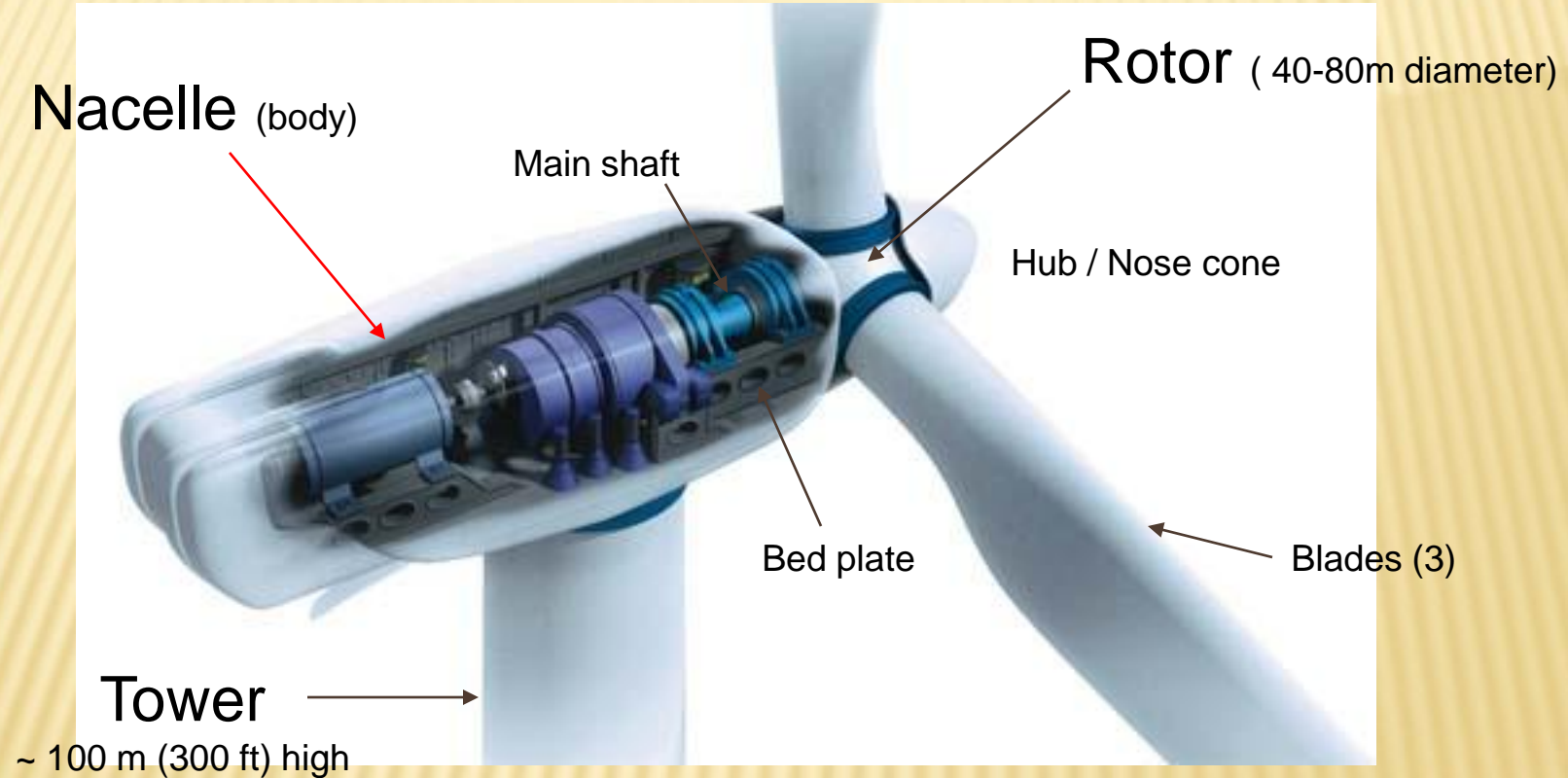


ACCOFLUOR & EVCO Seal Team Division
sealing solutions for wind turbines

Wind turbine basics



WIND TURBINE BASICS



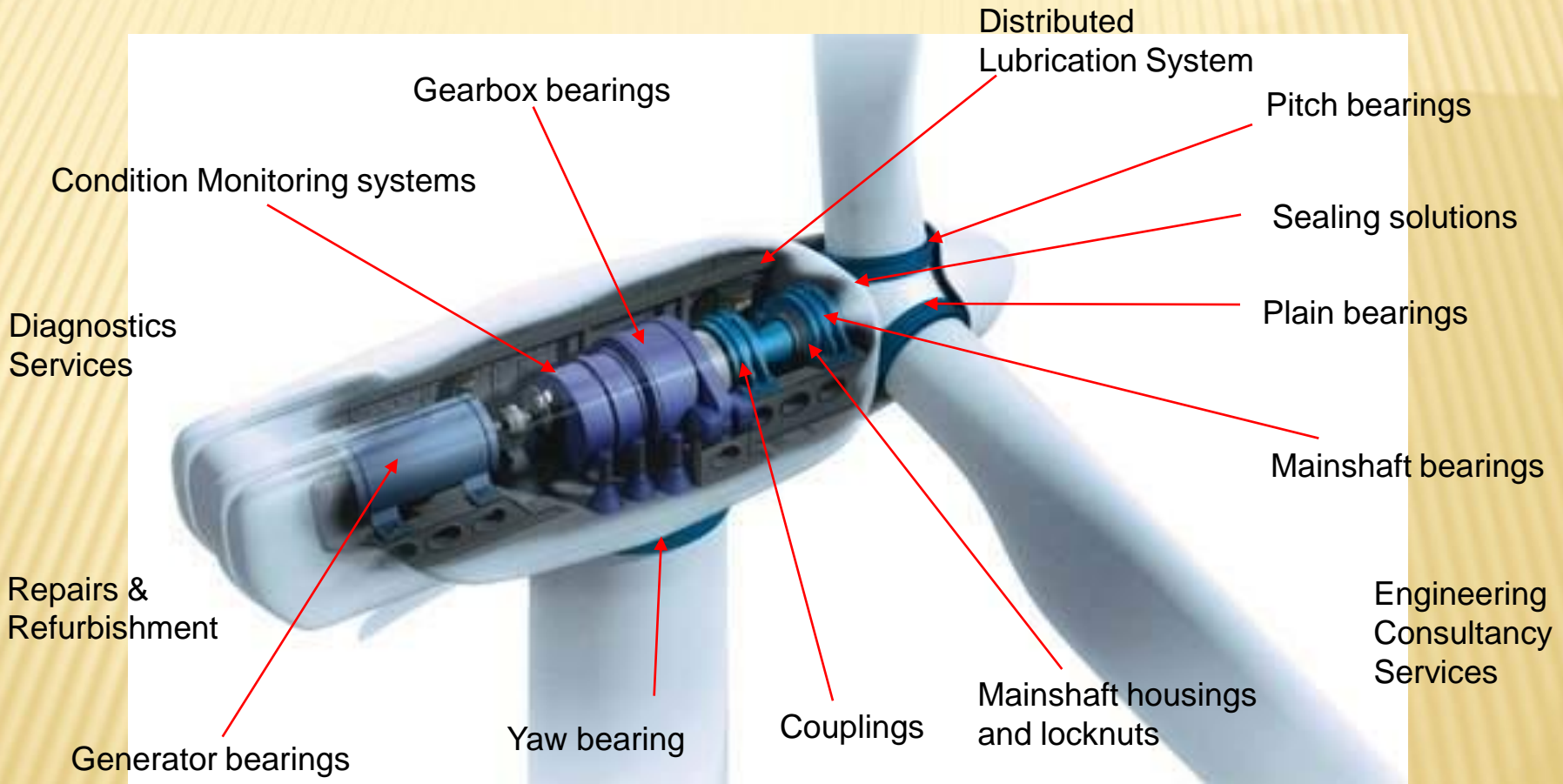
