

Thruster Experience-

Seal Issues

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Topics

- **Basic technologies**
- **Problems**
- **Solutions**
- **Table for technical specification for seals**

Azimuth Thrusters

- **Low Pressure-applications (propeller shaft draught less than 7m)**
- **High Pressure-applications (propeller shaft draught more than 7m)**

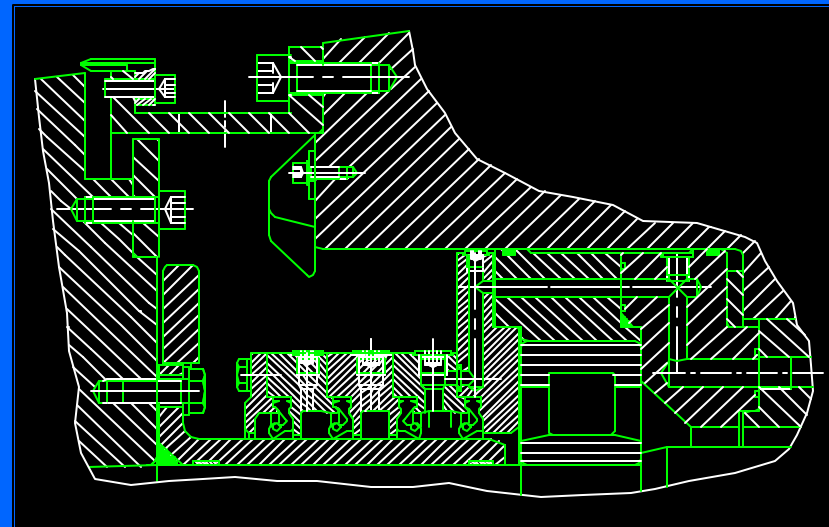
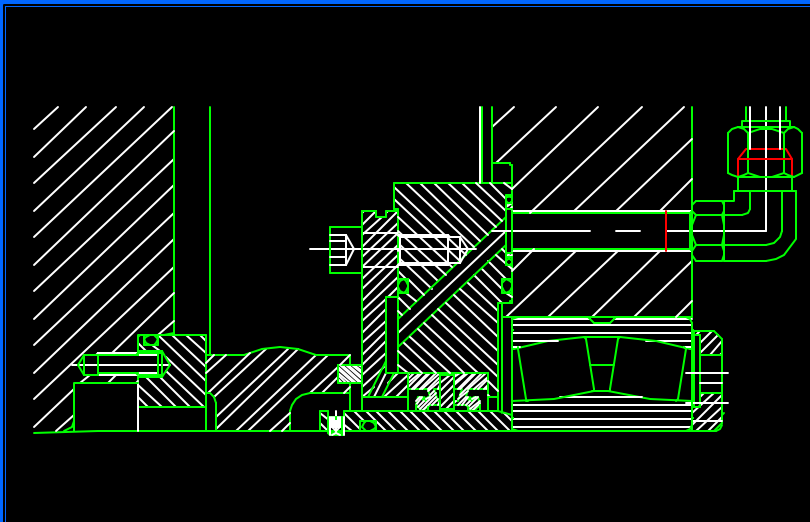
Low Pressure applications

