



THREE TAP MOTORS IN FAN POWERED TERMINAL UNITS

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OVERVIEW

A number of requests have been received for information concerning the use of multiple tap motors in fan boxes. Some serious problems have been noted in the field, (most notably in Houston,) with other manufacturer's units equipped these motors and SCR speed controllers, to the extent that all fan boxes are being condemned as a 'bad design'. There are several issues.

- The multiple tap motor is not a 'three speed' motor. It is a multiple torque motor, with, in effect, three hp ratings. These three torque ratings, when utilized on a PSC (Permanent Split Capacitor) motor, allow the motor to run at different 'slip', or reduced RPM, depending on the load imposed. Note that hp ratings on fractional hp motors are arbitrary, at the discretion of the box manufacturer, not the motor manufacturer.
- The actual operating RPM is a function of the blower selected and pressure across the blower. At high pressure drops, the blower unloads, and rpm increases. In many of these cases, a three tap motor will reach its non-slip rpm of 1175, and changing motor taps will not affect the delivered flow, eliminating the balancing potential of the 'three speed' switch.
- The only means of controlling flow in these cases is to physically block the air with a damper. Blocking the motor with a damper will increase RPM again (by unloading the blower), again making the three speed function ineffective. Note that inlet or discharge dampers always increase the noise of a fan-powered terminal.
- The most effective way to make a fan powered box quieter is to reduce the rpm of the fan. This is accomplished with a speed control. Typically an SCR (silicon controlled rectifier) type, the speed controller chops the sine wave signal to the motor, reducing the delivered electrical energy, and causing the motor to slip, reducing delivered cfm and blower tip speed, in turn reducing sound levels.
- The motor must be matched to the SCR for this to be effective, and to reduce motor 'hum'. (The motor tries to match the chopped sine wave, and creates a 'back current' that can be handled by a properly designed SCR circuit). While this is easy with a single winding motor, with a three-tap motor the SCR must be matched to the high-torque winding. When operated on lower torque windings, the match will not be optimal, unless three SCR's are supplied, one for each current rating. On low tap, the mismatch can be so great that the motor will over-current, run hot, and fail prematurely.
- The good news with a three tap motor is that it draws less current when connected at a lower h/p rating, than at the high. While this offers an opportunity for energy savings, the box must be wired with sufficient capacity for the high tap setting (per the NEC), so no installation savings can be realized. Note that the energy savings are canceled when the motor is replaced the first time.
- Assuming the manufacturer has managed to actually match his speed controller to all three taps (which is unlikely), affordable replacement motors are unlikely to be exactly as supplied in the OEM application, and again there is an opportunity (and great likelihood) for a problem.

For many of the reasons indicated above, Krueger uses a custom wired, single tap (but 4 voltage, in most cases) PSC motor designed to be used with SCR speed controllers, providing optimal starting torque, at the lowest amperage and heat generation for long life.