**WHITE PAPER:**

# BYPASS TERMINAL UNITS

KRUEGER

## INSTALLATION GUIDELINES

When designing small jobs (4,000 - 6,000 CFM), an engineer will often specify a constant volume air handler and then include in the design one or more VAV zone controls. To keep the air handler satisfied, they will specify pressure dependent bypass terminals. These units, when properly designed, installed, and maintained will work fine. All too often, however, they are miss-applied, miss-installed, and therefore do not work. A bypass unit requires a balancing damper upstream of the unit, (optional on the Krueger KLB) which is often left out when all parties do not understand the proper design of this system. Systems can be noisy or inoperative if not installed properly. Bypass systems must be carefully balanced and cannot be designed to be self-balancing.

## PRINCIPLE OF OPERATION

The bypass VAV terminal is a device that receives a constant volume into the unit and provides variable volume to the space. It diverts a portion of the supply airflow to the plenum, either through a duct to the return ductwork, or directly into a return air plenum. In order for the unit to operate properly, it must accomplish several tasks:

- It must be invisible to the air handler – that is, regardless of the position of the bypass damper, the airflow into the unit should remain relatively constant.
- It should always be located downstream of a balancing damper, as if it was a diffuser, as it cannot regulate the total quantity of air delivered to that branch.
- It should be balanced such that the pressure drop into the plenum or return duct is the same as to the diffuser(s) located downstream of the unit.

For these to take place, the balancer must carefully adjust the bypass relief damper and the upstream damper. As the unit does not regulate total flow, it cannot be provided with standard pressure independent controls. It may be fitted with a pressure dependent control, such as a VVT controller or with a pneumatic or electric thermostat controlled actuator.

## BALANCING GUIDELINES

- The balancer should adjust the upstream balancing damper (optional, or provided by the installing contractor) with 100% of the unit supply air going into the room, using standard balancing methods. A note should be made of the duct pressure at the inlet of the bypass unit in this condition.
- The balancer should then set the unit to 100% bypass. Then the discharge bypass damper should be set so that the duct pressure at the inlet of the unit is the same as when the unit is supplying all the air to the zone. This will ensure that the unit delivers relatively constant airflow over the full range of bypass damper positions.

Failure to perform this balancing operation will result is air quantities varying as the thermostat calls for more or less cooling and will likely adversely affect other constant volume zones on the system.

## CAUTIONS

Should a balancing damper not be provided, or adjusted, at the inlet of the unit, high pressure/ high flows may result in excessive noise and possible damage to the damper in the unit. It is designed to operate with no more than 0.6” pressure, typically seeing only 0.2” or less.

## AN ALTERNATE TO BYPASS TERMINAL UNITS

Bypass units cannot be set to guarantee ventilation airflows and may be noisy, even when properly configured, if not balanced carefully. There are alternatives to the bypass terminal.

An effective alternate to the bypass terminal is a pressure-relieved loop. This system is a standard pressure independent VAV terminal design with an additional VAV terminal at the end of the run that “dumps” excess air (and pressure) to the return plenum. This terminal is configured as a constant pressure unit, sensing pressure at a point typically 2/3 of the way down the run. The constant pressure option is available for both pneumatic and electronic control units. This unit is shown with a 90ø lined duct “attenuator” (by others, simply a section of lined duct with an elbow) attached. This will reduce the potential for any noise possibilities associated with the unit.

The VAV terminals, as well as the pressure relief damper, can all be factory set, requiring a minimum of field balancing and accurate flows to the space.

The “Dump” box should be sized for about 60% of the air handler capacity, depending on the expected system diversity. Note, however, that a typical pressure setting will be less than 0.5“ w.g. so the noise levels will be low, even for large units. In many cases, a slip-in damper will be a low cost solution for this application.

When possible, the bypass loop should be utilized in place of a bypass zone. The overall cost will not be significantly different, control will be much improved (pressure independent controls with reheat, or even fan terminals can be mounted), and the potential for problems will be significantly reduced.

Bypass terminals are an effective solution to small constant volume air handlers, but when designed or installed improperly, can not be expected to operate as desired.