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2-Position Vs Modulating Control Valves in Vertical Stacked Fan Coils

This paper describes the advantages of binary valve control, 2-position control, vs analog control, modulating control, as applied in vertical stacked fan coils with variable speed ECM fan control.

There is no question about the benefits of variable flow systems, be it water or air, vs constant flow in terms of thermal comfort, energy savings, and increased equipment life but is the most effective valve actuation binary or analog? Many think that all valve control in a variable flow system should be analog but does that thinking need to shift now that we've moved from 3 speed fan control to variable speed ECM control in smaller single zone HVAC systems?

Benefits 2-position Fan Control with Variable Speed ECM Fan

Having the ability for a terminal unit to match the space load is imperative to maintaining comfort. Discharge air temperature and air volume are the two adjustment points in a single zone system and the standard control strategy has been 3 speed fan and analog or binary valve control. Analog valve control was introduced and accepted as a "better" system because as you approached the zone setpoint, the 3 speed fan would decrease to low speed and the valve would begin to close to maintain a discharge air temperature of 55F. In some cases where a 2-position valve was used, the discharge air temperature would drop below 55F and create uncomfortable drafts in the space. This discomfort was caused by the fan delivering 40% of the maximum airflow a PSC or 3 speed ECM could deliver at a discharge velocity of over 200FPM.

In the last 6 years , ECM's have become the standard motor in fractional horsepower terminal units to power their fans. Temspec adopted ECM's in 2018 as their standard motor and took the added step of upgrading the forward curved fan, used for the past 75 years in terminal units, to a backward inclined impeller fan with variable speed ECM. This fan offers a wire to air efficiency improvement over the forward curved fan of 66% regardless of the motor type.

Backward Inclined Fan with Variable Speed ECM

Forward Curved Fan with 3 Speed ECM

The main advantage of this integrated ECM fan assembly is it's ability to operate down to 20% speed with the control valve 100% open which is ideal in cooling applications by increasing the dehumidification by 20% at a discharge velocity that does cause draft discomfort to the occupants. The human body cannot easily detect a heating or cooling affect with a air velocity below 60 FPM.

Benefits of 2-Position Valve Control with Variable Speed ECM Fan

1/ 2-position control valves are less expensive and more reliable than analog control valves

2/ Control of a 2-postion end device is less expensive and more reliable than control of an analog end device

3/ The thermostat algorithm modulates the fan speed to a minimum before closing the valve allowing more dehumidification without creating cool drafts in the space with the low discharge air velocity

4/ The variable speed fan control provides the ability to match the zones heating or cooling load the same way a modulating control valve but with additional energy savings from the BI fan

5/ The backward inclined variable speed ECM fan's standard control signal is 0-10VDC so there is no additional cost over 3 speed fan control

6/ Typical cooling water flow rates in a single zone system are less than 2.5 GPM making modulation very difficult. Heating system flow rates are even less making them impractical to modulate. 2-position valve control gives you the same energy savings through load diversity as modulating control so binary valve control should be considered on any system with a flow rate less than 4.0 GPM.

Summary
2-position valve control coupled with variable speed ECM fan control in a single zone system offers the lowest first cost, highest reliability, better humidity control, and more energy savings than traditional 3-speed fan control and modulating control valve.

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