

## PTI's revolutionary new **Sealed Bearing System**; the high performance/low cost environmental DC fan bearing solution

*Ball and sleeve bearings are used extensively in DC fan manufacturing to provide effective cooling solutions for a variety of industries. However, each has advantages and disadvantages that must be carefully considered in each design application. Pelonis Technologies' new Sealed Bearing System (SBS) reduces oil leaks and dust contamination, and combines the long life of ball bearing technology with the quiet operation of sleeve bearing technology, at a low cost.*

### Bearing Systems

There are two main types of bearings that are used in axial fans; ball bearings and sleeve bearings. When choosing between a ball bearing and a sleeve bearing fan, considerations must be made regarding the following:

- Fan Life*
- Heat Endurance*
- Fan Mounting*
- Noise*
- Friction*
- Lubrication*
- Cost*



Ball Bearings vs Conventional Sleeve Bearings		
Criteria	Ball Bearings	Sleeve Bearings
Fan Life	Longer	Shorter
Heat Endurance	Higher	Lower
Fan Mounting	Vertical, horizontal, angled	Vertical
Noise	Quieter at higher speeds	Quieter at low speeds and early life
Friction	Lesser friction	Greater friction
Lubricant	Evaporates Less	Evaporates More
Cost	Higher	Lower

### Fan Life

Fan reliability is the most critical factor in fan performance. A ball bearing fan will generally operate for more than 50,000 hours while a conventional sleeve fan will operate for more than 30,000 hours. Factors determining fan life include ambient temperature, fan mounting position, amount of friction, and bearing lubrication used. Initially, a sleeve bearing is much quieter than a ball bearing. But if there is a rise in temperature, the sleeve bearing will lose lubrication, leading to faster thermal breakdown.

Despite this drawback, sleeve fans remain relatively quiet until the lubrication is gone whereas ball bearing fans become noisier shortly after startup operation.



*SBS increases cooling fan life by reducing oil leaks and dust contamination*

*SBS reduces fan noise and costs significantly less than ball bearing systems*

## Heat Endurance

Sleeve bearings deteriorate faster under high temperatures because they are made from porous, powdered metals. Conversely, ball bearing fans can withstand higher temperatures because they are made from precision steel material. When ambient temperatures are relatively low, both ball bearing and sleeve bearing fans will last equally as long. As ambient temperatures increase, ball bearing fans will significantly outlast sleeve bearing fans.

## Mounting

Ball bearing fans can be mounted in any position because the bearing is more durable. Sleeve bearing fans can maintain life spans comparable to ball bearing fans when the sleeve bearing fans are mounted in vertical positions. However, when sleeve bearing fans are mounted in horizontal or angular position, their life span decreases.

## Noise

In many applications, noise is a primary consideration. Sleeve bearing fans generally run quieter than ball bearing fans at low fan speeds. For sleeve bearing fans, fan noise depends on the clearance of the fan's bushing. The levels of the noise generated will vary with the variance in the component parts.

## Friction

Friction will cause fan failure. The more friction a bearing sustains, the greater the likelihood for fan failure. Sleeve bearings have broad line-contact between the shaft and bearing during the back-and-forth sliding motion which generates significant friction. Ball bearings are point-contact bearings, which generate minimal friction.

## Lubrication

To reduce friction and minimize overheating, fans need lubrication. Ball bearing systems use thicker lubricants that have more additives and are less subject to evaporation. In contrast, while the lubricants within sleeve bearing fans have a greater concentration of oil, the sleeve bearings' bushings can only hold a fixed amount of lubricant. Since there is no periodic recharging of the oil, the lubrication within a sleeve bearing system is more likely to evaporate.

## Cost

The manufacturing process for ball bearings and sleeve bearings is fundamentally different, resulting in different costs. Because sleeve bearings are not precision made bearings, the manufacturing process is less costly and the bearings are therefore less costly. Conversely, ball bearing manufacturing is a more extensive process which results in a higher bearing cost.

## Improvements in Conventional Sleeve Bearing Technology

Various manufactures have tried to increase sleeve bearing life by reducing the noise throughout the life of the sleeve, by reducing or eliminating oil leaks, and by applying improved sleeve bearing systems to their fan products without a substantial increase in their final cost. Some techniques that have been employed include:

- A. **Increasing oil circulation** by making grooves in the outer surface of the sleeve bearing (**Fig 1**).

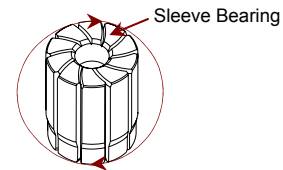


Fig 1

Arrows indicate the flow of oil in and around the sleeve bearing

- B. **Retaining oil** between the shaft and the inner surface of the sleeve bearing using one or both of the methods shown (**Fig 2 and Fig 3**).

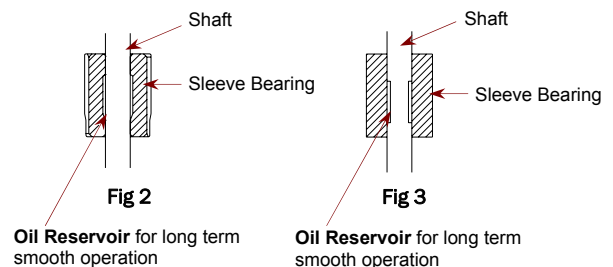


Fig 2  
Oil Reservoir for long term smooth operation

Fig 3  
Oil Reservoir for long term smooth operation

- C. **Hermetically sealing** the frame side opening of the bearing to avoid oil leaks (**Fig 4**).