- Tugboats
- Contaz-units



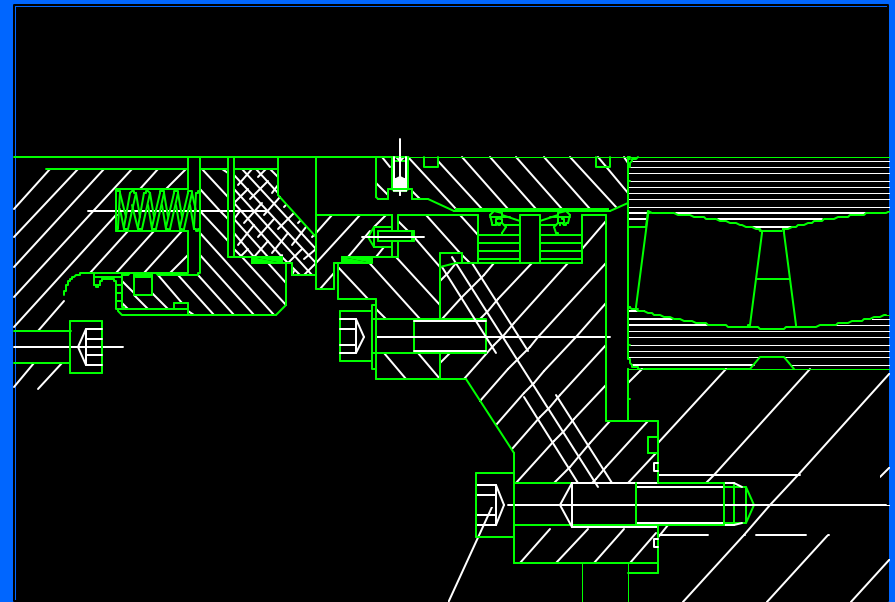
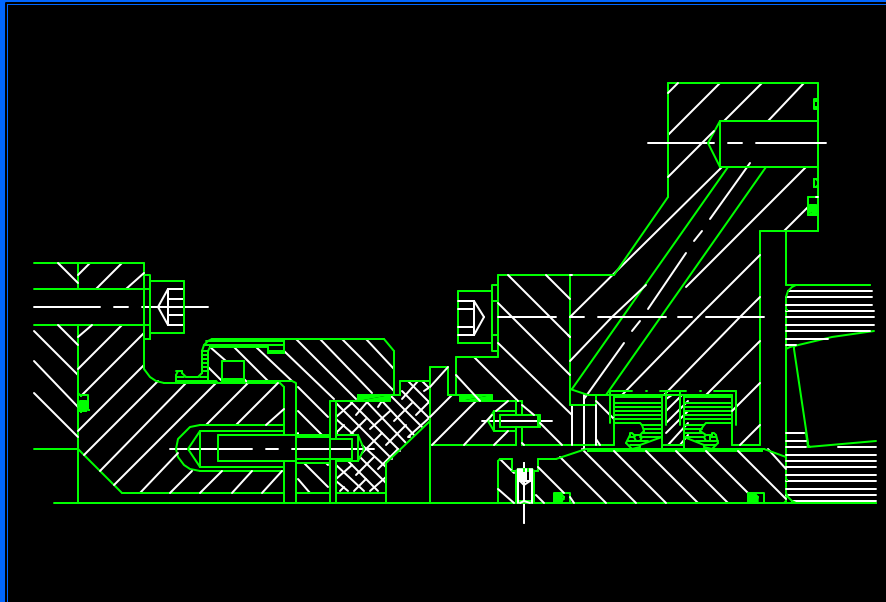
Low Pressure applications

