

THERMA-FUSER™

THERMALLY POWERED VAV DIFFUSER

BULLETIN



November 4, 1988

Supersedes 10.03EB1282

Subject: TF-HC Low Stratification Heating.

After five years of successful operation, some of our competitors are now telling customers that the TF-HC Therma-Fuser™ diffuser does not work in the heating mode due to excessive stratification. I guess this is one of the alternatives when you are blocked by the Acutherm patents from making a similar unit. This claim, however, borders on the irresponsible so some of you have asked us to review stratification.

INDUSTRY GUIDELINES

Hot air rises and it is commonly accepted that the best way of heating to avoid stratification is from below the window or with baseboard heat. Yet due to cost and space limitations, and perhaps due to the utter simplicity of it, our industry has long heated air from the ceiling following certain guidelines. These are:

- 1) Less than 650 BTU/lineal foot of perimeter (skin) heat loss. Most new buildings are well below this level. (Some are below the 250 BTU/lineal foot level where a TF-HC with a three way blow pattern away from the window can be used to induce air up the window).
- 2) Supply air temperature as low as possible – preferably within 20°F of room temperature. The lower loads of #1 mean that lower heating temperatures can be used.
- 3) Inside glass temperature above 50°F when looking at the gradient through the window. Even though space temperature may be at a comfortable level, low glass temperatures will produce a radiant cooling effect.

Stratification is not a problem when these guidelines are followed. Acutherm concurs with the industry and recommends following these guidelines to achieve low stratification.

THE BEST WAY TO HEAT FROM THE CEILING

Well insulated buildings have increased interest in heating from the ceiling with the same ducts used for cooling. To serve this need Acutherm answered the question of “What is the best way to introduce hot air from the ceiling?”

In 1982, before developing the TF-HC, Acutherm found that the key to low stratification is a high discharge velocity directed along the ceilings. For a VAV system, high velocity discharge is required at turndown conditions too. Horizontal high discharge velocities prevent hot air from accumulation at the ceiling and instead recirculate it to the lower portion of the space.

This finding was made after testing various ways of introducing heating air from the ceiling. Discharge velocities from high to low were tested in each of several directions from horizontal discharge along the ceiling to angled downward discharge to straight down.

The result was that in all cases high velocity discharge along the ceiling produced the least stratification and the smallest difference between average floor temperature and average ceiling temperature. In addition, this approach produced no noticeable drafts, hot spots or cold spots. Hot air directed downward at high velocity did not mix the room as well vertically or horizontally and, of course, produced a hot spot under the diffuser with cooler areas near walls and corners. It also produced a noticeable downdraft below the diffuser. The other methods of introducing air, including lower velocities along the ceilings, gave even poorer performance and resulted in more stratification.

continued

High discharge velocities directed along the ceiling create the best mixing of supply and room air. The entire air mass is gently churned and warm inlet air mixes rapidly with the room air. Most important for overhead warm air heating, however, is the ability to maintain mixing velocities at low air flows. Without this, VAV systems will still tend to stratify at turndown conditions.

ACUTHERM SUCCESS

Therefore, when developing the TF-HC, Acutherm used a design which controls flow at the very edge of the diffuser to produce the highest discharge velocities there at both full flow and turndown. The TF-HC controls with four perimeter blades rather than controlling in the neck of the diffuser. The resulting low stratification at both full flow and turndown produces good sensing of average room temperature at both conditions. One competitor has suggested that a 90°F thermal element is required for heating due to high stratification. Well, the stratification is so low with the TF-HC that the difference in wax melt point between the cooling and heating sensors is only 3°F.

The care taken in development and in our intensive pre-introduction test program has been justified by the very successful performance of the TF-HC. Since introduction in 1983 the Therma-Fuser TF-HC has consistently satisfied customers. Over 150,000 have now been installed without a hint of a problem due to excessive stratification. We've even used TF-HC's to fix jobs originally laid out to heat with TF-CW's.

Talking with people at your local jobs or a review of the Acutherm installation list should convince even the greatest skeptic. However, if that is not enough, we also have confirmation by an independent test lab.