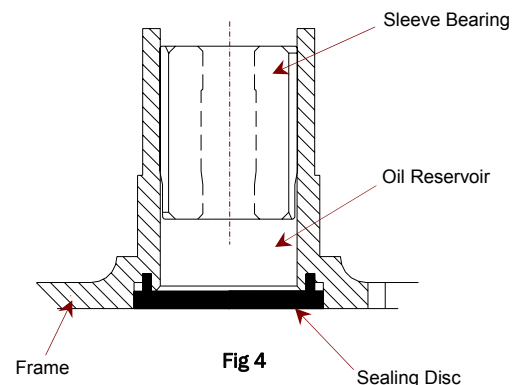


Fig 4

## PTI's Sealed Bearing System (SBS) – The high performance/low cost environmental bearing solution

Although improvements in sleeve bearing manufacturing resolve some of the drawbacks of the technology, they do not resolve the problem of oil leakage and dust contamination that occurs in the impeller side opening of the bearing. PTI's "SBS - Sealed Bearing System" resolves this problem by using a special sealer in the impeller side (Fig 5). Because the oil remains in the bearing without dust contamination, the sleeve life compares favorably to the life of the ball bearing, thus generating a lower noise and shock resistant operation.

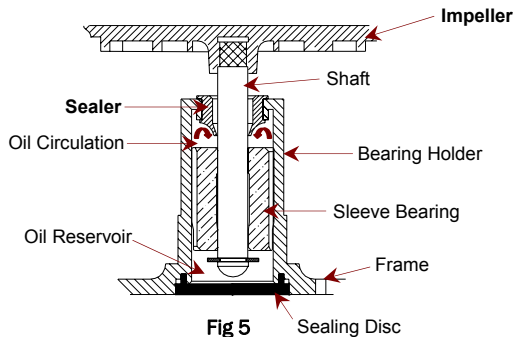


Fig 5  
Sealed Bearing System (SBS)

### SBS for Large DC Fans (40mm to 120mm sizes)

Fig. 5a shows the bearing assembly utilizing a double-cut shaft. The advantages of the double cut shaft are:

- The **double-cut shaft** maintains a **low tolerance** (typically down to 0.3mm) of the **shaft play** because the shaft cuts are placed at a fixed and well controllable distance. This tight tolerance avoids shaft/bearing "wobble" which normally occurs during the latter life of the bearing and greatly contributes to noise.
- The **double-cut shaft** maintains **tight and well controlled tolerance**. This ensures that the washers coming in contact with the sleeve bearing will force the circulating oil back into the center of the bearing for continuous lubrication of the sleeve/shaft assembly.

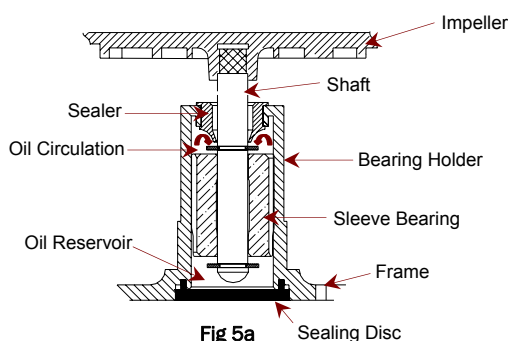


Fig 5a  
Sealed Bearing System (SBS)  
(for large DC fans)

### SBS for Small Fans (30mm sizes and below)

Fig. 5b shows the bearing assembly utilizing a single-cut shaft with a rounded off end tip. This method is employed in bearing assemblies where the fan motor thickness is less than 20mm because the total length prohibits the double cut shaft method. However, as the fan motor thickness is decreased, so is the weight of the blade. For small size fans (30mm and below), the blade is **suspended magnetically** by the magnetic force generated by the permanent magnet located in the blade hub and the stator. A well centered fan motor assembly will run without the necessity of the snap ring which is normally required to ensure that the blade does not separate from the frame. However, even if the position of the stator and permanent magnet is not ideally positioned, the shaft washer will touch the sleeve or the sealing disc. The structure can also be aligned such that the shaft touches the sealing disc. The end tip of the single cut shaft is rounded off so that the shaft and sealing disc establish a "point contact."

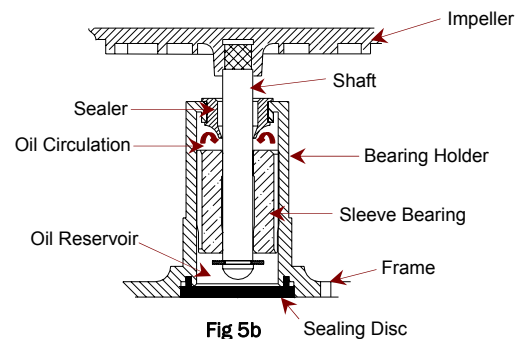


Fig 5b  
Sealed Bearing System (SBS)  
(for small DC fans)

#### Sleeve Bearings vs SBS

Benefits	Sleeve Bearings	SBS
Noise	Higher	✓ Lower
Shock Resistance	Lower	✓ Higher
Dust Resistance	Lower	✓ Higher
Life Expectancy	30,000 hrs.	✓ 40,000 hrs. +
Cost	✓ Lower	(slightly higher)

### SBS - The ideal DC fan bearing system!

The "SBS - Sealed Bearing System" is a practical solution for DC fan applications that require the benefits of both sleeve and ball bearings. The cost of the SBS technology is **slightly** higher than the conventional sleeve bearing technology but well below the ball technology. In addition, SBS reduces oil leakage and dust contamination associated with sleeve bearings, thus making SBS an **ideal high performance/low cost environmental DC fan bearing solution**.