Range in size from 600kW to 5MW

SEALING SOLUTIONS IN WIND TURBINES



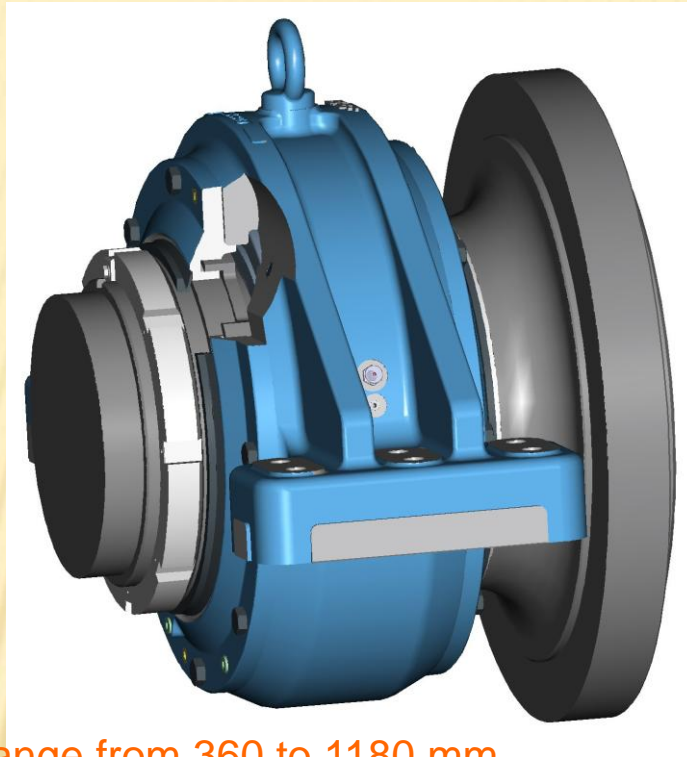
APPLICATIONS IN WIND ENERGY

*Global manufacturing output (2006) ; 15 300 MW
Average turbine price; € 1,2 Million/MW*



