WHITE PAPER:

OVERSIZING VAV TERMINALS

KRUEGER

Oversizing terminal unit products is a very critical issue. Ideally, terminal units should be sized to perform at as close to their maximum capacity as possible. The idea of oversizing the terminal unit to reduce noise and/or pressure drop may cause problems in some systems.

Oversizing an air terminal unit product severely affects the control of the unit. Pressure independent controllers may provide less than acceptable control at very low airflows. The sensed airflow at the VAV inlet sensor creates a pressure differential ranging from 0 to 1" of water column (0 to 1.0" Δ Ps). Terminal units should be selected at CFM values which will take advantage of as much of the available range as possible to get the best control performance of the unit. While recent independent tests conducted in California indicated that inlet sensors on most boxes are accurate to very low flows, at low pressure signals, the pressure transducers utilized on modern DDC controllers are subject to zero drift and lower accuracy than at higher flows.

Krueger catalogs maximum CFM values for each terminal unit size based on approximately 2600 feet per minute inlet velocity at approximately 1" Ps (between the high and low pressure sensor tubes). A terminal unit sized for the maximum rated CFM and a 0 minimum CFM would be close to an ideal selection. If a terminal unit is chosen at 50% of its maximum rated value, the sensor pressure signal required at maximum CFM is only in the range of 0.25" Δ Ps. This means that the unit is functioning within only 25% of the pressure independent controller's range. The unit is going from minimum airflow to maximum airflow in a very limited thermostat signal range. The result could be a two position terminal unit.

Add excessive system supply air pressure to an oversized unit and the terminal unit damper will only move a few degrees from the minimum CFM to the maximum CFM. Again, not a desired control situation.

Typically, the specified accuracy of most pressure independent controllers is + or – 5%. While this is likely down to approximately 20% of the terminal unit's rated airflow, most controllers will maintain airflow setpoint within that tolerance. When operating the unit below 20% of the maximum unit airflow, the unit controllability quickly deteriorates from the + or – 5% control accuracy. Many of today's DDC controllers are not recommended to be used when CFM values are below the 0.03" Δ Ps sensor differential pressure.

For an acceptable airflow control range and to guarantee that the unit will control at minimum, it is suggested that the maximum CFM setting of a terminal unit be at least 60% of its maximum CFM rating. These guidelines are also recommended when a single duct terminal unit is selected for constant airflow volume. Although a lower airflow could be selected (at least above the 20% level for + or – 5% control accuracy), the unit may have trouble if used for variable (modulating) control at a later date.

A problem has been noted with some installations of oversized VAV terminals and low airflow minimum settings. After time, the gasket on a 90° damper (used by most VAV box manufacturers) will take "a set". When slightly opened (as at low flow / high inlet pressure situations), the damper gasket can flutter, creating a low frequency sound that can be heard a surprising long distance away. The cure is to change either the minimum airflow setting, or to change the duct pressure control setting slightly.

Krueger will not label any VAV terminal with a minimum below the 0.03 minimum listed for each inlet size, as we cannot guarantee performance at these low flows, no matter whose controls are affixed to the units. We however are designing single duct VAV units with hot water heating coils and reduced inlet sizes. For example, a size 10 LMHS unit will be able to be ordered with an 8" inlet. This should help those engineers designing for as low a duct pressure as practical and still allow good minimum airflow control. This unit will have size 10 water coil performance, but size 8 maximum and minimum airflow.

These guidelines are for use whenever pressure independent controls are used, whether pneumatic or electronic. Pressure dependent control is not as critical because the thermostat has direct control of the damper actuator. However, pressure dependent controlled units should be selected with prudence.

The oversizing problem can relate to any terminal unit manufacture. The same or similar controls are used by most manufactures. Intelligent choices in unit selection will avoid the hazards of oversizing.