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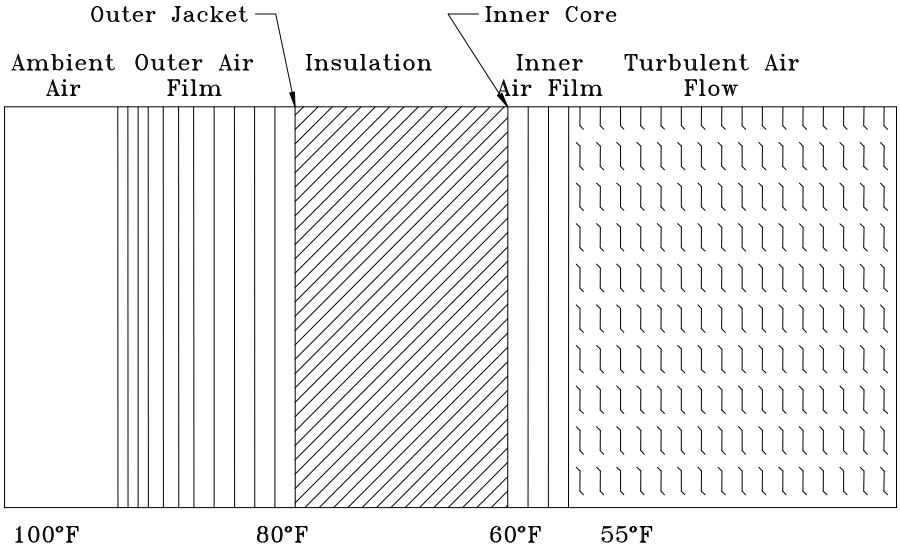
Duct Sweating

Condensation or "sweating" on duct surfaces is a complex problem that is primarily seen in areas of high humidity. Multiple factors can lead to condensation. It occurs on any substance where the surface temperature is colder than the dew point temperature of the air surrounding it. With air ducts it is most common to see condensation on the outer vapor barrier of the duct. However, condensation can also be found on the inner surface of a duct, regardless if the duct is the flexible type or if it is a sheet metal duct. Condensation can also occur at the plenum or on fittings or connections to fittings. You will have condensation any place on the duct system where the temperature at the surface is colder than the dew point temperature of the surrounding air.

To prevent condensation, it is necessary to either raise the temperature of the sweating surface or lower the dew point temperature of the air. It is only possible to lower the dew point temperature by decreasing the amount of moisture in the air (dehumidify) or by bringing in (mixing) drier air from the outside or inside. Thus, it is usually easiest to increase the temperature of the sweating surface by adding more insulation.

Figure 1 is an example of the temperature profile through the wall of an air duct. This figure shows a surface temperature of 80ºF at the duct's outer vapor barrier. Condensation will start to occur on the outer surface of the duct when the dew point temperature is 80ºF or higher.

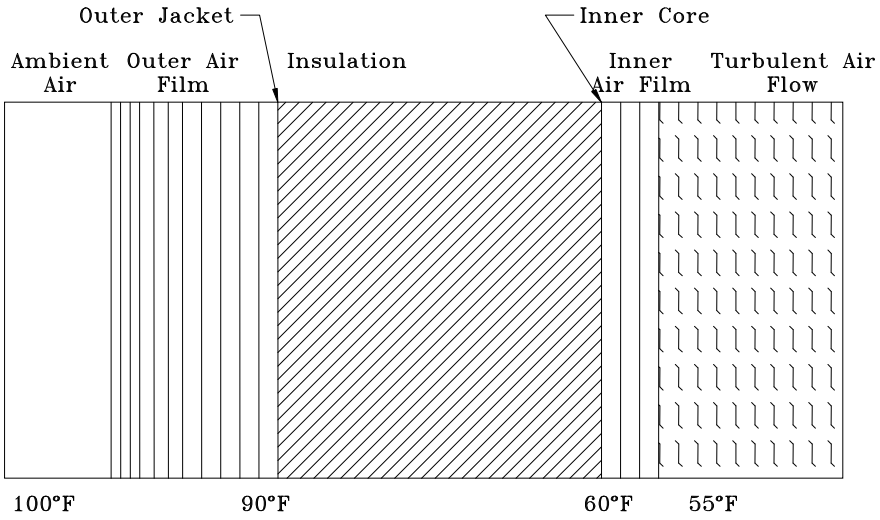
Figure 1



Duct Sweating (Cont.)