COMMON MAIN BEARING HOUSING

Gearbox side

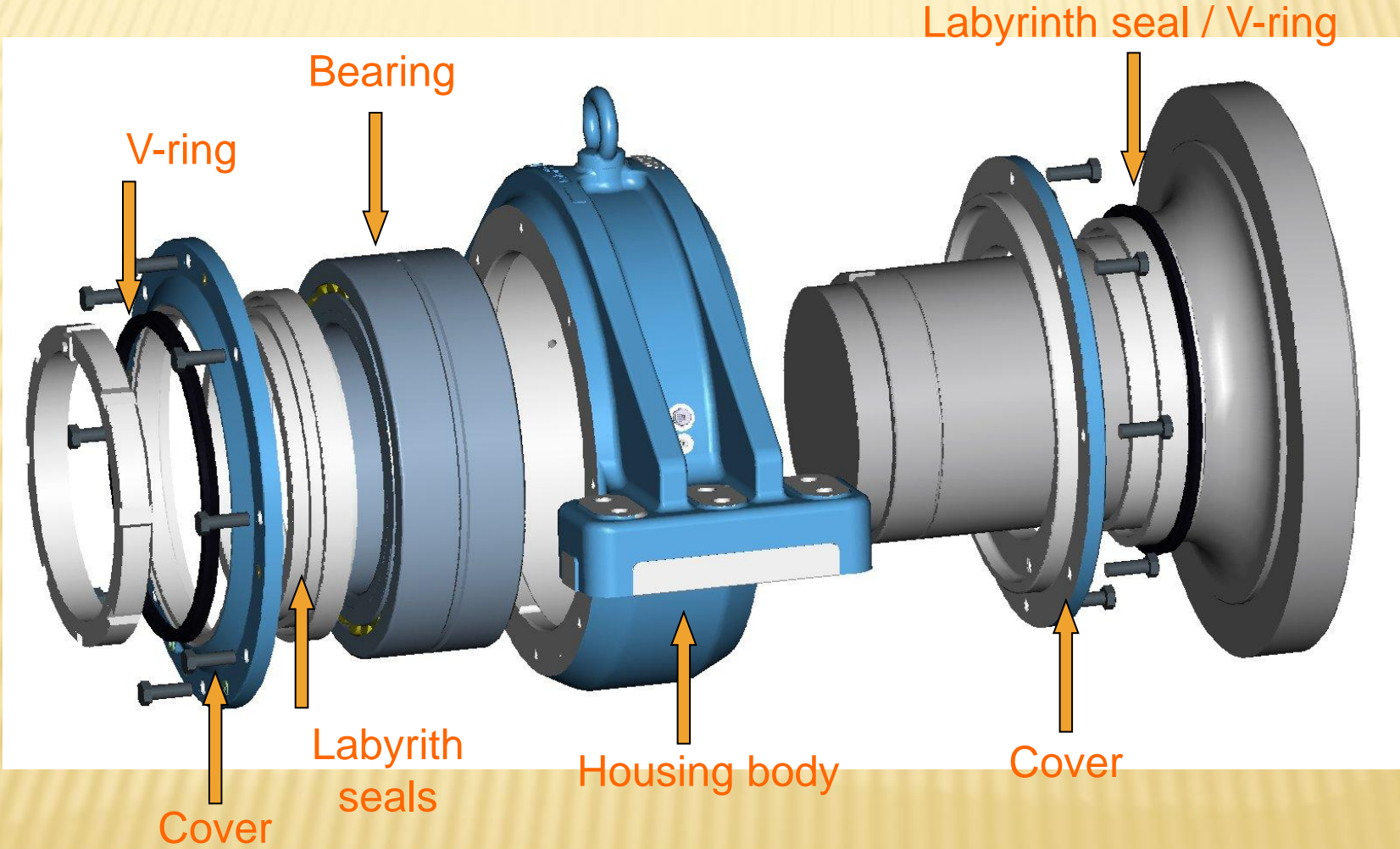


Rotor side

- ✦ SRB: Shaft sizes range from 360 to 1180 mm
- ✦ V-ring exclusionary seals

- ✦ TRB: shaft sizes up to 2 500 mm
- ✦ Radial lip seal solution integrated into bearing

MAIN BEARING HOUSING – EXPL. VIEW



SEALING SOLUTIONS

V-rings

