

To Plate or Not To Plate

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It was early 1980's when my soon to be business partner came up with an idea to improve the conductivity of a staple up systems in hopes of increasing the output in a cantilevered area of a home we were working on. He asked a local furnace shop to cut and form some long strips of sheet metal which was to be attached between the tubes and sub-floor. He knew it would work...but he didn't know how well! Those babies made all the difference in the world for this specific application and to this day it makes me wonder where our heads were at when we didn't patent his idea.

Zoom forward to the year 2002 and we have the ASHRAE Research Project 1036 Develop Simplified Methodology to Determine Heat Transfer Design Impacts Associated with Common Installation Alternatives for Radiant Conduit FINAL REPORT by Dr. Kirby S. Chapman and Jacque D. Shultz, National Gas Machinery Laboratory, Kansas State University.

The good Doctor Chapman and his test facility were challenged to "...develop an improved understanding of how heat energy transfers from a radiant conduit system to the built environment." So the boys and their toys set up in their lab, four configurations to test just what impact heat transfer plates and insulation have on transferring energy.

The hydronic systems included set ups with and without insulation below the tubes, and with and without extruded aluminum heat transfer plates.

For those who have not been following ASHRAE Research on radiant I'll bring you up to speed with a few quick conclusions.

Research Project 876 conducted by University of Illinois "investigated the impact of surface characteristics on radiant heat transfer from radiant panels. The results from this investigation showed that the only significant parameter is the insulating value of the material that covers the panel. The investigation conclusively found that the radiative properties of the covering insignificantly influenced the heat transfer from the panel."

Research project 1036... "focuses on answering the question of how the panel construction materials influence the amount of heat that is available for transfer from the panel surface...."

What did the scientists from KSU come up with... all things being equal... "the heat transfer plates increase the heat that is transferred to the occupied by space by between 160% and 172%, depending on where the insulation was positioned."¹

There you have it...most floor coverings make great radiators, plates make a difference and so does the position of the insulation.

Here some numbers for you to chew on:

Output Comparison			
Plates or No Plates	Air Gap	Test Run #	Output (btu/hr*ft ²)
No Plates	5/8"	1	24.7
No Plates	5/8"	2	22.4
With Plates	5/8"	1	45
With Plates	5/8"	2	47.6
No Plates	2"	1	24.2
No Plates	2"	2	28.1
With Plates	2"	1	43.6
With Plates	2"	2	40.3

Time To Reach Steady State			
Plates or No Plates	Air Gap	Test Run #	Time (hrs)
No Plates	5/8"	1	4.26
With Plates	5/8"	2	3.89
No Plates	2"	3	10.05
With Plates	2"	4	5.04

Does this mean every staple up systems should use plates...no, but it does mean:

1. If you use plates your systems can operate at lower temperatures.
2. If you want to stick with a single temperature system, plates can boost your output in high load areas.
3. Steady state times are considerably faster with plates. (Note: From the original data, exponential heat transfer was measured after 15 minutes ...too bad – so sad for those claiming radiant takes along time to heat up...not necessarily the case with high performance assemblies or low mass systems!)
4. You'll have to do your own capital cost comparison to see if plates make financial sense (pun intended).

1. Insulation for the test was "blue board". Researchers noted, further testing on using fiberglass batt would provide different results but testing the numerous configurations was outside the scope of the project.
2. ref. ASHRAE Research Project 1036 Develop Simplified Methodology to Determine Heat Transfer Design Impacts Associated with Common Installation Alternatives for Radiant Conduit FINAL REPORT by Dr. Kirby S. Chapman and Jacques D. Shultz, National Gas Machinery Laboratory, Kansas State University.