

THE ECM MOTOR STORY by Nailor Industries Inc.

EPIC FAN TECHNOLOGY® / ECM MOTOR

- Significant energy savings (67% average compared to PSC motors)
- Unique factory pre-set air volume capability (+/- 5%)
- Pressure independent fan operation
- LED for visual indication of air volume
- Field adjustable fan air volume controller
- Remote fan air volume adjustment capability from BAS
- Larger turn down ratios mean more flexibility for tenant changes



Since 1985, equipment manufacturers have used GE ECM™ motors in residential air conditioners and furnaces. These motors have made it possible to achieve SEER ratings of 12 and higher. Until more recently though, they were only manufactured in 120 and 240 VAC, which precluded their use in commercial applications. Following two years of research and development and the availability of a new 277 VAC version, Nailor was first to introduce the GE ECM™ motor to the commercial HVAC market (ASHRAE Journal, April 1997) as an option for use in series fan powered terminal unit applications.

WHAT IS AN ECM MOTOR?

The ECM (Electronically Commutated Motor) is an ultra high efficiency programmable brushless DC motor utilizing a permanent magnet rotor and a built-in inverter. DC motors are significantly more energy efficient than AC motors and much easier to control. The major weakness of series fan powered terminal units until now, has been their low fan motor efficiency. The widely used single speed fractional horsepower permanent split capacitor (PSC) induction motor in combination with an electronic SCR speed controller is extremely inefficient at typical operating conditions. Due to acoustical considerations, the fan motor is usually adjusted to operate at considerably less than full load (where PSC motor efficiencies may be as high as 62%). PSC motor efficiency drops off dramatically when turned down; typically by at least half. Installed PSC motor efficiencies are therefore typically in the range of only 12 – 45%. ECM motors in contrast, maintain a high efficiency of 65 – 72% at all speeds.

In addition to lower operating costs, EPIC Fan Technology® allows Nailor to pre-set the fan airflow volume at the factory.

The graphs in Table 1 show the lower watts per cfm (translating into lower operating costs as shown on the next page) and wider operating ranges of series terminals employing GE ECM™ motors versus PSC induction motors.

FEATURES AND BENEFITS

Soft starts and slewed speed ramps are programmed into the ECM motor eliminating stress transmitted to the mounting bracket or hardware. They incorporate ball bearings providing permanent lubrication unlike sleeve bearings requiring a minimum rpm operation for oiling. The wider operating range of the ECM motor allows each model to actually replace two

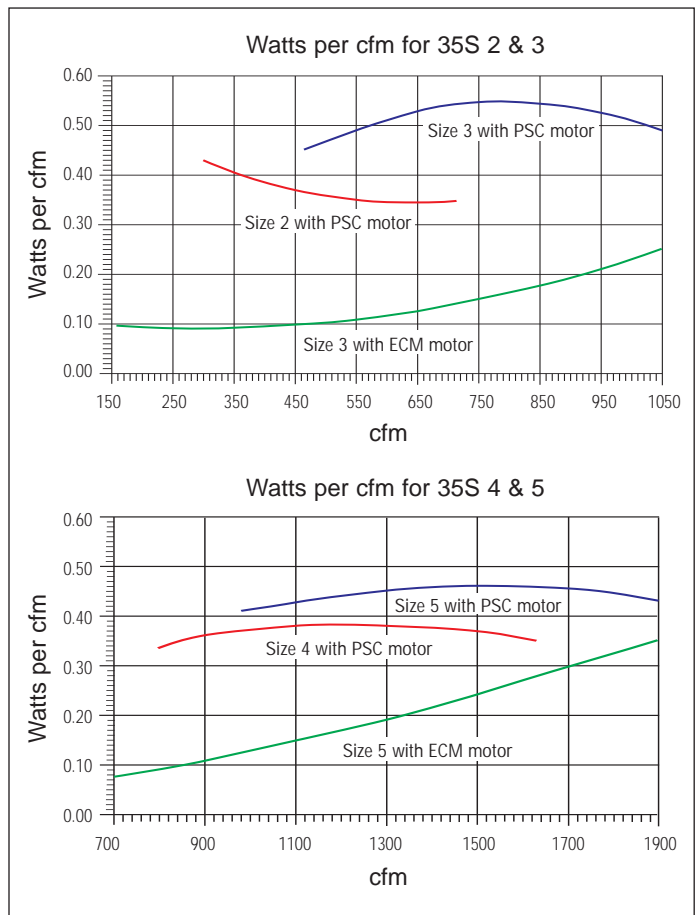


Table 1. Power consumption comparison of GE ECM™ versus PSC motors.

models using induction motors. This feature alone provides several benefits; a simpler product line to choose from, little or no equipment changes necessary when tenants change, more similar sized units on the job, decreased spare parts inventory and increased contractor flexibility. The low operating temperature of the ECM motor (essentially ambient) requires very little energy to offset the heat gain from the motor versus PSC motors which run hot (typically around 90 – 150°F).

These features also extend the life of the ECM motor, which are expected to provide an average 90,000 hours of operation (versus 50,000 hours for a typical PSC motor). This translates into about 25 years for a typical series fan powered terminal unit. In addition to these standard features are two primary benefits, energy savings and the ability to pre-set the fan airflow volume at the factory.

HOW DO YOU PRE-SET FAN AIRFLOW?