Centrifugal 'slinger' or deflector action

To fit the requirements of most applications, V-rings are available in a large variety of designs and sizes up to 2000mm.

Materials include NBR & FKM



VR1



VR2



VR3



VR4

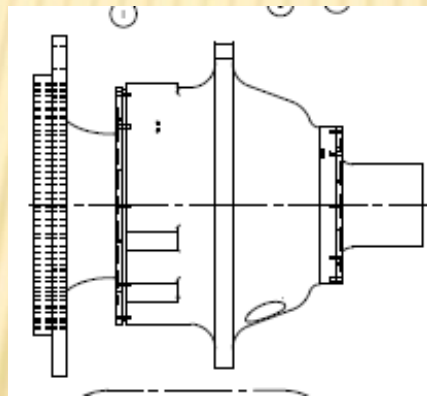
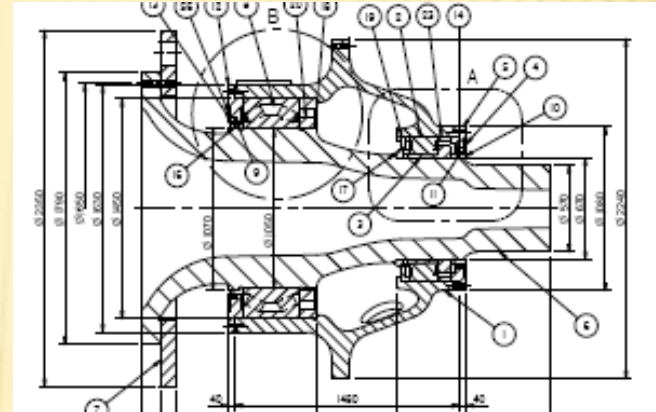
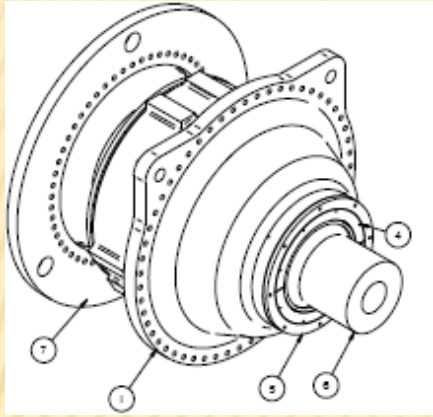


