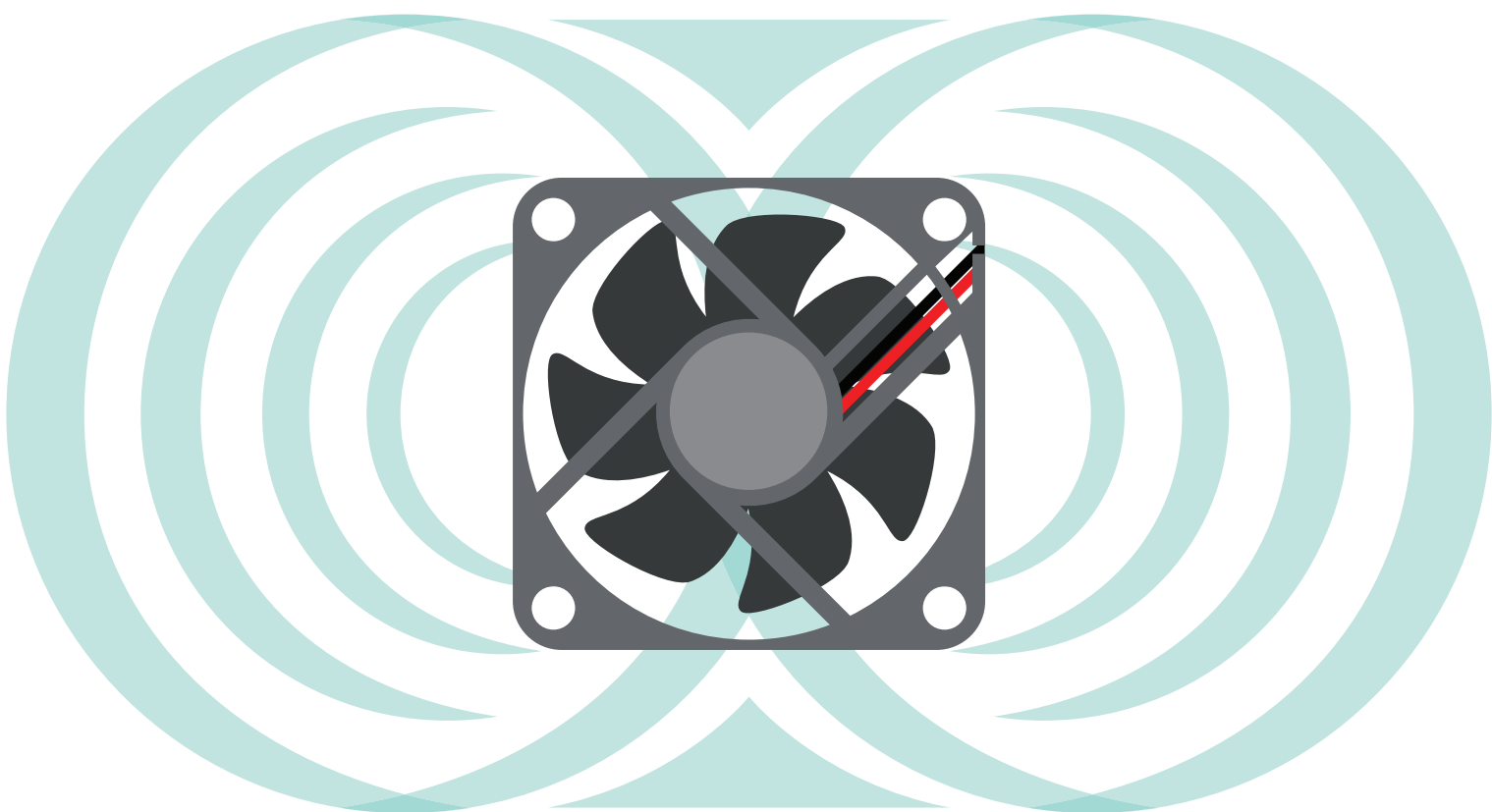


omniCOOL™ SYSTEM

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.

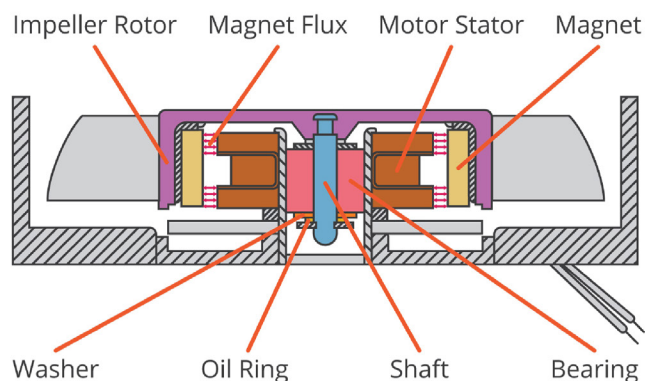
SLEEVE BEARINGS: THE PROS AND CONS

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.

