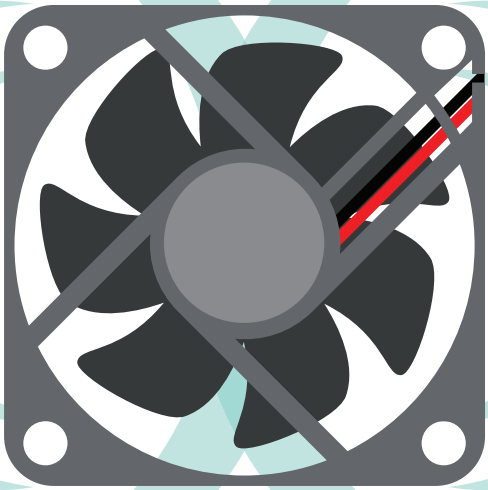
omniCOOL™ SYSTEM

Improved Longevity and Performance in Dc Fans



CUI DEVICES

Fans are all around us and form an integral part of our mechanized, electronics-centered lifestyles. From consumer appliances to large industrial machinery, devices we use every day rely on fans to expel hot air and keep them cool enough to operate reliably.

At the very heart of the fan – both literally and figuratively – is the bearing that enables the rotor to turn. A typical fan will need to make a significant number of rotations during its lifetime, so a lot gets asked of the bearing. It is therefore crucial that it is up to the task.

TYPES OF FAN MOTOR BEARINGS

Fan motor bearings typically come in two forms: sleeve bearings or ball bearings. Both are widely used and well-understood, but both have their drawbacks.

SLEEVE BEARINGS: THE PROS AND CONS

The simpler of the two traditional designs is the sleeve bearing (figure 1), so called because the central shaft rotates inside a cylindrical sleeve-like structure. Oil gets added to lubricate the bearing and enables the shaft to turn. The bearing sleeve holds the rotor in the correct position relative to the motor stator, and ensures there is a sufficient gap between the two.

Sleeve bearings are highly impact-resistant and are significantly less expensive than ball bearings, but they also have their drawbacks.

Firstly, the gap between the shaft and the inside of the bearing bore needs to be as small as possible to minimize rotor wobble and tilt as it turns. However, this increases the contact area between the shaft and the sleeve, creating friction that limits how quickly and easily the fan can be started. It also signifies that more energy is required to start the fan and keep it turning.

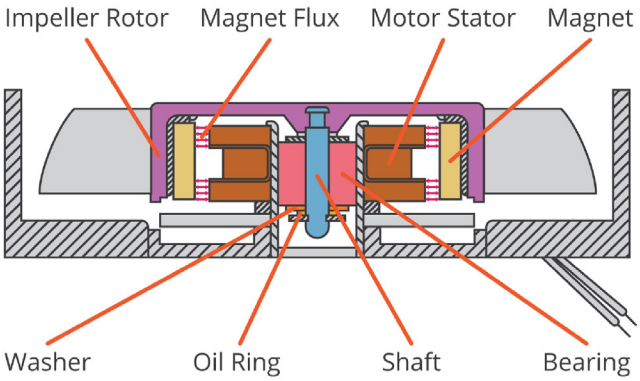


Figure 1: Cross section of a sleeve bearing

Secondly, in a straightforward sleeve bearing, there are no additional methods of holding the rotor in position. This means the rotor weight is borne entirely by the shaft sitting in the sleeve. As the shaft rotates, it gradually wears away the inside of the bearing bore. Over time, this will distort the cross-section of the sleeve. In fans that always operate in the same orientation, this results in an oval-shaped bearing sleeve that can make the bearing noisier, while affecting the rotation of the fan, causing it to wobble. Ultimately, this wear process shortens the life of the bearing and/or the whole fan unit.

This issue of bearing wear becomes a particular problem for fans required to operate in multiple orientations and angles, such as those used in portable equipment. As gravity will not always be pulling the rotor's mass in the same direction, the inside of the bearing will get worn in different directions and become uneven. This can exacerbate the noise and wobble challenges highlighted above.