VR5



VR6

OTHER MAIN BEARING HOUSING STYLES



⊕ Radial lip seal solution integrated into bearing

Sealing Solutions

Large diameter seals

- × Seal families
- × Technical information
- × Competitive survey
- × Market positioning

Sealing Solutions

Large diameter seals families

- ✘ Metal cased seals

- ✘ Rubber outside diameter seals

 - Fabric-reinforced

 - All-rubber

Sealing Solutions

Rubber outside diameter seals

- ✦ Fabric-reinforced

Sealing Solutions

Fabric-reinforced seals

Oil or grease

Multiple types

- ⊕ Split
- ⊕ Solid
- ⊕ Radial and axial lubrication ports
- ⊕ Cover plate needed
- ⊕ Available pressure profile

Available materials

- ⊕ NBR
- ⊕ FKM



Split
Solid

Sealing Solutions

Fabric-reinforced seals

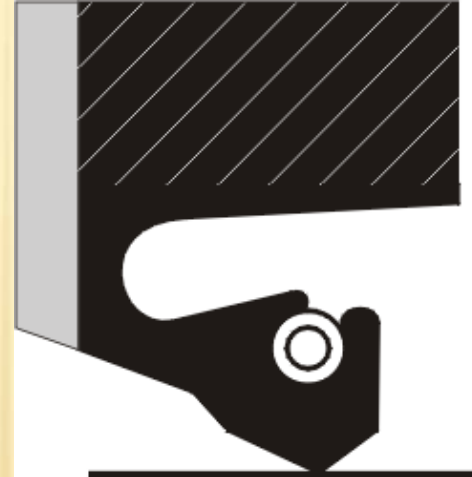
Applications

General industry

- × Typically older equipment
- × Many in use in steel industry

General information

- × Low to moderate conditions



Radial lubrication ports

Split

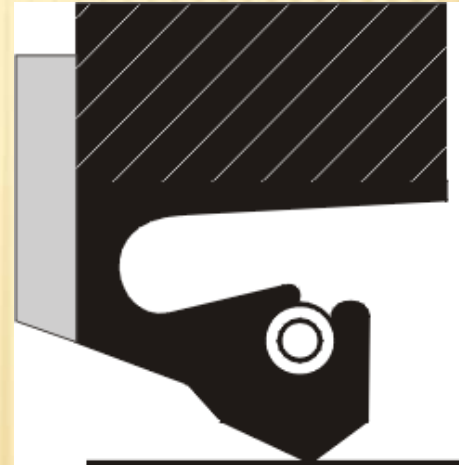
Solid

Sealing Solutions

Fabric-reinforced seals

Size Availability

- + Specific size listing
- + New tooling can be produced
- + Very limited sizes for pressure seal



Axial and Radial
Lubrication Ports
Split
Solid

WIND POWER COMPANIES

Year 2007

GE Wind (Germany, Spain, US)

Nordex (Germany)

REPower AG (Germany)

FKI-DeWind (Germany)

Suzlon (India)

Year 2008

GE Wind (Germany, Spain, US)

Nordex (Germany)

REPower AG (Germany)

FKI-DeWind (Germany)

ScanWind (Norway)

Suzlon (India)

Year 2009

GE Wind (Germany, Spain, US)

Nordex (Germany)

REPower AG (Germany)

EU Energy (Germany / US – '07)

ScanWind (Norway)

Dongfang (China)

Hyosung Corporation (Korea)

