

Design, Manufacturing, Assembling, Installation, Start-up and First Operating Experience of a 56 Foot Long Vertical Molten Sulphur Pump

25th International Pump Users Symposium, Houston, Texas

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Introduction

- **New safety concept at a chemical plant in Sweden**
- **No tapping of tanks on the side wall**
- **All equipment has to be introduced from the top of the tank**
- **New sulphur tank at the ship unloading terminal**
- **Requirement of a 56 foot long vertical molten sulphur pump**



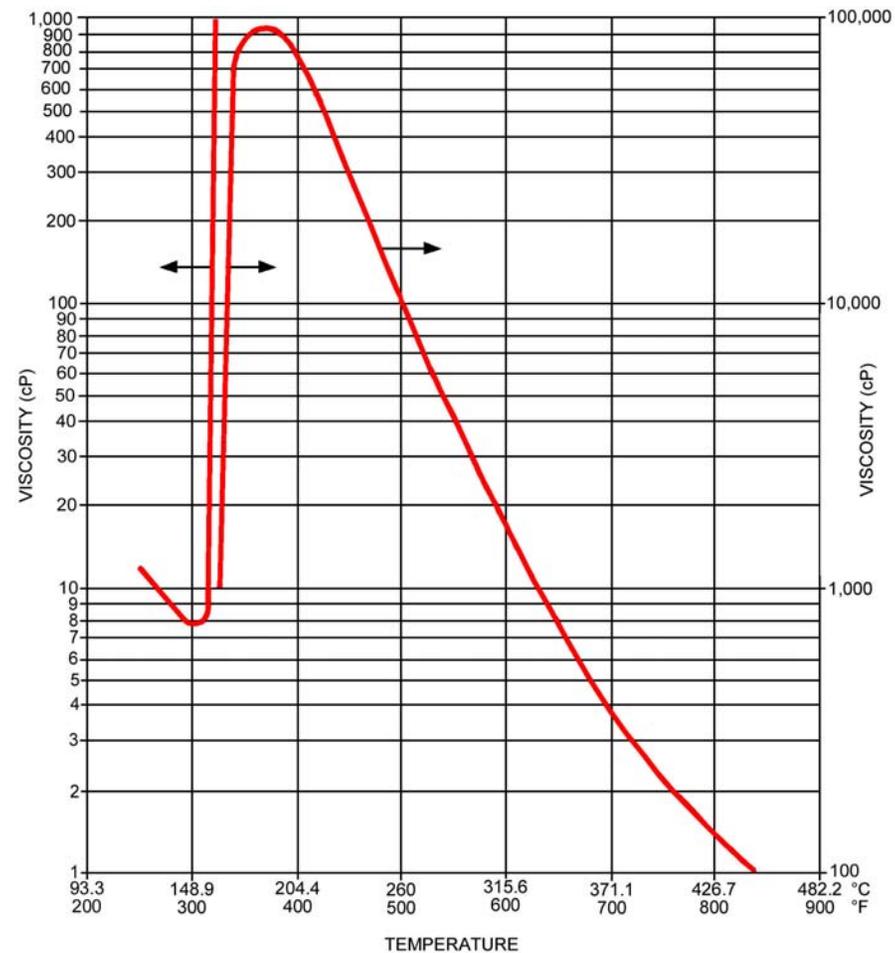
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Design