- Face-seal + 2 x lip-seal
- Lip-seal package

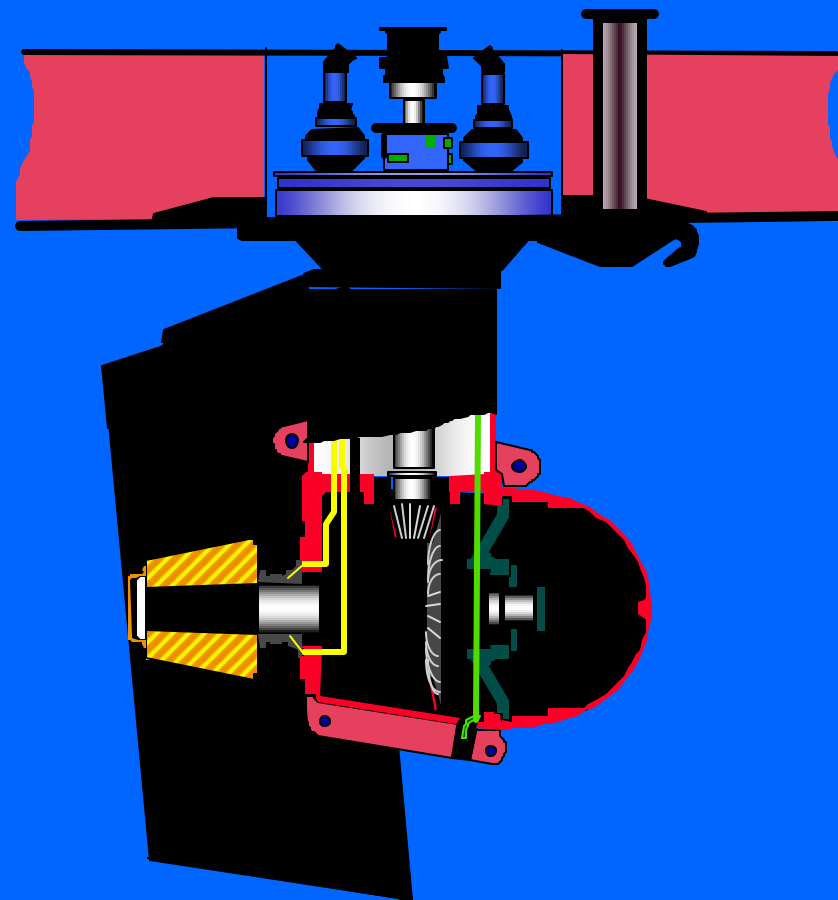


High Pressure applications

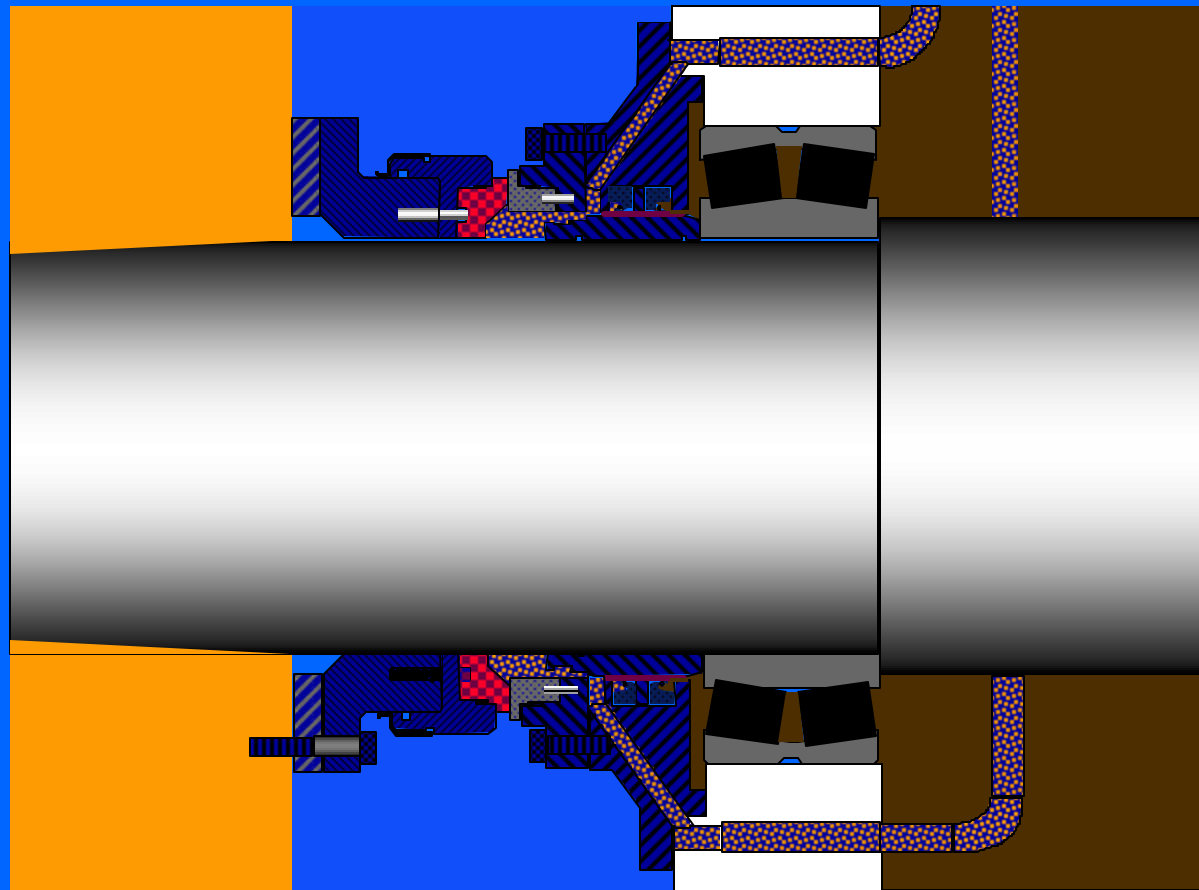
- Face-seal + 2 x lip-seal
- Flushing line



