Infinitum

Whitepaper | Anthony Lou

Key Considerations When Choosing Your Next Fan Motor

Traditional HVAC systems are the unseen workhorses of commercial building operations; they're critical to enhancing well-being, comfort, and productivity for occupants, but they can't quit – and they're rarely acknowledged by occupants unless they do.

Simply put: Building owners and operators – and occupants – want units that they can take for granted. And when something does go wrong, they want a fix – fast. Customer satisfaction starts with what's inside the unit. Modern air-handling units (AHU) are designed using plenum fans. In plenum fan powered air handlers, fan scroll housing, transitions, and distribution baffles are eliminated within the unit. In addition to space savings, this design offers airside efficiency and cost savings.

For the sake of performance and longevity, the motors that drive these plenum fan systems need to be as efficient as possible. There are several practical factors to consider when selecting a motor to maximize efficiency and future-proof a plenum fan unit. This white paper explores key considerations for informed decision-making.

How can I design for air handler reliability and longevity?

Motor failures are a growing industry-wide problem, and the consequences are significant; disruptions in HVAC operations impact productivity levels, safety, energy bills, and tenant comfort. This problem is exacerbated as motor technology matures because cost is squeezed out in the design process. If you manage to get 11 years of operation out of a traditional 10-year motor, you're considered one of the fortunate ones. Understandably, that can be frustrating for end-users. You can reduce this risk by factoring longevity and reliability into the motor selection process.

There are two main modes of failure for a traditional motor: windings and bearings. Windings fail with age and insulation deterioration. Together, heat and flexing of the wire bundles break down the insulation surrounding the windings, eventually causing a short.

If there's a short, the motor won't run, and a motor shop needs to go through the common and expensive practice of rewinding it. Frequent stops and starts can also stress the windings, making the insulation brittle and susceptible to breakage.

The second source of failure is in motor bearings. There are several factors that can cause bearings to fail: (1) age and wear, (2) transient currents induced by variable speed drives that ground through the bearing raceway, (3) inadequate lubrication caused by customer neglect (failing to regrease), or (4) significant rise in temperature – if a motor's running hot, the lubricating grease is burned off.

Infinitum motors eliminate most of these failure modes. With no winding or winding insulation, thanks to the PCB stator design, winding failure is eliminated. By monitoring bearings in real-time, customers can track and address bearing maintenance needs before system failure and service disruption. Infinitum motors can be securely connected to the internet, so more data is available to help predict maintenance needs and identify inefficiencies. Most motor installations today don't collect data at all, and if they do, it's typically local to the equipment and requires operators to access the unit directly. When data is difficult to access, operators are blind to potential issues beyond what they can hear and feel in the space. They're likely to miss early warning signs until an occupant complains. User-centric data collection and cloud capabilities open up avenues for maintaining efficiency using accessible, actionable data.

How does motor shape and wind shadow impact an AHU?

Every motor generates a wind shadow. Ideally, air is evenly dispersed on the face of the heat exchanger, but the inevitable presence of a motor wind shadow results in uneven distribution. A large wind shadow negatively affects the performance of the heat exchanger, reducing efficiency and diminishing unit capacity. Manufacturers tend to address this challenge by building blow-through (BT) AHUs with a longer plenum cabinet to counter the wind shadow from traditional motors.

In contrast, Infinitum motors have a distinctive “pancake” shape, seen in Figure 1. This is approximately 13 inches shorter than a traditional motor and up to 30% lighter. Replacing the long, heavy iron core components of a traditional motor with a flat printed circuit board (PCB) stator drastically reduces the overall length and weight of the motor. The result is an air handler with a lighter motor, that requires less support structure, and a shorter fan section.

5 HP Motor	Diameter	Length	Weight
NEMA Premium Induction	8.5 in	22.5 in	110 lb
Infinitum	14.75 in	9.2 in	79 lb

Figure 1: Volume and mass comparison of two motors with the same rating — a 5 HP 3,600 RPM Infinitum motor vs. a 5 HP 3,600 RPM NEMA Premium induction motor

A shorter motor will also reduce the required length of the cabinet by reducing the wind shadow. Altering motor shape and weight reduces cabinet size and structure, which has a direct and favorable impact on the overall cost of the air handling unit.

HVAC fans use a lot of energy; the cost of operating a fan over the course of one year can be up to 4 times the amount spent on the motor. A more efficient fan and motor can have a big impact on the overall success of the system by minimizing the ongoing operating cost. Beyond the natural gains from switching to a high-efficiency motor and fan configuration, a larger existing plenum box, initially used to accommodate a longer motor, offers more space to distribute air on the downstream heat exchanger when a “pancake” motor shape is used.

What other factors should be considered when selecting a motor?

Every motor will fail eventually. When failure does happen, that’s when lead times really matter. Customers should consider availability and delivery logistics early in the motor selection process. With many motor suppliers based in Europe, sourcing timelines can significantly impact installation and repair. When the need arises, European manufacturers often encourage customers to work with them directly rather than using a local repair shop. When working with these manufacturers, consider keeping a spare motor on hand to avoid extended wait times.

Infinitum motors are made in the North America, so parts and replacements can be shipped to local customers in a matter of days. Selecting a manufacturer that designs easily repairable motors can minimize the impact of disruptions.

Infinitum also lowers labor costs by integrating the motor and drive into a single package, see Figure 2. In traditional motor system design, these components are sold separately and field-wired. Generally, when manufacturers are developing new fans or pumps, the mechanical and electrical engineering teams work independently to select the motor and the drive. With disparate component evaluation and selection processes, the overall design cycle extends. An integrated motor system discourages siloed work and can dramatically speed up product development, installation labor, and wiring cost.

Lastly, Infinitum Aircore EC motors are optionally equipped for wireless IoT connectivity. Configuaration data and real-time performance information is available anywhere via the Infinitum IoT Portal.

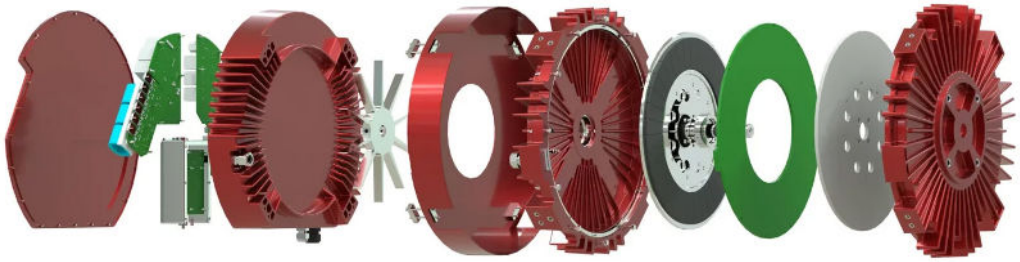

Figure 2: Infinitum's all-in-one solution combines motor, controls, and Internet of Things (IoT)

The bottom line

Equipment manufacturers and suppliers have a lot of decisions to make when it comes to designing or selecting the right products. The integrated nature of these systems means that motor choice initiates a domino effect. As much as you may scrutinize motor elements – cost, longevity, and repairability – be sure to apply the same care and consideration to the company supplying the motor. Are the manufacturer's supply chains healthy? Are they financially strong? Can they be trusted to foster a good long-term relationship?