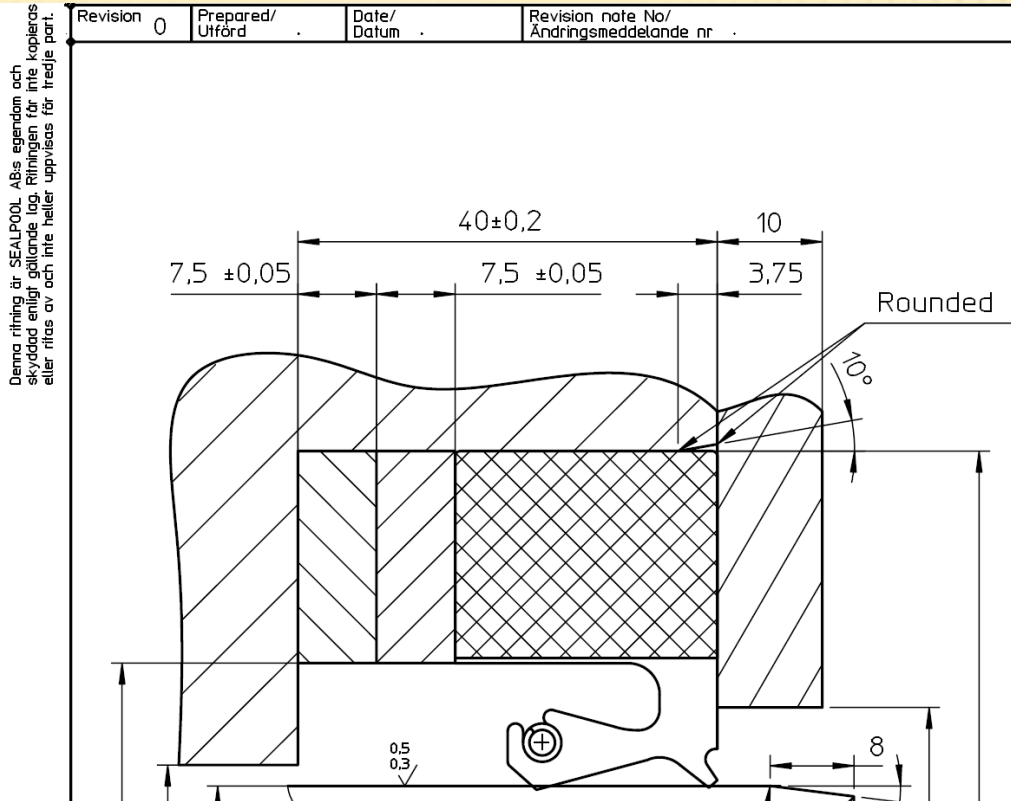
Suzlon (India)

ISSUES WITH TRADITIONAL LABYRINTH/V-RING SEAL



Example: – excessive grease purge when using labyrinth seals with V-rings

NEW TREND IN MAIN BEARING SEALING SOLUTION



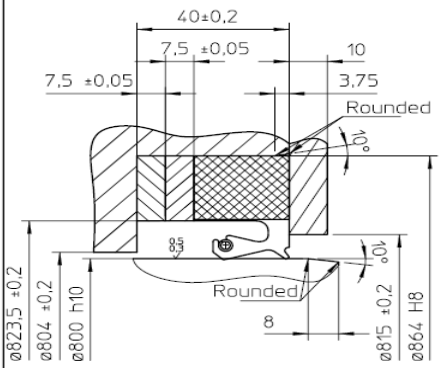
Endless seal for wind energy with two spacers

REPLACEMENT TO A SPLIT SEAL

Denna ritning är SEALPOOL. Alla dimensioner och toleranser gäller ritningen och inte tillverkningen av delarna.

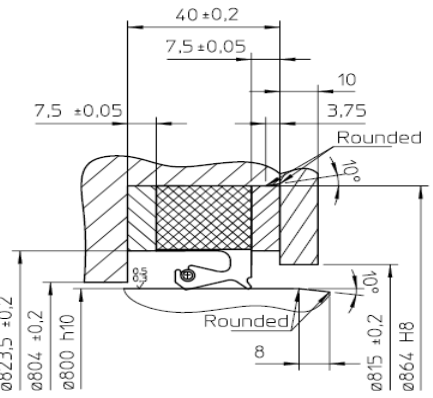
SEALPOOL AB and
 SEALPOOL AB
 2 a first part.

Revision 0	Prepared/ Utförd	Date/ Datum	Revision note No/ Ändringsmeddelande nr
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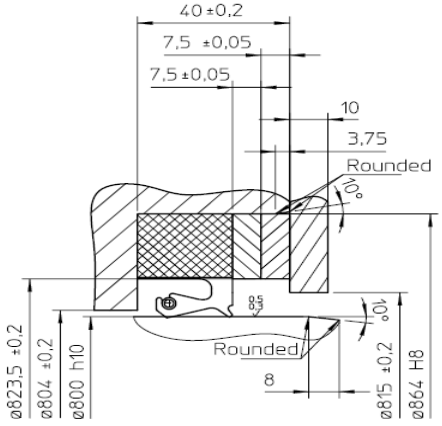


Seal countersurface plunge grinded
Break sharp edges

Step 1: Change of seal position by moving one of the back-up rings to the air side of the seal.

