Blender Products, Inc.

HVAC MIXING UPDATE

Are Freeze-Stat Trips a Mixing or a Control Problem?

Generally, freeze stat trips are blamed on poor controls. If nuisance freeze stat trips persist, a common solution is to modify the control strategy to prevent the problem. However, this "solution" is simply masking the real problem of insufficient mixing in the mixing box. If the mixing box can provide the required amount of mixing, a sound control strategy will work as intended. In other words, a mixing problem cannot be sufficiently corrected by a control strategy, but a control strategy can be dramatically improved by proper mixing. But how much mixing is sufficient to ensure that a control strategy will operate efficiently?

A significant obstacle in answering this question is how to qualify the level of mixing provided by a mixing box. Mixing boxes have many variables that impact mixing performance, including unit size and inlet damper arrangement. These variables prohibit significant levels of certainty in establishing mixing box performance. Because of this uncertainty, writing a control sequence of operation to avoid freeze stat trips is very difficult in the design phase. Therefore, the common approach is to use a generic control sequence for system startup, and then rely on the DDC contractor to make the appropriate modifications after the system is operating. In an effort to minimize or eliminate freeze stat trips, DDC contractors are often forced to depart from standard control strategies. The result is often inefficient system operation and unexpected energy usage.

This trial and error procedure for fine-tuning control systems can be significantly improved if the level of mixing provided by the mixing box is known. Such knowledge helps the designer predict the specific conditions (i.e. outside air temperature) at which freeze stats will likely trip. Below is a Temperature Gradient Chart, which is based on thermodynamic properties and equations for air stream mixing. This chart provides a useful analysis for determining when consideration should be taken to avoid frozen coils. Chart 1 shows the temperatures present at the freeze stat wire in a air handling unit with a standard mixing box. Based on this mixing performance, the stratified air entering the pre-heat coil will have temperatures that range from Tmax (Return Air) to Tmin (Outside Air). Chart 1 is representative of the temperatures inside a mixing box with 25% OA and 75°F RA over a range of Outside Air Temperatures from 60°F to –20°F.

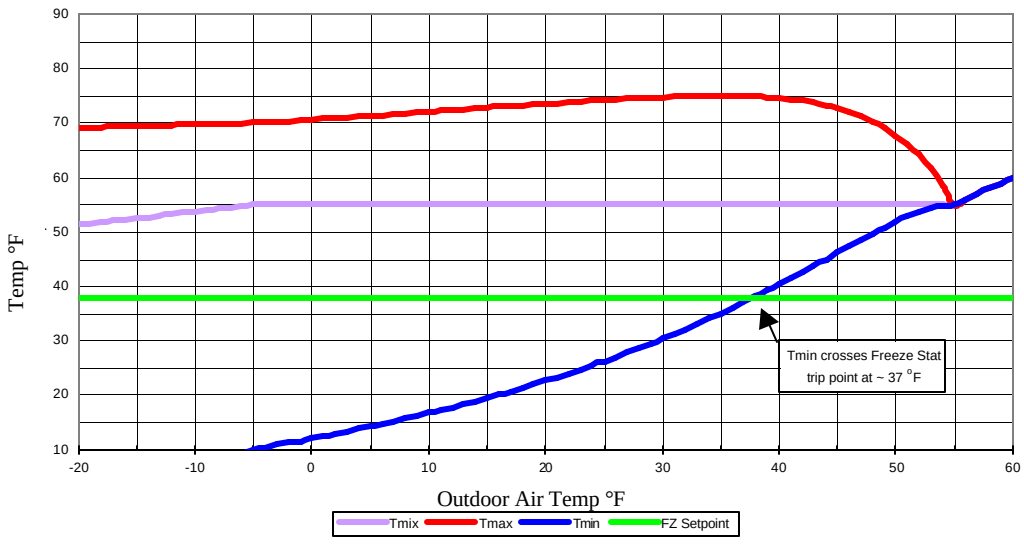

CHART 1: Mixed Air Temperature Range for 25% Minimum OA and 75°F RA

5010 Cook Street, Denver, CO 80216 • 303-295-6111 • 800-523-5705 • Fax 303-296-1520

Tmin falls below the freeze stat set point of 38°F at 37°F OAT. Because the mixing level provided by the mixing box is known, the appropriate control strategy can be established. However, in an effort to eliminate freeze stat trips the control strategy will likely be to modulate the heating coil open when the outside air temperature reaches 37°F. This is an effective strategy for eliminating nuisance freeze-stat trips, but it comes with a high energy cost.

