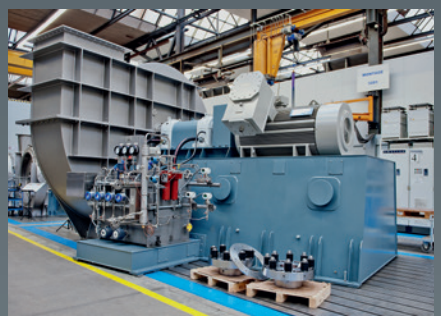
PILLER

Blowers & Compressors

MVR BLOWERS

AND SQUEEZE OIL DAMPER BEARING



PILLER MVR BLOWERS MADE FOR ENERGY SAVING

PILLER was the first company to introduce centrifugal blower solutions for the process of Mechanical Vapor Recompression (MVR) as used in Evaporation Units. Patented bearings and purposely developed high-performance impellers make PILLER the leading manufacturer of MVR Blowers.

EFFICIENCY THROUGH FLEXIBILITY

PILLER MVR Blowers ensure maximum efficiency, thus cost savings, and lower life cycle costs. We tailor our MVR Blowers to suit the individual customer's needs. Our products are of high quality and intelligent design along with a high level of standardization.

THE EXPERT AT YOUR SIDE

PILLER is the high performance blower specialist. Our customers have enjoyed the benefits of our MVR Blower production expertise for more than three decades. Our German engineering expertise and precision are worldwide benchmarks.

In-house R&D results in continuous development and invention such as our patented bearing system.