Properties of Molten Sulphur



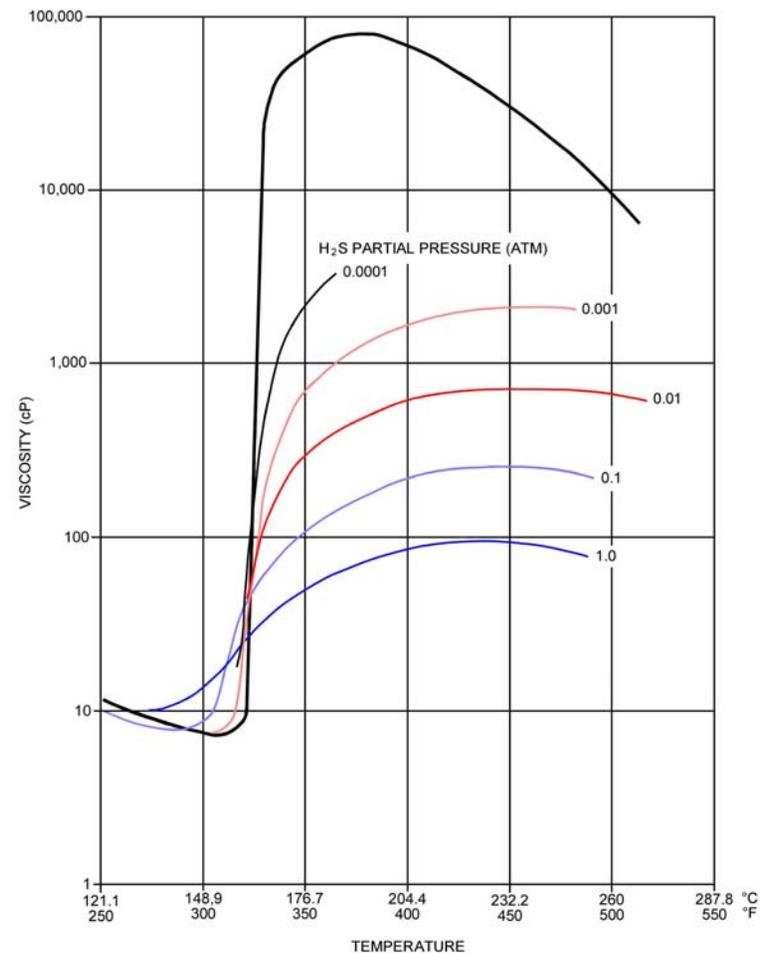
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Design

Properties of Molten Sulphur, H₂S Content

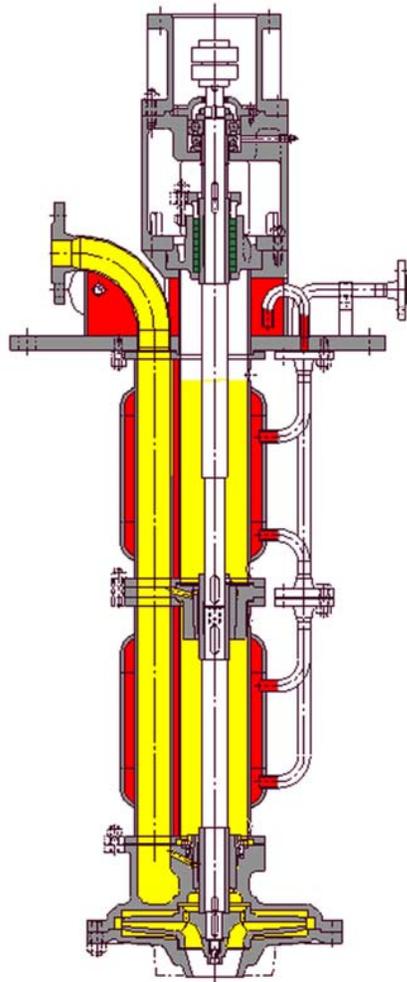


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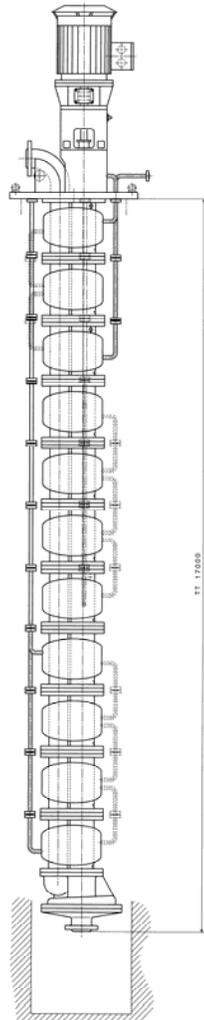