Thirdly, sleeve bearings traditionally include an oil ring and Mylar washer at either end of the bore. These retain the aforementioned lubricant that is required to keep the shaft turning smoothly and quietly. However, the very presence of the oil ring and washer adds friction and hinders the escape of the gases generated by rotational friction. If these gases cannot escape, they solidify into nitride particles, which gradually clog up the bearing, impeding the shaft's rotation and shortening the life of the bearing.

BALL BEARINGS: THE PROS AND CONS

The other common type of bearing found in fan motors is the ball bearing (figure 2), made up of a ring of little steel balls surrounding the shaft. There are typically two such bearings in a fan motor, one in front of the other. Compared to a sleeve bearing, ball bearings reduce the amount of friction that must be overcome to start and operate the fan motor.

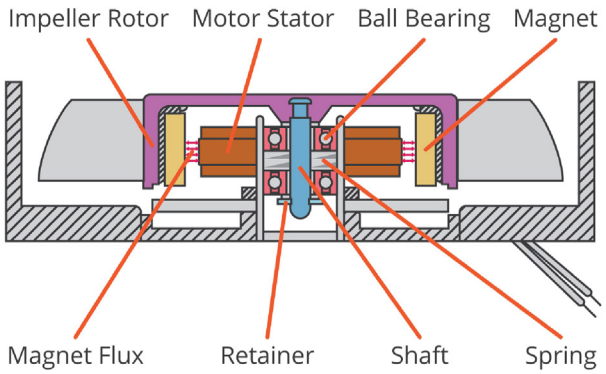


Figure 2: Cross section of a ball bearing

Ball bearing systems also help to address the problem of uneven wear and rotor tilt/wobble in sleeve bearings. This is because the two bearing rings are typically separated by springs that press them apart. The weight of the rotor rests on the inner bearing, closest to the rotor itself, while the springs help to mitigate any tilt to the fan blades that the weight of the rotor may cause. Having these springs all the way around the shaft means fans with this type of bearing can be used at any angle, making them suitable for portable devices. Less wear equates to a significantly higher MTBF on average compared to a sleeve bearing.

That said, ball bearings are not perfect. They are less robust than sleeve bearings, so they need to be treated with care and protected from impacts. They are also noisier, more complex, and costlier than their sleeve-based counterparts.

HOW THE OMNICOOL™ SYSTEM IMPROVES FAN DESIGN

There is a third option, labeled as the omniCOOL™ system, that can be found in CUI Devices' line of advanced sleeve bearing fans, which promotes extended fan life and performance. These designs incorporate either magnetic rotor-balancing (we will refer to it from here on as the 'magnetic structure') or an enhanced sleeve bearing.

MAGNETIC STRUCTURE

Dc fans with the omniCOOL system that utilize the magnetic structure design include a "-V" suffix on respective part numbers. The omniCOOL system's magnetic structure effectively makes the rotor work like a spinning top – but one that never falls over and can operate at any angle. The magnetic structure sits in front of the rotor and, because its flux is parallel to the direction of the rotor shaft, uniformly attracts the entire rotor, at whatever angle the fan unit is being held (figure 3).

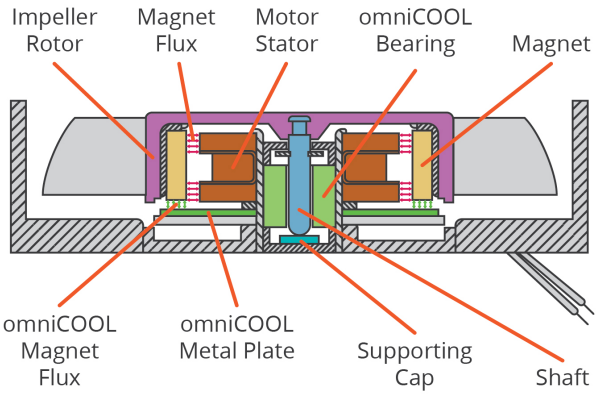


Figure 3: Cross section of a "-V" fan motor with the omniCOOL system's magnetic structure

