



Boost cryogenic pump reliability, availability and profitability

Benefits

- Increase mean time between repairs (MTBR)
- Reduce maintenance and associated costs
- Reduce unplanned downtime
- Help extend pump service life
- Help minimize production losses
- Increase worker safety

Typical applications

- Cryogenic pumps handling various liquefied gases:
 - Petroleum (LPG)
 - Ethylene (LEG)
 - Natural gas (LNG)
 - Hydrogen (LH2)



Deep groove ball bearing for cryogenic pumps, featuring VC4444, a special variant of SKF stainless steel, as well as low-friction ceramic rolling elements

The SKF cryogenic pump solution makes it easy in even the harshest conditions

Temperatures as low as $-253\text{ }^{\circ}\text{C}$. No traditional lubricants. Cavitation and particles in the liquefied gases. 24/7 start-stop cycles. High rotational speeds, elevated vibration and stray electric currents.

With operating conditions like these, it's no wonder that bearing service life for cryogenic pumps is often six months or less. And when the bearings fail, overhaul and repair operations can be quite expensive, or even dangerous, with high lost production costs. SKF has a much more reliable, cost-effective alternative.

Proven, high-performance design triples bearing service life

Already performing exceptionally well in commercial installations worldwide, the SKF cryogenic pump solution is helping companies more than triple cryogenic bearing service life, thanks to several high-performance design features.

SKF super-tough stainless steel

This SKF solution features VC4444, a specially heat-treated variant of SKF super-tough stainless steel. Patented in Sweden, the bearing solution utilizes this superior stainless steel to deliver excellent protection against corrosion, wear and fatigue, in combination with SKF's ceramic and PEEK technology.

Ceramic rolling elements

The SKF cryogenic pump solution also includes deep groove ball bearings with low-friction ceramic rolling elements. This silicon nitride ceramic material offers both prevention of electrical erosion and high surface fatigue resistance under poor lubrication conditions.

Glass fiber reinforced PEEK cage

Providing a further line of defense against harsh, media lubricated conditions, the bearings also feature a single piece, glass fiber reinforced PEEK (polyetheretherketone) cage. Compared to their conventional rigid and riveted steel, brass, or polymer counterparts, SKF's PEEK cages allow liquefied gases to easily flow through the bearing. At the same time, PEEK cages flex away from the dynamic movements of the rolling elements, improving operational efficiency.



Save time and money with world-class SKF solutions and services

The whole idea behind the SKF 360° Solution is to help you get more out of your machinery and equipment investments. This may mean lowering your maintenance costs, raising your productivity, or both! Here is an example of the SKF 360° Solution at work in the oil and gas industry.

SKF develops cryogenic pump solution to help boost plant reliability

The challenge

A large petrochemical plant in Western Europe was experiencing bearing failures in its cryogenic pumps. The high RPM pumps were submerged in and used to pump -100 °C liquid ethylene through start-stop cycles, 24/7. Poor lubrication was causing severe damage to bearing components, leading inevitably to failure. Wanting to increase pump reliability and thereby cut lost production costs and expensive maintenance in high-risk areas, the company looked to SKF.

The SKF solution

SKF application engineers began designing a robust bearing solution that would stand up to the harsh, contaminated operating conditions of medium-lubricated cryogenic pumps. The SKF team analyzed bearing materials, steel heat treatments, internal geometry and tolerances, and performed advanced

calculations and simulations using proprietary SKF application engineering software.

The resulting SKF solution features a bearing constructed with VC4444, a specially heat-treated variant of SKF super-tough stainless steel, deep groove ball bearings with low friction ceramic rolling elements, and a single piece, glass fiber reinforced PEEK cage. Dubbed the SKF cryogenic pump solution, it was installed on two of the facility's cryogenic pumps.

The result

After more than two years in service that included regular vibration monitoring performed by plant staff, the SKF cryogenic pump solution bearings were still performing well, with no signs of damage. SKF and plant management now consider a service life of 36 months



or more to be realistic. For an initial investment of €7 000 per pump, the plant is expected to achieve a 428% return on investment for each installation of the SKF cryogenic pump solution after the first year.

Return on investment (ROI) summary*

SKF solution investment costs per pump	€7 000
Annual savings from less downtime per pump.....	€37 000
Annual profit per pump	€30 000
Projected ROI after 3 years.....	4 265%

*All numbers are rounded off and based on customer estimates. Your particular cost savings may vary.

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PUB 52/S2 11080 EN · April 2011

Printed in Sweden on environmentally friendly paper.

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