System Commissioning

After the system has been installed, it needs to have the duct system tested for leakage, the refrigerant charge checked and the airflow measured and balanced.

Duct leakage

Duct leakage can be measured as total leakage or leakage to the outside. Total leakage measures all duct leakage and can be useful for testing the system after the rough-in is complete and the system has been installed, but before the duct-work is concealed by gypsum board. For total leakage, the ducts are pressurized to + 25 Pa and the fan pressure is converted to airflow.

Since duct leakage to the outside of the building envelope is the leakage with the direct energy penalty, it is measured by pressurizing the house to a + 25 Pa pressure difference with respect to the outside. With all the supply and all but one of the return registers sealed off, the duct testing apparatus (duct blaster) is attached to the unsealed return. The air from the house will flow through the duct

pressurization fan and will pressurize the ducts as well. When the pressure in the ducts is measured at the nearest supply register, it will be less than or equal to 0 Pa. If it is 0 Pa, the duct system is really tight (meaning the ducts are maintaining the same pressure difference as the house w.r.t. the outside). If it is less than 0, the duct system is showing leakage to the outside (not able to maintain the house pressure). By turning on the duct pressurization fan and carefully pressurizing the duct system, the ducts can be brought to the same pressure as the house (zero pressure difference between house and duct). The amount of fan pressure needed to do this can be converted to flow (cfm_{25}, for a 25 Pa pressure difference) and the amount of duct leakage can be established from charts. Some folks prefer to depressurize the ductwork- please RTFM (Read The Friendly Manual!) if you choose to perform duct depressurization (I call people who do that “duct suckers”!).

A high performance system should have less than 5% duct leakage normalized by conditioned floor area. The target is calculated by multiplying the conditioned floor area served by the system by 0.05; once the leakage has been determined from the test results, divide the test re-

sult by the conditioned floor area and multiply that answer by 100 to get the actual duct leakage percentage.

Refrigerant charge

For units that do not have a thermal expansion valve, use the superheat method. To measure ***superheat***, you will need a pressure gauge and a digital thermometer.

1. Let the system run for at least 20 minutes
2. Read the pressure on the suction line
3. At the same time, take the temperature of the suction line within 6" of where you are reading the pressure
4. Use a pressure-temperature chart and convert the pressure reading to a temperature
5. Subtract the converted pressure temperature from the actual temperature

The result is the amount of superheat

Look up the ideal superheat value from the manufacturer's table or slide rule. If the superheat is less than the manufacturer's value, remove 2 to 4 ounces of the

refrigerant, following all of the EPA rules. If the superheat is higher, add 2 to 4 ounces of refrigerant. Let the system run for 10 minutes to establish normal operating conditions and test the superheat again. Repeat this procedure until you are within 1˚F of the manufacturer's value for ideal superheat (obviously, you will have to vary the amount of refrigerant added or removed each time).

In order for this to be accurate, you must have correct airflow across the coils, the outdoor temperature has to be above the minimum specified by the manufacturer, the equipment needs to be past the initial pull-down time (see the section on ductwork), there should be a temperature drop across the indoor coil between 15˚F and 25˚F, and there shouldn't be any leaks in the refrigerant lines.

To measure refrigerant charge in systems with a TXV, measure the ***subcooling***. You will need the same tools used to measure superheat and follow the same procedure. Instead of measuring the suction line, measure the temperature and pressure on the liquid line.

If the measured subcooling is higher than the manufacturer's ideal value, remove some refrigerant. If the subcooling is

lower than the ideal value, add refrigerant. Let the system run for 10 to 20 minutes to establish the new operating conditions and run the subcooling test again. Repeat this procedure until the subcooling matches the manufacturer's ideal value or is between 10°F and 15°F (if you don't have the manufacturer's value).

The ideal method for measuring refrigerant charge is to weigh it. This is done by recovering the refrigerant from the unit and recharging the system with refrigerant. Follow the manufacturer's recommendations and try to get the charge within 1 ounce of their recommended charge. This ***refrigerant weigh-in*** method can be used when superheat or subcooling cannot (when outdoor conditions are outside the scope of those tests).

With the compressor turned off, add the liquid refrigerant to the liquid line. If the liquid refrigerant stops flowing before the correct charge is established, turn the compressor on and add the remaining refrigerant to the suction line as a vapor. Before opening the suction line service valve, make sure that the cylinder pressure is higher than the suction pressure by checking your low-pressure gauge.

Airflow measuring and balancing

Proper airflow is critical to providing comfort to the people who are going to live in the home. It needs to be measured and balanced in order to make sure the system is installed and operating correctly.

To measure airflow, you can use a flow hood or a velometer. You can place the flow hood over the return and measure the amount of air that moves through it. This is the airflow entering the system. To measure how much airflow is being delivered, you can use the flow hood over each supply and total them up. The amount of air delivered should be very close to the amount of air that entered the system through the return.

Round Duct Cross-Section Surface Area, ft^2	
4”	0.087
5”	0.136
6”	0.196
7”	0.267
8”	0.348
10”	0.545
12”	0.785
14”	1.068
18”	1.766
24”	3.14

In order to accurately use the velometer, you will need to know the size of the ducts to calibrate the device. Each duct size has a different cross-sectional area which affects flow rate and velocity. The flow rate is equal to the area multiplied by the velocity (Q = A x V), when area is measured in square feet.

The commissioning of the system is the fine tuning of the comfort system and ensures that the installed system is operating correctly. Will it guarantee no complaints? Of course not! But will you be able to defend your installation practices and demonstrate that this system was installed correctly- the answer is “YES!” The reality is that performing commissioning on the system goes a long way to reducing comfort call-backs. Those call-backs can eat up every bit of profit made at the sale and performing commissioning work is simply a means of ensuring profitability over the long haul.