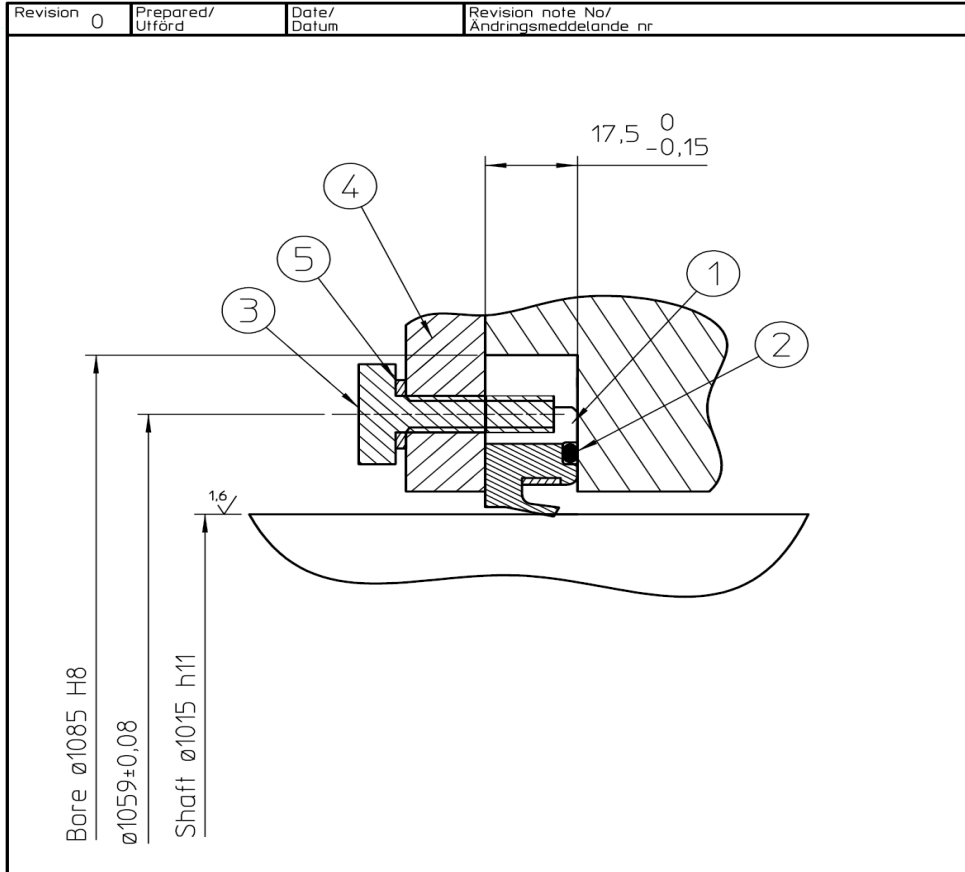


Step 2: Change of seal position by moving the second back-up ring to the air side of the seal.

