TECHNICALLY SPEAKING

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Fixed Orifice Systems: Checking the operation

Checking the operation of an air conditioning system with a fixed orifice metering device can be very simple if the right approach is taken. Remember: the best method to use is the one listed by the manufacturer. In the absence of manufacturer's data, the system can be charged and operation can be confirmed by simply measuring the superheat and checking the discharge air from the evaporator. This article reviews the procedure for checking both of these measurements.

First superheat on a fixed orifice system is never constant. The superheat will change as the load in the space changes and as the outdoor temperature changes. The load in the space is directly related to the humidity within the space. Remember: the first function of an A/C system is to remove moisture from the air. In order to measure humidity, you need to know the wet bulb and dry bulb temperature of the air. Wet bulb temperature can be measured with a pyschrometer (digital or sling). When the wet bulb and dry bulb temperatures are equal the Relative Humidity is 100%. Typically, the wet bulb temperature will be lower than the dry bulb temperature. It is best to measure air temperatures at the blower inlet and not in the space. There can be a difference in temperature between the space temperature and the temperature of the air entering the blower due the condition of the return duct (Is it pulling air from the basements? Is the duct picking up heat because it runs through an unconditioned space?).

An example of a sling psychrometer

Now that the wet bulb temperature is known the next step is to measure the temperature of the air entering the condenser. Don't assume it is the same as the outdoor temperature, measure it. There are a lot of factors that can affect the temperature of the air entering the condenser. The temperature of the air entering the condenser directly influences the superheat and the head pressure at which the system operates.

FIGURE 1: CALCULATING SUPERHEAT (Fixed metering device)

Condenser Entering Air Dry Bulb Temperature

Indoor Wet Bulb Temperature	55	60	65	70	75	80	85	90	95
52	12	10	6	-	-	-	-	-	-
54	14	12	10	7	-	-	-	-	-
56	17	15	13	10	6	-	-	-	-
58	20	18	16	13	9	5	-	-	-
60	23	21	19	16	12	8	-	-	-
62	26	24	21	19	15	12	8	5	-
64	29	27	24	21	18	15	11	9	6
66	32	30	27	24	21	18	15	13	10
68	35	33	30	27	24	21	19	16	14
70	37	35	33	30	28	25	22	18	15
72	40	38	36	33	31	28	26	24	22

Required Super Heat at Service Valve +/- 5° F

1. Measure indoor wet bulb temperature
2. Measure dry bulb temperature of air entering condenser
3. Find appropriate readings on each line
4. Follow the lines until they intersect
5. The point where they intersect is the degrees of superheat required for the operating conditions
6. Measure actual superheat
7. If superheat is not within +/- 5 degrees of calculated, then determine the reason!

** Do not attempt to adjust the charge if the required superheat indicates a -

** Superheat = Measured suction line temperature – evaporator temperature (Temperature obtained from PT (Pressure/Temp.) chart using measured Low Side pressure)

Example: If the wet bulb temperature entering the blower is 67° and the dry bulb temperature is 76°, then the air leaving the evaporator should be at a temperature of 60°. If the air temperature is not within range, then it indicates a problem with the system.

Once you know the wet bulb temperature of the air entering the blower and the temperature of the air entering the condenser, the superheat can be calculated using the chart in figure 1. Let's say that the wet bulb temperature entering the blower is 66° and the temperature of the air entering the condenser is 80°, the required superheat at the condenser suction service valve would be 18°.

As you can see, the required superheat varies greatly depending on the conditions at which the system is operating. Under the right conditions, there can be no superheat or it can be as high as 30°.

Another way to check system operation is to check the discharge air temperature coming from the evaporator. This will tell you if you have the correct air flow. Used in conjunction with the superheat, it can help identify system problems. If the evaporator leaving air temperature and the superheat are correct, then the unit is most likely operating properly.

To determine the proper leaving air temperature, you need to measure both the wet bulb and dry bulb temperature of the air entering the blower. Once you have these measurements, use the chart in figure 2 to determine the proper evaporator leaving air temperature.

FIGURE 2: PROPER AIR FLOW RANGE (non TXV)

Indoor Entering Wet Bulb Temperature

Indoor Dry Bulb Temperature	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
70	51	51	52	52	53	53	54	55	55	56	57	59	60	-	-	-
72	52	52	53	53	54	55	55	56	57	57	58	59	60	61	62	63
74	53	53	53	54	55	55	56	57	58	58	59	60	61	62	63	64
76	54	54	54	55	55	56	57	57	58	59	60	61	62	63	64	65
78	55	55	55	56	56	57	57	58	59	60	61	62	63	64	65	66
80	56	56	56	56	57	58	58	59	60	61	62	63	64	65	66	67
82	57	57	57	57	58	59	60	60	61	62	63	64	65	66	67	68
84	-	58	59	59	60	60	61	61	62	63	63	64	65	66	67	68

Proper Evaporator Leaving Dry Bulb Temperature +/- 3° F

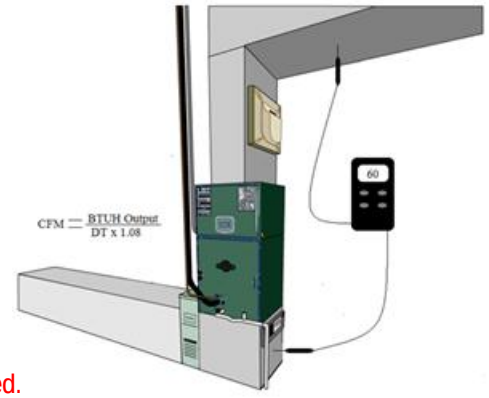
Air Flow can be calculated by measuring the temperature rise and BTU output of a gas or electric furnace:

$$CFM = \frac{\text{BTU Output}}{\Delta T \times 1.08}$$

BTU Output Electric =
Volts x Amps x 3.414

Btu Output Gas =
BTU input x Efficiency *
* Measured Combustion Efficiency

1. Measure indoor wet bulb & dry bulb temperatures
2. Find appropriate readings on each line
3. Follow the lines until they intersect-
4. This is the required evaporator leaving air dry bulb temperature
5. Measure the leaving air dry bulb temperature from the Unit
6. Is leaving air temperature within +/- 3 degrees?
7. If leaving air temperature is 3 or more degrees lower increase fan speed
8. If leaving air temperature is 3 or more degrees higher decrease fan speed



NEVER adjust fan speed unless filter, superheat, coils and duct dampers have been checked.

In closing, checking the operation of a fixed orifice system can be pretty simple if you take the time to get the correct measurements and have the proper charts. In order to do this you will need a psychrometer (digital or sling), a set of gauges, a thermometer and a PT (Pressure/Temp.) chart. The hard part is deciding what to do when these readings do not match the system readings. That is a topic for a future technical bulletin.

** For additional support contact Meier Supply at any of our locations **

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