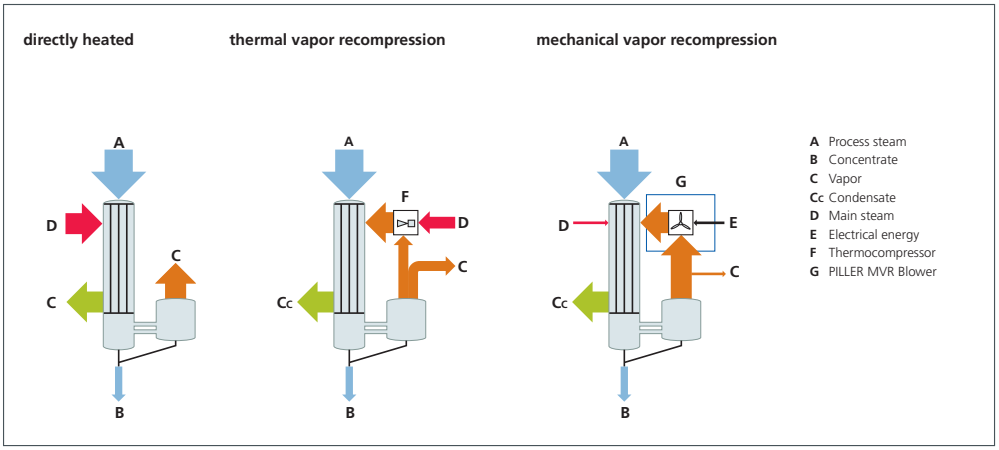


Fig. 1: Methods for heating evaporators

PERFORMANCE RANGE

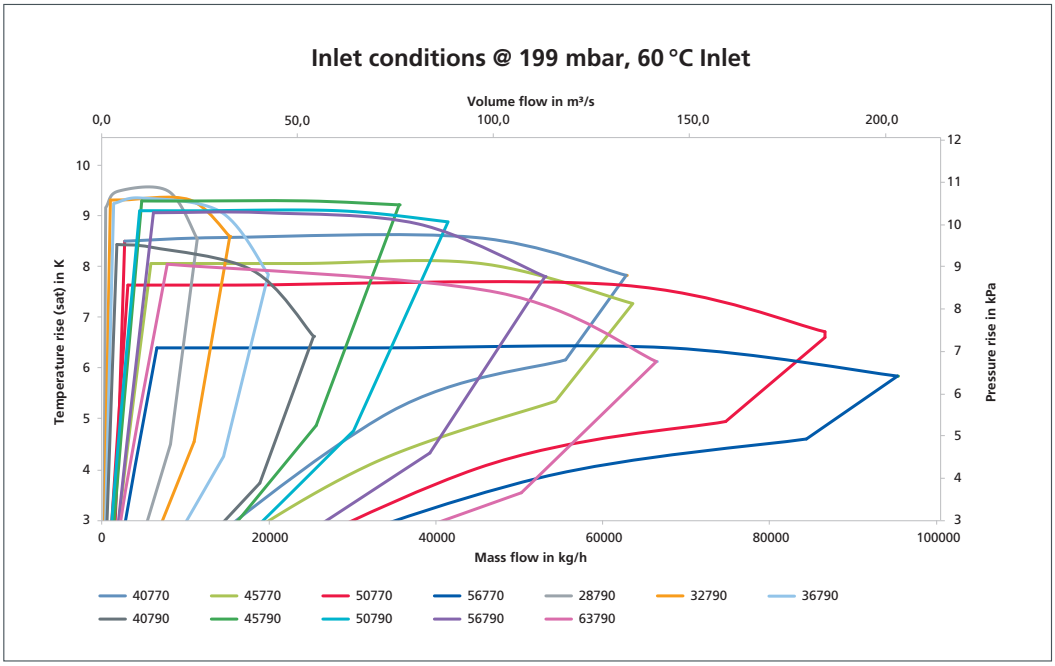


Fig. 2: Product Line Summary at 60° C

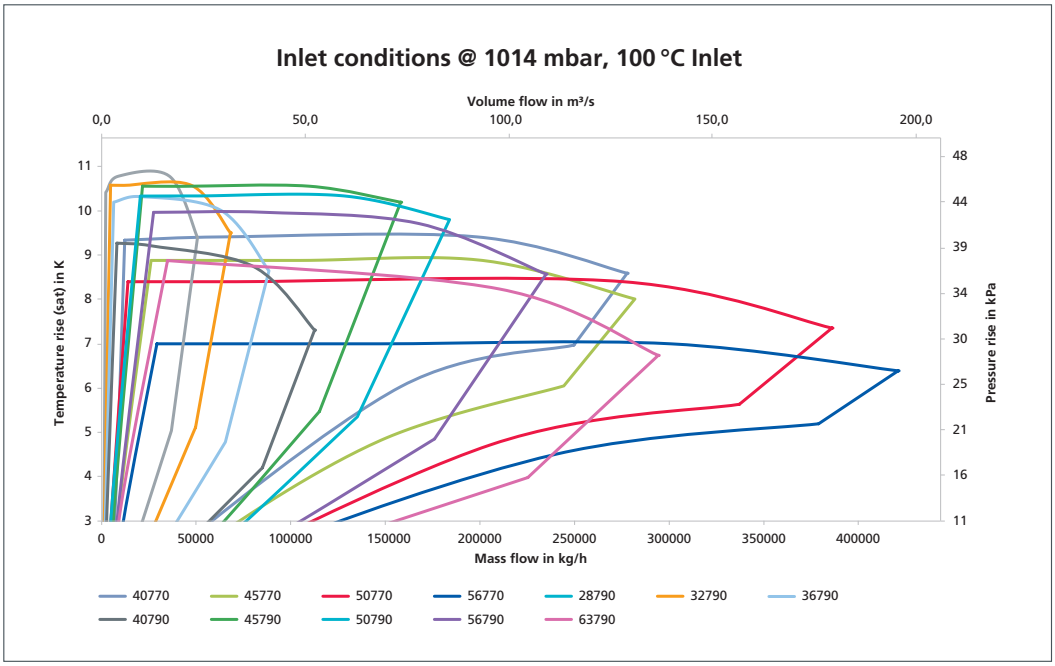


Fig. 3: Product Line Summary at 100° C

FACTS

PILLER MVR Blowers are designed for system pressures from 0.05–5 bar customized according to the process.

- Tip speeds of up to 320 m/s
- Water injection keeps impellers clean and the steam saturated
- Low wear floating carbon ring labyrinth seals guarantee longterm tightness
- Our patented squeeze-oil-damping combines the simplicity of anti-friction bearings with the performance of hydrodynamic bearings
- For higher temperature rises up to four MVR Blowers can be used in series
- Suitable for conditions of corrosive environment such as sulphuric acid vapors

MVR Specifications	
Medium	Steam
Motor capacity	up to 5 MW
Temperature increase	up to 11 K single stage
Impeller speed	up to 320 m/s
Efficiency	up to 86 %

FIELDS OF APPLICATION

Mechanical vapor recompression was initially used almost exclusively in the milk and dairy industry. The areas of application have grown since with PILLER MVR Blowers having proved successful in many different fields.