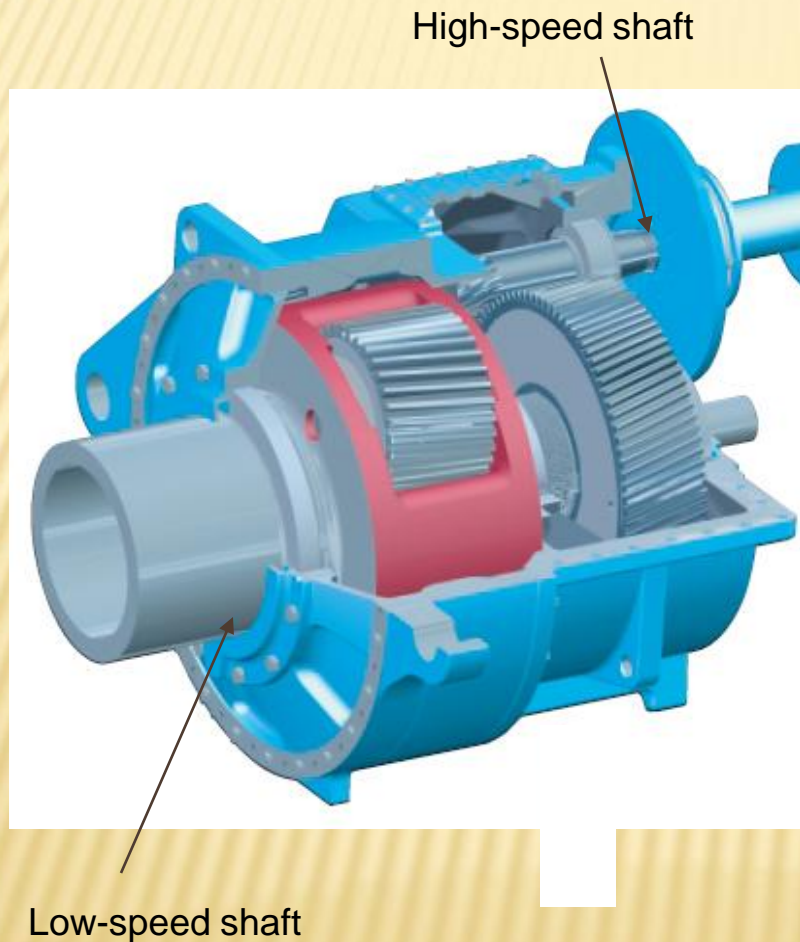


PTFE SEAL FOR WIND ENERGY

Denna ring är SEALPOOL. ABS egendom och skyddad enligt gällande lag. Ringen får inte kopieras eller ritas av och inte heller uppvisas för tredje part.



PLANETARY GEARBOX

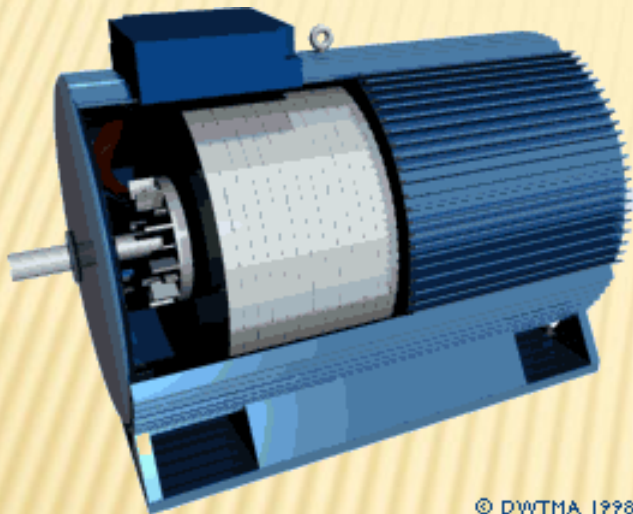


- 3 stage, single planetary style w/ 2 helical stages is most common
- ✘ Low-speed input shaft (~700 mm)
- ✘ High-speed output shaft (~300 mm)
- ✘ Primary reliability component in wind turbines (bearing failure)
- ✘ Significant aftermarket rebuild opportunities

MAJOR WIND GEARBOX MANUFACTURERS

- ✘ Winergy/Flender (Germany/US) Owned by Siemens/Bonus
- ✘ Hansen (Belgium) Owned by Suzlon (India)
- ✘ Bosch/Rexroth (Germany) Owns Lohman & Stolterfoht
- ✘ Eickhoff (Germany)
- ✘ Moventas (Finland / US) Formerly Metso/Valmet
- ✘ Jahnel-Kestermann (Germany)
- ✘ Echesa (Spain) Owned by Gamesa
- ✘ GE Transportation (US) Manufactures wind gearboxes for GE

GENERATOR – SEALING OPPORTUNITY



© DWTMA 1998

3-phase asynchronous
(induction) generator is most
common

Converts rotating mechanical
energy into electricity (AC)

600kw – 3,6 MW machines

High-speed input shaft seal
opportunity

WIND ENERGY – ACCOFLUOR

- + Will grow 15% to 20% per year for the foreseeable future
- + OEM market big \$\$\$ and developing
- + Turbines are coming out of OEM warranty.
- + The aftermarket is coming.



SEALING SOLUTIONS IN WIND TURBINES

Thank you!