- Up to 3 stages: high heads at slow speeds
- Discharge and shaft column compact unit
- Small opening in the tank
- Wet shaft, pressure from impeller back side
- Bearing lubrication from discharge pipe
- Double volute casing, low radial loads
- Materials: Cast Iron, Cast Steel, Stainless Steel

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- Pump size 4" discharge flange
 12" impeller diameter
- Capacity 308 gpm; Head 72 foot
- 11 sulphur lubricated intermediate bearings
- 11 shaft pieces
- Setting length 56 foot
- 3 independent heating sections
- Cast Material: Cast Iron GG 25
- Sleeves: Chrome steel (13%)
- Bushing: Alloyed cast iron (3% Ni)
- Pipes and Shaft: Steel
- Weight: 3.300 lb

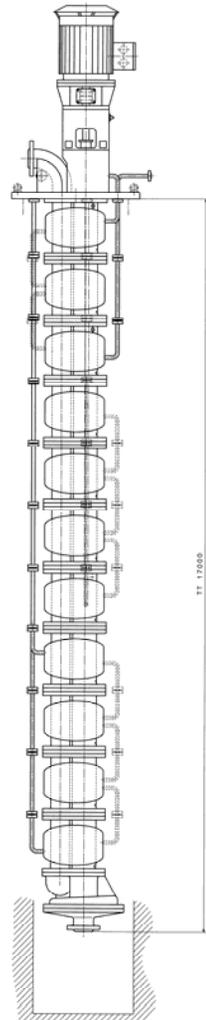


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Design



- Material with similar heat expansion coefficient
- Pump will grow 1,1" (30mm) after heating up
- Steam lines and all internal connections flanged
- Drain holes in each section to avoid solidification
- Shaft piece connections with threats but also sleeves with keys to allow reverse rotation
- FEM calculations are mandatory for these pumps