The shaft tip is held in place by a supporting cap at the very front of the bearing bore. This forms the point around which the rotor can rotate, like the point on a spinning top. Thanks to the magnetic structure, the shaft and bearing sleeve no longer bear the weight of the rotor, which is instead suspended in the air. Additionally, the magnetic field works to lower the center of gravity by pulling the shaft downward, which minimizes the tilt and wobble issues that exist with traditional sleeve bearings, thereby enabling a fan with the omniCOOL system's magnetic structure to be used at any angle. It also dramatically reduces the friction between the shaft and the inside of the bearing. This leads to a longer operating life than a traditional sleeve bearing (figure 4).

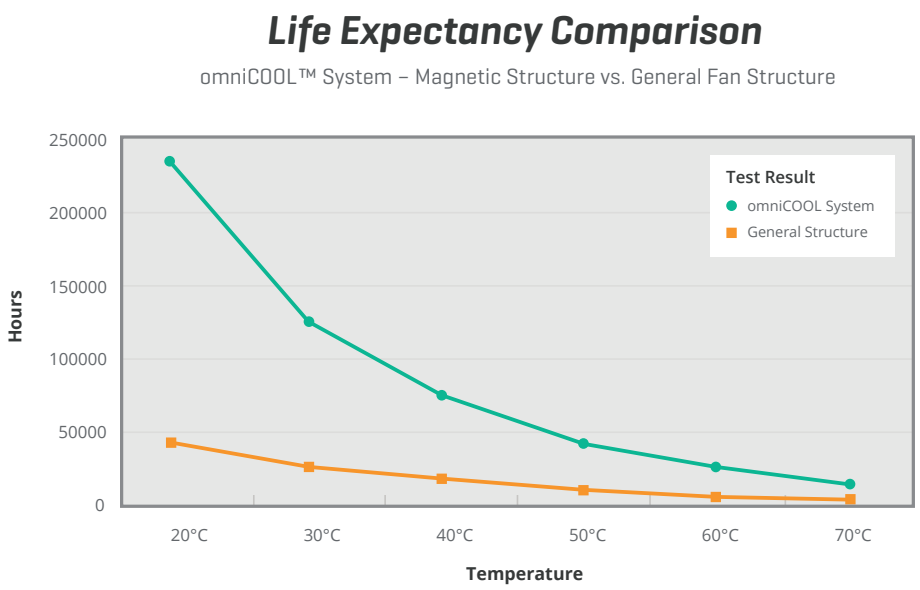


Figure 4: Life expectancy of the omniCOOL system's magnetic structure versus a general fan structure

Useful Life	*Temperature*	20°C	30°C	40°C	50°C	60°C	70°C
omniCOOL	*Test Result (Hours)*	231509	120459	65349	36820	21473	12923
General Structure		41842	24643	15013	9431	6092	4037

In addition, because the magnetic structure prevents the shaft from physically rubbing against the inside of the bearing, the need for lubricant is reduced. The omniCOOL system takes advantage of this by removing the oil rings and Mylar washers that would be required in traditional sleeve bearings. This has several advantages. It removes a big source of friction, which reduces noise and makes it easier to physically start the motor. It also creates a clear space at either end of the shaft, enabling the gas generated by the rotational friction to escape, rather than solidifying and clogging the bearing.

ENHANCED BEARING

Dc fans with the omniCOOL system that utilize the enhanced bearing design include a "-C" or "-CF" suffix on respective part numbers. The omniCOOL system's enhanced bearing design incorporates specialized grooves on the outside of the bearing that assist with circulation of lubricant around the shaft. As the fan begins to rotate, heat generated by the rotating shaft naturally draws lubricant up between the bearing and shaft. The specialized grooves on the outside of the bearing then promote the flow of lubricant back downstream, thus forming an improved lubrication cycle.

