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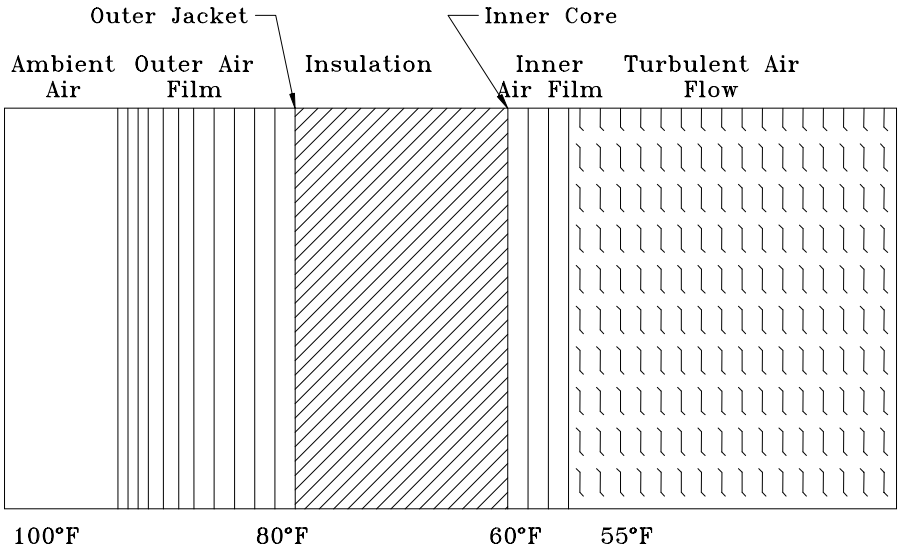
Duct Sweating

Condensation or "sweating" 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 wet bulb temperature (dew point) of the air surrounding it. In 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 ducts, regardless if they are the flexible type or if it is a sheet metal system. Condensation can also occur at the fittings or the plenum. Any place where the temperature of the surface is colder than the wet bulb temperature of the surrounding air, you will have condensation.

To prevent condensation, it is necessary to either raise the temperature of the sweating surface or lower the wet bulb temperature of the air. It is usually easiest to increase the temperature of the sweating surface by adding insulation. However by increasing ventilation it may also be possible to lower the wet bulb temperature of the air.

Figure 1 is an example of the temperature profile through the wall of an air duct. The figure shows a surface temperature of 80 degrees at the outer vapor barrier. In Figure 1, condensation will occur on the outer surface with a wet bulb temperature of 80 degrees or higher.