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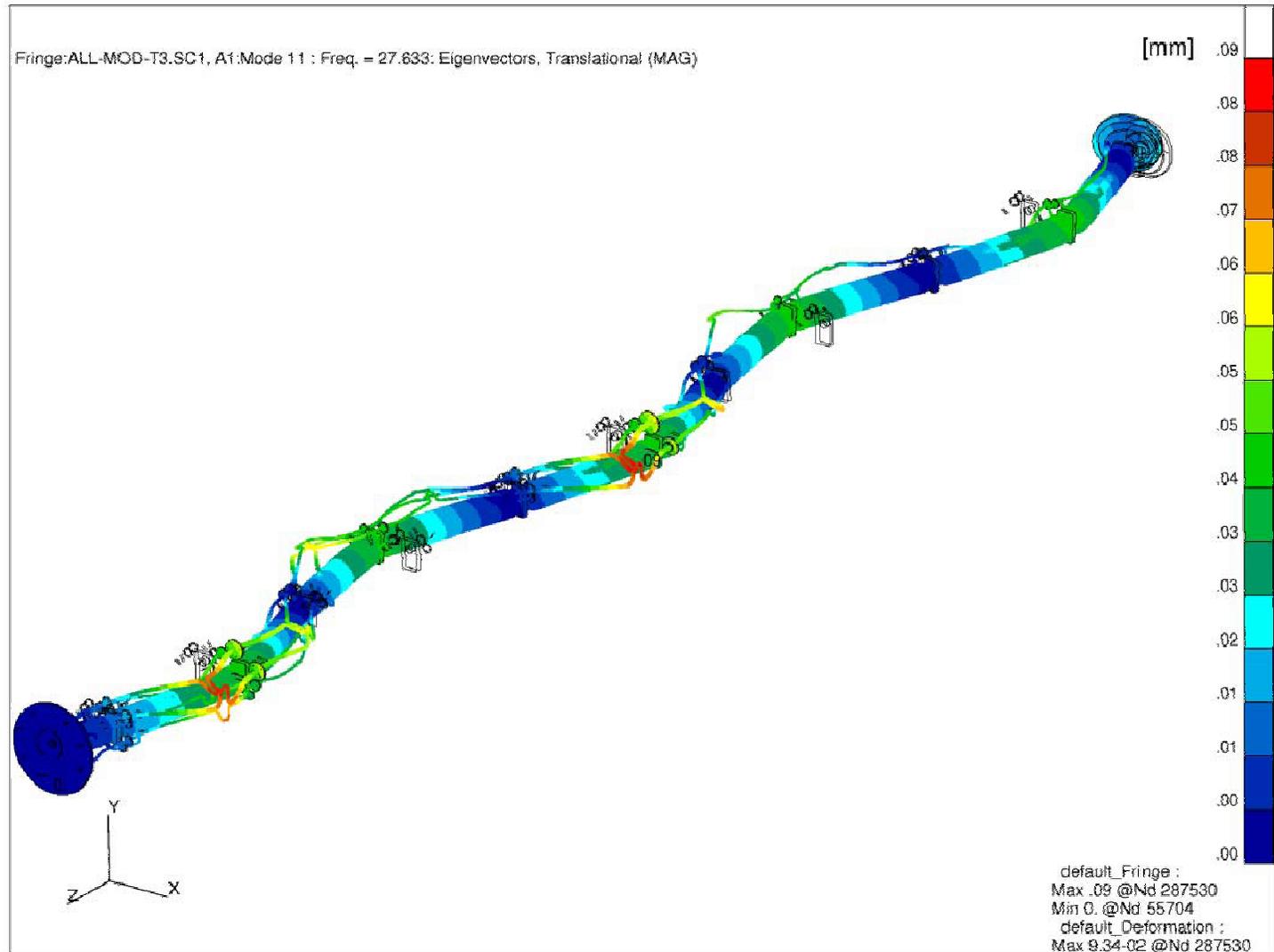


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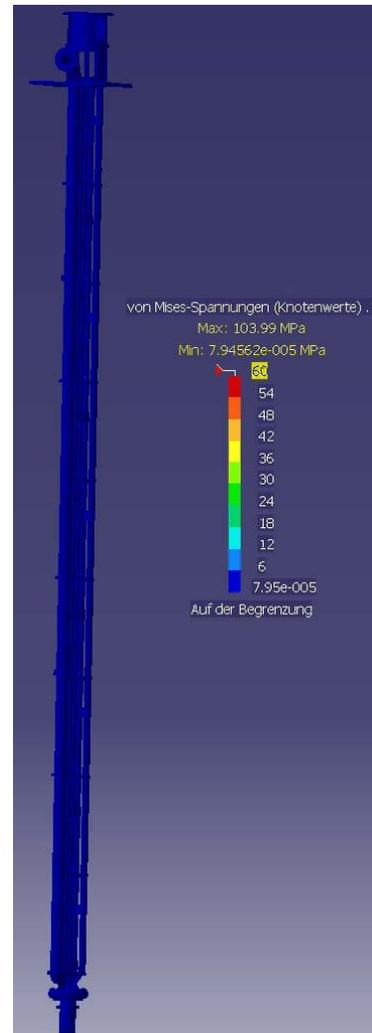