- Milk/Whey
- Starch
- Sugar
- Yeast
- Alcohols
- Bioethanol
- Gelatine
- Pectins
- Grain Processing
- Vegetable Processing
- Fruit Juices
- Electrolyte Baths
- Saline Water
- Citric Acid and Acetic
- Sulphuric Acid
- Sewage Sludge and Lacquer Sludge
- Liquid Manure
- Oil Recycling
- Recycling of special metals
- Seawater Desalination
- Wood Drying, Pellets Drying and Peat Drying
- Paper Drying
- Boiler Feedwater
- Blood Plasma
- Commercialisation of Meat and Fish

Petrochemical

- PTA
- EPDM
- Butadiene
- Waste water

The PILLER MVR Blowers are advanced design solutions that have been standardized to a high degree. There is no other PILLER product that passed through so many innovations. Our standardized design provide for cost-effective solutions which can quickly be realized.

TECHNOLOGY

The PILLER high-performance Blowers reach temperature rises through impeller peripheral speed of up to 300 m/s, using special materials even up to 320 m/s. Impeller geometries have also been optimized for best possible aerodynamic loading and efficiency.

SHAFT SEAL

Various shaft seal concepts are available, depending on the intended use. In general, distinctions are made between the following operating conditions:

- Process operates in a high vacuum
- Process operates above ambient condition

WATER INJECTION

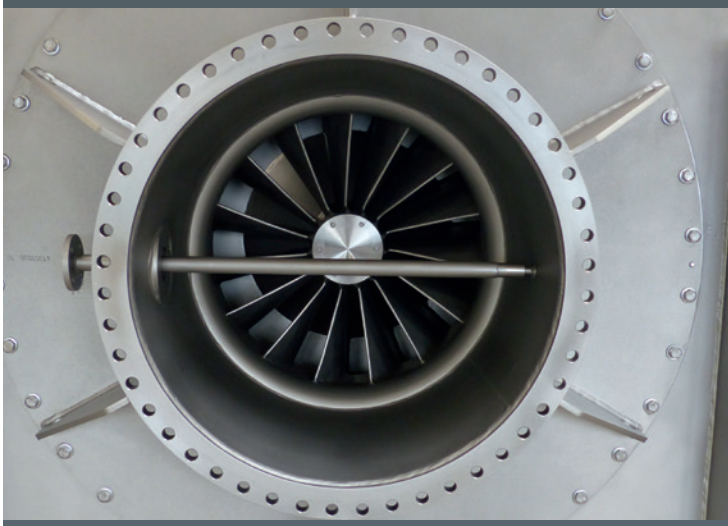
A specially designed water injection nozzle keeps steam near saturation point increasing the heat transfer.

INSTRUMENTS

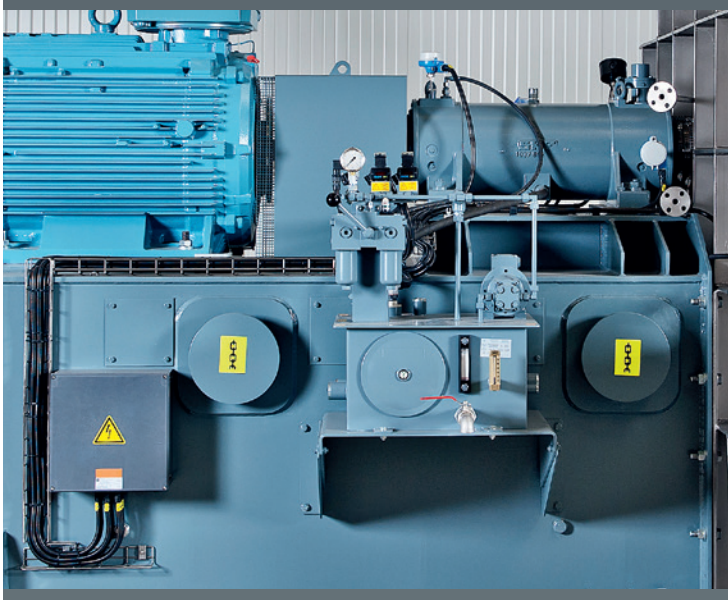
Every PILLER MVR Blower is equipped with control instrumentation. These instruments are wired to a common junction box so that customers can bring back these instrument signals to the plant control system. Typical instruments monitor the following parameters:

- Casing temperature
- Bearing temperatures
- Shaft vibration
- Speed
- Oil temperature
- Oil level
- Oil flow to the blower bearings
- Oil pressure
- Condensate level in the casing

Shaft seal

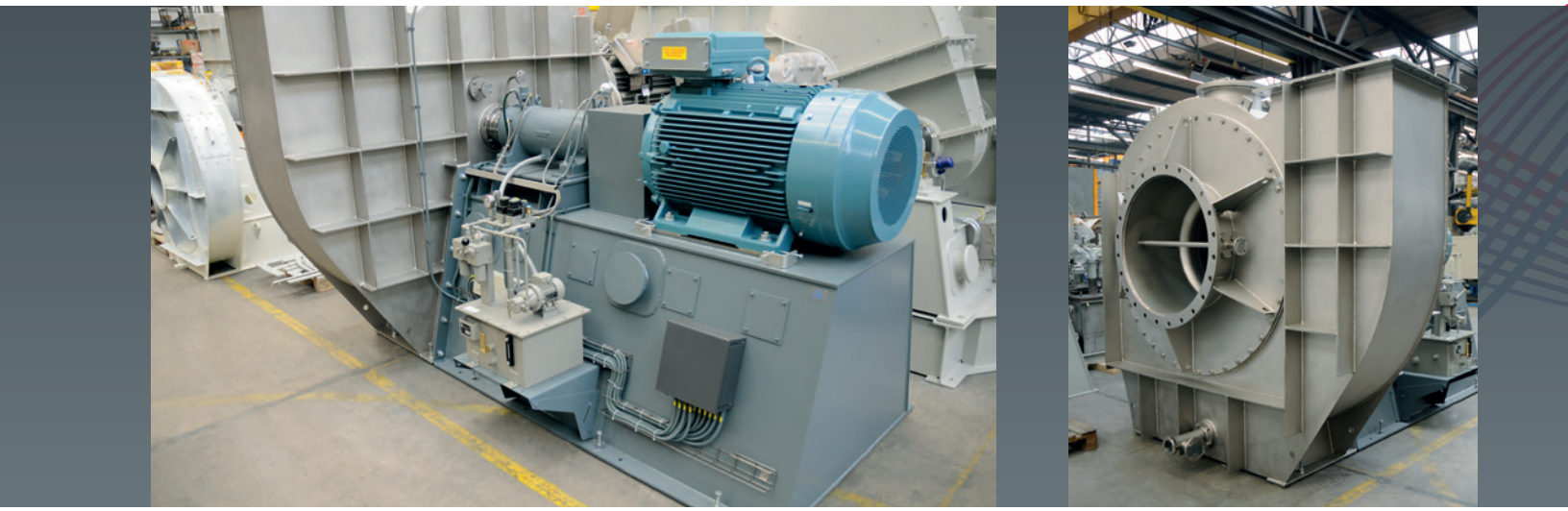


Water injection



Instruments

PILLER'S SQUEEZE OIL DAMPER BEARING



MVR Blower with Squeeze Oil Damper Bearing

Demands for increased MVR Blower performance has required higher blower speeds so that most MVR Blowers now run above their first critical speed. A rotor running above its first critical speed is known as a super critical rotor. Traditionally, a super critical rotor required the use of sleeve type fluid film bearings to provide the damping necessary to pass through the critical speed on startup or coast down. For a fluid film supported rotor to run reliably the blower speed must be selected to be significantly above or below a critical speed so that the blower vibration during operation was not influenced by the critical speed. This required separation margin in turn limits the blower allowable operating speed range. A minimum standard separation margin of 20 percent is often specified. Figure 4 below shows the calculated vibration amplitude of a blower rotor supported by three common types of fluid film bearings, a two segment bearing, a four segment bearing and a 5 pad tilting pad bearing.