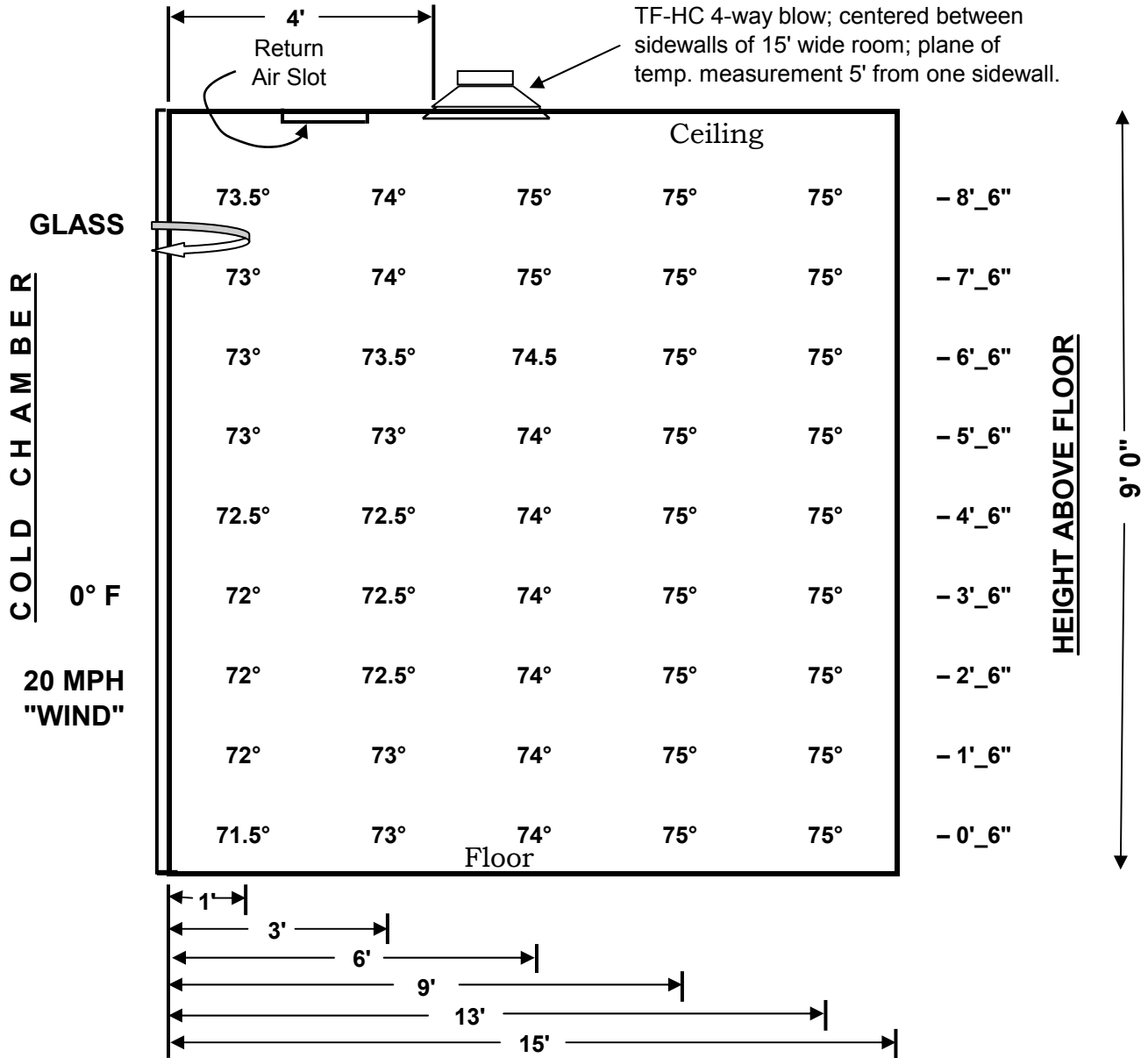
CONFIRMATION BY AN INDEPENDENT LAB

Energistics Incorporated is a laboratory in Houston, TX specializing in testing air distribution of specific buildings using the actual window and mullion. Tests were made there during 1988 to demonstrate to an office building owner how the TF-HC compared to the existing distribution of a particular building. The existing distribution was slot diffusers selected in 1984 after extensive testing in the same laboratory. The owner was interested in the individual temperature control provided by the TF-HC. Temperatures were measured at 90 points around the room and velocities were recorded. Temperature outside the window was 0°F with fans producing a 20 mph wind for a wind chill factor of -39°F on the glass.

The results of the tests, summarized in Fig. 1, showed that the TF-HC would improve the already excellent air distribution in the building by lowering the temperature spread through the space. The owner was convinced.

So if someone tells you the TF-HC Therma-Fuser will not work well on heating due to excessive stratification, ask if they are talking about application outside the industry accepted limits for low stratification heating from the ceiling. Then explore the thoroughness of the tests they have to back up the claim and if the tests were confirmed by an independent lab. You will undoubtedly find that the claims are not correct.

Note: A recent paper describes a VAV heating diffuser built by the author which does not work. Reference is also made to a competitor which achieves the same poor result using operating temperatures for the thermal elements of 70-78°F for cooling and 80-95°F for heating. This does not apply to Acutherm as the TF-HC has only a 3°F difference between heating and cooling operating temperatures.



VERTICAL PLANE THROUGH TEST CHAMBER - 5 feet from one side wall
 (similar plane was measured toward other sidewall with similar results.)

NOTES:

1. Window wall separating test room from cold chamber was floor-to-ceiling glass with .48 "U" factor.
2. Cold Chamber was maintained at 0° with 20mph velocity air flow directed at glass; windchill factor -39°F.
3. Air velocities up to 6' off floor and to 6" off walls did not exceed 50 fpm AND no "dead spots" present. At 1" off walls velocities were between 50 fpm & 150 fpm. Gentle air motion could be felt throughout the room.
4. Temperatures in room are in °F.
5. Supply air temperature was at 84°.
6. Inside glass temperature was at 59°F.
7. 240 CFM supplied.