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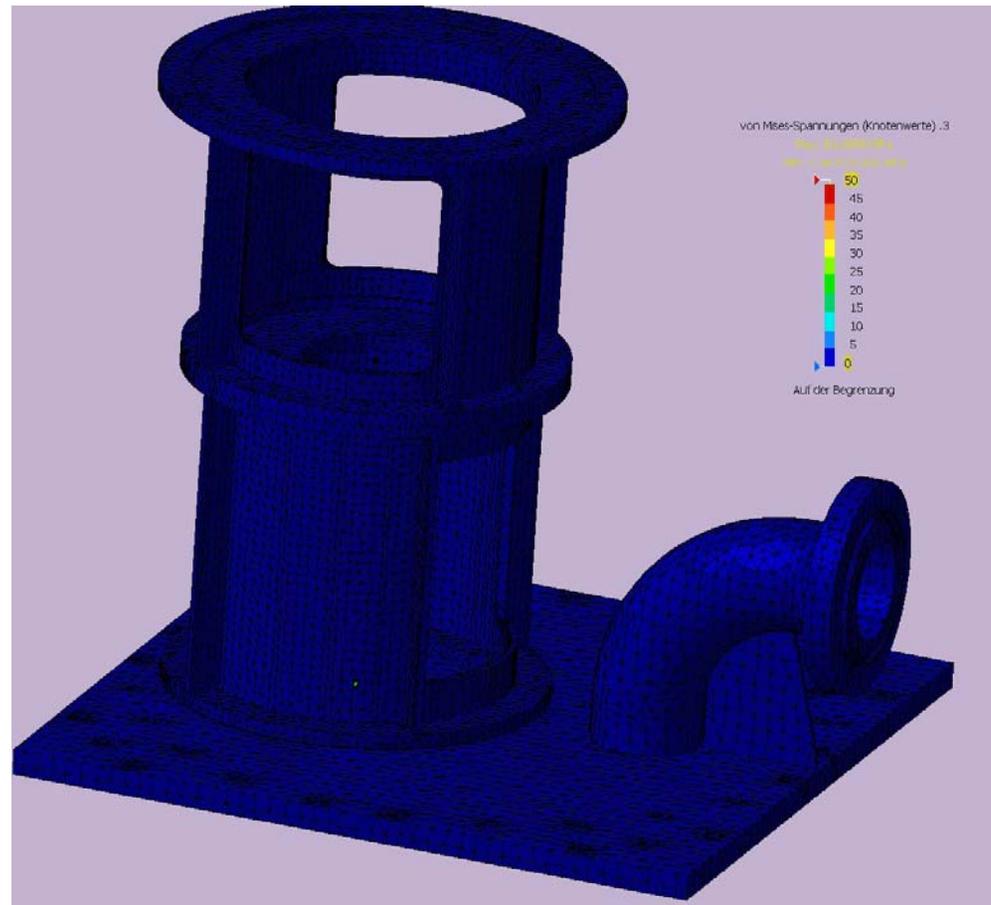