High Pressure applications / UUC type DP-thruster



High Pressure applications / UUC type DP-thruster



Problems

- oil leakage out
- water leakage in
- oil leakage between gravity-chamber and gearbox
- pumping effect
- swelling
- shrinking
- face material wear
- housing fracture (composite)
- seat material corrosion

Solutions

- change of seat material NiResist => SiC
- increasing gravity pressure (tank height+pressurization)
- yard's involvement: corrections to tank installation and pipeline (correct slope, cleanliness)
- change of housing material composite => stainless steel on face side, bronze on seat side
- change of seal type on low pressure applications face => lip seal package (axial pumping)

Common understanding

- Problems in both categories
- mostly due to:
 - in some cases: insufficient knowledge of products/applications
(example: vibration effects)
 - too many suppliers within one sealing solution
 - in some cases: insufficient specifications to seal suppliers

Future vision

- **way of thinking: close co-operation with seal suppliers**
- **better control of the design**
- **common table for technical specification**
- **lip seal packages in low pressure applications**
- **possible “anti-pollution” seals in high pressure applications**

Common table for specification

Specification of Requirements Seals

UUC 505 OUTER SEAL

Basic Values

Shaft diameter	480 mm	
Shaft rotational speed	148 RPM	
Static pressure difference (max. over one seal)	1 bar	
<i>Line velocity</i>	<i>3,71965 m/s</i>	
<i>Static PV-value</i>	<i>3,71965 bar m/s</i>	

Mechanical Vibrations

Dynamic axial movement	0,1 mm	
Dynamic radial movement	0,1 mm	
Axial frequency	9,87 Hz	
Radial frequency	9,87 Hz	
<i>Axial amplitude</i>	<i>0,05 mm</i>	
<i>Radial amplitude</i>	<i>0,05 mm</i>	
<i>Axial vibration speed (MAX)</i>	<i>3,10075 mm/s</i>	
<i>Radial vibration speed (MAX)</i>	<i>3,10075 mm/s</i>	
<i>Axial vibration speed (RMS)</i>	<i>2,19256 mm/s</i>	
<i>Radial vibration speed (RMS)</i>	<i>2,19256 mm/s</i>	
<i>Axial vibration acceleration (MAX)</i>	<i>192,293 mm/s²</i>	<i>0,019602</i>
<i>Radial vibration acceleration (MAX)</i>	<i>192,293 mm/s²</i>	<i>0,019602</i>
<i>Axial vibration acceleration (RMS)</i>	<i>135,972 mm/s²</i>	<i>0,013861</i>
<i>Radial vibration acceleration (RMS)</i>	<i>135,972 mm/s²</i>	<i>0,013861</i>

Given Value
Calculated Value

Maximum Static Displacements (shaft related to surroundings, from 0-position to other end)

Axial Displacement	0,4 mm
Radial Displacement	0,4 mm

Lubrication (media)

Lubricant = liquid/gas at higher pressure

Lubricant	Mineral Gear Oil
Viscosity at 40 deg	150 cSt
Viscosity at 100 deg	15 cSt
Operating temperature	50 deg

Lifetime

Required lifetime without change of components

5 years	with	7000 h / year
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Operational profile

Time share	PV / PVmax
80 %	100 %
10 %	50 %
10 %	25 %

Corrosion protection

required on seal

Acceptable level of leakage

In	0 ml/h
Out	5 ml/h

Time for