The best operating speed of many MVR Blowers is between 3000 and 3600 rpm. As shown in this figure, at this speed range all three types of fluid film bearings are going to be influenced by the critical speed and in almost all cases we cannot maintain the requested separation margin from critical speed cannot be maintained. For the 2 and 4 segment bearings, the blower operating speed would be limited to below 2500 rpm which would significantly limit the blower performance or above 3700 rpm which may not be possible because of the tip speed limit of the blower impeller. In any case the influence of critical speeds with sleeve type fluid film bearings significantly limits operating speed range and blower selection.

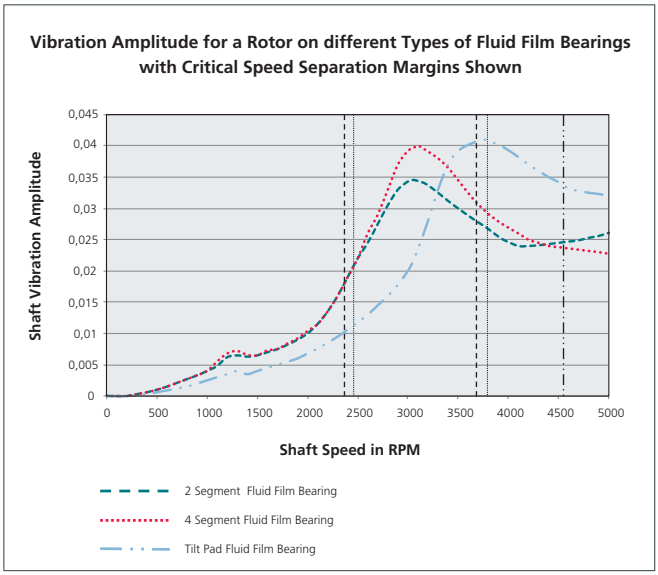
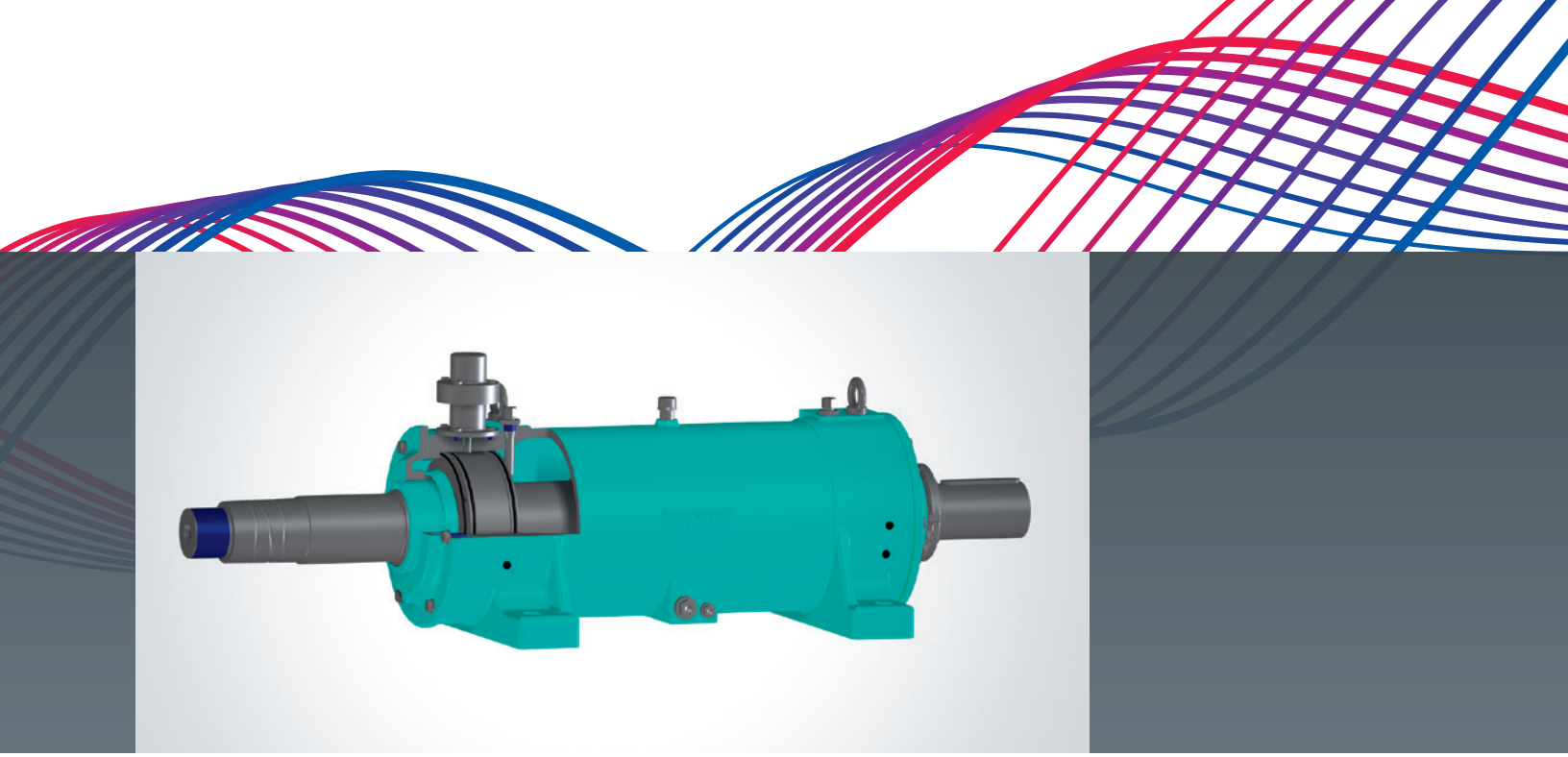