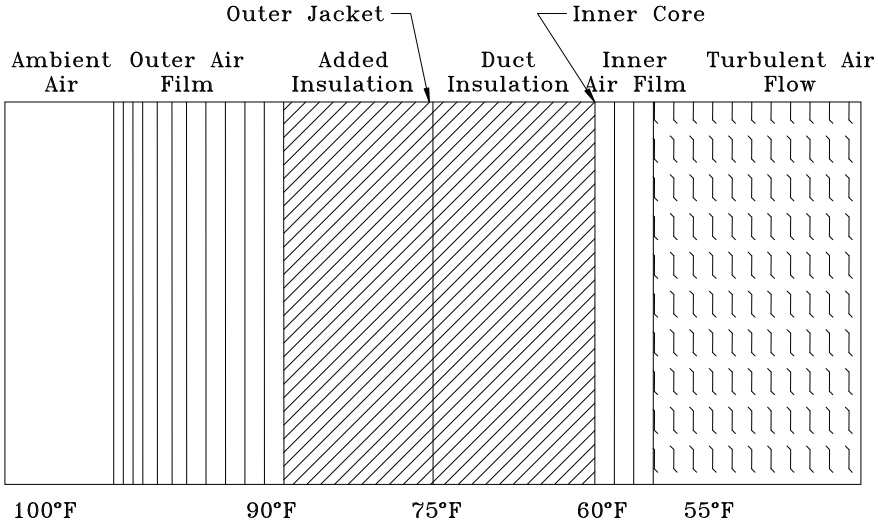
By increasing the insulation thermal performance (as shown in Figure 2), the surface temperature of the outside of the duct should increase. Condensation would not occur until the dew point temperature was 90ºF or higher.

Figure 2



It is important to recognize that the increased insulation should be integral to the duct construction. Adding insulation over the outside of existing duct vapor barrier can in itself cause additional condensation problems, as shown in Figure 3. When extra insulation is added over the top of an existing vapor barrier, the surface temperature of the sandwiched vapor barrier is now reduced. Condensation will occur on the vapor barrier surface at a much lower dew point temperature (75ºF in this example).

Figure 3



Duct Sweating (Cont.)

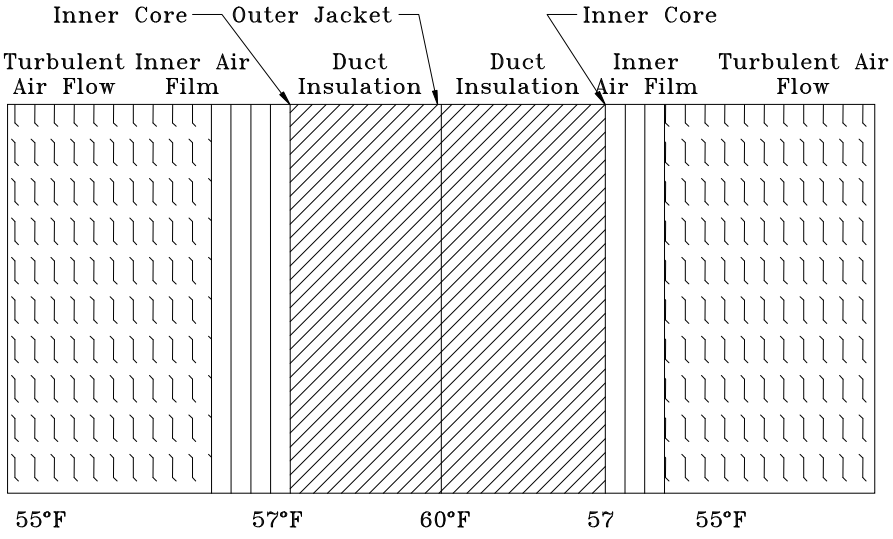
Sweating problems can also occur when air ducts are touching each other, as in where one air duct crosses over the top of another or when two ducts are run side-by-side and touch.

First, when air ducts are lying on top of each other there is the probability that the insulation will be compressed thus reducing the thermal performance. This is not as big of an issue with flexible ducts as it might be with sheet metal ducts due to the lighter weight. Still it should be noted and taken into account in areas conducive to condensation.

Second, the added thermal resistance offered by the outer air films is negated as the air space is lost where the ducts are touching.

Lastly, the temperature of the outer duct surfaces will be "steady state" with the internal duct temperature. As a result, you now have a very low "local" surface temperature at the point where the ducts are touching (see Figure 4) which can easily be below the dew point temperature. At the same time, ventilation around the duct surface is reduced or non-existent which will lower the heat transfer resulting in a colder vapor barrier surface temperature. This is the worst-case situation and condensation will definitely occur at the junction where the ducts are touching when the junction surface temperatures are below the dew point temperature.

Figure 4



Note: ATCO offers the information in this text as a general guide to assist in evaluating problems associated with condensation that occur with HVAC systems in areas of high relative humidity. Since, many factors contribute to moisture related problems with HVAC systems, the details of this text should not be considered as all-inclusive. A qualified HVAC professional should be consulted when diagnosing problems related to condensation.