Pre-setting the fan airflow (cfm) has always been a problem for fan powered terminal manufacturers for two major reasons. First is that AC motors are not synchronous machines and second the rpm, and consequently the unit cfm, changes when static pressure changes. The difficulty in pre-setting the fan lies in estimating the motor workload required at the job site in actual working conditions. The fan will not produce the same volume of air as it did at the factory without the duct work. Because there is no way to accurately predict the downstream static pressure as it would exist at the job site, it was impossible to pre-set the fan cfm. The ECM motors are DC and inherently synchronous machines. The motors are programmed to calculate the work they are doing and then compare the work accomplished to the cfm requirement. The integral microprocessor based controller automatically adjusts the speed and torque in response to system pressure changes and pressure independent constant airflow operation is achieved without the need for an external flow sensor feedback loop.

Nailor series fan powered terminal units incorporate our own custom EPIC fan controller. An electronic PWM volume control device that allows adjustment of airflow volume. This value can be pre-set on the assembly line. It is field adjustable either manually using a screwdriver and voltmeter locally at the terminal or more conveniently, remotely using a 0 – 10 VDC analog output from a digital controller via the BAS. A fan volume versus DC volts calibration chart is provided. The importance of this feature is that the balancer never has to go into the ceiling to adjust the fan. This relieves the balancer of most of his work per zone on fan powered terminal units and related headaches. This also removes the uncertainty of diffuser flow measurement with hoods. Laboratory tests show the fan cfm to be accurate within +/- 5% of the factory set point. This is a huge benefit to the owner, the controls contractor, the mechanical contractor and the ceiling contractor.

ENERGY SAVINGS

The graphs in Table 2 show the energy savings of units with GE ECM™ motors compared to using units with Nailor engineered PSC motors. It is important to note that the PSC motors in Nailor fan powered terminal units are more efficient than those used by most of our competitors. The PSC motors used by Nailor are built specifically for Nailor fan powered terminal units. A couple of our competitors use motors that approach the efficiency of Nailor motors but none are as efficient. The comparison shows Nailor units with GE ECM™ motors versus Nailor units with PSC motors.

AT NAILOR, TOMORROW'S IDEAS ARE TODAY'S REALITIES

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Tel: 281-590-1172
Fax: 281-590-3086

TORONTO, CANADA
Tel: 416-744-3300
Fax: 416-744-3360

THETFORD, NORFOLK, ENGLAND
Tel: (0)1842 753624
Fax: (0)1842 762032

LAS VEGAS, NEVADA
Tel: 702-648-5400
Fax: 702-638-0400

CALGARY, CANADA
Tel: 403-279-8619
Fax: 403-279-5035

Comparison using Nailor units with ECM motors and a competitor's units with PSC motors would show even greater savings.

The typical range of operation for the size 3 would be 200 to about 900 cfm. The typical range of operation for the size 5 unit would be 700 to 1700 cfm.

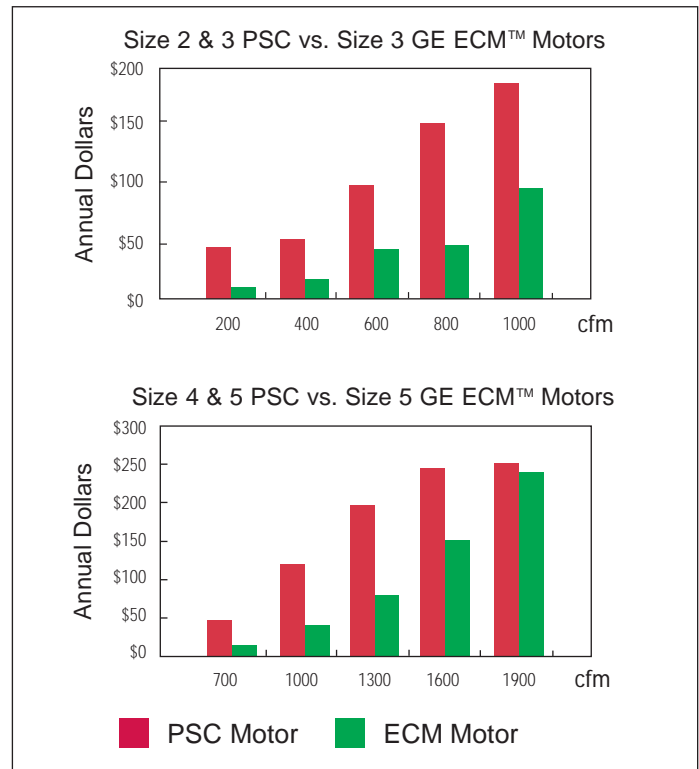


Table 2. Typical operating cost comparison.

WHAT IS THE PAYBACK PERIOD ON ECM MOTORS?

The payback period varies. It depends on which unit you use, where you set the cfm, how much you run the equipment and what you are paying for electricity. The graphs above are calculated assuming 66 hours per week operations and \$.10 per kWh. If you run the equipment longer in your building or if you pay more for electricity, the payback will change proportionally. Considering the pre-set capability of the motor, there should be an up-front savings on balancing. That should be rebated to the owner and should be considered as part of the payback from the motor. Typically, with the balancing rebate and the operating expenses as shown above, the payback period should be anywhere from 6 to 18 months.

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