Fig. 4: Vibration Amplitude for a Rotor on different types of Fluid Film Bearings

To overcome the limited operating ranges of sleeve bearing systems, PILLER developed a unique and patented Squeeze Oil Damper Bearing System. It is made up of a static oil damper that supports a standard antifriction bearing usually a cylindrical roller bearing at the impeller end of our rotor and a deep groove ball bearing at the coupling end of the rotor that acts as both the coupling end radial bearing and thrust bearing. Our squeeze oil damper not only provides the required damping to pass through the critical speed but also reduces the bearing stiffness so that the critical speed is lowered well below any required blower operating range.



Squeeze Oil Damper Bearing

Figure 5 shows the calculated vibration amplitude or rotor response for a rotor on antifriction bearing with and without the squeeze oil damper. As you can see the amplitude of the rotor through the critical speed with the squeeze oil damper is an order of magnitude lower than the amplitude without the damper. The influence of the critical speed with the squeeze oil damper is actually negligible. Further the critical speed with the squeeze oil damper was lowered from 2900 rpm to 900 rpm allowing this rotor design to operate without any significant influence of a critical speed from 0 to 4900 rpm.

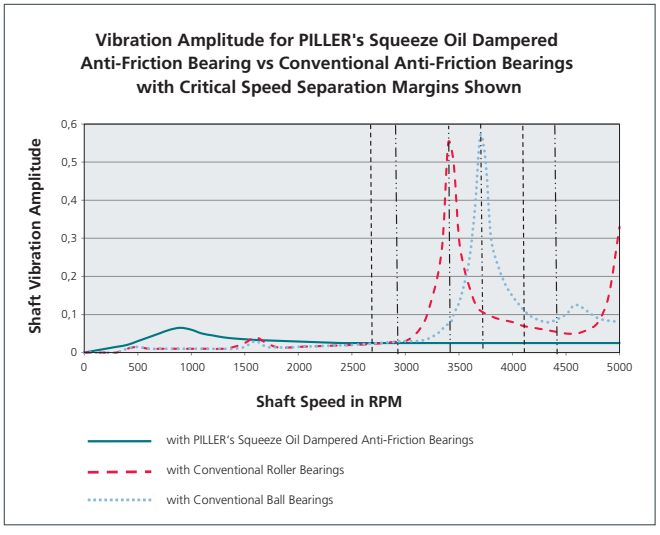


Fig. 5: Vibration Amplitude for PILLER's Squeeze Oil Damper Anti-Friction Bearings vs. Conventionally Mounted Ball and Roller Bearings

The PILLER Squeeze Oil Damper Bearing design also has the following advantages:

