Light Weight Sealing System for Wind turbine applications

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SKF and the Energy Industry

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Energy is an important business area for SKF

- **RENEWABLE ENERGY**
  - Wind
  - Ocean
  - Hydro
  - Solar
  - Biomass
  - Biofuel

- **OIL GAS**
  - Exploration
  - Production
  - Transportation

- **COAL**

- **POWER GENERATION**
- Industrial
- Household
- Transport
SKF and Wind Energy
Degree of integration

- Turbines with gearbox: 1200 – 1800 rpm
- Hybrid Turbines: 150 – 400 rpm
- Gearless Turbines (Direct Drive): 12-30 rpm
SKF offers to the wind industry

SKF high-capacity CRB and SKF high-capacity separable CRB

SKF Wind Farm Management Conference

SKF Remote Diagnostic Services

SKF High Endurance Slewing Bearings

SKF Nautilus

SKF roller bearings for wind turbine main shafts

SKF XL Hybrid bearings

Black oxide-coated bearings

Automatic centralized lubrication kits

SKF Spare part management programme

HRS – Polyurethane seal

Axial excluder seal GR06

LGBB 2 grease
- Countries with SKF seals moulding and/or machining facilities, engineering, sales and customer service units

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- In most of the countries in white SKF is represented through authorized distributors/dealers
Quick facts

LWSS – Light Weight Sealing System for Senvion 6.2M152

- Project Start 2013
- SoP 07/2018
- Seal carrier + seal for main bearing housings
- Seal diameter Ø 1772 mm & Ø 1398 mm

- Status: Series delivery
- 32 wind turbines for Trianel

- Hans-Jürgen Liesegang
  Business Development Manager & KAM Erneuerbare Energien
„Keep grease inside“

„Keep dirt & water outside“
Customer Senvion (Germany) was looking for a new improved Sealing system for the upcoming Wind-Turbine 6.2M-152 -> (predecessor 6.2M-126 with cast labyrinth rings + V-Rings)

„...pollution by dust etc. coming out of nacelle should be less than today and grease-leakages should be less than with the current labyrinth system...“ (Carsten Eusterbarkey, R&D Senvion)

Further requirements:

- robust
- reliable
- easy to change/replace seal
- better inspection of bearing raceways
- dismountable in nacelle (weight reduction)
SKF proposal

- Replace cast Labyrinth rings with sheet metal sealing carrier \(\rightarrow\) evolution design form one piece sheet metal carrier + radial shaft lip seal (Bild eno)
- Simplified design to reduce mounting complexity and manufacturing cost
  - All parts bolt up – no welding or metal-cutting operation necessary
  - New extruded seal design based on two lip design
Sealing carrier design

- Sealing carrier delivered pre-assembled
- Split halves for easier mounting / dismounting
- Sheet metal parts not welded – assembly is bolted
- Seal can be easily replaced
- Additional features – like grease outlets etc. can be implemented
Sealing carrier design

- All parts laser cut from 8 mm to 10 mm steel plates
- Main carrier 180° - horizontal split (leakage and cost reduction)
- Clamping rings etc. segmented
- Metal parts (S355 MC) ZnNj galvanized (10 μm – dipping bath)
- Corrosion protection 1000 h acc. To DIN EN ISO 9227 (salt spray tests)
- Fittings for inspection / endoscopy, air filter and grease outlets (defined grease flow / grease level acc. to operating conditions)

→ Only one relevant centering diameter for seal positioning
→ Positioning of assembled sealing carrier will be aligned to shaft during installation
→ Position of seal main carrier is fixed in housing during first mounting at customer
→ Biggest single piece weighs max. 40 kg
Complete sealing-carrier with a mounted LWSS-HNBR-Rubber-Seal

Senvion-Design as an example

SKF-Mounting-tool for a simplified centering of the seal to the shaft
Freezing of the sealing-carrier-position with a simplified fitting-pin & fitting-sheet
Field testing

- Prototype in operation since Q3/2014
- Several inspections and seal replacement since then
- Customer feedback very positive: performance of seal is better than expected – only small leakage as expected
- Higher grease filling degree in bearing – bearing raceways in excellent conditions
- After 2 years of operations some issues with leakage occurred - caused by high degree of grease filling in housing
  \[\rightarrow\] change of initial filling degree for housing for series and change of run in process
- Further customers interest – field test started 09/2018
Summary

1.) Main benefit: combination of effective contact seal and proper designed grease flow (filling degree, outlet size and positioning) increases bearing performance and service lifetime.

Sufficient steady-state level is necessary for migration

- The steady-state level $L$ is the major driver for how much lubricant (grease/oil) is re-entered into the bearing. Due to hydrostatic pressure, a high level “L” forces more grease back into the bearing than what a low “L” does.

- The steady-state level $L$ is a function of the grease replenishment flow in relation to the lubricant leakage flow through the labyrinth gap (volume per time), the grease NLGI number [stiffness], the grease oil bleeding ability and the housing shape.
2.) Main benefit: It is easy possible to take out the „old bleed-to-death“-grease after 5 years.

The background is the technical request to replace the grease in the bearing & bearing-housing (free-spaces) in 5 years. Based on that request SKF calculates the re-greasing-volumes for the pump-systems.
Prototype mounting – Senvion 6.2M152
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Prototype mounting – Senvion 6.2M152
Seal – replacement tools
Seal – replacement tools
Seal cutting
Seal replacement
Seal replacement
Seal replacement
Seal replacement
Vielen Dank für Ihre Aufmerksamkeit Fragen....?