Figure 1



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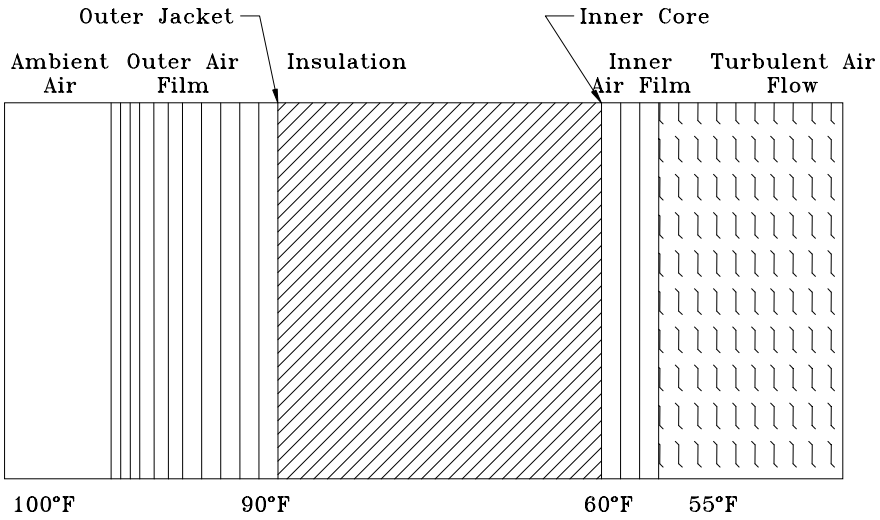
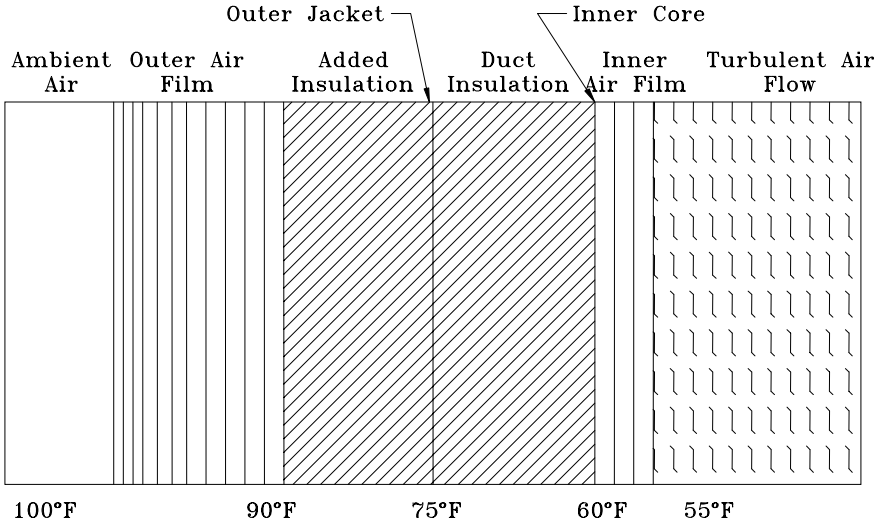
By increasing the insulation thermal performance (as shown in Figure 2), the surface temperature of the outside of the duct should increase. In Figure 2, condensation would not occur until the wet bulb temperature was 90 degrees or higher.

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 barriers can in itself cause condensation problems, as shown in Figure 3. When insulation is added to the outside of the existing vapor barrier, the surface temperature of the barrier is reduced causing sweating at the lower wet bulb temperature of 75 degrees.

Figure 3



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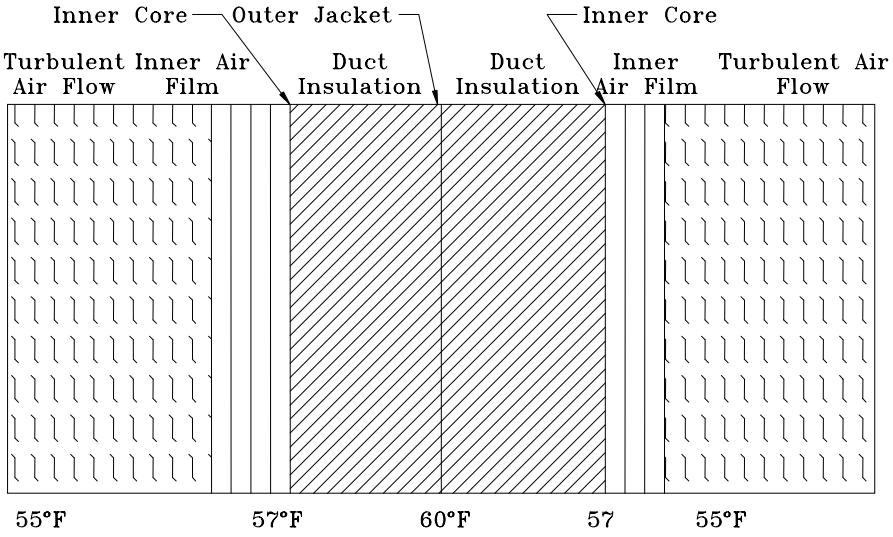
Sweating problems can also occur when air ducts are touching each other, as in where one air duct crosses over the top of another or when two ducts are run side-by-side and touch.

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.

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

And last, 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 points where the ducts are touching (see Figure 4) which can easily be below the dew point temperature. Also, at the same time, potentially the ventilation is reduced around the duct surface and this may also raise the wet bulb temperature of the surrounding air. This is the worst condition and the result is that condensation will occur at the junction where the ducts are touching.

Figure 4



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.