- The antifriction bearings used are available off the shelf from almost any bearing supply house
- The oil lubrication system is a smaller and simpler system than those supplied with fluid film bearings
  - The total oil flow to our Squeeze Oil Damper Bearings is less than one liter per min
  - In most cases we do not need an oil cooler or heater as the oil viscosity is not as important for antifriction bearings. As long as we can spray oil on the bearing our system is good. With fluid film bearings oil needs to be controlled to a certain temperature to maintain a design oil viscosity to get the proper bearing performance
  - The oil in the antifriction bearings is sufficient for coast down so there is no need for added pumps fed from uninterruptable power or run down tanks to keep the bearings from being damaged on loss of oil during shutdown
- Our vibration monitoring is simpler, there is no need for X and Y probes as we do not have an orbit. A single proximity probe is all we recommend

PILLER standard bearings are a roller and ball bearing, simple, very effective, low in cost and available everywhere.

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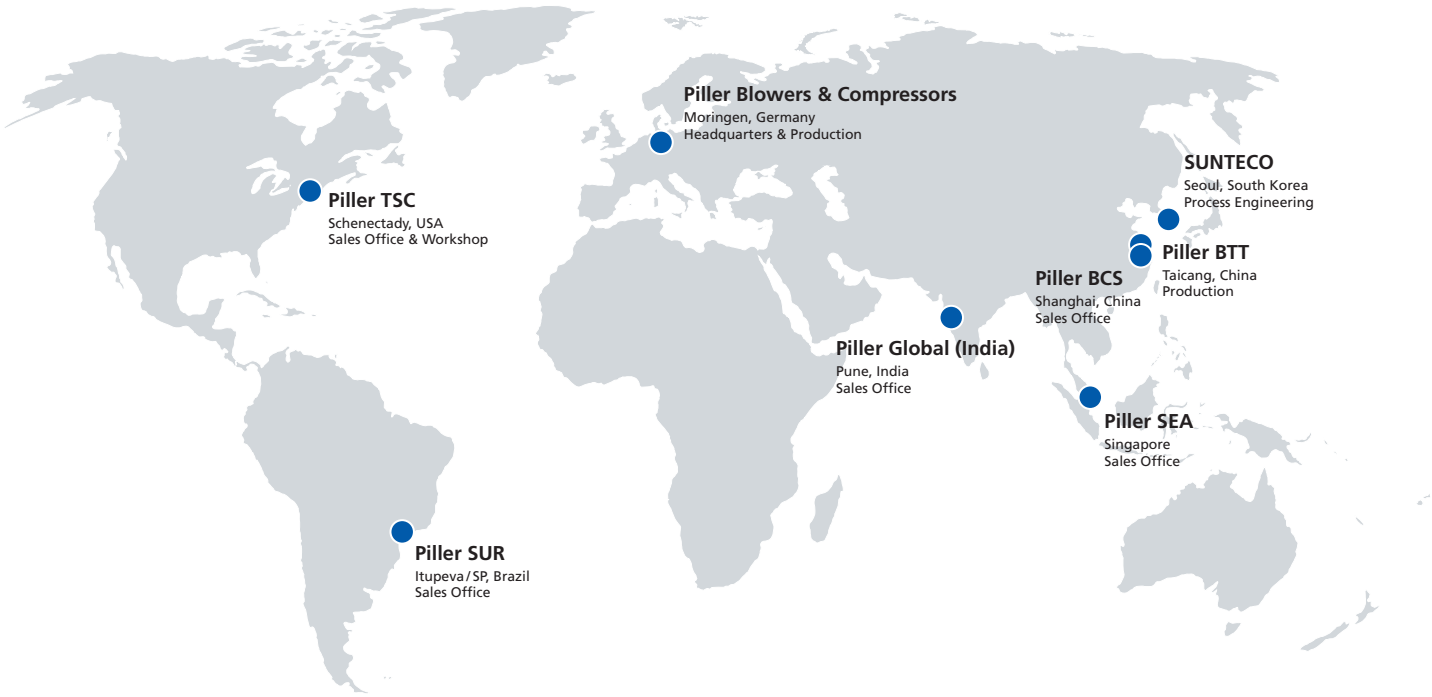

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