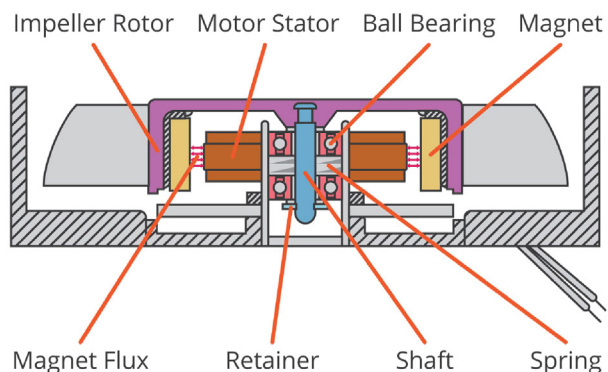
This issue of bearing wear becomes a particular problem for fans required to operate in multiple orientations and angles, such as those used in portable equipment. As gravity will not always be pulling the rotor's mass in the same direction, the inside of the bearing will get worn in different directions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



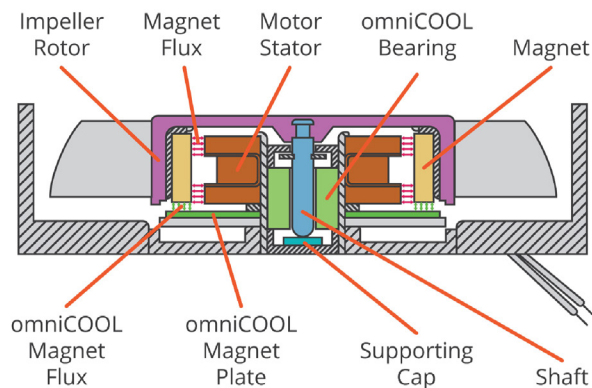
Ball bearing systems also help to address the problem of uneven wear and rotor tilt/wobble in sleeve bearings. This is because the two bearing rings are typically separated by springs that press them apart. The weight of the rotor rests on the inner bearing, closest to the rotor itself, while the springs 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, a fan design that incorporates magnetic rotor-balancing (we will refer to it from here on as the ‘magnetic structure’) and an enhanced sleeve bearing. This combination is called [the omniCOOL™ system](#) (figure 3).

Figure 3:
Cross section of a
fan motor with the
omniCOOL system



In the omniCOOL system, the 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.

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 to be used at any angle. It also dramatically reduces the friction between the shaft and the inside of the bearing.

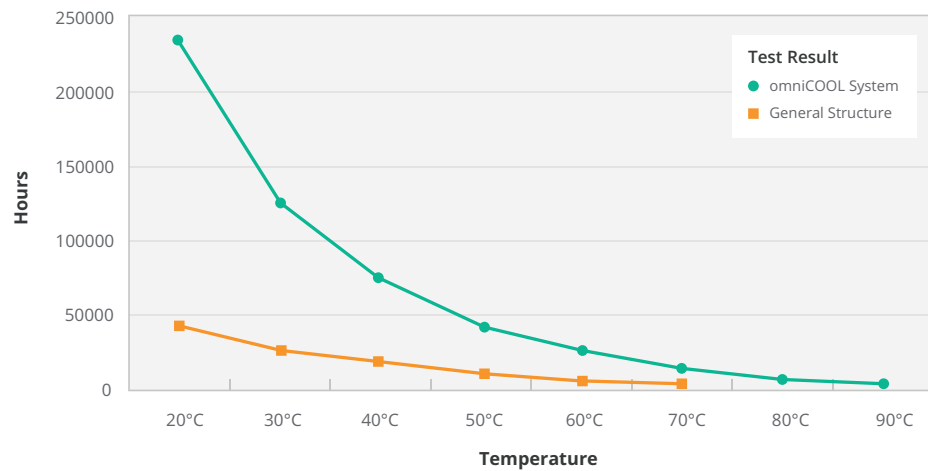
This type of magnetic structure can be applied to a traditional sleeve or ball bearing, but on its own it would not address all of the challenges we have looked at. And this is where the omniCOOL system’s enhanced bearing design comes in.

Coupled with the magnetic structure, the omniCOOL system also incorporates an enhanced bearing design to further improve performance. While the magnetic structure greatly reduces contact between the shaft and the inside of the bearing, the bearing in the omniCOOL system is specially hardened to provide additional resistance to any abrasion that does occur. The omniCOOL system’s bearing lining is highly heat-resistant, capable of operating at up to 90°C. Therefore, this bearing design has a much longer operating life than a traditional sleeve bearing.

Life Expectancy Comparison

omniCOOL™ System vs. General Fan Structure

Figure 4:
Life expectancy of the omniCOOL system versus fans with a traditional sleeve bearing



Useful Life	Temperature	20°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C
omniCOOL	Test Result (hours)	231509	120459	65349	36820	21473	12923	8004	5090
	General Structure	41842	24643	15013	9431	6092	4037	-	-

Secondly, 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.

The eradication of the oil rings, Mylar washers, and other small components required in sleeve or ball bearings, means the omniCOOL system requires fewer parts, is easier to manufacture, and its quality is easier to assure compared to more complex designs.

OMNICOOL SYSTEM SOLVES LONG-STANDING CHALLENGES OF FAN MOTOR DESIGN

CUI Devices' omniCOOL system's blend of technologies results in a fan motor that addresses the long-standing challenges of traditional ball and sleeve bearings.

Integrating a magnetic structure with an enhanced bearing delivers a quiet, robust, longer-life fan that can be used in any orientation, and is 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 axial fans with omniCOOL™ system

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