Chart 2 is a temperature gradient chart for the same conditions as above with the mixing effectiveness of a Series IV Air Blender® mixer included. Because mixing effectiveness of the Air Blender mixer is defined, the freeze stat trip point can be established under actual operating conditions.

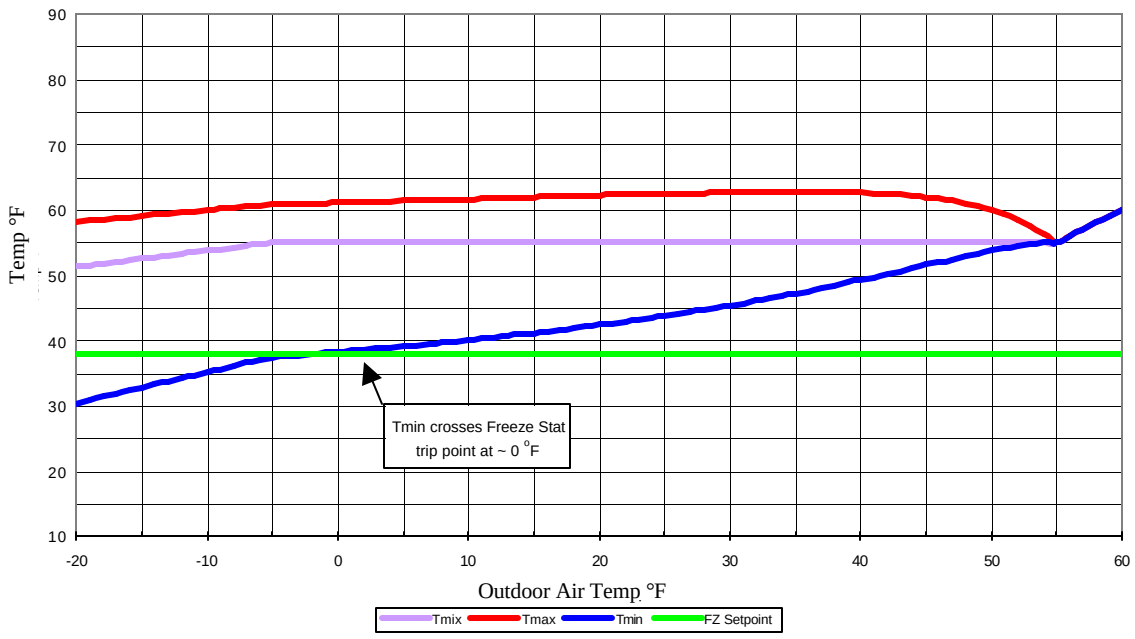

CHART 2: Mixed Air Temperature Range for 25% Minimum OA and 75°F

Chart 2 shows that using a Series IV Air Blender mixer reduces the threat of Tmin approaching the freeze stat trip point to 0°F OAT. The improved mixing significantly reduces the required use of the heating coil when compared to use of a standard mixing box. Because the level of mixing provided by the Air Blender mixer is known, the control strategy can be developed to maximize system performance and minimize energy usage.

If the level of mixing provided by a mixing box is not known, establishing an effective control strategy is difficult. By knowing the mixing effectiveness of a system, temperature critical decision points can be established. Further, by maximizing the mixing performance of a system, significant energy savings can be realized. The Series IV Air Blender mixer provides both predictable levels of mixing and the highest level of mixing of any other mixing device on the market. Therefore, this product can be effectively used to ensure a control strategy that will prevent nuisance freeze stat trips and maximize energy efficiency.