ESP vs. ECM

GE ECM
By REGAL-BELOIT

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How does External Static Pressure relate to the reliability and efficiency of Premium ECM Models 2.0/2.3 & 2.5 (Variable speed) indoor blower motors?

The reliability of ECM motors produced by ***GE ECM*** **by Regal-Beloit** has been greatly improved since their introduction in the late 1980's. The HVAC OEM (Original Equipment Manufacturer) has done the work to limit operation so that the motor never operates outside of its designed envelope. Current generation model 2.3 and 2.5 ECM motors are rarely overworked. They are speed limited by manufacturer design so they will not overwork themselves if static pressure gets to high. When static pressure is increased, the motor will use more energy, to increase the speed of the blower wheel, to maintain airflow. Some manufacturers even have fault codes that will lockout the system if the motor is running over the rated speed.

- If the motor gets to the speed limit from high static pressure (typically above the maximum pressure recommended by the OEM), in simple terms, it just runs at that level without continuing to add torque.

- If static pressure increases above this point (the speed limit) the motor will gracefully reduce airflow to protect itself, while still operating the system.

- If static pressure gets too high (typically well above the maximum pressure recommended by the OEM), the motor may oscillate (speed up, slow down, speed up, slow...). Oscillations at high static pressure are the result of an interaction of non optimal limiting parameters in the motor program and actual motor operation (this can only happen in the 2.3/2.5 models). This is how the program in the motor control protects itself from running faster than it was designed to. Field reports of this occurrence are rare, but documented. Obviously these situations should be fixed (the static pressure should be lowered).

It should be noted that the maximum recommended static pressure by the OEM and the motors speed limit are not the same. Depending on the OEM program, somewhere above the maximum recommended static pressure, the motor may reach the speed limit. The key point here is to understand that even a constant airflow motor has a performance limit, related to the maximum amount of power the motor can safely deliver, to maintain airflow, at high static pressure.

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The best recommendation for static pressure is whatever the manufacturer of that equipment recommends. Keep in mind that the typical recommendation of 0.5 in. wc. (inches water column) ESP (External Static Pressure) is usually set for the rating of the equipment, not where it can and will work at. If you look at the performance charts for each equipment you will see that they typically top out at between 0.8 and 1.0 in. wc. ESP. For that reason I suggest keeping the equipment running below the maximum listed on their chart and as close to their rating as possible. Airflow **will** be maintained up to and possibly slightly above the maximum pressure listed by the OEM. However, the system will most likely be noisy and there is no room for the pressure to increase without the potential for system performance loss, due to dirt load on the air side components and/or blockages of grilles and registers.

ECM motors can save a significant amount of energy at lower static pressure by operating at lower speeds. The closer the ESP is to the manufacturer rating the closer the unit is to running at the efficiency it was designed at. Higher static pressure equals to higher operating speeds and more energy usage by the motor to maintain airflow. However, as long as airflow is being maintained, and ESP is not too high (as recommended above), the effect of using more energy by the motor is not detrimental to the motor, only less efficient than it could be at the lower rated ESP.

- Higher pressures mean higher operating speeds, more noise and consequently more input power, conversely, lower pressures result in very low power consumption and less noise.

- At higher static pressures the motor **is** using more energy to maintain airflow. However, this has only a marginal effect on the overall efficiency of the system as long as static pressure does not get to high as discussed here.

In conclusion, if everything is operating properly (within OEM design specs for airflow and temperature rise) and static pressure is within a couple of tenths of OEM design, the ECM motor should meet or exceed the design life of the system. Measuring the actual ESP with a meter and comparing that reading to the OEM performance charts will show where the unit is operating, compared to the manufacturers numbers. This practice is highly recommended at the time of installation and during servicing of suspected airflow or motor issues. If the pressure is high, you should investigate why. If the system is operating between the rated ESP and the maximum listed all is good, with the understanding that closer to rated is more electrically efficient. Because this is a motor operated by a control, it is the speed limiting described here that is most crucial and most relatable to extreme high static pressure issues and decreased system performance.

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This motor does have an FLA (Full Load Amp) rating, and is designed to operate up to this rating without detriment of its intended life. However, it is unlikely that the motor will actually operate at that level. Measuring the correct amperage on an ECM motor would also require a True RMS meter. I would not recommend the technician to measure anything except pressure. If current draw is high, it is most likely because static pressure is high. If the motor operates at reduced power (lower static pressure) its life will be extended.

Technicians in the field should keep in mind that early model and even current model Premium ECM indoor blower motor failures can be largely related to the motor being used in applications outside of the manufacturers recommended parameters. Speed limiting allows the control to keep the motor from operating at speeds that may harm the motor. We have also potted (sealed) the electronics to help protect the motor from moisture released from the cooling coils. Both of these situations can be attributed to systems operating at external static pressures higher than the manufacturer recommends. The bottom line, keep external static pressure below the manufactures recommended maximum level and the ECM motor should live a long and efficient life.

For additional troubleshooting information and motor identification please reference the “ECM Service Guide”. This guide can be downloaded for free or purchased in a durable pocket sized version on our website at www.theDealerToolbox.com by entering the “Service Tools” drawer and clicking on “ECM Service Guide”.

This material has been created and distributed for the purpose of education and to encourage best practices of the HVAC industry. The integrity of the industry we share is the responsibility of every one working in it including its educators to uphold the faith of the consumers who put their trust in us as professionals.

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