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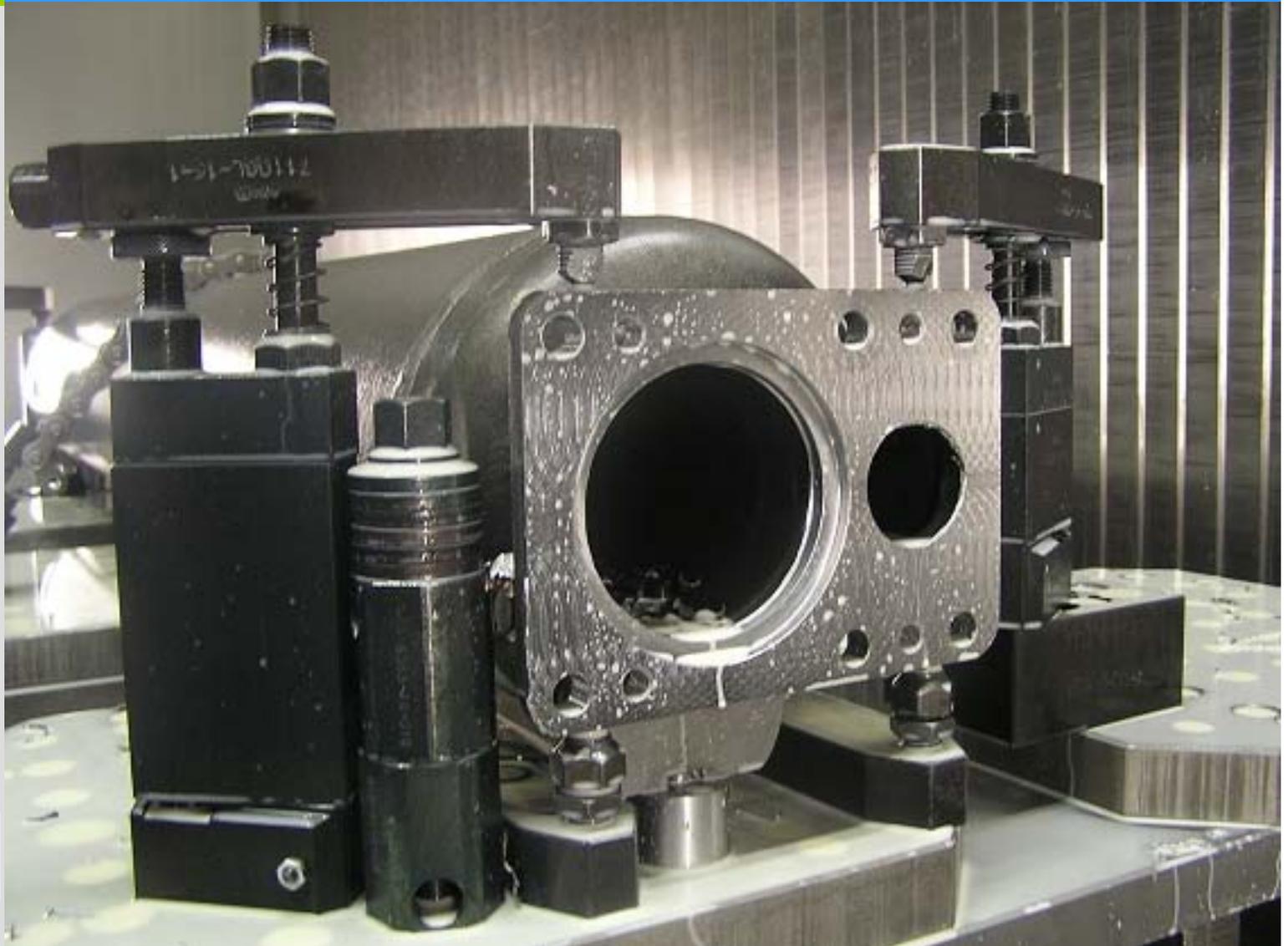


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**Site assembly
&
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Site assembly & installation



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Heating cycles (empty tank)

Heating Section	Heating Time		
	1. Day (24 hours)	2. Day	3. Day
1 Top			
2 Center			
3 Bottom			

- Heating up of entire pump
- Check turning of shaft by hand
- Check direction of rotation
- Start the pump
- Monitor vibrations and current



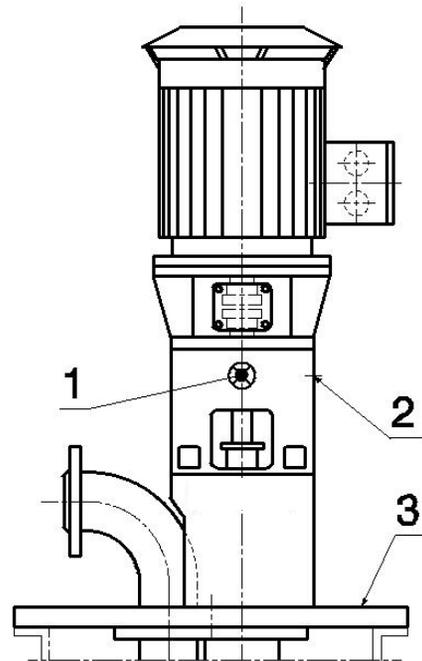
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Start-up and
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Vibration Measurement



- Start up in May 2006
- Vibration values from 0,07 to 0,1 in/s
- Life time of sleeve bearings?