissioning.

**Lecture Notes 3.2:**

*This is used for illustrative purposes only and is not meant to be a guide on commissioning.*

Using conventional tools, the commissioning process involves pen and paper calculations. The technician verifies all system components are as expected. They verify the system is providing proper airflow by measuring the total external static pressure using a manometer. They take return and supply wetbulb and drybulb temperatures and use an enthalpy chart to find the supply and return enthalpies which allows them to calculate the operating capacity. They would compare the operating capacity to the rated capacity to ensure the system is performing as intended.

Using smart diagnostic tools, the technician will enter the system information, measure airflow or let the application auto-calculate the airflow, then insert probes in the supply and return airstreams. The application then calculates the operating capacity and compares it to the rated capacity.

The application can also generate a report to be shared with the homeowner. These reports can be used as documentation for the HVAC company and for the homeowners that the HVAC system was properly installed, and can help your client have peace-of-mind about their investment that is backed by real data.

**Learning Objective 3.3:**

* Demonstrate how smart diagnostic tools can be applied to troubleshooting and diagnostics.

**Lecture Notes 3.3:**

*This is used for illustrative purposes only and is not meant to be a guide on troubleshooting and system diagnostics.*

Another area where these advanced tools have a major impact is in troubleshooting and system diagnostics. With conventional methods, a technician would need to have years of experience to troubleshoot and diagnose issues within a system. Based on a combination of observations and measurements, a technician would use his or her expertise and experience to deduce what is wrong and what corrective actions should be taken.

While smart diagnostic tools are no substitute for proper training on HVAC installation, commissioning, and troubleshooting, smart diagnostic tools put years of experience in the hands of newer technicians and also speed up diagnostics for experienced technicians. Once the technician has connected the correct probes and sensors, the diagnostic applications can identify system faults and suggest corrective actions.

**Problem Set 3.3:**

True or false: Smart diagnostic tools replace the need for HVAC training.