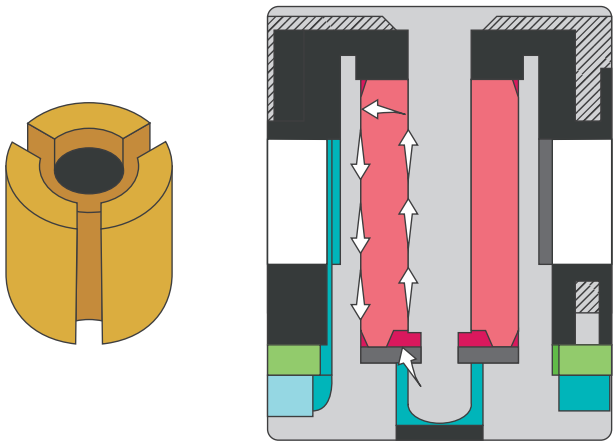


Figure 5: Specialized grooves of the omniCOOL system's enhanced bearing improve the circulation of lubricant around the shaft

The improved circulation of the omniCOOL system's enhance bearing also works to reduce friction and build-up of lubricant, leading to more efficient operation, less noise, and longer life expectancy compared to traditional designs (figure 6).

While the magnetic structure of -V series fans and the enhanced bearing of -C or -CF series fans both minimize the cost-performance tradeoff of traditional sleeve and balling bearing designs, the -V series does offer a longer life expectancy than the -C or -CF series. On the other hand, the enhanced bearing of -C or -CF series fans are more economical.

Life Expectancy Comparison

omniCOOL™ System – Enhanced Bearing vs. General Fan Structure

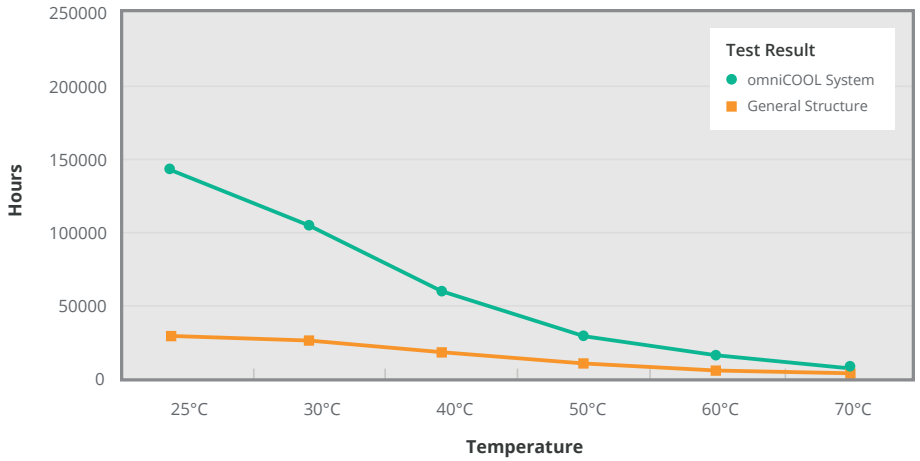


Figure 6: Life expectancy of the omniCOOL system's enhanced bearing versus fans with a traditional sleeve bearing

Useful Life	*Temperature*	25°C	30°C	40°C	50°C	60°C	70°C
omniCOOL	*Test Result (Hours)*	149125	105447	52723	26362	13181	6590
General Structure		33244	24643	15013	9431	6092	4037

OMNICOOL SYSTEM SOLVES LONG-STANDING CHALLENGES OF FAN MOTOR DESIGN

CUI Devices' omniCOOL system's alternate technologies result in fan motors that address the long-standing challenges of traditional ball and sleeve bearings.

Integrating a magnetic structure or enhanced bearing help to deliver quiet, robust, and longer-life fans that are more affordable than a ball bearing design. As a result, CUI Devices' fans with the omniCOOL system neatly bridge the gap in the market between ball bearings and sleeve bearings, giving designers a genuinely new and different option when it comes to cooling their products.

View CUI Devices' full line of sleeve bearing fans with omniCOOL™ system

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